COMPARATIVE PRODUCTION AND REPRODUCTION PERFORMANCE OF DAIRY CATTLE IN LARGE, MEDIUM AND SMALL SCALE FARMS: THE CASE OF ADDIS ABABA MILK SHED IN NORTH SHEWA ZONE, OROMIA REGIONAL STATE, ETHIOPIA

MSC THESIS

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HAWASSA UNIVERSITY

COLLEGE OF AGRICULTURE

HAWASSA, ETHIOPIA

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A THESIS SUBMITTED TO THE SCHOOL OF ANIMAL AND RANGE SCIENCES HAWASSA UNIVERSITY COLLEGE OF AGRICULTURE

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(SPECIALIZATION: ANIMAL BREEDING AND GENETICS)

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This is to certify that the thesis entitled "**comparative production and reproduction performance of dairy cattle in large, medium and small scale farms: the case of Addis Ababa milk shed in north Shewa zone, Oromia regional state, Ethiopia**" submitted in partial fulfillment of the requirements for the Degree of Master of Science in Animal and Range Sciences with Specialization in Animal Breeding and Genetics. The graduate program of the department/school of Animal and Range science, and has been carried out by **Zewde Tolcha Dadi**, ID No. **GpAnBrR/0020/011** under my/our supervision. Therefore, I / we recommend that the student has fulfilled the requirements and hence can submit the thesis to the department.

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We, the undersigned, members of the Board of Examiners of the final open defense by **Zewde Tolcha Dadi** have read and evaluated his/her thesis entitled **comparative production and reproduction performance of dairy cattle in large, medium and small scale farms: the case of Addis Ababa milk shed in north Shewa zone, Oromia regional state, Ethiopia** and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the Degree of the science in Animal and Range Science (specialization: Animal Breeding and Genetics).

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As members of the Board of Examiners of the final Master's degree open defense, we certify that we have read and evaluated the thesis prepared by **Zewde Tolcha Dadi,** under the title ''**Comparative Production and Reproduction Performance of Dairy Cattle in Large, Medium and Small Scale Farms: The Case of Addis Ababa Milk Shed in North Shewa Zone, Oromia Regional State, Ethiopia**," and recommend that it be accepted as fulfilling the thesis requirement for the degree of Master's in Animal and Range Sciences with Specialization in **Animal Breeding and Genetics**.

_____	_____	_____
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Thesis approved by

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DEDICATION

This work is dedicated to my family, for nursing me with affection and love and for their committed partnership in the success of my life. To my wife, Mesert Diriba and my children for all their patience, encouragement and unreserved assistance in achieving my objective.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my north Shewa zone of Oromia work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfilment of the requirements for MSc degree at Hawassa University, College of Agriculture and deposited at the University/College library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate. Brief quotations from this thesis are acceptable without special permission provided that accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the College when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, However permission must be obtained from the author.

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LISTS OF ABBREVIATIONS (ACRONYMS)

AFC	Age at First Calving
AFS	Age at First Service
AI	Artificial Insemination
AIBP	Agro industrial by products
ALL	Average lactation Length
ANRS	Amhara National Regional State
BCS	Body Condition Score
BRIDGE	Building Rural Income through inclusive Dairy Business Growth in Ethiopia
CB	Cross Breeds
CFSI	Cows First Service Insemination
CI	Calving interval
CLA	Conjugated Linoleic Acid
CSA	Central Statically Agency
DDAO	Degem District Agricultural Office
DDLFO	Degem District Livestock and Fisheries Office
DLDAO	Debra Libanos District Agricultural Office
DLDHO	Debra Libanos District Health Office
DLDLFO	Debra Libanos District Livestock and Fisheries Office
DO	Day Open
FAO	Food and Agricultural Organization
FMD	Foot and Mouth Disease
GDP	Growth Domestic Product
GL	Gestation Length

HF	Holstein Frisian
ILDP	Integrated Livestock Development Project
LSD	Lumpy skin Disease
NSC	Number of Service Per Conception
NSZAO	North Shewa Zone Agricultural Office
NSZLFO	North Shewa Zone Livestock and Fisheries Office
ONRS	Oromia National Regional State
SD	Standard Deviation
SSA	Sub-Saharan African
WDAO	Wuchale District Agricultural Office
WD LFO	Wuchale District Livestock and Fisheries Office

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Comparative Production and Reproduction Performance of Dairy Cattle in Large, Medium and Small Scale Farms: The Case of Addis Ababa Milk Shed in North Shewa Zone, Oromia Regional State, Ethiopia

Zewde Tolcha Dadi

Advisors: Sintayehu Yigrem (PhD) and Kefena Effa (PhD)

ABSTRACT

The purpose of the study was to assess productive and reproductive performance of dairy cattle in large, medium and small scale farms in Debra Libanos, Wuchale and Degem districts in North Shoa Zone Oromia regional state, Ethiopia. A total of 180 dairy farms dairy holding households were randomly selected from each of large, medium and small scale farms of the study areas. From each districts three sample sites or kebeles were purposively taken based on dairy potential and availability of different dairy farm scale. The survey study was conducted on randomly selected of 42 dairy farmers that have large farms (> 30 cows), 63 dairy farmers who have medium scale dairy farms (> 5 ≤ 30 cows) and 75 dairy farmers who have small scale farms (≤ 5 cows). The survey results showed that, the average daily milk yield for local and their crossbreed of different exotic blood level of 50% ,75% and >75% was 3.05±0.55, 15.56±1.17, 20.56±2.23 and 25.64±1.78 liters per days respectively. The average lactation length (months) for local and cross breeds cows with 50%, 75% and >75% blood levels were 6.57±1.80, 8.17±0.63, 8.98±0.78 and 9.49±0.83 months. The Age at first services (AFS) for local and cross breed with 50%, 75% and >75% blood level was 46.53±0.95, 20.18±0.93, 19.10±0.30 and 18.12±0.32 months. The Age at first calving (AFC) for local and exotic crossbred cows with 50%, 75% and >75% blood levels were 54.55±0.62, 28.61±0.53, 27.79±0.36 and 27.26±0.29 months respectively. The Days Open (Days) for local and crossbred cows with 50%, 75% and >75 % blood levels were 122.86±8.01, 83.13±5.63, 67.43±2.95 and 60.63±2.99 days respectively. The Calving interval (months) for local and crossbred cows with 50%, 75% and >75% blood levels were 36.31±0.63, 17.04±1.06, 12.20±0.59 and 11.35±0.51 months respectively. The Number of service preconceptions (NSC) for local and crossbreds cows with 50%, 75% and >75% blood levels were 1.46±0.49, 2.52±0.29, 2.06±0.18, 1.67±1.78 respectively. Generally, the productive and reproductive performance of all types of crossbred and local dairy cows indicated good at farm level, districts and blood levels. Therefore, the dairy sector of the study area should plan technical and institutional improvement strategies to improve management practice of dairy farms (feeding practices, health care and housing), and regularly supplying dairy inputs to improve dairy productivity and sustain the dairy industry.

Keywords: **Production performance, Reproduction performance, Dairy Cattle, large scale farms, medium scale farms, small scale farms and North Shewa Zone**

1. INTRODUCTION

1.1. Background of the study

Ethiopia is ahead of other African countries in holding the largest livestock population in Africa. Recent census by the Central Statistical Agency (CSA, 2020/21) show that the livestock population of Ethiopia is estimated at 70.2 million heads of cattle, 49.9 million sheep, 52.4 million goats, 10.7 million donkeys, 2.2 million horses, 0.382 million mules, 8.1 million camels, 56.99 million chicken and 6.96 million beehives. The livestock resources of Ethiopia contributed up to 40% of agricultural Gross Domestic Product (GDP), nearly 20% of total GDP, and 20% of national foreign exchange earnings (World Bank, 2017). Furthermore, livestock contribute an important nutritional supplement to the most vulnerable groups in the society, enhance the pliability of smallholder households in times of shortage of food and help in the maintaining of traditional social safety nets/financial security (Randolph *et al*., 2007).

The livestock sub-sector also plays an important role in providing job opportunities to millions of jobless citizens involved in farming activities across Africa, ensure food security, provide services, contributing to cultural, social, asset and environmental values and sustaining livelihoods (Solomon, 2003; Sintayehu *et al.*, 2010; CSA, 2017). Under the Ethiopian context, the use of animal power to cultivate crops fields is highly underestimated. For instance, evidences shows use of farm implements or mechanization covers only about 10% of the total cultivated land areas while the majority of the power to cultivate crops comes from the use of animal power. The dairy sector is an essential component of the global livestock production systems. They play essential roles both in ensuring food security and generating income, most importantly at the small household

level in the developing world. Under the Ethiopian context, however, dairy development is hampered by climate change, gender inequalities, lack of opportunities for young men and women, and lack of coordination in the sector. Dairy support services including extension and advisory services, input supply, financial services, veterinary services and breeding services are not easily accessible for most farmers. Lack of farmer organization, management of organizations, innovative and inclusive business models, lack of appropriate action research, in addition to low milk quality are factors affecting the dairy value chain in the country.

As a matter of fact, the number of improved dairy cattle (crossbred and purebred) is currently limited at 1.14 million cows, which constitute only about 1.6% of the total cattle population regardless of the country's potential to support intensive and large dairy production (CSA, 2020/21). The small scale rural dairy production systems produce about 98 percent of the milk, which is produced by pastoralists and agro-pastoralists, smallholder mixed crop-livestock farmers, smallholder peri-urban and urban milk producers. The remainder of the milk is produced by an estimated 600 medium and large scale commercial producers.

The main milk producing regions are respectively Oromia, SNNPR, Amhara, and Tigray regions (BRIDGE, 2018). In these regions, milk production can be considered in terms of production systems and milk-sheds. The term milk-shed is defined as geographic area where farmers/milk collectors bring/send their dairy products to a known market place, which is close to them and offers a relatively attractive price. Addis Ababa city is one the milk shed areas which have formal milk marketing options such as processing plants which collect milk through milk collection points along the main roads (Tadele and Tewodros, 2013). Due to the availability of milk processing plants such as Sebeta Agro-

industry, dairy farms that are operating in Sebeta have better access to formal milk marking. Similarly, dairy farms operating in Sululta, in the well-organized Selale dairy-belt have the option to sell their milk to processing plants, collectors and dairy cooperatives, several small, medium and large scales dairy processing industries will be established around Addis Ababa areas. In this milk shed, the rural-based smallholder dairy producers supply milk to the formal market, while most of the intra- and peri-urban small holders supply milk to the informal market, mainly through household supply on contractual arrangements and retailing (Hurissa, 1994).Associated with its long history of dairy development for more than 50 years, North Shewa Zone of Oromia National Regional State is one of the zones in the country with the largest number of improved dairy cows estimated at more than 149,231(NSZLFO, 2019). As a matter of fact, this zone is one of the major milk producing areas that supply the majority of milk to the capital city, Addis Ababa.

This zone is also known for hosting small to large scale market-oriented commercial dairy producers in the country. Recently, Under the Ethiopian context, team of Experts agreed to cluster small scale dairy farm (≤5 dairy cows), medium scale dairy farms (>5≤30 dairy cows) and large scale dairy farms (>30 dairy cows) (Amare *et al*., 2019). Furthermore, these farms keep different dairy genotypes whose exotic gene inheritances range from as low as 25% to pure exotic dairy breeds. Therefore, this study was aimed to characterize the comparative production and reproduction performances of different scale dairy farms and keeping different dairy genotypes North Shewa Zone of Oromia National Regional State.

1.2. Statement of the Problem

In order to design relevant research that suits the area, it is essential that researchers understand the existing situations. For the research to be effective and to meet the needs of the farmers, evaluation of the different scale of dairy production, problems associated with each scale is essential to develop appropriate development intervention options. The dairy farms within different scale production and different classes of dairy genotypes are not well evaluated in terms of production and reproduction performances as well as other factors associated with dairy production.

1.3. Objectives

1.3.1. General objectives

- To study the comparative performance of large, medium and small scale dairy farms in terms of dairy cattle production and reproduction traits in the study area.

1.3.2. Specific objectives

- To identify the dairy farming practice in the study area.
- To assess milk production performance of dairy cows under small, medium and large scale dairy farms in the study area
- To assess reproduction performance of dairy cows managed under large, medium and small scale farms.

2. LITERATURE REVIEW

2.1. Overview of Dairy Production in Ethiopia

Livestock contributes to the livelihoods of 60-70% of the Ethiopian population (Aklilu, 2002; Ayele *et al.*, 2003; Ejigu, 2003) in one way or the other. It is raised in all of the farming systems by pastoralists, agro-pastoralists, and crop-livestock farmers. Dairy production is an important component of livestock production in Ethiopia. It is an important source of food, income and creates job opportunity for many people in urban, per-urban and rural settings. However, despite its huge number, the performance of the sub sector in general is low compared to its potential, and the direct contribution it makes to the national economy is limited (Sintayehu *et al*., 2008). In Ethiopia, the national average milk yield per cow per day is 1.482 litres for indigenous cows and the per capita/ milk consumption in the country is about 19.24 kg/year, which is much lower than African and world per capita average of 27 kg/year and 100 kg/year, respectively (CSA, 2019/2020).

According to the report of the Central Statistical Agency (CSA, 2019/2020) the indigenous cattle breeds accounted for 97.4%, while the hybrids and pure exotic breeds counted for about 2.29% and 0.31%, respectively. Despite its large livestock resource base and an ecological setting suitable for dairy production, it is not yet self-sufficient in milk production. Although it was difficult to suggestion the ownership of improved dairy animals, it is estimated that state and private farms own a total of 1,142,682 grade and pure female dairy animals of which the sector owns 997,227 and 145,455 crosses and improved exotic female dairy cattle (CSA, 2019/2020). The indigenous zebu breed produces about 400-680 kg of milk/cow per lactation period compared to grade animals

that have the potential to produce 1,120 up to 2,500 litres over 279 day lactation (Mohamed *et al*., 2004). Dairy production system can also be categorized into three, based on market orientation, scale of production and production intensity. These are traditional smallholders, privatized state farms, and urban and per-urban systems (Gebre *et al*., 2000). The traditional smallholder system, roughly corresponding to the rural milk production system described above. It contributes to about 97 % of the total national milk production and 75% of the commercial milk production. This sector is largely dependent on indigenous breeds with low-productivity native zebu cattle, about 400-680 kg of milk per cow per lactation (Mohamed *et al*., 2004). The state dairy farms, now being privatized or in the process of privatization, use grade animals (those with more than 75 percent exotic blood) and are concentrated within 100 km distance around Addis Ababa. The urban and per-urban milk production system, the third production system, includes small and large private farms in urban and per-urban areas concentrated in the central highland plateaus (Feleke and Geda, 2001). Dairy production system is now expanding in the highlands among mixed crop-livestock farmers, such as those found in Selale and Holetta, and serves as the major milk supplier to the urban market (Gebre *et al*., 2000; Holloway *et al*., 2000).

2.2. Reproductive and productive performance of dairy cattle in Ethiopia

Reproductive efficiency of a herd is an important element of dairy cattle productivity in Ethiopia. Economic losses because of poor fertility can be attributed to the cost of extended calving interval, increased insemination costs, reduced returns from calves born and forced replacements in the event of culling. A stay in conception because of poor fertility increases calving interval mostly due to the increase in the number of days from calving to conception (Nishida *et al*., 2006). Both genetic and non-genetic factors

influence the reproductive as well as productive performance of animals. The reproductive performance in dairy animals affects the total milk production and calf crops that is obtained during the life time of dairy cows. Local cattle in Ethiopia are known to be the top source of milk around the production systems excluding urban and peri-urban dairy systems where crossbreeds have significant contribution to milk production. The reproductive efficiency of dairy cattle can be measured in several traits, like age at first service, number of service per conception, age at first calving, lactation length, calving interval, days open and average milk yield per day and per lactation.

2.2.1. Age at first service

Age at first effective service is one of the most important fecundity properties in dairy cattle. It has a direct effect on age at first calving since length of gestation has physiologically constant value. Age at first effective service includes the period from the birth of heifer to first insemination at the age when animal has reached breeding maturity enabling it normal gravidness. Age at first effective service is determined within defined time limits. Bottom limit is date of birth, and top limit date of conception (Novakovic *et al*., 2011). Age at first breeding joined with reproductive efficiency to first and subsequent breeding determines age at first calving because gestation length is a fixed interval (282 days) once conception occurs. Thus, the major reproductive challenge for breeding age crossbred heifers is to achieve conception by 14 to 16 months of age. Husbanding of crossbred heifers to initiate puberty by 11-13 months so that breeding can occur in a timely fashion is critical to the overall success of a heifer rearing program.(Habib, 2011) and (Amin *et al*., 2013) reported that average age at first of crossbred and local heifers were 40.2 months and 42 months respectively. The desirable age at first calving in local breeds is 3 years and 2 years in crossbred cattle. Prolonged

age at first calving will have high production in the first lactation but the lifetime production will be decreased due to less no of calving. If the age at first calving is below optimal, the calves born are weak, difficulty in calving and less milk production in first lactation (Nerja Kumar and Kibrom Tkuri, 2014). Genotype and agro-ecologies variation in AFS is possibly due to the effect of non-genetic factors including variation in management and feeding systems.(Shiferaw *et al*., 2003) also reported the reproductive efficiency of dairy cows that is susceptible by various factors, which include production system, genetic, nutrition, season, age, housing and management and environment and diseases.

2.2.2. Age at First Calving

Age at first calving is the earliest measure of reproductive performance in dairy cattle; only after the first calving production cycle starts (Dabdoub, 2009). The age at first calving changes the heifer from a non-producing expensive item into an income generating cow. Early AFC decreases unproductive period and a higher the AFC will be the additional raising cost of the animal (Panja and Taraphder, 2012). Age at first calving is closely related to generation interval and, therefore, affects response to selection. Under controlled breeding, heifers are usually mated when they are maturing sufficient to withstand the stress of parturition and lactation. This increases the likelihood of early conception after parturition. In traditional production systems, however, breeding is often uncontrolled and heifers are bred at the first opportunity. This frequently results in longer subsequent calving intervals (Dayan *et al*., 2013).

The age at first calving is the age when a calf individual gives birth for the first time. First calving characterizes the start of the productive life of a cow having an influence on both reproductive and productive life of the female, directly having an effect on her

lifetime calf crop and milk production, and indirectly through its influence on the cost that has been participated for the upbringing (Azage *et al*., 2011; Tewodros, 2008). In line with a study that was conducted recently, dietary supplementation of heifers during their growth period reported a decrease from birth to age at first service for the interval and age at first calving (Amin *et al*., 2013).

2.2.3. Calving Interval

Calving interval is a time passed between two consecutive successive parturitions. Average calving interval of local cattle breeds and their 50% crosses were 431.5 and 429 days. Similarly, (Yifat *et al*. 2012) reported that cross breeds have slightly shorter calving intervals than indigenous in Tatesa Cattle Breeding Centre (622.6 days). Another study supporting this finding reported in the North Shewa zone indicated that local breeds have larger calving intervals (748.2 day) than crossbreds (660 day) (Mulugeta and Belayneh, 2013). Still, in contradiction of the expectation, shorter calving interval in higher inheritance level, and longer calving intervals was reported in 75 and 87.5% cross breeds, respectively. Relatively longer calving interval might be indicative of poor nutritional status, poor breeding management, lack of own bull and artificial insemination service, longer days open, diseases and poor management practices (Belay *et al*., 2012). Gestation Length (GL) is the period between the date of fertile service and the date of calving. This period is almost invariable within individuals in a breed or type. Gestation length, which is more or less constant, varying slightly due to breed, calf sex, litter size, damage, year, and month of calving, and little can be done to significantly manipulate the gestation length (Asheber, 1992; Addisu and Hegde, 1999; Giday, 2001 and Fikrie *et al*., 2007).

2.2.4. Days Open

Days open, the number of days between calving to conception, affects profitability of the dairy industry. The average length of days open recently reported for crossbred dairy cows in Ethiopia was 85.6 to 197 days (Zewdie *et al*., 2011; Belay *et al.,* 2012b; Hunduma, 2012; Niraj *et al*., 2014). The major nutritional factor decreasing reproductive efficiency of milking dairy cows resulted by negative energy balance that brings a stay in first ovulation after calving (a low Ocytes quality) and increase in embryo death incidence with interval from calving to conception that increases over 120-130 days (Rossi *et al*., 2008). (Leroy *et al*., 2010) studied and concluded that the lack of oestrus events during the early postpartum period in dairy cows contributed to negative energy balance. Report also shows the scale and duration of the prepartums energy status (i.e., negative energy balance) has a negative effect on subsequent reproductive and productive performances in high producing dairy cows (Nishany *et al*., 2013). The degree and duration of energy shortage during this early postpartum period is positively connected with the number of days to first oestrus (Leroy and Boles, 2009).

2.2.5. Number of service per conception

NSC is one of the measurements for reproductive efficiency. It expresses the fertility level of the dairy herds. It is a good measure of reproductive status, but still, it usually does not indicate reasons on heifers and cows that fail to conceive. The NSC depends largely on the breeding system used. It is higher under uncontrolled natural breeding and low where hand mating or artificial insemination is used. The NSC was significantly affected by herd, season, placenta expulsion time, lactation length and milk yield (Abdel and Aleman, 2008). The number of services per conception is directly related to the conception rate in a herd. Conception rate or the proportion of cows inseminated which

actually become pregnant, is often reported as “percent successful services”. Oestrus detection accuracy may significantly influence conception rate. It should be noted that even though oestrus detection accuracy plays a major role, it is not the only thing that affects conception rate. Physiological stress from increased milk production or heat stress, reproductive disorder (i.e. Retained placenta, metritis, mastitis, cystic ovaries (Whittier *et al*., 2002). (Motlagh *et al*., 2013) found that the number of services per conception tends to increase significantly with increase in age (47 to 48 month). The possible cause of the low NSC for younger cows was not clear. (Razi *et al*., 2010) observed that the conception rate of parity 3 and 4 was 77% and 75%, respectively. Cows with parity 3 and 4 have several times increased conception rate than nulliparous. Among the age group, the highest conception rate was in between 4 and 5 years, 71% and 74%, respectively and lowest conception rate was in cows of 9 years of age or above.

Animals with one to two services showed conception rate 61% and animals with 3 and more than three services showed conception rate was 50%. Conception rate was significantly increased in both parity 3 and parity 4 than nulliparous, but cows with age groups more than 9 have significantly decreased conception rate than other age group. However, (Habtamu *et al*., 2010) working with Jersey cows observed that there is an insignificant effect of parity number on number of services per conception. Similar results also were reported by (Hammond *et al.*, 2010) study on reproductive performance of Friesian cows under semiarid conditions in Egypt, Who reported that Parity had no significant effect on NSC. The NSC was highest at the third lactation followed by the first lactation**.**

2.2.6. Average milk yield and lactation length of dairy cattle

Average milk production of local cattle per cow is very low. Milk production potential of local cattle such as Boran, Arsi and Fogera is low and it ranges from 494-809 kg per lactation. For example, average milk production per cow per day in Western Gojam Zone is about 1 litre per day, resulting in an estimated milk production of 46,710,335 litres per lactation for all lactating cows (CSA, 2005). Total milk production is further affected by relatively short lactation length, and extended postpartum anoestrus period resulting in lower reproductive efficiency. This is basically due to the fact that these animals have been selected primarily for survival traits and possess well-established adaptive traits to the environment in which they are expected to survive and produce. In general, the reproductive efficiency of a breeding cow is determined by factors like age at first calving, calving interval and number of services per-conception.

Lactation length of local cattle increased in correspondence of exotic blood levels. For example, the average lactation length of local Arsi and Boran breeds was 203.75 days while the average lactation length of their 50, 75 and 87.5% cross were 262.25, 284.25, and 294.25 days respectively (CSA,2005). Similarly, another study conducted in the North Showa zone indicated that local breeds (273.9 days) had shorter lactation length than cross breeds (333.9 days) (Mulugeta and Belayneh, 2013). Even though there was an incremental trend in lactation length as blood level increased, they could not reach the generally accepted 305 days of lactation length for crossbred. This might be due to the reason of poor nutritional status, poor breeding management, diseases and poor management practices (Belay *et al*., 2012).

2.3. Factors affecting reproduction and production performance of dairy cattle

2.3.1. Factors affecting reproduction performance of dairy cattle

The reproduction performance of animals depends not only on their genetic merits, but also on other factors such as nutrition, management and environment (Lobago *et al.*, 2007). Low level of management, lack of proper breeding management, disease prevalence and feed shortage (both in terms of quality and quantity) were reported to low productive and reproductive performance of crossbred dairy cows (Belay *et al*., 2012). Report on stay on postpartum resumption of ovarian activity due to longer CFSI, poor expression of oestrus by the cow, failure to detect oestrus by herd attendant or both are also the major causes for poor reproductive performance of Holstein Frisian dairy cows (Tadesse *et al*., 2010). According to Mekonnen *et al*.(2010) recording system, absence of heat detection aids, improper AI technique, shortage of experienced inseminators, poor management (feeding, housing and heat detection) of dairy cows and heifers ,early embryonic mortality are the implicated factors on reproductive performance and poor AI efficiency of smallholder dairy cows and heifers. Feeding management of dry and early postpartum cows, inefficient heat detection and breeding programs and inadequate reproductive health programs are also the major factors associated with reproductive inefficiency of dairy herds (Ben Salem *et al*., 2006).

2.3.1.1. Breed

According to CSA (2015) about 98.66% of the cattle population in Ethiopia is local that are adapted to feed and water shortages, disease challenges and harsh climates. The productivity of indigenous livestock is, still, believed to be poor even if no practical recording scheme at national level has been used to judge their value. There has been no dairy herd recording scheme at national level, Less than 1% of the 49.3 million cattle

populations of Ethiopia are exotic or crossbred dairy cows (CSA, 2008). Crossbreds had apparently better conception rate and fewer number of services per conception compared to local breeds (Haileyesus, 2006). The same author indicated that Zebu cattle exhibited less intensive symptoms of heat and remained in oestrus for shorter periods than temperate breeds may be due to the poorer calving rate and NSC of local cows. Local breed cows inseminated with Jersey semen required 0.35 more inseminations per conception than those local breed cows inseminated with Friesian semen. On the other hand, crossbred cows inseminated with Jersey semen required 0.23 less number of insemination per conception than those inseminated with Friesian semen (Haileyesus, 2006). The same authors report indicated that crossbred cows required 0.23 and 0.81 fewer numbers of inseminations per conception than the local breeds when they are inseminated with Friesian and Jersey semen, respectively. Parity exerted a significant effect on the number of service required per conception, on both days open and calving interval.

The NSC reduced from 2.1 in the first parity to 1.6 in the fourth parity. In the first parity cows, the cause of this age- related difference in reproductive performance might be due to delayed resumption of ovarian activity after calving. (Gebregziabher *et al*., 2005) stated that long CFSI could result from poor breeding and due to the influences of genetic (breed) and non-genetic (parity, calving year, calving age and weight, body weight gain) factors. The same authors noted that heritability of days to first breeding (service) is generally low which suggests that improvement of the calving to first service interval is mainly possible through the development of non-genetic factors.

2.3.1.2. Nutritional factors

Nutrition has the major limiting influence on productive and reproductive performance in all animals. It also plays a major role in improving reproductive efficiency of dairy cows. Energy and protein are the major nutrients required in the greatest amounts and should be in the top most significance to improve reproduction in dairy cattle; but also minerals and vitamins cannot be neglected and must be optimum in the diet (Bindari-Raj *et al*., 2013). The same author stated that nutrients should not be over-fed as this may also damage reproduction. Environmental factors, especially nutrition, determine pre pubertal growth rates, reproductive organ development, and onset of puberty and subsequent fertility may advance or delay AFS and AFC (Emebet, 2006). This substantial evidence exists that dietary supplementation of heifers during their growth reduced the interval from birth to first calving, probably because heifers that grow faster cycle earlier and express overt oestrus. Energy deficiency, particularly in postpartum cows, is most likely the major feeding factor involved in poor reproductive performance of dairy herds (Ben Salem *et al*., 2006).

It results from the feeding of poor quality forages, which in most cases is coupled with insufficient supplementation. Malnutrition, disease, milk let down interference, weak heat symptoms, calving season, body condition score (BCS) at calving, calf-rearing method (bucket-fed or partial suckling) and parity number significantly influenced the daily milk yield (Msanga *et al*., 2005). Besides, (Muraguri *et al*., 2004) from Kenya reported that commercial concentrate supplementary feeding of lactating smallholder cows led to a significantly higher mean daily milk yield than that of non-supplemented ones throughout the year (18.6% higher annual milk off-take). Changes in feeding systems which occurred from year to another as well as to differences between years in the quantity and

quality of forage availability have a significant effect in year of calving or birth on reproductive performance of dairy cows (Hammoud *et al*., 2010).

2.3.1. 3. Management factors

Management factors such as precision of heat detection, timing of insemination, proper insemination techniques, semen quality, proper semen handling and skills in pregnancy diagnosis have been reported to reduce the NSC (Shiferaw *et al*., 2003). Poor oestrus detection by herdsman, poor oestrus expression of HF cows also contributes to long CFSI (Tadesse *et al*., 2010). Similarly, (Gebeyehu *et al*., 2007) added that proper heat detection, feeding and postpartum reproduction management may reduce NSC, and hence there is a possibility of reduction in days open and calving interval. Furthermore (Emebet, 2006; Habtamu *et al.,* 2010) revealed that changes in management and environmental condition from year to another year stays at first service and calving.

2.3.2. Factors affecting production performance of dairy

Performance of a dairy animal is judged from the milk it produces during a definite period of lactation. Differences were observed in lactation milk yield from lactation to lactation in the same animal. The main reason for variation attributed to the physiology of lactation is the given set of genes and their reaction with non-genetic factors. The lactation performance of dairy cattle is usually measured by defining total milk yield per lactation or per year, average daily milk yield, lactation length (Zewdu *et al*., 2013). Genetic background, climate, diseases, feeding, year and season of calving, breed, age, stage of lactation, parity and milking frequency have been reported to affect milk production and lactation length (Msanga *et al*., 2000 and Epaphras *et al*., 2004).

2.3.2.1. Climate

The climate in a certain geographical area, mainly temperature and relative humidity, significantly influence the production potential of the animals. In lactating cows body heat production is associated with increased milk yield because metabolic processes, feed intake and digestive requirements increase with yield (West, 2003). The heat stress to which a lactating cow is exposed is a mixture of heat accumulated from an environment and a failure to dissipate heat associated with metabolic process (Usman *et al*., 2013). According to (West, 2003) the temperature (28°C) at a high humidity (80%) showed more effect on the cows' feed intake, milk yield, milk composition, heat production, evaporative heat loss and time spent lying down than when humidity was low (40%). The effects of humid hot conditions are more severe than the dry hot. High temperature and relative humidity reduces evaporative cooling, so under hot and humid conditions the dairy cattle cannot dissipate sufficient body heat to avoid a rise in body temperature. The dry hot condition can be relieved by providing sprinklers and fans, whereas, in the humid hot case the cows specially rely upon evaporative cooling in the form of sweating and panting (West, 2003).

2.3.2.2. Parity

Parity is one of the major sources of variation in milk yield (Mulindwa *et al*., 2006). Cows in 4th and more lactations were no longer better producers compared to those in their 3rd lactation. The older age may contribute to reduced milk production through turnover rate of secretory cells, with higher numbers failing compared to the newly produced active secretory cells. Fat tissue cells usually replace dead secretory cells. (Thakur and Singh, 2001), (Javed *et al*., 2004), (Sattar *et al*., 2004), (Komatular *et al*.,

2010) and (Zewdu *et al*., 2013) stated that the lactation milk yield was significantly affected by parity.

2.3.2.3. Lactation season

Many reports showed that season of calving play an essential role in most of the productive traits in dairy animals (Amasaib *et al*., 2008). (Zewdu *et al*., 2013) reported that the lactation milk yield was affected by season of calving, found higher lactation milk yield in autumn than those which calved during winter, spring and summer seasons. (Stadnik and Louda, 1999), (Abdel *et al*., 2007), (Gaur, 2007) and (Mishra and Joshi 2009) reported that milk production was highest in winter than the other seasons. Whereas (Bilal *et al*., 2008) and (Usman *et al*., 2011) found non-significant effect of season of calving on lactation of milk yield.

Seasonal difference in animal performance in tropics is expected to be mainly a manifestation of variation in feed quality and quantity (Javed *et al*., 2004). (Afridi, 1999) suggested that milk yield was sensitive to seasonal variation. Generally, the cows calving in autumn produced the maximum milk, apparently due to low environmental temperature and accessibility of good quality fodder. The animals that calved in spring were next in order of merit. The cows calving in dry hot and humid hot seasons were the poorest producers. The cows calving during summer season would have gone through the last trimester of the gestation period during the scarcity period of fodder and severe dry and humid hot season and were immediately challenged with the dry and second shortage of fodder period (November- December) as they approached highest lactation.

2.4. Breeding systems of dairy cattle

Both natural and artificial insemination (AI) services are used to breed dairy cows. The strength of using the two breeding systems differs and most dairy farmers use natural service rather than AI. This finding is held by (Megersa *et al*., 2011) who reported more (46.4%) smallholder dairy farmers using natural service compared to 20.3% of them who use AI. This may indicate that smallholder dairy farmers are not satisfied with the AI service. Numerous studies have shown more dairy farmers in urban areas who used AI than those in per- urban areas (Lobago *et al.,* 2007, Mureda *et al.,* 2008 and Sintayehu *et al.,* 2008). This is mainly due to easy availability of AI service and difficulties of feeding bulls in towns. On the other hand, the use of AI service has resulted in a low conception rate when compared to natural service. Good examples are reported from urban dairy units in Tanga Tanzania (Msanga *et al.*,2005) and Addis Ababa Ethiopia (Lemma and Kebede,2011) ,where 2.3 and 2.1 mating's respectively were required for AI service compared to natural service that required a relatively small number of mating's 1.7 per conception. This finding is supported by (Kivaria *et al.*,2006) who reported heifers that were served by bull mating were six times more likely to become pregnant than heifers served by AI.

2.5. Milk Marketing and Consumption

2.5.1. Milk Marketing

Dairy production in developing countries improves the food of consumers and the profits and livelihood of smallholders (McDermott *et al*., 2010). Access to livestock source foods is facilitated by the links that producers and consumers have to markets for livestock products, which range from selling to one's neighbour over the fence to

providing supermarkets in distant cities through combined market chains. Good market access increases the food security of producers through assured income and the food security of consumers by ensuring that food products are locally available when needed. The largest and fastest growing population lives in towns and cities, and its demand for equitably priced products, including milk has been a strong inducement to increase livestock food systems so that economies of scale can be realized and market chains managed efficiently (FAO, 2011). Marketing their products is a common limitation for small-scale mixed farmers. While for livestock dependent societies, the challenge is mainly one of distance to markets, small scale mixed farmers face problems of obstacles posed by food safety and quality demands and of a concentrated market chain that makes it difficult for them to compete (FAO, 2011). Milk and milk products are marketed through both informal and formal marketing systems/ market channels based on the production system and type of the dairy product produced. In the formal marketing system, there are cooperatives and private milk collecting and processing plants that receive milk from producers and channel to consumers, caterers, supermarkets and retailers. Overall, marketing of milk and milk products varies depending on the source of the milk, access to market, culture of the society, season and fasting period (Tegegne *et al*., 2013).

Cooperatives have been important in helping dairy smallholders to market their milk and lower their operating costs, providing economies of scale (Bernard and Spiel man, 2009; Moti *et al*., 2013). On the other hand, there are cooperatives that implement well, that are highly entrepreneurial, and that provide good services to their members (Land O'Lakes, 2010). The cooperatives have largely contributed to the development of dairy by buying milk from farmers at a reasonable price, running a breeding program for cattle

development, providing cattle health care support, and Ensuring farmers' participation in the whole system (Shamsuddin, 2011). But, it may not be a guarantee in driving sustainable dairy production systems if it cannot continue providing input and support services (feeds, AI, veterinary, training) to smallholder dairy producers.

2.5.2. Milk consumption

Milk has been known as nature's most complete Food. More than 100 different components have been identified in cow's milk. Cow's milk protein may help to increase bone strength, improve immune function, reduce blood pressure and risk of some cancers, and protect against dental caries. Milk fat is also a source of energy, essential fatty acids /linoleic, fat soluble vitamins (A, D, E, and K), and several health promoting components such as conjugated linoleic acid (CLA), sphingomyelin, and butyric acid. For example, emerging scientific findings reveal that CLA may protect against certain cancers and cardiovascular disease, enhance immune function, and reduce body fatness/increase lean body tissue. Milk and other dairy foods are important sources of many vitamins (riboflavin, vitamin B12 and vitamin A) and minerals (calcium, phosphorus, potassium, zinc, magnesium).

A sufficient intake of calcium helps to reduce the risk of osteoporosis, hypertension, some cancers, and some types of kidney stones, and may have a beneficial role in weight management (Huth *et al*., 2006; Jarvis *et al*., 2007). Cow's milk products have a central role in treatment of under nutrition in low-income countries, and the introduction of products with high milk content has resulted in marked improvements in weight gain, linear growth, cognitive function and reduction in mortality in undernourished children (Moore *et al*., 2008; Michelson *et al*., 2011; FAO, 2014). In per-urban areas of Shashemene Della milk shed, about 25% of dairy households used milk for home

consumption, while in the urban dairy production system (e.g. Hawassa); only 14.2% used milk for family consumption (Tegegne *et al*., 2013). In another study by (Amstu *et al*., 2015), 6 % of milk produced was consumed in the Oromia special zone (Sebeta, Sululta and Holetta districts). Therefore, research and development for husbandry and food based approaches to improved nutrition also face the challenges of enhancing the food and nutrition security of poor people (Beuchelt and Badstue, 2013). To this end, consumers, industry and governments need up to date information on how milk and dairy products can contribute to human nutrition and how dairying and dairy-industry development can best contribute to increasing food security and improving poverty (FAO, 2013).

2.6. Herd Size and Composition within Different Dairy Production Systems

There is a variation in herd size and composition per household in different production systems, as reported by (Ayenew *et al*., 2008), a larger number of cattle kept by crop-livestock farmers, like in Peri-Urban and Rural areas, than by livestock farmers in urban areas. The case of large herd size in peri- urban and in rural than in urban reported by (Tesfaye *et al*., 2001) is stated that in rural area there is large number of oxen which provide draught power which is imperative for cultivation and reflects the importance of cropping in peri-urban and rural area. Total number of crossbred cattle were lower in rural than Urban and peri-urban production systems as reported from Bure by (Azage *et al*., 2013) the proportion of crossbred cattle is very low in rural dairy production system, better in per urban and higher in urban dairy production system. Expand the dairy farming lead farmers who were for testing of innovative good dairy management practices which was to lead to their contact famers to adopt improved practices for increased productivity and expansion of dairy herds. (Singh *et al*., 2016) resulted that the

average lactation yield was significantly higher for large herd size farms (5062 litres), whereas, lowest (4232 litres) for small herd size farms, which may be due to the better management practices followed at large dairy farms as compared to small dairy farms. (McDougall, 2006) reported that reproductive performance decreased with increased herd size. Besides, (Lemma and Kebede, 2011) found that small size farms exhibited the largest days open 217.6 ±102.5 than medium and large sized ones 171.4±68.5 and 161.1±69.6, respectively. However, the number of services per conception was higher in large farms (2.9 ±1.8) than medium (2.2 ±1.1) and small ones (2.5 ±1.3). (Jago and Berry, 2011) reported that expanding herds and large herds have superior reproductive performance relative to non-expanding and small herds. (Atashi *et al*., 2012) depicted that larger herd size was associated with an average decrease of (0.22 ± 0.02) days in calving interval per 50 cows per herd. In a study conducted by (Sasaki *et al*., 2016) demonstrated that cows in smaller herds showed low reproductive performance than large ones. Likewise, (Singh *et al*., 2016) found that the herd size has a significant effect on days open as the small farms had the maximum days open 112 days followed by the medium and large farms. Based on the previous studies, aims to focus on the effect of herd size on the productivity and reproductive of the dairy farms

2.7. Constraints and Opportunities of Dairy Production Systems in Ethiopia

Ethiopia has a huge potential for increasing livestock production for both local use and export purposes. However, expansion and productivity were constrained by quantitatively and qualitatively insufficient and imbalanced nutrition, irregular disease outbreak, water shortage, lack of suitable livestock extension services, inadequate and unreliable data to plan the services and inadequate information to improve animal performance, marketing, processing and combination with crop and natural resources for sustainable productivity

and environmental health (Aynalem *et al*., 2011). Previous studies in different parts of Ethiopia also illustrated that the dairy production was constrained by insufficient supply of quality feed and its high cost, access to credit, seasonality of demand, particularly in fasting time and lack of the processing industry (Ahmed *et al*., 2003; Sintayehu *et al*., 2008; Asaminew and Eyassu, 2009; Adebabay, 2009). Lack of land was reported as the most limiting factor in urban dairy production systems (Belay *et al*., 2011; Azage *et al*., 2013). In Boditti town, South Ethiopia dairy production system was most challenged by factors like land shortage, availability and costs of feeds, shortage of genetically improved dairy animals, discouraging seasonal marketing systems, poor animal health services, problems related to waste disposal (for urban producers), poor extension services and knowledge gap regarding improved dairying (Asrat *et al*., 2013).

In Mekelle city, the major constraints for dairy development were scarcity of feed, high costs of feeds, insufficient land for dairy expansion and preparation of feeds, seasonality of milk demand occurred due to fasting season, lack of improved breed animals with affordable price, less access to credit, AI problem, shortage of water and knowledge gap in identifying quality cross breed cattle (Solomon, 2014). Cattle productivity in Gondar town, North West Ethiopia was affected by various factors and the most important constraints associated with dairy production were land shortage, feed shortage, disease occurrence, poor government attention on extension service, poor veterinary service, lack of improved dairy cattle breed, high cost of feed, water shortage, lack of improved forage pasture and poor transportation (Malede *et al*., 2015). The large and various dairy animals genetic resources adapted to the wide and different agro-ecologies, establishment of several structures and service centres such as veterinary health and AI centres, high demand for intake of dairy products, huge human population with long-standing tradition

of consumption of dairy products, high rate of urbanization and income growth, availability of trained manpower, research institutions and technologies shows that Ethiopia has sufficient opportunities for dairy development (Azage *et al*., 2013). A recent study by (Tadesse and Mengistie ,2016) described that the main opportunities for dairy farm development in Ethiopia were livestock genetic resources and production system, accesses to services and land inputs, research institution opportunities, indigenous knowledge, demand for and consumption of milk, income generation and employment opportunities and service providers. In Mekelle city Solomon (2014) also mentioned that the rapid urbanization, wide population growth and change in the living standard of the people, to generate income as dairy is highly demanded, highly profitable sector, accessing animal health service, AI, extension and training services were an opportunities for the development of dairy production.

Generally the challenges, opportunities and prospects of dairy farming in Ethiopia, Challenges and problems for dairying vary from one production system to another or from one location to another. These challenges can be technical like, health problems, reproductive problems, institutional like inadequate extension and training services, policy and socio-economic challenges like environmental problems and marketing linkage problems. This challenge lowers the production and reproduction efficiency of dairy cattle in Ethiopia. Dairy farm developments also have different opportunities: availability of access services and land inputs, high income generation and employment opportunities, the presence of service providers, the presence of indigenous knowledge. Dairying constitutes an important part of the Ethiopian smallholder dairy sector, a careful planning of dairy policy is required for the generation of appropriate and demand driven technologies in order to attain sustainable dairy farm development

3. MATERIALS AND METHODS

3.1. Description of the Study Area

This study was conducted in three districts of North Shoa Zone, namely Debre Libanos, Wuchale and Degem districts. Those three districts were purposely selected for convincing and arguable reasons that these districts are the most popular districts in North Shoa Zone due to their historic improved dairy developments, where improved dairying was introduced since the early 1950s and where dairy is highly intensified and production is mainly market-oriented. The study districts (Degem, Debre Libanos and Wuchale) were shown at the bottom of the map (Figure 1)

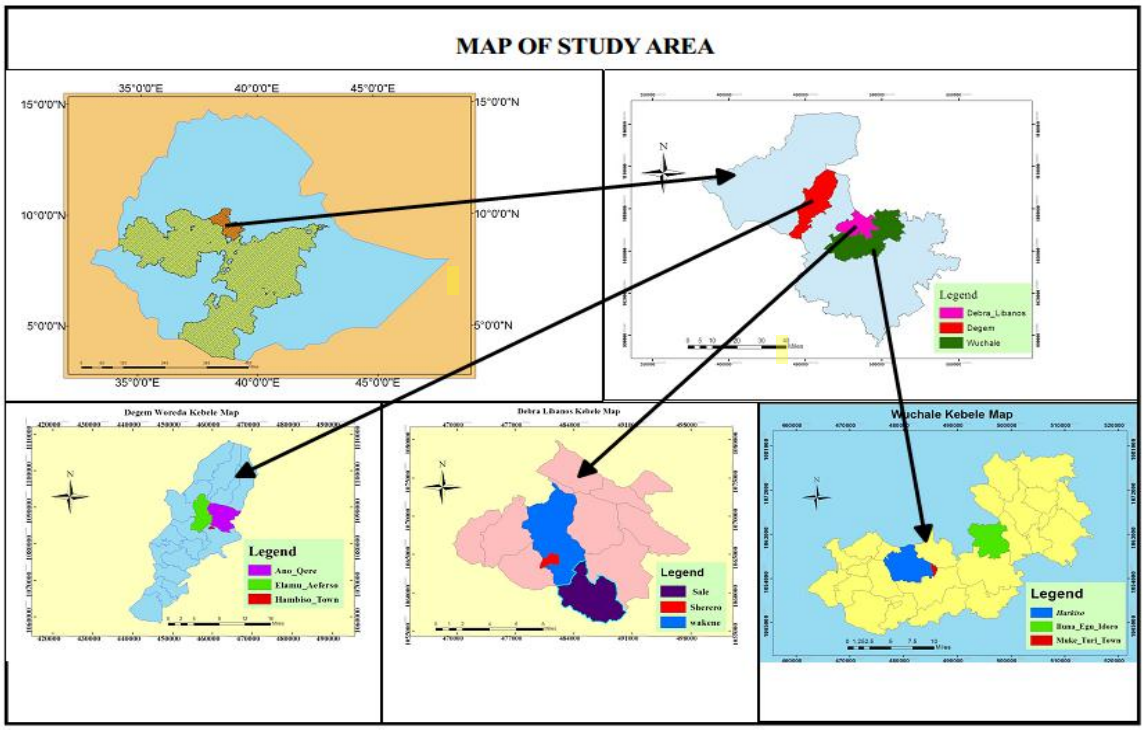

Figure 1: Map of the study districts (Agagnehu, 2019

3.1.1. Debre Libanos District

Debre Libanos was one of the districts of north Shewa zone. The area was located at 9 38′ 20″N and 38 53′ 20″ E, about 89 km north east of Addis Ababa and about 31 km south of Fiche town. Debre Libanos was bordered on the North West by Gerar_Jaarso woredas, on the south west by Yaya Gulele, on the south and south east by Wuchale and on the north east by Amhara_Region. It was situated at an altitude ranging from 2650 to 2700 m. a. s. l and has area coverage of 29776 ha. The area receives an average annual rainfall that ranges from about 800 to 1200 mm. The minimum and maximum daily temperatures of the area are 15℃ and 23℃, respectively. The major crops grown in the area was wheat, barley, teff, bean, chicken pea; horticultural crops such as onion and carrot Debre Libanos district Agricultural Office (DLDAO, 2018).

According to (DLDHO, 2020/2021) this district had a total population of 67611 of whom 34,144(50.5%) are men and 33,467 (49.5%) women; 52,684 (77.92%) are rural dwellers 14,927 (22.08%) are urban inhabitants. The livestock populations are estimated at 63,120 cattle, 5,278 sheep, 5,993 goats, 7,160 horses, 12,757 donkeys, 234 mules, 36,870 poultry, 1,063 beehives (DLDLFO, 2019). The district has 10 rural *kebeles* and 1 urban *kebeles,* from this district the selected *kebeles* (Pas) for this study are Sele, and wakene. From rural kebeles, Sherero from urban

3.1.2. Wuchale District

Wuchale was one of the districts of north Shewa Zone. The area was located at11° 30′ 0″ N and 39° 36′ 0″ E, about 84 km north-east of Addis Ababa and about 36 km south of Fiche town, Wucale was bordered on the north west by Yaya Gulale on the south west by Chanco, on the south and south east by Jidda woredas and on the north east

by Amhara Region. It is situated at an altitude ranging from 2700 to 2800 m. a. s. l and has area coverage of 90481 ha. The area receives an average annual rainfall that ranges from about 900 to 1500 mm. The minimum and maximum daily temperatures of the area are 13°C and 25°C, respectively. The major crops grown in the area are wheat, barley, teff, bean and horticultural crops such as onion and carrot (WDAO, 2019). The district has a total population of 124,721 of which 62,946 (50.46%) are men and 61,775 (49.54%) women. About 93,540 (75%) are rural dwellers while 31,181 (25%) are urban inhabitants. The livestock populations are estimated at 146,101 cattle, 85,341 sheep, 5,451 goat, 19,397 horses, 21,068, donkey, 1,597 mules 82,687, poultry and 2054 beehives (WDLFO, 2019). The district has 24 rural *kebeles* and 3 urban *kebeles.* Out of these two rural *kebeles* (Harkiso and Idoro) and one urban *kebeles* muka turi town was selected for the study.

3.1.3. Degem district

Degem was one of the districts of north Shewa zone, Degem was bordered on the south by Mugger River which separates it from East Wollega Zone, on the west by kuyu on the northwest by Hidabu Abote, on the north by Jamma River which separates it from Amhara_Region, on the north east by Gerar Jaarso and on the east by Yaya Gulale and Debra Libanos. It is located at 9 40′ 0″ N and 38 40′ 0″E at 125km North West of Addis Ababa. Its altitude ranges from 3080 to 3541 m. a. s. l. and has area coverage of 64,919 ha. The area receives an average annual rainfall that ranges from about 900 to 1400 mm. The minimum and maximum daily temperatures of the area are between 15 ^{0}C and 22 ^{0}C, respectively. The major crops grown in the area are barley, wheat, teff, Sorghum, bean, chicken pea and horticultural crops such as onion and potato (DDAO, 2019). The district had a total population of 138,577 of whom 68,596 (49.5%) are men

and 69981 (50.5%) women; 97,004 (70%) are rural dwellers or 41,573 (30%) are urban inhabitants, whereas the livestock population cattle (98,828), sheep (80,715), goat (17,475), horses (5,085), donkey (29,421), mules (175) and poultry (43,133), beehives (6,190) (DDLFO, 2019). The district has 18 rural kebeles and 2 urban kebeles, from these districts two rural kebeles Ano Qare and Elamo Ifarso and from urban Hambiso towns were selected for the study.

3.2. Study Design

3. 2.1. Sampling Techniques and Sample Size Determination

The sampling process was structured in a multistage purposive sampling method comprising the hierarchical administrative set up of selected zones. The survey was conducted in three sample districts which were selected based on the presence of a relatively large proportion of the dairy cattle population. From each three sample districts three sample sites or *kebeles* were purposely taken based on relatively large dairy cattle population size and road accessibility. For this particular study, the scale of the dairy farms was defined as small, medium and large scale based on the number of dairy cows they owned. According to this definition, dairy farms that own ≤ 5, $> 5 \leq 30$ and > 30 dairy cows were defined as small, medium and large-scale dairy producers, respectively (Amare *et al*., 2019). A total of 75, 63 and 42 farms were identified as small, medium and large scale farms, respectively were used in three study districts with the overall dairy farms studied summed up to 180 farms with 20 dairy farms sampled per 9 study *kebeles*. From three (3) urban and six (6) rural kebeles Sample size was determined by using Yamane (1967) formula as:

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

Where n is the sample size, N (328) is the designated total number of households in nine (9) *kebeles* who have both local and cross breeds dairy cattle and e is the level of precision. In this study, the level of precision desired was 95% and e was set at 0.05 Sample size, therefore, reasonably determined taking into consideration all the above factors.

3.2.2. Data type and data collection procedure

Two types of data were collected in this study: qualitative and quantitative data. Qualitative data was obtained by holding group discussion with three groups of dairy cattle producers in the three study districts six (6) groups in each district (3 *kebeles* per district). For the quantitative data, a pre-tested semi-structured survey questionnaire was developed and administered to the three groups of dairy producers (small, medium and large-scale) in the three study districts to gather reliable information on the production and reproduction performances as well as other important traits of dairy cows. Performance and household characteristics data were collected between February and March, 2021. Data collected include daily milk yield (DMY), lactation length (LL), lactation milk yield (LMY), age at first service (AFS), age at first calving (AFC), calving interval (CI), days Open (DO) number of service per conception (NSC) and also other household characteristics data

3.2.3. Data Management and Statistical Analysis

The collected data from different sources were coded and set into a computer using Microsoft Excel spread sheet 2010. For qualitative data descriptive statistics was used to calculate frequency, percentage, means and standard deviation. Quantitative data on production and reproductive parameters were analysed using General Linear Model

(GLM) procedures of Statistical Analysis System (SAS version 9.3, 2009). A preference ranking and dairy cattle production constraint was ranked by calculating index values with the principle of weighted average according to the following formula.

Index = $(R_n \times C_1 + R_n\text{-}1 \times C_2 \ldots + R_1 \times C_n)/ \sum (R_n \times C_1 + R_n\text{-}1 \times C_2 + \ldots + R_1 \times C_n)$

Where, R_n = the last rank, C_n= the percentage of respondents in the last rank, C_1=the percentage of respondents ranked first. Mean comparisons was performed using the Least Significant Difference (LSD) for variables whose F values showing a significant difference at P-value set at 0.05.

The model used developed for the analysis was:-

$$\mathbf{Y_{ijkl} = \mu + B_i + H_j + L_k + e_{ijkl}}$$

Where:

Y_{ijkl} = Response variables (LL, DMY, LMY, NSC, AFS, CI and DO)

μ = Overall mean of the respective variable

B_i = Fixed effect of i^{th} blood level (Local dairy cattle, 50%, 75% and >75% of exotic blood level)

H_j= j^{th} herd sizes effect (small scale= ≤ 5; medium scale= > 5 and ≤ 30 and large scale >30)

L_k= k^{th} locations effect (Debra Libanos, Wuchale and Degem) districts

Eijkl = residual effect**.**

The mean separations were done by using Duncan Multiple range testing. Tables and figures were presented by descriptive statistics such as mean, frequency, standard errors, standard deviations and percentages

4. RESULTS AND DISCUSSION

4.1. Socio- Economic Characteristics of the Respondents

4.1.1. Household Characteristics of the Respondents

The socio-economic characteristics of the study sites are presented in Table 1. The study showed that majority of the surveyed dairy farms were owned by male headed households (90%), while only (10%) of them were owned by female headed households , which was in agreement with results of Azage (2004) in Addis Ababa and Yitaye *et al.* (2009) in north west Ethiopia. The mean average age of the dairy farmers were 42.58±10, 44.08±7.60 and 43.03±10.57 years, respectively in Debra Libanos, Wuchale and Degem districts (ranging from 25 to 78 years). This indicates that there is a growing tendency and interest by youth groups to run dairy as a profitable business. Larger percentages 91.67% of the dairy farmers were owned by married owners while 3.89, 3.33, 1.11% were single, widowed and divorced owners respectively. The overwhelming majority of the respondents 97.78% follow Orthodox Christianity while a few proportions follow Islam and Protestant religion.

Regarding the educational status of the respondents,48.33, 22.22, 13.34 and 9.44% attended primary school (1-8 grades), secondary school (9-10), tertiary education (diploma and degree) and illiterate (no formal education), respectively (Table1). Overall, the majority of the respondents 90.56% can read and write. Education is one of the key factors that contribute to higher adoption rate of agricultural technologies in general and that of dairying in particular. Education as a tool to adopt improved agricultural technologies has been reported in some other studies such as Kerealem (2005) and Assemu *et al.* (2013). The herd sizes per districts were 12.48±8.22, 12.07±9.05 and 12.23±8.54 respectively, in Debra Libanos, Wuchale and Degem districts respectively

there is no significance differences ($p < 0.0001$) in the case of districts, but in the case of farm scale there is highly significances ($p < 0.0001$). The average mean of herd sizes was 12.26±3.00 animals per household in the case of districts there is no significance differences but in the case of farm scale there is highly significances differences ($p<.0001$).The average family size was 6.98±2.34, 6.82±2.44 and 6.80±2.12 respectively, in Debre Libanos, Wuchale and Degem districts respectively there is no significant difference in districts and also farm sizes ($p > 0.05$). The average mean of family size was 6.88±2.31 persons (ranging from 2 to 12 persons per household). In this regard; the smallest family size reported in this study has a positive implication on the average land holding size of the respondents. Similarly, this result was also less than the reports of Berhanu *et al*. (2007) in Bure district that might be attributed to the difference in the response of the respondents in telling the actual family size. The average farming experience was 8.20±2.87, 8.58±3.37 and 5.92±2.37 years respectively, in Debre Libanos, Wuchale and Degem districts respectively there is significance differences between districts ($p \leq 0.05$), with average mean 7.56±2.88 which (ranged from 2 to 17) years.

Table 1: Socio-Economic Characterize of the respondents in the study areas

Variable	Debra Libanos		Wuchale		Degem		Overall	
	N	%	N	%	N	%	N	%
HH head								
Male	56	93.33	53	88.33	53	88.33	162	90.00
Female	4	6.67	7	11.67	7	11.67	18	10.00
Marital status								
Married	55	91.67	56	93.33	54	90.00	165	91.67
Single	3	5.00	1	1.67	3	5.00	7	3.89
Divorced	0	0.00	1	1.67	1	1.67	2	1.11
Widows	2	3.33	2	3.33	2	3.33	6	3.33
R**eligion**								
Orthodox	60	100	56	93.33	60	100	176	97.78
Muslim	0	0.00	2	3.33	0	0.00	2	1.11
Protestant	0	0.00	2	3.33	0	0.00	2	1.11
Educational								
1 to 8	33	55.00	30	50.00	27	45.00	90	48.33
9 to 10	18	30.00	7	11.67	15	25.00	40	22.22
Degree	1	1.67	7	11.67	4	6.67	12	6.67
Diploma	3	5.00	7	11.67	2	3.33	12	6.66
Illiterates	5	8.33	0	0.00	12	20.00	17	9.44

Cont.…

Over all	Age		Number of cows		Family size		Experience on dairy	
	Mean±SD	P-Value	Mean±SD	P-Value	Mean±SD	p-value	Mean±SD	P-Value
Overall	43.23±9.50	0.2681	12.26±3.00	<.0001	6.88±2.31	0.99	7.56±2.88	<.0001
CV	21.99		24.47		33.65		38.12	
District	**ns**	0.6823	**ns**	0.1930	**ns**	0.8947	***	<.0001
D/Liban.	42.78±10.26		14.76±8.22		6.98±2.33		8.29±2.87[b]	
Wuchale	44.24±7.60		14.00±9.04		6.82±2.43		8.66±3.36[a]	
Degem	43.16±10.57		13.82±8.53		6.80±2.12		5.98±2.36[c]	
Farm	**ns**	0.1109	***	<.0001	**ns**	0.9731	**ns**	0.1645
Large	43.75±9.28		25.37±3.1[a]		6.81±2.26		8.03±2.84	
Medium	44.90±10.69		12.55±4.0[b]		6.88±2.28		7.82±2.99	
Small	41.53±8.42		4.68±1.50[c]		6.92±2.24		7.12±3.33	

N=Number of respondents, SD=Standard Deviation, a, b, c=Means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), **ns**=non significances, ***=highly significance, %=Percent

4.1.2. Land holding and land use pattern

Land holding and land use patterns in the current study areas are presented in Table 2. The overall average mean of land holding per house holding was 1.35±0.84 ha in the study area. Average land holding sizes of the respondents was 2.11±1.17, 1.31±0.75 and 0.97±0.67 ha in large, medium and small scale farms, respectively. The land holding per household was significantly ($p<0.05$) higher in large farms than in medium and small

scale dairy farms. This perhaps is attributed to the fact that large farms need large areas to dairy farms for animal feeds and forage production. The overall mean land holding per household observed in the study area was much related to the average land holding size of 1.33 (ha) reported by Adebabay Kebede (2009) in Bure district and also higher than that reported by Ayalew Mekonnen (2017) in the rural, per urban and urban areas of South Wollo Zone, which were 0.45ha. Relatively larger size ($P<0.05$) of land was owned by large scale dairy farmers compared to medium and small scale once. Furthermore, the current land holding estimate is lower than the overall mean land holding of 2.66 ha by Asaminew Tassew (2007) who reported for Mecha and Bahir Dar Zuria districts. The national average land holding size is 2.5ha (CSA, 2013). The overall mean of land allocated for crop land, hay and grazing, and cultivated forage in the study areas were 0.91±0.42, 0.65±0.34 and 0.38±0.19 hectares respectively Table 2.

Table 2: Land holding in hectares and land use pattern per household in the study areas

Variables	Large =(42) Mean±SD	Medium=(63) Mean±SD	Small=(75) Mean±SD	Overall Mean±SE	P- value
Source of land					
Owned	1.16±0.41 [a]	0.88±0.37 [b]	0.75±0.26 [b]	0.90±0.34***	<.0001
Rented	1.36±0.44 [a]	0.88±0.32 [b]	0.58±0.27 [b]	0.91±0.34***	<.0001
Given by Family	0.96±0.53 [a]	0.73±0.26 [b]	0.66±0.27 [b]	0.77±0.36**	>.0135
Total	2.11±1.17 [a]	1.31±0.75[ab]	0.97±0.67 [b]	1.35±0.84***	<.0001
Land use					
Crop land	1.13±0.52 [a]	0.97±0.43[ab]	0.72±0.34 [b]	0.91±0.42***	<.0001
Hay and grazing	0.83±0.40 [a]	0.65±0.29 [b]	0.54±0.35 [b]	0.65±0.34**	>.0005
Cultivated forage	0.48±0.24 [a]	0.39±0.21 [b]	0.29±0.10 [b]	0.38±0.19**	>.0025

SD=Standard Deviation, a, b=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ****=highly significances, **=$p<0.001$, SE=Standard error

4.1.3. Livestock Composition

The overall average cattle holding per household and per type of cattle across the farms were presented in Table 3. The livestock species kept in the area are included cattle, sheep, and chicken, equine and honey bees, respectively Table 3. Crossbred cattle were significantly ($p<0.0001$) higher in large scale than medium and small scale dairy farms. In all cases cattle show the dominant composition in each household from the other livestock proportion of all livestock species Adebabay Kebede (2009).

Table 3: Household level livestock herd compositions

Type of cattle	Farm scale				
	Large =(42) Mean ±SD	Medium =(63) Mean ±SD	Small=(75) Mean ±SD	Over All Mean±SD	P-value
Cross breeds	11.40±3.43 [a]	4.69±1.38 [b]	1.54±0.70 [c]	4.95±1.91	<.0001***
Local breeds	5.00±4.14 [a]	3.02±1.44 [b]	1.92±0.76 [c]	3.02±2.23	<.0001***
Total Cattle	16.40±5.31 [a]	7.72±2.01 [b]	3.46±1.05 [c]	7.97±2.90	<.0001***
Sheep	12.73±10.68 [a]	8.90±5.08 [b]	7.14±3.06 [b]	9.03±6.18	0.0007**
Horses	1.67±0.84 [a]	1.57±0.64 [a]	1.38±0.55 [a]	1.52±0.60	0.3404 ns
Donkeys	2.93±1.52 [a]	1.90±0.90 [b]	1.62±0.70 [b]	2.05±1.03	<.0001***
Mules	0.87±0.35 [a]	1.09±0.30 [a]	1.00±0.00 [a]	1.00±0.24	0.4151 ns
Chicken	18.00±40.67 [a]	8.72±5.57 [a]	7.50±3.92 [b]	10.29±19.75	0.0558 ns
Honey bees	1.33±0.77 [b]	1.70±0.84 [a]	2.04±0.76 [a]	1.76±0.64	0.0935 ns

SD=Standard Deviation, a, b, c=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ***=highly significances, **=$p<0.01$, ns=no significance

4.2. Cattle Husbandry Practices

4.2.1. Purpose of Keeping Cattle

Purpose of keeping livestock in general and dairy animals in particular is portrayed in Table 4. As an integral part of the mixed farming system, livestock production plays a substantial role in the household food security in Oromia national regional states (ONRS).It meets urgent financial need, dietary requirements, draft power, transport, loan repayment, dowry and gift, fuel, fertilizer, as a buffer in the case of crop failure, and also for social and cultural functions.The major farming activity in the study area was crop production followed by cattle rearing. 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. Cattle are the most important component of the mixed-farming system in the study area since they offer milk (1^{st}) rank, draught power (2^{nd}), Reproduction (3^{rd}), marketing (4^{th}), meat (5^{th}), transportation (6^{th}) and manure (7^{th}) and income to the farmers and costing for purchasing agricultural inputs like fertilizers and improved seeds and for other home inputs.

The role of animal manure in this subsystem was very important to the crop production which increases soil productiveness, due to more production available to the farmers and as fuel. These functions of livestock were also reported by Asaminew Tassew (2007) in Mecha and Bahir Dar Zuria districts of Western Gojam (Kerealem Ejigu, 2005) in Enebise esar Midir and Amaro special district of Ethiopia. A study by (Adebabay Kebede, 2009) in Amhara national regional states (ANRS) also reported the multipurpose role of cattle. The major purpose of keeping cattle in the study area was for milk production following draught power Table 4.

Table 4 : Purpose of keeping cattle in the study areas (ranked by respondents)

Activity	Rank									
	1st	2nd	3rd	4th	5th	6th	7th	Score	Index	Rank
Milk	24	8	12	2	5	3	2	307	0.334	1
Drought Power	19	6	9	0	4	3	1	233	0.254	2
Reproduction	6	0	3	3	8	2	4	101	0.120	3
Marketing	9	3	0	2	3	0	2	100	0.110	4
Meat	7	5	1	0	2	0	3	93	0.101	5
Transportation	0	5	0	2	1	2	0	45	0.049	6
Manure	2	1	2	0	1	3	0	39	0.042	7

Index = $(R_n \times C_1 + R_n\text{-}1 \times C_2 \ldots + R_1 \times C_n)/ \sum (R_n \times C_1 + R_n\text{-}1\times C_2 +\ldots + R_1 \times C_n)$

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

4.2.2. Source and Labor Allocation on Dairying

Division of labour in the study area is shown in Table 5. Family members were the major source of labour to farm households for any dairy activities (Yoseph *et al*, 2003). Milking is done mainly by men and it is contrary to the practice in other parts of the country reported by Alganesh Tadesse (2002) (Solomon Bogale, (2004), Where female members of the household undertake milking in small scale farms rather than medium scale and large scale farms. Moreover, sale of live animals and stall feeding of animals were undertaken mostly by men. On the other hand, milk processing, sale of dairy products (88.89%) and barn cleaning were performed by female members of the household.

Herding of cattle was the responsibility of children (62.23%) and hired employees (37.78%); it is comparable with (Lemma Fita, 2004) in east Shoa zone of Oromia Region. Generally, even though there was sharing of responsibility for different husbandry activities among all members, Herd employed and Household played a major role in dairy production.

Table 5: Division of labour among family members (%) in the study areas

Activities	**Children**		**Hired Labour**		**Adults**		**House hold**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Herding	112	62.23	68	37.78	-	-	-	-
Milking	20	11.11	88	48.89	49	27.22	23	12.78
Processing	-	-	16	8.89	34	18.89	130	72.22
Cleaning	6	3.33	156	86.67	10	5.56	8	4.44
Sale of Dairy product	-	-	-	-	20	11.11	160	88.89
Sale of Animal	-	-	-	-	-	-	180	100
Feeding of Animal	73	40.55	93	51.67	-	-	14	7.78
Feed Collection	75	41.67	89	49.44	-	-	16	8.89
Health Monitoring	-	-	37	20.56	93	51.67	50	27.78

N=Number of Respondents, %=Percent

4.2.3. Housing and Facilities

Housing conditions and housing type of dairy cows in the study area are indicated in Table 6. Milking cattle were often housed at night and day. The type of housing provided

varied depending upon the classes of milking animals, agro-ecology, production system, physiological stage of dairy animals (Berhanu Gebremedhin *et al*., 2013). The types of houses provided, in general, varied from roofed to simple corral with no roof. In large farms majority of the farmers keep exotic crossbred cattle in own house of standard barn (55%) and Separate house (40%);while some keep them in attached with the compound open shade (5%) in small scale farms .With regard to housing of local cattle 95% of the milk producers keep their cattle within the herd and type of facility available in the house/barn this is a good advantage for cattle managing system in the barn and that is to reduce wastage of feed and water. The purpose of housing is to keep livestock in comfortable conditions so that the cattle can produce optimally.

A good dairy cattle housing must be able to meet the needs and health requirements of dairy cattle (Haskell *et al*., 2006), housing in the study area was to protect cattle from predators and from extreme weather conditions and feeding management. Facilities of the cattle house play an important role to offer the dairy cows clean feed and water within the house. The result indicated that the flour of the house concrete (74.44%), stone slab (22.78%) and hardened soil (2.78%).About (89.72%) of the farmers had feed and water trough in the barn having crossbred cattle, followed by 100% had feed trough and 79.44% have water trough in the barn and (20.56%) have no water through in the barn and (18.33%) have cattle crash and (81.67%) have no cattle crash. According to the respondent, the ventilation of the house good ventilation (53.89%), medium ventilation (41.11%) and no ventilation (5%).The frequencies of cleaning the barn one (1) times a day (5%), two (2) times a day (50.56%) and three (3) times a day (44.44%) a clean barn is critical to the health of the cattle, for clean milk production and profitability of the farms.

Table 6: Dairy Housing

Variable	Large farm		Medium farm		Small scale farm		Over all	
	Fre.	%	Fre.	%	Fre.	%	Fre.	%
Housing								
Standard Barn	18	42.86	37	58.73	44	58.67	99	55.00
Separate house	22	52.38	22	34.92	28	37.33	72	40.00
Open shed	2	4.76	4	6.35	3	4.00	9	5.00
Flour type								
Concrete	26	61.90	47	74.60	61	81.33	134	74.44
Stone Slab	13	30.95	16	25.40	12	16.00	41	22.78
Hardened Soil	3	7.14	0	0.00	2	2.67	5	2.78
Water trough								
Yes	39	92.86	50	79.37	54	72.00	143	79.44
No	3	7.14	13	20.63	21	28.00	37	20.56
Feed trough								
Yes	42	100	63	100	75	100	180	100
No	0	0.00	0	0.00	0	0.00	0	0.00
Cattle crash								
Yes	10	23.81	11	17.46	12	16.00	33	18.33
No	32	76.19	52	82.54	63	84.00	147	81.67
Ventilation								
Good ventilation	23	54.76	31	49.21	43	57.33	97	53.89
Medium ventilation	17	40.48	28	44.44	29	38.67	74	41.11
No ventilation	2	4.76	4	6.35	3	4.00	9	5.00
Freq.of cleaning the barn								
One(1) times a day	3	7.14	5	7.94	1	1.33	9	5.00
Two(2) times a day	23	54.76	24	38.10	44	58.67	91	50.56
Three(3) times a day	16	38.10	34	53.97	30	40	80	44.44

Fre. = Frequency, %= percent

4.3. Reproductive and Productive Performances of Dairy Cows

4.3.1. Reproductive Performances of Dairy farms

Reproductive Performances of the dairy cow and heifer was one of the most important factors that influence the profitability of the dairy sector. The main indicators that would be measured in considering reproductive performance are age at first services (AFS), age at first calving (AFC), calving interval (CI), days Open (DO) and number of service preconception (NSC).

4.3.1.1. Age at First Services (AFS)

The average age at first service (AFS) of heifers in the study area was 25.97±12.19, 26.06±12.09 and 25.92±11.62 months in large, medium and small scale farms respectively and the average AFS was 25.70±11.89, 26.03±11.67 and 26.22±12.21 months respectively in Debra Libanos, Degem and Wuchale districts. The AFS for local breed in the study area was 46.53 ± 0.95 months while for cross breeds it was 19.13±1.03 months. Considering blood level the AFS was 46.53±0.95, 20.18±0.93, 19.10±0.30 and 18.12±0.32 months respectively, for local breeds, 50, 75 and >75% Table 7. AFS was significantly ($p < .0001$) differences on the all source of variation. Significantly ($p < .0001$) higher differences between was reported local and crossbred in age at first services. These were due to good management practice in large scale farms and hetrosis differences between genotype compositions. The mean age at first service of local heifer revealed in the study area was longer than the mean of 42.48 months reported by Adebabay (2009) in Bure district and Giday Yifter (2001) reported for Fogera heifer (44±8) at Andassa Livestock Research Centre. Significantly shorter age at first service was reported 53 months for highland Zebu (Zewdie wondatir, 2010), 53.9 months for Boran cattle inseminated artificially (Ababu Dekaba, 2002) and greater than 34.4 months

for Ogden cattle (Getinet Mekuriaw, 2005). Smaller AFS was reported for crossbreed cow by Nibret Moges, (2012) that was 15.3±0.23 and 15.5±0.24 for urban and peri-urban areas respectively in Gondar and lower result was recorded 24.9±3.8 for Asella Town (Hunduma Dinka, 2013).The desirable age at first calving in local breeds is 3 to 4 years and 1.8 to 2 years in cross breed cattle. Prolonged age at first calving have high production in the first lactation but the life time production would be decreased due to less number of calving (Hunduma Dinka, 2013).

4.3.1.2. Age at first calving (AFC)

Age at first calving is one of reproductive performances which measures the age at which the heifer success-fully deliver its first offspring. It is economically important traits that can help to assessment of productive and reproductive performance of a given animal in its future live. The respondents in the study area confirmed that the average AFC for the local cows was as scale of farm level 34.32 ± 11.88, 34.57 ± 11.60, 34.67 ± 11.40 in large, medium and small scale farms respectively highly significance ($p < .0001$) and as district level of variation the AFC was 34.52 ± 11.44, 34.62 ± 11.65, 34.50 ± 11.66 respectively in Debra Libanos, Degem and Wuchale districts Table 7. Highly significance ($p < 0.0001$). The Overall mean of AFC for local cows and cross breeds in the study area was 54.55 ± 0.62 and 27.89 ± 0.68 months' respectively. The AFC as the source of variation of blood level for local breeds, 50, 75 and >75% were 54.55 ± 0.62, 28.61 ± 0.53, 27.79 ± 0.36 and 27.26 ± 0.29 months respectively Table 7, there is significance difference between blood levels ($p < 0.0001$). The Overall mean AFC of local cattle of the zone is close to the mean of AFC of Begayet cattle 48.8 months (Mulgeta, 2015) at Chacho area cattle North Shewa zone 47.16 ± 8.7 months (Mulgeta and Belayneah, 2013). AFC of crossbred cows in the study area was lower than 46.0 and 43.3 months in

Bahir Dar and Gondar urban and peri-urban respectively (Ayenew Alemayehu *et al.*, 2009) and 31.9 Zeway urban (Yifat Demberga *et al.,* 2009); 33.20 ± 2.49 month in Markos (Zemenu Yayeh *et al.,* 2014);34.5 ± 0.5 month (Tiwari Ali *et al.,* 2013);36.7 Holetta urban (Yoseph Shiferaw *et al.,* 2003); 36.2 Dare Dawa peri-urban (Emebet Mureda and Zeleke Mekuriaw, 2008); 33.2 Addis Ababa urban (Lemma Abate and Kebede Solomon, 2011); 39.2 Holetta, urban/peri-urban (Tadesse Million *et al.*,2010) Pure exotic and crossbred cows attain AFC differently. For instance, pure exotic cows in peri urban dairy units of Khartoum (Gader *et al.,* 2007) and crossbred cows in Addis Ababa (Ayenew Alemayehu *et al.,* 2009) had lower 29.7 months and higher months AFC respectively. Since the results were reported from different cities then management and feeding differences could be the reasons.

Farm size has been indicated to affect AFC in dairy animals for differences in AFC, According to Lemma and Kebede, (2011) small and large dairy farms in Addis Ababa had longer (34.2 months) and shorter (32.6 months) AFC, respectively. This was significantly longer AFC (43.77 ± 4.2 months) for local Zebu cows (Million Tadesse *et al*., 2006); 32.8 ± 0.9 months for Arsi breed (Enyew Negussie *et al*., 1998); 41.3 ± 2.1 month (Tiwari Ali *et al.,* 2013); 47.6 ± 0.77 months for Fogera (Addisu Bitew, 1999); 52.49 ± 0.91 months (Kedija Hussen, 2007); 53.52 months (Adebabay Kebede, 2009); 50.8 ± 0.36 months reported for Fogera cattle at Metekel cattle breeding and multiplication ranch (Melaku Menale *et al*., 2011) and 52.43 ± 0.17 months (Almaz Bekele, 2012) at Metekel ranch. Reproductive performance of local and crossbred cattle, especially age at first calving, was good; this was probably due to good management and breeding practice, higher level of feeding, lower burden of diseases, parasites and problems in heat detection.

Table 7: List square means of Dairy cattle in months on AFS and AFC in the study areas

Source of variation	N	AFS Mean±SD	P-Value	N	AFC Mean±SD	p-value
Over all mean	540	25.98±0.66	< .0001	540	34.55±0.45	
CV		2.57			1.30	
Farm scale		**	0.0478		***	<.0001
Small	300	22.92±11.62 [b]		300	34.67±11.40 [a]	
Medium	252	26.06±12.09 [a]		252	34.57±11.60 [b]	
Large	168	25.97±12.19 [b]		168	34.32±11.88 c	
District		***	<.0001		***	0.0015
Debra Liban.	`240	25.70± 11.89 [a]		240	34.63±11.44 [a]	
Degem	240	26.03± 11.67 [b]		240	34.53±11.65 [b]	
Wuchale	240	26.22± 12.21 [c]		240	34.50±11.66 [b]	
Breed		***	<.0001		***	<.0001
Cross breed	540	19.13±1.03 [a]		540	27.89±0.68[a]	
Local breeds	180	46.53±0.95 [b]		180	54.55±0.62 b	
Blood Level		***	<.0001		***	<.0001
0 % (local)	180	46.53±0.95 [a]		180	54.55±0.62 [a]	
50 %	180	20.18±0.93 [b]		180	28.61±0.53 [b]	
75 %	180	19.10±0.30 [c]		180	27.79±0.36 [c]	
>75%	180	18.12±0.32 [d]		180	27.26±0.29 [d]	

N=Number of observation, CV=Coefficient of variation, [a, b, c, d]=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ***=highly significances, SD=Standard deviation, AFS= Age at first service, AFC=Age at first calving

4.3.1.3. Calving interval (CI)

Extended calving interval is one of the major problems that reduce lifetime productivity of dairy herds (Belay Duguma *et al.*, 2012). However, the calving interval is perhaps the best indicator of reproductive efficiency. CI was significantly not different ($p > 0.05$) in

large, medium and small scale farms. The result of this study showed that the calving intervals (CI) of cows were 19.47 ± 10.02, 19.20 ± 10.02, 18.84 ± 10.26 months in small, medium and large scale dairy farms, respectively and the overall mean of CI was 19.22 ± 0.68 months; and considering districts, the CI was 19.08 ± 10.25, 19.31 ± 9.94 and 19.28 ± 10.23 months respectively in Debre Libanos, Degem and Wuchale districts Table 8. As the source of` variation is breed the average CI of cross and local breeds was 13.52 ± 2.62 and 36.53 ± 0.63 months respectively. As the source of variation is blood level the CI for (0%) or local breeds, 50, 75, and >75 blood levels were 36.31 ± 0.63, 17.04 ± 1.06, 12.20 ± 0.59 and 11.35 ± 0.51 months respectively.

There is significance differences in all source of variations on CI ($P<0.0001$) Table 8. Genetic factors, year and season of calving, nutrition and age of cow are known to have significant effects on calving interval (Mukasa-Mugerwa, 1989). Lower CI of local cow was reported by Enyew Negussie *et al*., (1998) 13.69 months for Fogera breed, 18.6 months (Gidey Yifter, 2001) for Fogera breed, 18.7 months for Fogera breed (Million Tadesse *et al*.,2006), (Kedija Hussen, 2007) overall mean value 16.01±0.49 months in Mieso district,(Addisu Bitew *et al*.,2007) on farm Fogera district 20.04 months and (Tewodros Bimerew, 2008) for indigenous dairy cows of North Gondar 17.8 ± 2.23 months, 14 months for local cattle (Aynalem Haile *et al*.,2009), (Getnet Mekuriaw *et al*., 2009) also reported 16.4 months for Ogden cattle, 19.6 months (Melaku Menale *et al*., 2011), 19.4 months (Almaz Bekele, 2012) at Metekel, 15.11 months and 14.4 months for Gondar and Mekelle local cows respectively (Niraj Kumar *et al*., 2014a and b). Higher values for CI were also reported by Mukassa Mugrewa *et al*.,(1989) 25 months for traditionally managed Ethiopian high land zebu cattle, (Adebabay Kebede, 2009) the overall mean of 26.04 months in Bure districts and 24.94 ± 4.1 months (Mulugeta

Ayalew and Belayeneh Asefa, 2013) at Angolellantera district and in line with for local cows 23.16 months (Gebrekidan Tesfaye *et al*., 2012) per urban area of Tigry ,Shorter CI crossbreed cow reported 13.26 ± 0.29 and 15.57 ± 1.04 Marko's urban and rural area respectively (Zemenu Yayeh *et al*., 2014), 406 day Zeway urban (Yifat Demberga *et al*., 2009) and 446 day Holetta urban/peri-urban (Tadesse *et al*., 2010). Greater CI in crossbreed cow was reported 555 day Bahar Dar and Gondar urban and peri-urban respectively (Ayenew Alemayehu *et al*., 2009) and 534 day Dare Dewa peri-Urban (Emebet Mureda and Zeleke Mekuriaw, 2008).

4.3.1.4. Days Open (DO)

An increase in the number of days between calving and conception, also known as days Open, is normally associated with reduced profitability in dairy cows. This reduction is partly caused by factors such as increased breeding cost, increased risk of removal from the farms and replacement costs, and reduced milk production (DeVries, 2005). DO was significantly ($p<0.001$) higher in small and medium than large farms and higher differences between local and crossbred. These were due to good management practice, DO in the study areas as the source of variations was farm scale 84.81±23.82, 84.21±24.89 and 80.15±25.89 days in small, medium and large scale farms respectively and the overall mean of DO were 83.51±4.95 days and as the source of variation is districts the DO was 84.32±23.41, 82.45±24.99 and 83.45±26.27 days in Debre Libanos, Degem and Wuchale districts respectively Table 8. As the source of variations is breeds the DO for cross and local breeds were 70.40±10.26, 122.86±8.01 respectively and as the source of the variations is blood levels the DO for (0%) or local breeds, 50, 75 and >75% was 122.86±8.01, 83.13±5.63, 67.43±2.95 and 60.63±2.99 days respectively there is a significant difference in all source of variations of the study's ($p<0.0001$) Table 8. The

overall mean of DO was 83.51 ±4.95 days. The DO of crossbreeding in the study area was lower than HF Crossbreed 93.11±43.87 day (Niraj Kumar *et al.,* 2014*).* The higher DO recorded were due to low management practice in the household level than station and differences of blood level. If the DO is too short, the animals suffer from stress and in the next lactation, the milk production drops substantially and also it gives birth to weak calves. On the other hand if the DO is too high, it may not have that much effect on increasing milk yield in the next lactation, rather it decreases the production in the current lactation. Feed shortage, silent oestrus and lack of proper heat detection might be other contributory factors for long DO reported in this study.

4.3.1.5. Number of Services per Conceptions (NSC)

The average value for number of services per conception of dairy cows' (NSC) in the study area was 1.99±0.60, 1.91±0.45 and 1.83±0.39 in small, medium and large scale dairy farms respectively. The NSC also were 1.89±0.54, 1.91±0.48 and 1.98 ±0.51 respectively in Debra Libanos, Degem and Wuchale districts Table 8 .The overall mean of NSC of local and cross breeds was 1.46±0.49 and 2.08±0.41 .more over the NSC for (0 %) or local breeds, 50, 75 and >75 % were 1.46±0.49, 2.52±0.29 and 2.06 ±0.18 and 1.67±1.78 respectively Table 8. They were significant difference ($p<0.0001$) in all source of variation of the study, higher differences between local and cross breeds, higher in crossbred than local breeds. This report is greater than the mean value of 1.28±0.06 (Melaku Menale *et al*., 2011) reported in Fogera cattle at Metekel ranch, 1.54 ± 0.69 (Tewodros Bimerew, 2008) in North Gonder, 1.59 (Adebabay Kebede, 2009) in Bure district, 1.54 (Giday Yifter, 2001), 1.62 (Gebeyehu Goshu *et al*., 2005) Fogera breeds at Andassa Livestock Research Centre, and similar to ($P>0.001$) 2.2±0.2 (Niraj Kumar *et al.,* 2014a) in Gondar, 2.1±0.1 (Niraj Kumar *et al*., 2014b) in Mekelle. NSC of cross bred

cows was greater than the mean value of 1.4 in Gondar (Nibret Moges, 2012), 1.56±0.3 (Niraj Kumar *et al*., 2014), and 1.52±0.9 Asella Town (Hunduma Dinka, 2013).

According to Mukassa Mugerwa, (1989), cows with values of NSC greater than two are regarded as poor and the result of this study is considerable. The better NSC might be because matting was conducted at the field where bulls and cows graze not together where matting was controlled and the blood level increased NSC decreased. The differences of NSC could be attributed to differences in management practices and agro-ecology of the respective areas. Appropriate and timely heat detection and insemination are also among major factors to lower or higher number of service per conception (Yifat *et al*., 2009)

Table 8: List square means of Dairy cattle on CI, DO and NSC in the study areas

Source of variation	N	CI Mean±SD	P-Value	DO Mean±SD	p-value	NSC Mean±SD
Over all mean	540	19.22±0.68	< .0001	83.51±4.95	<.0001	1.93±0.30
CV		3.55		5.92		16.00
Farm scale		***	<.0001	***	<.0001	***
Small	300	19.47±10.02[a]		84.81±23.82 [a]		1.99±0.60 [a]
Medium	252	19.20±10.20 [b]		84.21±24.89 [a]		1.91±0.45 [b]
Large	168	18.84±10.26 [c]		80.15±25.89 [b]		1.83±0.39 [c]
District		***	<.0001	***	0.0007	**
Debra Libanos	`240	19.08± 10.25 [b]		84.22±23.41 [a]		1.89± 0.54 [b]
Degem	240	19.31± 9.94 [a]		82.45±24.49 [b]		1.91± 0.48 [b]
Wuchale	240	19.28± 10.23 [a]		83.87±26.27 [a]		1.98± 0.51 a
Breed		***		***		***
Cross breeds	540	13.52±2.62 [b]		70.40±10.26 [a]		2.08±0.41 [a]
Local breeds	180	36.53±0.63 [a]		122.86±8.01 a		1.46±0.49 [b]
Blood Level		***	<.0001	***	<.0001	***
0 (Local)	180	36.31±0.63 [a]		122.86±8.01 [a]		1.46±0.49 [a]
50%	180	17.04±1.06 [b]		83.13±5.63 [b]		2.52±0.29 [b]
75%	180	12.20±0.59 [c]		67.43±2.95 [c]		2.06±0.18 [c]
>75%	180	11.35±0.51 [d]		60.63±2.99 [d]		1.67±1.78 [d]

N=Number of observation, CV=Coefficient of variation, [a, b, c, d]=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), *** =highly significanct, SD=Standard Deviation, CI= Calving interval, DO=Days Open, NSC=Number of service preconception.

4.3.2. Production Performances of Dairy farms

4.3.2.1. Lactation Milk Yield (Per day and per lactation period)

The daily milk yield of local and cross breed dairy cows in the study area is shown in Table 9. Milk yield in small, medium and large farms was 15.22±7.97, 16.52±8.56 and 17.93±9.47 litres respectively. Milk yield is significantly ($p<0.0001$) higher in large and medium farms than small scale dairy farms .In the case of districts the milk yield was 16.16±8.44, 16.16±8.60 and 16.71±8.77 litres, in Debra Libanos, Degem and Wuchale districts respectively. Milk yield per days of local and cross breed cows in the study area was on average 3.05±0.55, 20.73 ± 4.50 litters respectively. The milk

yield of local breeds, 50, 75 and >75% blood levels were 3.05±1.37, 15.56±1.17, 20.99±2.23 and 25.64±1.78 liters respectively Table 9. There is significant difference in all source of variation of the studies ($p<0.0001$) .The lactation milk yield for cows with (0%) or local breeds, 50%, 75% and >75% blood levels were estimated at 788.00, 3828.05, 5666.73 and 7332.48 liters respectively.The average daily milk yield of local cows in the present study was higher than that reported by Zewdu Wuletaw (2004); Adebabay Kebede (2009) which produces 2 litres per day per cow, and lower than the value reported by (ILDP, 2004) which was only 4 litres and Gebrekidan Tesfaye *et al*. (2012) 2.56±1.12 litre respectively, whereas CSA, (2019/2020) reported 1.482 litres overall average in the country. In addition to improved nutrition and management, selection for milk yield traits within the indigenous breeds may be planned as a long-term objective in order to increase milk yield from indigenous cattle. However, in order to meet the immediate demand for milk, crossbreeding indigenous cattle with exotic cattle breeds can be planned and implemented in the study area.

4.3.2.2. Average Lactation Length (ALL)

Lactation length refers to the time of period from when a cow starts to secrete milk after parturition to the time of drying off. The lactation length of dairy cows in the study area was 8.47±1.09, 8.82±1.23 and 9.33±1.19 months in small, medium and large scale farms respectively. The overall mean and standard deviation of average lactation length *(*ALL) of dairy cows were 8.79 ±0.93 months and the ALL of dairy cows in study districts were 9.46±1.25, 8.64±0.86 and 8.28±1.17 months in Debra Libanos, Degem and Wuchale districts respectively Table 9. The LL as the breed is the source of variation for cross and local breeds the average lactation length was 8.87±0.92 and 6.57±1.80 months

respectively Table 9. For local, 50, 75 and >75%, the LL was 8.57±1.80, 8.17±0.63, 8.98±0.78 and 9.49±0.83 months, respectively Table 9. There is significance at all source of variation of the studies ($p < 0.0001$). Gebrekidan Tesfaye *et al.*, (2012) reported 6.83±2.5 litre; while Zewdu Wuletaw, (2004); and Adebabay Kebede, (2009) reported 8 litres per day per cow for cross breeds. The current estimated average lactation length was shorter than the ideal lactation length of 305 days defined by Foley *et al*. (1972). This might be due to the extended utilization of the farmers for more milk production which is responsible for extended calving interval.

The current observed lactation length is comparable with previous findings of Belay *et al*., (2012) and (Kumar *et al*., 2014) who reported mean lactation length of 255.75 and 247.11±22.64 days respectively for local Ethiopian milking cows. Whereas the current lactation length of local cows is higher by two months as compared to CSA (2017) who reported that the average lactation period per cow during the reference period at country level is about six months. But lower than the report of lactation length reported by Lemma *et al*.(2005), Mulgeta and Belayneh (2013) and Zeru and Lijalem (2016) who reported mean lactation length of 9.5, 9.13±2.63 and 10.80 + 0.053 months for native cattle in/ around Bahirdar, North Shoa zone, Amhara region, East Shoa zone, Oromia region, Wolaita zones Southern region respectively.

Table 9: List square means of Dairy cattle on DMY, LMY and LL in the study areas

Source of variation	N	DMY (Lit.) Mean±SD	P-Value	LMY (Lit.)	LL Mean±SD	p-value
Over all mean		16.31±1.17	< .0001	4403.81±548	8.79±0.93	
CV		7.18		12.46	10.67	
Farm scale		***	< .0001	***	***	< .0001
Small	300	15.22±7.97 [c]		3877.43 [c]	8.47±1.09 [c]	
Medium	252	16.52±8.56 [b]		4467.22 [b]	8.82±1.23 [b]	
Large	168	17.93±9.47 [a]		5248.66 [a]	9.33±1.19 [a]	
District		***	< .0001	***	***	< .0001
Debra Libanos	`240	16.16± 8.44 [b]		4547.61[a]	9.46±1,25 [a]	
Degem	240	16.16± 8.60 [b]		4248.35[c]	8.64±0.86 [b]	
Wuchale	240	16.71± 8.77 [a]		4415.48[b]	8.28±1.17 [a]	
Breed		***		***	***	< .0001
Cross breed	540	20.73±4.50 [a]		5609.08 [a]	8.87±0.92 [a]	
Local breeds	180	3.05±0.55 [b]		601.16 [b]	6.57±1.80 [b]	
Blood Level		***	< .0001	***	***	< .0001
0 (Local)	180	3.05±0.55 [d]		788.00 [d]	8.57±1.80 [c]	
50%	180	15.56±1.17 [c]		3828.05 [c]	8.17±0.63 [d]	
75%	180	20.99±2.23 [b]		5666.73 [b]	8.98±0.78 [b]	
>75%	180	25.64±1.78 [a]		7332.48 [a]	9.49±0.83 [a]	

N=Number of observation, CV=Coefficient of variation, a, b, c, d=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ***=highly significances, SD=Standard Deviation DMY= Daily milk yield, LMY=Lactation milk yield and LL= Lactation length, %=percent

4.3.3. Milking Procedure and Frequency of Milking

In the study area cows were hand milked and calves are allowed to suckle their dams prior to as well as after milking cross breeds 76(46.16%) farmers practice to suckle calves their dams, where us 104(53.84%) farmers do not allow to suckle calves their dams Table 10. All of the respondents 180(100%) practiced to stimulate udder before

milking. The respondents noted that they also milk their cows in the absence of their calves having crossbreed cows. In the study area milking practice observed no suckle and milking 59.52, 61.90 and 66.67% respectively in large, medium and small scale farms ,once suckle and milking 40.48,38.10 and 33.33% respectively in large, medium and small scale farms , crossbred were milked on the average twice a day 95, 85 and 80 per cent of the respondents in large, medium and small scale farms respectively similar findings were also reported by Asaminew and Eyassu (2009), Amstu *et al.*(2015) and Sintayehu *et al.(*2008) that farmers milked their herds twice using hand milking. While 5, 15 and 20 percent of the respondents in large, medium and small scale farms milk their local cows once a day.

Majority of respondents reported that they wash cow's udder and use towel before milking cows 100, 89 and 85% in large, medium and small scale dairy farms, respectively; Moreover, milkier swim their fingers into the vessel containing milk and moistening teats of the cows to facilitate milking 69, 56 and 15% in small, medium and large scale farms, respectively. Similar practices are done in east Shoa Zone of Oromia region Lemma Fita, (2004).This practice may cause microbial contamination of the milk from the milkier hand and thus farmers need to be given training on sanitary milking practices and basic milk hygiene.

Table 10: Milking Procedure and Frequency of Milking

Variable	Large Farm		Medium Farm		Small scale Farm		Over all	
	Fre.	%	Fre.	%	Fre.	%	Fre.	%
Cross bred Calf suckling								
Yes	26	61.90	39	61.90	11	14.67	76	46.16
No	16	38.10	24	38.10	64	85.33	104	53.84
Stimulate udder								
Yes	42	100	63	100	75	100	180	100.00
No	0	0.00	0	0.00	0	0.00	0	0.00
Milking practices								
No suckle and milking	25	59.52	39	61.90	50	66.67	114	62.70
Once suckle and milking	17	40.48	24	38.10	25	33.33	66	37.30
Frequency of milking								
Cross breeds twice a day		95.00		85.00		80.00		86.67
Local cows once in a day		5.00		15.00		20.00		13.33
Wash udder and use towel		100.00		89.00		85.00		91.33
Swim the finger in to vessel		15.00		56.00		69.00		46.67

Fre. =Frequency, %=percent

4.3.3.1. Equipments Used for Storage and Processing of Milk Products

Three types of containers are used for storage and processing of milk products depending on the scale and type of milk enterprise. These include gourd, clay pot, plastic and steel buckets. Clay pot and plastic is the major container used for milking and storing of the

milk products in the rural area, especially by smallholder farmers. According to their size (small, medium and large size) gourds are used for milking, storage and churning of milk Table 11. In the study area, plastic materials and steel buckets are used for milking and as milk storage equipment, whereas Clay pots and gourds are used for churning. This result was similar with Adebabay Kebede, (2009) in Bure district, Azage Tegegne *et al*. (2013) in pilot learning districts and Belete Anteneh (2006) in Fogera district

Table 11: Equipment's used to processing and storage of dairy products in the study areas

Purpose	**Large Farm in %**			**Medium Farm in %**			**Small Farm in %**		
	Guard	Clay pot	Plastic (Bucket)	Guard	Clay pot	Plastic	Guard	Clay Pot	Plastic
Milking	-	-	100	-	-	100	15	-	85
Churning	10	75	15	10	60	30	20	65	15
Storage									
Ferment milk	-	75	25	10	75	15	25	25	50
Buttermilk	-	-	100	-	-	100	-	25	75
Cottage cheese	-	35	65	-	30	70	-	40	60
Butter	-	-	100	-	-	100	-	-	100

%=Percent

Milk products like fermented milk, buttermilk, cottage cheese and butter are stored in the majority of large, medium and small scale farms in plastic material and steel buckets.

4.4. Input supply and Marketing

4.4.1. Breeding and Mating Practices

Genetic improvement of cattle is the key element in the production of milk and milk Products that determine the potential of dairy cattle. In order to respond to high milk demand in the study area and exploit the potentials and resources available there, provision of genetically higher dairy cattle or good breeding services as per the needs of producers is one of the prerequisites for the development of dairying in the studied areas. The fact that the majority of respondents stated “grading up” as their breeding strategy indicates that AI is more broadly used than crossbred bulls. As less than full replacement of local genes with exotic genes is desirable (Marta Kiuzczynska, 2012), it has to be questioned if appropriate cross breeding methods and effective dissemination schemes enabling maintenance of desired exotic blood levels were established. The study showed significantly ($p<0.001$) above AI and bull in large, medium, and small scale dairy farms.

In large farms breeding practice 16.98% AI service, 38.71% both bull and AI services, and 29.73% bull service were used. In medium farms 25% AI service, 14.45% both services, and 56.78% bull service used. In small-scale farms 58.04% AI service to upgrade their dairy cattle blood level most of the small scale farms use AI breeding practices, 16.13% both services and 13.51% bull service used. Significantly ($p<0.001$) higher crossbred (80%) than local (20%) used AI. In the present study, this argument could be supported by the fact that very few farmers based their breeding bull selection on recommendations from extension staff. Further possible reasons for fluctuations of exotic blood level are numerous: Lack of knowledge led to random breeding decisions. Bulls were used as an alternative option if AI technicians or semen was not available or AI service failed repeatedly. It was indicated that AI service offered semen from exotic

bulls exclusively. Some farmers did not know the exotic blood level of the bull with which their cows were inseminated. However, there is clear evidence that the majority of farmers have some kind of knowledge about exotic inheritance, experiment themselves, and search for the appropriate level of exotic blood in their herd. As farmers explain, the suitable level depends on the animals' adaptation to the surroundings and their individual management potential (ability to satisfy feed and health requirements). Rogers, (2008) explains this occurrence as reinvention, which is a way of making an innovation well fit its own realities. An on-farm survey like this one does not result in an exact determination of blood levels but gives an important insight into farmer's knowledge on herd composition. For current and future challenges, it is imperative to develop and implement cattle genetic improvement strategies in Ethiopia which are sustainable and suitable to prevailing production systems (Kefena Effa *et al*., 2003). The most productive and adapted animals for each environment must be identified for breeding purposes (Philips son *et al*., 2011).

In this study Two types of breeding practices visa: natural mating and artificial insemination are common in the study areas, AI was the most common method for mating crossbred cows used (33.24%) and natural bull service (33.34%) mating both AI and natural bull (23.10%) and respectively. AI was statistically significant ($p<0.05$) higher in large than medium and small scale dairy farms, and crossbred higher significance ($p<0.05$) than local breeds. AI service is well known for its various advantages, but can be an expensive undertaking if not used efficiently (Zewdu Wuletaw, 2004). The results of this study indicate that farmers in all areas had very good access to AI service and that the majority (91%) was satisfied with the availability and the service they received. Timely insemination was facilitated by use of mobile telephones, available

infrastructure and use of car or motorbikes by AI technicians. As an example (Desta Kelay, 2002) and (Abdi Nasir, 2000) reported a wide use of AI service in areas with good infrastructure for AI close to cities but very low application far from cities. In this case natural service was recommended as the best practical option in faraway areas. Nearly half of farmers (46.7%) in Addis Ababa had problems with AI according to (Desta Kelay, 2002). Exotic semen from both Holstein Friesian and Jersey was used for insemination in the study areas with only 11% of farmers using Jersey semen additionally to Holstein Friesian (89%). According to (Zewdu Wuletaw, 2004a) in the project region, nearly 90% of the inseminations were done using Holstein Friesian semen. Zewdu criticized the low utilization of Jersey even though the breed showed better adaptive potential and overall suitability in mid altitude areas. Furthermore, the overall interest of farmers (93%) to try a different breed with better qualities fitting the environment, the long distances to markets and a present good market outlet for butter would be in favour of the Jersey breed special in small scale farms most of the farmer's needs.

Breeding bulls are mainly selected by farmers according to their availability, quality (body conformation, good performance, desired colour) and level of exotic blood, rarely as an alternative option for AI. Different results were obtained by (Desta Kelay, 2002) who in a survey asked farmers more specifically about their preferred performance traits for breeding bulls. High daily milk yield was the most important preferred performance trait followed by high fat content and shortage at first calving. (Addisu Bitew *et al*., 2011) further reported that crossbred bulls were used as an alternative mating option in situations in which AI was not reliable.

Table 12: Percent of breeding and mating practices across the study areas

Breeding practices	Large farm	Medium farm	Small farm	Over all
AI (Artificial insemination)	16.68	25	58.04	33.24
Both bull and AI	38.71	14.45	16.13	23.10
Bull Service	29.73	56.78	13.51	33.34

%=Percent

4.4.2. Breed Preferences of Dairy Farms across Study Areas

Majority of the respondents prefer the Holstein Friesian 67.78%) breed compared to jersey 28.33% and local 3.89% breed Figure 2. The majority of respondents stated in all dairy farms systems have commitment to continue crossbreeding with high exotic blood levels in crossbred offspring (Genotype composition).That means they did not keep the initial proportion of exotic genes in their herd constant but they need to improve by increase exotic blood level and also need to use different exotic blood breed type

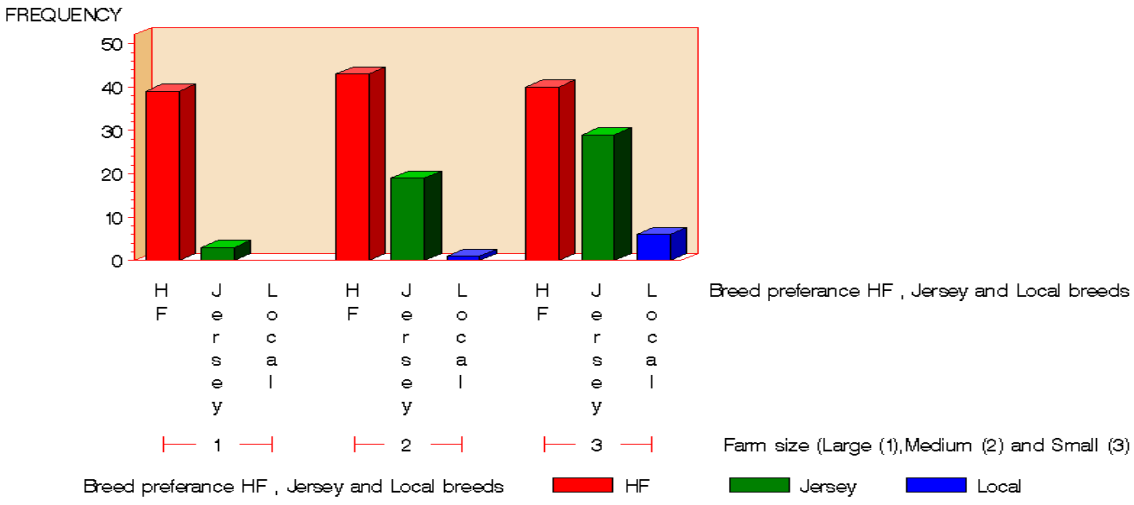

Figure 2: Breed preferences across the study areas

As shown on Figure 2. Crossbreeding local animal with Holstein Frisian of exotic breed by using AI to improve blood level was the most practiced strategy in all Small, large and

medium scale dairy farms result was similar with the finding of kahi, (2002), who stated that utilization and improvement of the desired crossbred population can only be efficient in situations where breeding programmers' with well-defined breeding objectives are developed; which is often lacking at smallholder level in the tropics. Similar findings were documented, for example, by Rege *et al. (*2001) for the Kenyan Zebu breeds, whereas crossbred animals were preferred for their dairy traits (Ababu Dekeba *et al.*, 2006; Effa Kefena *et al.,* 2006). The Reasons for Preferring Holstein Friesian and Crossbred Dairy Cattle under the Ethiopian dairy production system where milk is sold on volume basis, high milk yield is the most important criteria for selecting a specific dairy cattle breed and crossbreed dairy cattle are present for the Holstein Friesian dairy producers; high milk yield, high reproductive efficiency and fast growth rate were the most preferred traits for large, medium and small scale dairy farms, respectively.

4.4.3. Constraints of AI

The major constraints of the AI delivery system were presented in their order of importance here below. The most outstanding constraints of AI service were the unwillingness of AI technicians, no AI access, efficiency of AI technicians, and Shortage of liquid nitrogen and semen Table 13. According to Haileyesus Abate (2006) the major AI service constraints ranked as, the unwillingness of AI technicians, Shortage of liquid nitrogen and semen, no AI access, and efficiency of AI technicians for AI the order of their importance. Even though, different from (Haileyesus Abate, 2006), both exploited major problems of AI service. According to Damron, (2000) and Barrett, (1974), heat detection; AI technicians' efficiency, and the fertility level of the herd were the most severe problems of AI service delivery. Whereas the current study showed that ($p<0.001$) higher in small and medium than large scale farms, unwillingness of AI technician, no

AI access, efficiency of AI technicians and Shortage of liquid nitrogen and semen were also serious problems for AI service respectively. Concerning AI technicians, not only their skill problem, but also motivation, attitudes and the facilities available have deep influence on the effect of AI service.

Table 13: Constraints of AI in study areas

Constraints	Large (N=42)		Medium (N=63)		Small (N=75)		Overall		Rank	P-Value
	Fr.	%	Fr.	%	Fr.	%	Fr.	%		
Problem of AI										
Yes	17	40.48	27	42.86	55	73.33	99	52.22		0.0001
No	25	59.52	36	57.14	20	26.67	81	47.78		0.0001
No AI access	14	33.33	14	22.33	12	16	40	23.89	3	0.0001
Unwillingness of AI technician	12	28.57	19	30.16	26	34.66	57	31.12	1	0.0001
Shortage of liquid nitrogen and semen	9	21.43	24	38.10	13	17.33	46	25.35	2	0.0001
Efficiency of AI technician (double insemination)	5	11.90	1	1.59	7	9.33	13	7.34	4	0.0001

N=number of respondents; Fr. =Frequencies; %=percent

4.4.4. Feed and Feeding Management

The major sources of feed for cattle in the study area were crop residues, hay, natural pasture, concentrate, and non-conventional feedstuffs (local brewery by-products) Table 14. Livestock feeds are the major inputs in any milk production activity Sintayehu *et al*. (2008). Livestock feed resources in Ethiopia are mainly obtained from natural and improved pastures, crop residues, forage crops, agro-industrial by-products, and non-

conventional feeds (CSA, 2012). The contribution of feed resources, however, depends upon the agro-ecology, the type of crop produced, accessibility, and production system Seyoum *et al*. (2001); Ahmed *et al*. (2010). Natural pasture is the major source of livestock feed in Ethiopia. However, its importance is gradually declining because of the expansion of crop production into grazing lands, redistribution of common lands to the landless, and land degradation Berhanu *et al.*(2009). Urban and peri-urban dairy production depends on purchased concentrate and roughage feeds with limited grazing Azage *et al*. (2013).

Generally, crop residues from cereals such as teff straw, wheat straw, barley straw, and Bean straw from the basal diets of the animals. This result was different from the findings of (Seyoum Yigrem *et al*., 2008) who reported that the major basal feed resources for cattle in the highlands of Ethiopia were natural pasture, crop residues, and stubble grazing. Similar reports in Ethiopia animal production systems were primarily based on native pasture and crop residues (Firew Tegegne, 2007). In the study area, crop residues provide the major feed to cattle followed by hay, natural pasture, and concentrates. Moreover, farmers keep a portion of their land for pasture production and grazing.

The use of private grazing land in three districts was believed to be a good beginning for better use of pastures. A similar practice was followed by farmers in the North Gonder Zone where farmers allocate part of their land for pasture production (Zewdu Wuletaw, 2004). The report of (Belete Anteneh, 2006; Seyoum Bedie *et al*., 2007); (Kedija Hussen, 2007) and (Adebabay Kebede, 2009) indicated that the major basal feed resources for cattle in Fogera district, the highlands of Ethiopia, in Miso districts and Bure district respectively, are natural pasture, crop residue, and stubble grazing. The use of improved forages such as dasho grass, sasbania, and tree lucerne was common in the study area.

Considering the three districts, more farmers grow improved forage species Sasbania (*Sesbania sesban*), Tree lucerne *(Cytisus proliferus),* Cowpea (*Vigna unguiculata*), Red Rhodes grass (*Eustachys paspaloides*) Dasho grass*(Pennisetum pedicellatum)* and elephant grass (*Pennisetum purpureum*), Vetch (*Vicia sativa*), Oat (*Avena sativa*), Alfalfa (*Medicago sativa*) in large and medium as compared to small scale farms, and concentrate feeding is generally low. However, those respondents who owned crossbred cows feed concentrate feeds like nuke cake (*Gizotia abyssinica*). Nuke cake and wheat bran to their animals, on the contrary the concentrate was given to local cattle in few amounts as compared to crossbreeds in the study area.

Other important feed resources in the surveyed areas were local brewery by-products namely Attela, by-products of the traditional beverages *Tella* and *Arekie,* both in wet and dry seasons of the year Table 14. According to the respondent's farmers use Attela as a substitute for conventional concentrate feeds. Given the high costs of concentrate feeds, the use of these non-conventional feedstuffs might be a viable alternative; however, the effects of these feedstuffs on milk yield and composition need to be investigated before recommending them for dairy cows.

Table 14: Feed resource across the study areas

	Rank								
	1st	2nd	3rd	4th	5th	6th	Score	Index	Rank
Feed Resource									
Crop residue	34	12	17	4	7	9	367	0.47	1
Hay	16	5	4	1	3	4	150	0.19	2
Private grazing land	9	4	5	0	0	2	96	0.12	3
Concentrates	5	4	0	3	3	4	69	0.09	4
Improved forage	5	2	1	3	1	2	57	0.07	5
Attela	3	2	1	2	2	0	42	0.05	6

Index = $(R_n \times C_1 + R_n\text{-}1 \times C_2 \ldots + R_1 \times C_n)/ \sum (R_n \times C_1 + R_n\text{-}1 \times C_2 + \ldots + R_1 \times C_n)$ Where, R_n = the last rank, C_n= the % of respondents in the last rank, C_1=the % of respondents

Attela was byproducts of traditional beverages of *Tella* and *Arekie*. In small scale farms 65% and in medium scale farms 56% of interviewed farmers feed their local cattle differently than their crossbred, whereas in large 75% of farmers use the same feeding strategy for crossbred cattle. There was a significant difference ($P<0.05$) between large, medium and small scale farms. Farm size did not have a statistically significant effect on feeding patterns ($P>0.05$). Feeding strategies, which differ significantly between study areas ($P<0.05$) were compiled in Table 15. In all study sites, crossbred cattle have restricted grazing time; none can graze freely. Some farmers stated that during this shortened grazing time crossbred cattle were herded in order to prevent unwanted mating, intake of harmful plants and water which was infected with parasites. The remaining time cattle are stall-fed. Farmers were aware that stall-feeding prevents diseases and protects cattle from heat stress and heavy infestation with parasites. Crossbred cattle graze mainly

on private land, seldom on communal grazing grounds. All sites, but especially in large scale use a cut and carry system that means zero grazing. In medium scale crossbred cattle graze seasonally, which means they either graze during the rainy season or they graze on crop aftermath. Zero grazing was practiced to a higher extent in all study areas. By comparison, much more local cattle were found to graze freely on private and communal grazing grounds. Generally, farmers intensified their farming practices shifting from free grazing (traditional for local cattle) to semi-intensive backyard dairying and controlled grazing or zero-grazing (common for crossbreds). This finding is in agreement with reports by (Addisu Bitew *et al.*, 2011)

Table 15: Feeding strategy in Percent (%) across the study area.

Feeding strategies	**Large**		**Medium**		**Small**	
	Local	**Cross**	**Local**	**Cross**	**Local**	**Cross**
All day free grazing	0.00	0.00	0.00	0.00	30.00	0.00
Restricted grazing/few hours	0.00	20.00	28.00	8.00	0.00	13.00
Zero grazing/ stall-feeding	0.00	79.00	0.00	56.00	0.00	42.00
Seasonal grazing	100	0.00	100	5.00	100	0.00

%=Percent

4.4.5. Calf rearing practices

The calf rearing period covers the time from birth to 12 weeks of age. It includes feeding (colostrum, milk/milk replacer, concentrates, fiber and water), housing, general husbandry and health management of calves from the moment they are born up to four

weeks post weaning. Calf rearing practice is one of the most important husbandry practices, which sustains the milk herd through supplying replacement stock. Proper management and constant attention is required for calves, as they form the future dairy herd, after parturition cows are not milked for about two weeks during which calves are kept with and allowed to suckle their dams freely. Milking commences after two weeks of calving and the calves were allowed to suckle their dams for short time before and after milking.

In the traditional dairy production system, calf suckling was recommended because it results in higher milk yield and long lactation length of the dam, higher pre-weaning gain of the calf and higher weaning weight (Gebre-Egziabher G/Yohannes *et al.,* 2000). Calf suckling 100 and 35% for local and cross breeds. The majority of the respondents practiced partial pre-weaning feeding of calves. Bucket feeding of milk was practiced before weaning mainly by farmers who owned crossbred cows 68.89% and partial suckling 31.11% crossbreed calves. The overall average weaning age of local calves was 8 months that was; the calves suckle their dams up to eight months of the lactation period while for crossbred calves the average weaning age was 5 months. Which was similar from the reports of (Asaminew Tassew and Eyassu Seifu, 2009) the overall average weaning age of local and crossbred calves were 11 and 6 months respectively. Majority of the respondents have calf houses in the study areas 38.67, 68.25 and 90.47% in small, medium and large farms respectively.

Table 16: Calf rearing Practices in the study areas

Variable	Farm scale						Breed	
	Small Farms		Medium Farms		Large Farms		local	Cross
	Fre.	%	Fre.	%	Fre.	%		
Calf suckling								
Yes	11	14.67	39	61.90	26	61.90	100.00	35.00
No	64	85.33	24	38.10	16	38.10	0.00	68.00
partial suckling		21.00		6.00		4.11		31.11
Bucket feeding		17.00		25.00		26.89		68.89
colostrum feed								
Yes	75	100.00	63	100.00	42	100.00	100.00	100.00
No	0	0.00	0	0.00	0	0.00	0.00	0.00
Average weaning age							8 month	5 month
Calf Housing								
Yes	29	38.67	43	68.25	38	90.47	25.00	83.00
No	46	61.33	20	31.75	4	9.53	75.00	17.00

Fre. =Frequency, %=Percent

4.4.6. Water sources and frequency of watering

Water sources and watering frequencies in the study areas are shown in Table 17. The main sources of water identified in the present study areas were pipe water, rivers, wells, pond, lakes and spring waters. The majority (51.60 %) of the households obtained water from pipe water, 18.60 % from river, 20.40 % from wells and 17.40 % from ponds. With regard to large farms producers the majority (63.00 %) obtained water from pipe water. Although relative, all the interviewed dairy producers perceived that they provide good quality water to their cattle. The survey result showed that the average watering frequency of the study area was free accesses (15.60%), once a day (10.20 %), twice a

day during wet season (46.19%) and three times a day during dry season (34.80%).This watering frequency was depending on the season and distance of the water sources. The result was different from Kedija Hussein,(2007), in Mieso district, Oromia Region, watering frequency of cattle were reduced from '*every day'* watering in the wet season to '*once in two days*' for 79 % of the households in the dry season. During the dry season, cattle travel a maximum of 1.5 km from the homestead to the water point in search of water with overall mean distance of 1.0±0.65 km. This result was smaller than the overall average distance reported as 6.6±0.52 km Kedija Hussein, (2007). According to herders, the end result of the long distance traveled and the less frequent watering of animals, especially during the dry season, results in loss of body weight and substantial decrease in milk production of cows.

Table 17: Water sources of the study areas

Source of Water	Number of respondents						Percentage (%)	
	Small		Medium		Large		Overall	
	N	%	N	%	N	%	N	%
Pipe Water	17	30.60	34	61.20	35	63.00	87	51.60
River water	21	37.80	8	14.40	2	3.60	31	18.60
Wells Water	19	34.21	12	21.60	3	5.40	33	20.40
Pond water	18	32.40	9	16.20	2	3.60	29	17.4
Frequencies of watering								
Free accesses(*adlibtum)*	2	3.60	10	18.00	14	25.21	26	15.60
Once a day	12	21.61	3	5.40	2	3.60	17	10.20
Twice a day	35	62.99	28	50.40	14	25.19	79	46.19
Three times a day	26	46.80	20	36.00	12	21.6O	58	34.80

N=Number of respondents, %= percent

4.4.7. Animal Health Service

Disease and Animal health problems of dairy farms practices are shown in Table 18. The overall occurrence of common infectious diseases, in percent including LSD, Black leg, FMD ,Anthrax, Internal parasites, mastitis and External parasites was 32.69, 15.89, 14.08, 13.34, 8.47, 8.47 and 4.43% respectively. The prevalence of dairy cattle disease was associated with poor housing conditions (Mekonnen *et al.*, 2010). Prevention of diseases can be done by maintaining the cleanliness of the housing, cleanliness of livestock, providing feed according to the needs, providing worm medicine, and vitamins periodically (Anggraeni and Mariana ,2016; Simamora *et al.*, 2015) . The reason why infectious diseases occurred more often among local than crossbred cattle was low immunity to resist disease and they are easily attacked by disease. Before crossbreeding local cattle were more often treated with traditional indigenous methods. Crossbred cattle were exclusively treated by veterinarians. Even though farmers experienced crossbred cattle to be more susceptible, the overall occurrence of infectious diseases reduced due to introduction of veterinary services and vaccination programs.

An improvement in access to animal health service was also observed by Benin *et al. (2003*). However there is evidence that with increasing production level diseases of strengthening (e.g. mastitis, reproductive disorders) might increase. Local cattle were less affected by tick borne diseases and parasites than their crosses, which are in agreement with other reports (Marta Kiuzczynska, 2012). Few farmers stated that heat detection was more challenging and that heat period was shorter in crossbred cows. Whereas in studies carried out by (Molalegne Belay and Shiv, 2011) and (Yoseph Shiferaw *et al.*, 2005) 26.5% and 39% of cows were diagnosed positive for reproductive disorders, respectively**.** Health service of the study areas were 83.82% of the farmer was obtained from

government health services and 16.18% from private clinics and pharmacies, But the cost of services was double payment that of governmental services.

Table 18: Percent of Animal health problems across the study areas

	Large		Medium		Small		Overall	
Disease type	**Fr.**	**%**	**Fr.**	**%**	**Fr.**	**%**	**Fr.**	**%**
LSD	17	40.48	22	34.92	17	22.67	56	32.69
Black Leg	5	11.90	4	6.35	22	29.33	31	15.89
FMD	1	2.38	10	15.87	18	24.00	29	14.08
Anthrax	6	14.29	12	19.05	5	6.67	23	13.34
Internal parasites	6	14.29	7	11.11	6	8.00	19	8.47
Mastitis	6	14.29	7	11.11	0	0.00	13	8.47
External parasite	1	2.38	1	1.59	7	9.33	9	4.43
Health services								
Government	35	83.33	53	84.13	63	84.00	151	83.82
Private	7	16.66	9	15.88	12	15.99	29	16.18

Fr. =Frequency, %=Percent, FMD=Foot and mouth disease, LSD=Lumpy skin disease

4.4.8. Institutional Support and Milk Production Extension Service

Institutional support and milk production extension Service of the study area are indicated in Table 19. With regard to milk production extension service, the result of this study revealed that the contact of development agents with milk producers was frequent and regular. In this regard 82.94% of the respondents had access to extension service and 17.06% had not access to extension services. The majority of respondents obtained various information types concerning milk production; these include how to manage milk

cows properly, improvement of breeds and use of artificial insemination, improved feeding, frequent health care, market opportunity, conservation and treatment of agricultural crop residues. The GOE is responsible for transfer of technical information on commercialization of dairy smallholders, as well as enhanced growth in the rural areas (GOE Master Plan, 2007).

Regarding to contact with DAs results show that DAs contact yes n=144(55.56 %) and no 36(21.48%), contact once in a week n=92(50.08%), contact once in three week n=43 (22.83%), contact once a month n=26 (14.93%), never contact with DAs n=5(3.44%) and no DAs nearby n=14 (8.39%) in large farm areas. This shows Das have not addressed farmers the rule of extension service and they are in contact with woredas experts. From the sampled milk producers of the three farms, the project supports 36.44, 5.66, and 57.90% training, technology delivery and supports both training and technology delivery of them in the three scales of farms of the study areas Table 19. This survey showed that informal knowledge flow plays a vital role for sharing of experiences among milk producers that in turn build up indigenous knowledge. The majority of milk activity is geared by self-owned forms of indigenous knowledge. This again indicated the necessity of taking indigenous knowledge into consideration in each and every modern milk development intervention similar with the report of Belete Anteneh, (2006) and Adebabay Kebede, (2009).The source of information was got 63.36, 29.04 and 7.60 % from Extension Agent, Radio and Farmer association respectively.

Table 19**:** Institutional Support and Milk Production Extension Service in the study areas

Characteristics		Large (N=42)		Medium (N=63)		Small (N=75)		Overall (N=180)	
		Fr.	**%**	**Fr.**	**%**	**Fr.**	**%**	**Fr.**	**%**
Provided Extension Service	Yes	32	76.19	55	87.30	64	85.33	151	82.94
	No	10	23.8	8	12.70	11	14.67	29	17.06
Contact with DA	Yes	28	66.67	56	20.00	60	80.00	144	55.56
	No	14	33.33	7	11.11	15	20.00	36	21.48
DA Contact once in a week		20	47.62	30	46.62	42	56.00	92	50.08
DA Contact once in three week		7	16.67	15	23.81	21	28.00	43	22.83
DA Contact once in a month		7	16.67	11	17.46	8	10.67	26	14.93
DA Never contact		3	7.14	2	3.17	0	0 .00	5	3.44
No DAs nearby		5	11.90	5	7.94	4	5.33	14	8.39
Project Supports									
Training		17	40.48	19	30.16	29	38.67	65	36.44
Technology Deliver		1	2.38	5	7.94	5	6.67	11	5.66
Both		24	57.14	39	61.90	41	54.67	104	57.90
Sources of information									
From Extension Agent		20	47.62	36	57.14	64	85.33	120	63.36
Radio		17	40.48	21	33.33	10	13.33	48	29.04
Farmer association		5	11.90	6	9.52	1	1.38	12	7.60

N=Number of respondents; DA=Developmental Agent; Fr. =Frequency, %=Percent.

4.4.9. Marketing of milk and milk products

Fresh milk is distributed through the informal and formal marketing systems. In both rural and urban parts of the country, milk is distributed from producers through informal (traditional) means. This informal market involves direct delivery of fresh milk by

producers to consumers in the immediate neighborhood or to any interested individuals in nearby towns (Dayanandan, 2011*;* Sintayehu Yigrem *et al.*, 2008). Formal marketing systems as reported by many authors, farmers' milk marketing groups and dairy cooperatives play a key role for milk marketing outlets, which as a result encourages farmers to produce more Zegeye Yigezu, (2003). In the current study, farmers practice an informal marketing system where they sell their milk and milk products to neighbors or the local markets. The farmers in Addis Ababa milk shed area of North Shewa Zone of Oromia Region also sell their dairy products through farmers' milk marketing channel/dairy cooperatives.

The average total milk produced in the study areas was 57.55±39.29 liter per day and the average milk sold was 53.03±41.06 liter per day. The dairy products sold in the study area were fresh whole milk, butter, cottage cheese and Yoghourt. About 48.32, 33.33, 39 and 28.33% percent of the respondent's sold in the study areas respectively Table 20. These figures were comparable with the report of (Zelalem Yilma and Ledin, 2001), in the central highlands of Ethiopia, (Alganesh Tola, 2002) in eastern Wollega and (Lemma Fita, 2004) in east Shoa Zone of Oromia region, where most of the farmers in these areas sell fresh milk but selling of butter in these areas was also a common practice but different in large and medium scale dairy farms fresh milk sold higher than butter. All the respondents in the large, medium and small scale dairy farms stated that they sold milk and milk products in the market.

4.4.9.1. Milk Product Processing and Marketing System across the Study Areas.

The mean milk/litter/day produced and sold was presented in Table 20

After adoption of cross breeding, milk consumption and processing at home decreased. This agreement with Sintayehu Yigrem *et al. (*2008) states that before a few years sales

of milk on the open market were formerly not common practice; on the contrary in some regions selling was restricted by traditional taboos.

Table 20: Milk consumption, processing and selling in litter across the study areas

Parameter	Large=42 mean ± SD	Medium =63 mean±SD	Small=75 Mean ± SD	Overall mean± SD	P-Value
Total milk produced	83.07±84.27[a]	51.67±51.67[b]	48.20±47.5[b]	57.55±39.29	< .0001
Total milk sold	77.33±68.72	46.49±31.46	35.28±23.00	53.03±41.06	< .0001
Home consumption	2.88±2.60[a]	2.85±1.63[a]	2.73±1.55[a]	2.81±1.83	0.8980
For processing	0.85±1.18[a]	0.72±1.48[a]	0.63±3.79[a]	0.75±1.40	0.6991
For calf feeding	4.25±6.53[a]	3.62±1.76[b]	3.29±1.59[b]	3.65±2.03	0.0517
Dairy products sold in %					
Fresh milk	68%	49%	27.96%	48.32	
Butter	15%	40%	45%	33.33%	
Cheese	17%	45%	55%	39%	
Yoghourt	18%	32%	35%	28.33%	
Buyer type					
Consumer/monthly contract	12%	35%	63%	36.67%	
Trader	69%	47%	23%	46.33%	
Catering shop	25%	34%	45%	34.67%	
Cooperative	15%	23%	0%	12.67%	

N=Number of respondents; SD=Standard Deviation, a, b =means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), %=Percent

There were significant differences ($p< 0.0001$) in the amount of total milk produced through the three farms .Milk processed ,amount of milk used for home consumption and for calf feeding were observed among dairy farms ($p>0.0001$) there is no significance between the three farm scales. In all dairy farms higher amounts of whole milk were sold than used for home consumption, processed at home and for calf feeding. The overall mean out of all milk produced on farm, milk sold ,consume at home, for processing and for calf feeding were 57.55±39.29 liter, 53.03±41.06 liter, 2.81±1.83, 0.75±1.40 and

3.65±2.03 respectively Table 20. The higher milk is produced in large farms than medium and small scale farms, processing and home consumption are relatively similar in three farms. According to the respondent, buyer types in study areas show 46.33, 36.67, 34.67 and 12.67% trader, consumer/monthly contract, catering shops and cooperative respectively. Significantly ($p<0.001$) higher were in large and medium than small scale farms. The current result was greater than the amount of milk sold to the milk seller group reported in Mieso District by Kedija Hussein, (2007) stated that from the total (n=94) households who sell milk, only 22 (23%) were involved in the milk seller groups.

4.5. Major Challenges on Input Delivery for Dairying across the Study Areas

Concentrate feed and Agro industrial by product is very important for dairy animal for their energy balance and giving production but a shortage of inputs delivery and unbalance cost of dairy input like Feed (concentrate feed, roughage and forage seeds), improved breed (Heifers or Breeding bulls), health facilities (medicine) and AI facilities (Liquid nitrogen, semen, AI technician) was reported in study area.

Table 21 : Percent on shortage of dairy inputs supply across the study area

Type of Input	Large Scale=42		Medium Scale=63		Small Scale=75		Overall		Rank
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	
Concentrate feed/AIBP	35	83.33	47	74.60	17	22.67	99	60.20	1
AI facility	5	11.90	7	11.11	18	24.00	30	15.67	2
Improved Breed Supply	1	2.38	7	11.11	12	16.00	20	9.83	4
Health care facility	1	2.38	2	3.17	28	37.33	31	14.29	3

AIBP=Agro Industrial Byproduct, Fr. =Frequency, %=Percent

In the present study even if there was comparative access of dairy input supply in the area but the farmers in all study areas had difficulties to acquire concentrated feeds, agro-industrial byproducts , medicine and semen as they wanted in quantity and quality. As listed in Table 21 in small scale farms health facility rank as 1st problem with result 37.33 percent. AI facilities were 2nd rank in small scale dairy farms and concentrated feed were the 3rd ranks of the problem of small scale farms and improved breed supply were the last problem of small scale dairy farms. In case of AIBP feeds of small scale farms may be due to that even if there was other feed available in rural areas in terms of supplying concentrate feed and agro industrial by products that needed for dairy animals especially for crossbreds not satisfy the demand. Shortage of improved breed and health care facilities were ranked as 3rd and 4th problems.

In large scale and medium scale dairy farms in the study areas Shortage of supplying concentrate feed and agro industrial by product was ranked as 1st with 83.33 and 74.60 percent respectively followed by shortage of AI facilities 11.90 and 11.11 percent in large and medium farms. As whole, shortages on feed and AI facilities, which were the first and second rank problems resulted in 60.20 and 15.67 percent that delayed dairy development. Also health facilities and improved breed supply are the 2nd and 3rd problem in dairy production farms. These findings were similar to those of (Addisu Bitew *et al.,* 2011) and (Mekonnen *et al.,* 2010) in the study area the seriousness of resource, service and input related problems were the main problems on dairy production.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The current study was conducted to study the comparative performance of large, medium and small scale dairy farms in the case of Addis Ababa milk shed in north Shewa zone Oromia region. Accordingly, productive performances traits like daily milk yield and its expected lactation milk yield and lactation length; and reproductive performances traits like age at first services and age at first calving, calving interval, Days open and number of service pre conception of local and their crossbred of different exotic blood level of cows and household characterizations, breed preference of the farmers, characterization of extension service and marketing were studied by analyzing survey taken from 180 household owner of the dairy farmers. It was observed that significant difference in production and reproduction performance existed among different blood level categories of (local breeds, 50%, 75% and >75%) within three dairy farms being defined as small, medium and large scale dairy farms.

The survey result in this study confirmed that the performance of local and crossbred cows for milk yield traits had increased as exotic blood level increase which was observed for local, 50, 75 and >75% had 3.05±0.55, 15.56±1.17, 20.99±2.23 and 25.64±1.78 liter/day respectively, the lactation milk yield (LMY) was 788.00, 3828.05, 5666.73 and 7332.48 litter per lactation length and the lactation lengths (LL) are 6.57±1.80 and 8.87±0.92 months for local and cross breeds. This is indicative of improvement of crossbred management under smallholder farmers in handling, breeding management, and better access to inputs in the study area. The breed preference of dairy farmers under this study had shown that the farmers under small scale preferred the

Jersey sire lines whereas the medium scale and large scale preferred the Holstein Friesian. The reason for preferring Holstein Friesian by large scale farms was selling milk than processing it to butter and in small scale selling butter are more advantages than selling milk due to lack of infrastructure and long distance from milk collection centers and the ability of Jersey breed with standing low quality and quantity feed, poor housing and heat stress. Each exotic blood level crossbred dairy cows had better production and reproduction performance in large scale than small and medium scale.

The variation in performance of the same exotic blood level animal in different farm scales was due to differences in management of animals such as feeding, housing, health care and breeding management of the farmers in each farm scales. A shortage of inputs delivery and unbalanced cost of dairy inputs like feed (concentrate feed and mill byproduct, roughage and forage seeds), improved breeds (heifers or bulls), AI facilities (liquid nitrogen, semen, AI technician) and health facilities (medicine) and lower price of milk compared to price of dairy input were the major problems that hindering dairy production in the study area. Generally reproductive and productive performance of crossbred with different exotic blood levels and local dairy cows was affected by different factors like exotic blood level, farm size and management practice. Properly placing the genotype to right farming system (it more best assigning high exotic blood level (75% and >75%) to large scale farms, medium exotic blood level (50-75%) to medium scale farms and lower exotic blood level (50% to >50%) to small scale farms. According to their management practice of dairy farms (feeding practices, health care and housing), and improving management and regularly supplying dairy inputs can improve dairy productivity and sustain the dairy industry.

5.2. Recommendation

Reproduction and production performance of local, and exotic crossbred dairy farms are mostly affected by management (feeding, housing, health care and breeding), Gene and production system. Based on the present study, the following areas need attention to support dairy production to be developing into a market-oriented business operation in study areas.

- There should be a sustainable extension service that expresses problems of lack of Awareness for the three farms (small scale, medium scale and large scale dairy farms), health care, and feeding and AI services.
- To receive optimum profit from exotic inheritance, it calls for creating strategic breeding systems independently under each dairy farms to allocate right exotic blood level at right place with consideration of adaptation problem (it more best assigning high exotic blood level (75% to >75) to large farms, medium exotic blood level (50-75%) to medium scale farms and lower exotic blood level (50% and above 50%) to small scale dairy farms.
- As local breeds had the ability of better adaptability, there should be a controlled cross breeding strategy in line with conservation of the local adaptive traits of the breeds under study.
- Non-Governmental Organizations, feed supplying companies are supposed to initiate dairy industries by doing forage development, genetic improvement, solving market problems by acting in the value chain of milk production.
- As exotic blood level of crossbred animal was increased the reproduction and production performance is increase and it reach optimum condition so; it's a best

making backcross after reaching high production and reproduction of crossbred exotic blood level of greater than 87.5% to re enhance hetrosis effect

- For breed improvement, AI is critical but it is not easily accessible and hence the government and concerned body must work hard on it.
- To solve the problems on price of milk, Governmental organizations should be performing by creating foreign chains to realize profitability of dairy producers and supplying crossbred heifers/ Breeding bulls and other dairy inputs with subside price.

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7. APPENDICES

7.1. Appendix Tables

Appendix Table 1: Household level livestock herd compositions

Type of cattle	Farm scale				
	Large Farm=(42) Mean ±SD	Medium =(63) Mean ±SD	Small=(75) Mean ±SD	Over All Mean±SD	P-value
Cross breeds	11.40±3.43[a]	4.69±1.38[b]	1.54±0.70[c]	4.95±1.91	<.0001
Local breeds	5.00±4.14[a]	3.02±1.44[b]	1.92±0.76[c]	3.02±2.23	<.0001
Total	16.40±5.31[a]	7.72±2.01[b]	3.46±1.05[c]	7.97±2.90	<.0001
Sheep	12.73±10.68[a]	8.90±5.08[b]	7.14±3.06[b]	9.03±6.18	0.0007
Horses	1.67±0.84[a]	1.57±0.64[a]	1.38±0.55a	1.52±0.60	0.3404
Donkeys	2.93±1.52[a]	1.90±0.90[b]	1.62±0.70[b]	2.05±1.03	<.0001
Mules	0.87±0.35[a]	1.09±0.30[a]	1.00±0.00[a]	1.00±0.24	0.4151
Chicken	18.00±40.67[a]	8.72±5.57[a]	7.50±3.92[b]	10.29±19.75	0.0558
Honey bees	1.33±0.77[b]	1.70±0.84[a]	2.04±0.76[a]	1.76±0.64	0.0935

SD=Standard Deviation, a, b, c=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ***=highly significances, **=$p<0.01$

Appendix Table 2: List square means of Dairy cattle on AFS and AFC in the study areas

Source of variation	N	AFS Mean±SD	P-Value	N	AFC Mean±SD	p-value
Over all mean CV	540	25.98±0.66 2.57	< .0001	540	34.55±0.45 1.30	
Farm scale		**	0.0478		***	<.0001
Small	300	22.92±11.62 [b]		300	34.67±11.40 [a]	
Medium	252	26.06±12.09 [a]		252	34.57±11.60 [b]	
Large	168	25.97±12.19 [b]		168	34.32±11.88 c	
District		***	<.0001		***	0.0015
Debra Liban.	`240	25.70± 11.89 [a]		240	34.63±11.44 [a]	
Degem	240	26.03± 11.67 [b]		240	34.53±11.65 [b]	
Wuchale	240	26.22± 12.21 [c]		240	34.50±11.66 [b]	
Breed		***	<.0001		***	<.0001
Cross breed	540	19.13±1.03 [a]		540	27.89±0.68[a]	
Local breeds	180	46.53±0.95 [b]		180	54.55±0.62 b	
Blood Level		***	<.0001		***	<.0001
0 % (local)	180	46.53±0.95 [a]		180	54.55±0.62 [a]	
50 %	180	20.18±0.93 [b]		180	28.61±0.53 [b]	
75 %	180	19.10±0.30 [c]		180	27.79±0.36 [c]	
>75%	180	18.12±0.32 [d]		180	27.26±0.29 [d]	

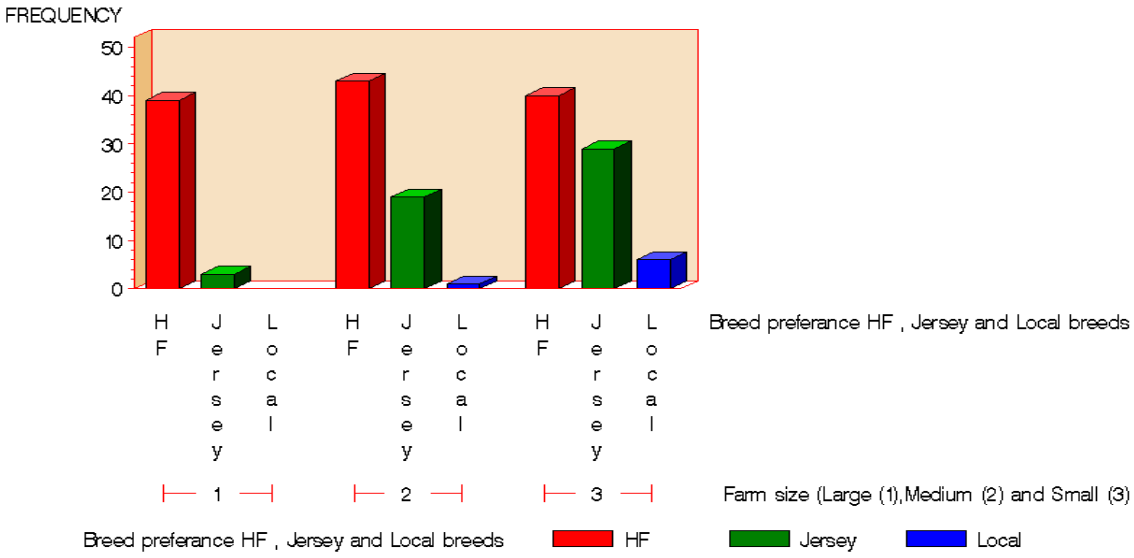
N=Number of observation, CV=Coefficient of variation, [a, b, c, d]=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ***=highly significances, SD=Standard deviation, AFS= Age at first service, AFC=Age at first calving

Appendix Table 3: List square means of Dairy cattle on DMY, LMY and LL in the study areas

Source of variation	N	DMY (Lit.) Mean±SD	P-Value	LMY (Lit.)	LL Mean±SD	p-value
Over all mean		16.31±1.17	< .0001	4403.81±548	8.79±0.93	
CV		7.18		12.46	10.67	
Farm scale		***	<.0001		***	<.0001
Small	300	15.22±7.97 [c]		3877.43[c]	8.47±1.09 [c]	
Medium	252	16.52±8.56 [b]		4467.22[b]	8.82±1.23 [b]	
Large	168	17.93±9.47 [a]		5248.66[a]	9.33±1.19[a]	
District		***	<.0001	***	***	<.0001
Debra Libanos	`240	16.16± 8.44 [b]		4547.61[a]	9.46±1,25 [a]	
Degem	240	16.16± 8.60 [b]		4248.35[c]	8.64±0.86 [b]	
Wuchale	240	16.71± 8.77 [a]		4415.48[b]	8.28±1.17 [a]	
Breed						
Cross breed	540	20.73±4.50 [a]		5609.08[a]	8.87±0.92 [a]	
Local breeds	180	3.05±0.55 [b]		788.00[b]	6.57±1.80 b	
Blood Level		***	<.0001	***	***	<.0001
0 (Local)	180	3.05±0.55 [d]		788.00[d]	8.57±1.80 [c]	
50%	180	15.56±1.17 [c]		3828.05[c]	8.17±0.63 [d]	
75%	180	20.99±2.23 [b]		5666.73[b]	8.98±0.78 [b]	
>75%	180	25.64±1.78 [a]		7332.48[a]	9.49±0.83 [a]	

N=Number of observation, CV=Coefficient of variation, [a, b, c, d]=means with different superscripts within the same fixed effect indicates statically difference ($p < 0.05$), ***=highly significances, SE=Standard error, DMY= Daily milk yield, LMY=Lactation milk yield and LL= Lactation length, %=percent

7.2. Appendix Figures



Appendix Figure 1: Breed preferences across the study areas

Appendix Figure 2 : Large Dairy Farms in the study areas

Appendix Figure 3 : **Small and Medium scale Dairy farms in the study areas**

Appendix Figure 4 : Milk marketing at the milk shed in the study areas

Appendix Figure 5: Hay and Improved Forage Feed resources in the study areas

7.3. Appendix of Survey Questionnaire

Survey Questionnaire used to the study for individual interview Questionnaire on the Comparative Production and Reproduction Performance of Dairy Cattle in Large, Medium and Small Scale Dairy Farms: The Case of Addis Ababa Milk Shed in North Shewa Zone, Oromia Regional State; Ethiopia

1. Socio-economic Characteristics

- Questionnaire No_____ Date _____
- Name of Enumerator _____ Signature_____
- Region: _____ Zone:_____
- District/woredas:_____ Kebele:_____

Dairy production system in this case is disaggregated into small (1-5 dairy cows), medium dairy farm (6-20 cows) and large scale dairy farms (> 20 dairy cows).

1.1. Name of the household _____

- Sex: Male/Female
- Age (years)_____
- Number of family members directly engaged in dairy activity_____

1.2. Religion of household head (HHs) A/ Orthodox B/ Muslim C/ Protestant D/Traditional E/ Catholic F/ Other Specify_____

1.3.Marital status: A/ Married B/Single C/ Widow D/ Divorced E/Not Relevant

1.4. Educational level of the household A) Illiterate B) Read and Write C) Elementary school D) High school E) Diploma and above

1.5. Herd size?_____ (Check with the table below)

1.6. No. of hired workers (non-family members): A) Daily_____ Permanent_____

1.7. Dairy farm experiences in years_____

1.8. Herd structure and Composition

No	Breed/Type of crosses	Milking Cows	Heifer	Female calf	Male calf	Breeding bull
	Cross Breeds					
1	Crossbreed 25%					
2	» 50%					
3	» 75%					
4	More than 75%					

Local Cattle Species	Total number
Heifers	
Bulls	
Oxen	
Dry cows	
Lactating Cows	

Other Livestock Species Owned (Herd Composition)

Type	No	Purpose
Sheep		
Goat		
Horses		
Donkeys		
Honey bee		
Chicken		
Mules		
Others (Specify)		

2. Land ownership, how acquired and land use system

- Owned (ha)_____
- Rented (ha) _____
- Leased (ha)_____
- Given by family (ha)_____
- Covered by crop (ha)_____
- Fallow land (ha) _____
- Grazing land (including land for hay) (ha) _____
- Land used to cultivate improved forage (ha)_____
- Other (specify) (ha) _____

2. Barn standard/Housing

2.1. What types of barn do you have for your dairy cattle? A) Shared with household; B) Separate house; C) Open shade; D) Backyard enclosure (fenced); E) standard barn

2.2. Floor type: A) Concrete; B) Stone slab; C) Hardened soil

2.3. Ventilation: A) Good ventilation; B) Medium ventilation; C) No ventilation

2.4. Barn sanitation (frequency of cleaning): A) Three times a day B) Two times a day C)Once a day D) Others (specify) _____

2.5. Herd management during different seasons of the year (more than one answer)

Management type	Seasons		Both seasons
	Dry season	Rainy season	
Crossbred cows			
Free grazing			
Partial grazing			
Tethering			
Stall feeding			
Others (specify)			
Calves			
Grazing			
Partial grazing			
Tethering			
Stall feeding			
Others (specify)			

3. Barn facilities

3.1. Do you have?

A) Watering trough? (Yes/No)
B) Do you have a feed trough? (Yes/No)
C) Do you have a crash for artificial insemination/treatment? (Yes/No)
D) Do you have private veterinarian who follow your dairy animals (Yes/No)
E) If not, who treats/follows your dairy animals? (mention)_____

Responsibilities/activities disaggregated by gender for decision making

S/N	Activities	Children (<16 years of age)		Adults (>18 years of age)		Hired employee		Household	
		M	F	M	F	M	F	M	F
1	Herding								
2	Milking								
3	Processing								
4	Cleaning								
5	Sale of dairy product								
6	Sale of animal								
7	Feeding of animal								
8	Feed collection								
9	Health monitoring								

4. Dairy production Objectives

No	Production Objectives	Rank (Degree of importance)	
		Female	Male
A	Exclusively for milk production		
B	Replacement oxen for crop production		
C	Both milk production and replacement oxen		
D	Social value (Prestige)		
E	Income sources		
F	Others specify		

1. What is the major household income?
   A) Sale of milk B) Crop C) Sale of milk and crop D) Side businesses
   E) Other livestock species F) Others (Specify)
2. How long have you engaged in milk production? _____
3. How many times do you milk your cow per day?
   3.1. Exotic Breed cow A/ Once a day B/ Twice a day C/ Three times a day
   3.2. Cross Breed cow A/ Once a day B/ Twice a day C/ Three times a day
4. How many liters on average do you get?
   4.1. Exotic cow A/ per day _____ liter B/ per lactation _____ liter
   4.2. Cross cow A/ per day _____ liter B/ per lactation _____ liter
5. How long does the cow stay milked? local _____months? Cross _____months
6. Do you milk your animals in the absence (death) of their calves? A/ Yes B/ No
7. If yes, how? Exotic _____ cross bred _____
8. Do you stimulate the udder before milking? A/ Yes/ B/ No
9. If yes, what is the means of stimulation? (Allowing the calf to suckle, washing by slightly hot water) _____
10. For how much time the calf stayed with his dam to suckling? A/ For 10 minutes B/ For 20 minutes C/ For 15 minutes D/ For 5 minutes
11. Do you know crossbred calf suckle? A/yes B/no Why?
_____
12. How many months do the calf stay suckling? (4, 5, 6 months.....)
13. What are the milking practices observed in your dairy farming?
    A/ Alternate suckle and milk
    B/ Once suckle and milk
    C/ No suckle and milking

14. Why do you keep crossbreed animals in your farm? A. They produce a higher amount of milk. B. They produce calves faster C. They grow better and faster. D. All

5. Milk Handling

1. What type of milking equipment do you use for the different dairy products produced? _____
2. What traditional methods do you use to preserve raw milk? _____
3. Milking hygienic practice A/ Wash milkier hands and milk vessels B/ Wash udder Before milking C/ Wash udder before and after milking D/ No hygiene F/ Use towel
4. Do you process milk into its byproducts? A/ Yes B/ No
5. If yes, what are the byproducts you process (butter, cheese, Yogurt ...)
6. Is there any means of preserving dairy products while transporting them to market? A/ Yes B/ No
7. If yes, describe_____
8. At which season/month(s) do you fetch the maximum and minimum price from the Sale of milk and milk products?

Products and price		Minimum		Maximum	
Products	price (birr)	Season and/months	price (birr)	Season and/months	price (birr)
Milk					
Butter					
Cheese					
Yogurt					

Codes for months: 1. January 2. Feb. 3. March 4. Apr. 5. May 6. June 7. July 8. Aug. 9. Sept. 10. Oct. 11. Nov. 12. Dec. ***N.B: For more than one choice write possible code***

9. What factors affect the price of milk and milk products? _____
10. Is there any period that you have a problem of marketing your milk products? A. Yes B. No
11. If yes, which months? A. Fasting month's B. In any month of the year, specify_____
12. Have you ever experienced spoilage of milk and milk products due to lack of market? A.Yes B.No
13. Do you use milk for a purpose other than drinking (e.g. medicinal value?) 1. Yes 2. No
14. If yes, what type of milk for what type of diseases? _____
15. What type of churn do you use? A. Gourd B. Clay pot C. Other
16. Uses of butter A. consumption B. For market C. Ointment D. Other (specify)
17. What type of milk do you use to produce cottage cheese? A. Whole milk B. Butter milk C. Both
18. How is milk consumed? A. In its raw state B. After souring C. After boiling

19. Who has the priority in the household for milk consumption? A. Children B. Wife C. Husband D. Others (specify) _____
20. Did you encounter sickness due to consumption of contaminated milk? 1. Yes 2. No.
21. What are the major problems with respect to milk production, processing and marketing of milk products? (Prioritize) _____
22. What is the trend of milk production in the last 5 years? A. Increased B. Decreased
23. In what way shall the government contribute to bring development in milk enterprise?

No	Milk Utilization pattern	Amount in liters/day
A	Total Milk produced	
B	For calf feeding	
C	For home consumption	
D	For processing	
E	For sales	

6. Calf Rearing Practices

1. Do you wean your calf? A/ Yes B/ No
2. If yes, at what age do you wean the calf (in months)?

	Local	Cross breed
A/ Male	_____	_____
B/ Female	_____	_____

3. If yes, which type of weaning do you exercise? A/ Partial weaning B/ abrupt weaning C/ Other (specify) _____
4. Who weans the calf mostly? A/ The cow refusal B/ Owner C/ Refusal of the calf due to lack of milk D/ Others (specify)
5. If the owner does weaning, explain the reason? A/ To get more milk B/ Prepare the cow for mating C/ Give rest time for next calving D/ Combination of them E/ Others (specify) _____
6.System of weaning exercised by the owner? A/ Isolation and herding separately B/ Protection from sucking without isolation C/ Other (specify) _____
7. What method do you use for pre-weaning milk feeding? A/ Bucket feeding (for local, cross or both) B/ Partial suckling (for local, cross or both) C/ Other for local, cross or both
8. Do you provide colostrum for your newborn calf? 1. Yes 2. No
9. For how long is the newborn calf supplied with milk (In months)? A/ Local __ B/ Crossbred__

7. Breed, Breeding and Reproduction

1. Do you keep crossbred milk cow/s? A/ Yes B/ No
2. If yes, when did you start keeping crossbred milk cattle? _____
3.Source of crossbred heifer(s): A/ Government ranches B/ NGOs C/ Market D/ Relatives
4. Which breed of milk cows do you like to keep in the future? A/ Local B/ Crossbred C/Both
5.Why do you select it? _____
6.What is the average age at first calving (year)? A/ Local _____B/ Crossbred _____
7. Which breed sire mostly you use for natural mating? A/ Crossbred B/ Local C/ Both equally
8. What is/are your criteria(s) to mate heifers? A/ Age B/ Size C/ Both age and size
D/ whenever they manifest estrus
9. What type of breeding practices do you use for milk cows? A/ Natural (bull service)
B/ Artificial insemination (AI) C/ Both
10. If you use AI, what is the source of it? A/ Government recruited technicians B/NGO's C/ Private D/ others (specify) _____
11. Which method do you prefer and why? A/ Natural (bull service) B/ Artificial insemination
12. Is there a problem with AI? A/ Yes B/ No
13. If yes, why? A/ No access B/ Unwillingness of AI technicians C/ Shortage of liquid nitrogen and semen D/ Others (specify) _____
14. Do you have your own breeding bull? A/ Yes B/ No
15. If yes, breed type_____
16. If not, where is your source for the bull? A/ Neighbor B/ Rent from neighbor C/
Bull services (Rent) C/ Others (specify) _____
17. Is mating seasonal? A/ Yes B/ No
18. If yes, why? A/ Due to feed shortage in some months B/ Planned for heat period and time of Calving C/ Other (specify) _____
19. What are the peak mating months of the year? (Mention in descending order)
A_____B/ _____ C/ _____
20. How long (in years) a milk cow and bull stays in a herd for breeding in their lifetime?

Cow	Bull
A/ Local Breed _____	A/ Local Breed _____
B/ Cross Breed _____	B/ Cross Breed _____

21. What is the source of your replacement breeding bull?
A/ Own herd B/ another herd C/ purchase D/ Other (specify) _____
22.How many calves are most likely to occur in the cow lifetime? A/ Local _____
B/ Crossbreeds_____
23.When do you mate the cow after calving (in days)? A/Local __ B/ Crossbreeds___
24. What is the average number of services per conception? A/ Local cows_____
B/Crossbreed _____

8. Cattle productivity

1. What are the main constraints for dairy cattle production?

No	Constraints	Tick/make sign	Rank
1	Feed shortage		
2	Water shortage		
3	Disease		
4	Low genetic potential		
5	Market		
6	Others (specify)		

2. How many abortion cases occurred in your herd over the last 12 months? _____
3. What are the causes of abortions? _____
4. Do you castrate male bulls? A/yes, reason_____ B/no,reason_____
5. At what age and season do you castrate? _____ _____
7.Breeding/mating A/ controlled B/ uncontrolled, If uncontrolled what is the reason?
_____
8. What are the main constraints for dairy cattle breeding for you_____
9.What do you expect from government to solve you face_____
10. What about from local and foreign NGOs too _____

9. Extension Service

1. Have you been provided with extension services with dairy A/Yes B/ No
2.Did you have any contact with a Development agent in your area? A. Yes B. No
3. If not, why? A. No DA nearby B. No need for service C .Others (specify)
4. Have you ever taken any dairy training course? A/ Yes B/ No
5. Do you get any livestock technology (forage seed)? _____
6. Is there any project that supports the dairy sector in your locality? A/ Yes B/ No
7. Have you ever participated in the project? A/ Yes B/ No
8. If yes, what are the major supports of the project? A/ Training B/ Technology delivery C/both
9. When did you start dairy farming? _____
10. How do you get information on dairying most of the time? A/ Radio B/ Newspaper C/ from farmer's association D/ from extension agents F/ none

Productive and reproductive performance.

No.	Parameters	Local breed	Cross breed
1	Age at first service (months)		
2	Age at first calving(months)		
3	Calving interval (months)		
4	Days open/dray period (days)		
5	Average lactation length (days)		
6	Average lactation yield(liters)		
7	Daily production per animal, peak period (liter)		
8	Daily production per animal, lean period (Liter)		
9	Average number of offspring given throughout their life		

10. Feed and Water use

10.1. Feed

1. Could you mention a maximum of three main types for each of the following classes of feeds you are using for milk cows? (In decreasing order of importance)

No	Classes of feeds	Reason	Rank
1	Hay		
2.	Crop residues		
3.	Grazing land		
4.	Improved forage		
5.	Concentrates		

2. What are the main problems in the area of concentrate feed availability for milk cows? Rankly put. A/ Lack of awareness B/ Lack of access C/ Costly D/ others (specify).
3. Which crop residue is your dominant feed? Rankly put. A/ Teff straw B/ Barley Straw C/ Wheat straw D/ Maize and Sorghum straw
4. To which classes of cattle do you give relatively more feed? Rankly put. A/ Milking cows B/ Milking + pregnant cows C/ Pregnant cows D/ Dry cows E/ Draught oxen F/others (specify)
5. In what form are you using the natural grazing lands you have? Rankly put. A/ Continuous grazing B/ Rotational grazing C/ Cut-and-carry system
6. Do you supplement your lactating animals? A/ Yes B/ No
7. Do you often encounter feed shortage? If yes, when? _____
8. How do you cope with feed shortage in your locality? _____

2. Watering

1. What is the water source of cattle?

No	Water Sources	Season	Distance of water source from the homestead in km for a trip	Availability of Water (month)
1	Tap water			
2.	Rain			
3.	Wells			
4.	Pond			
5.	River			
6.	Others(specify)			

2. What is the frequency of watering your animals?

No	Species	Frequency	
		Wet season	Dry season
1	Crossbred milking cow		
2	Local bred milking cow		
3	Crossbred calves		
4	Local bred calves		

NB:-Codes of Frequency of watering: A/ Free access B/ Once in a day C/ Twice in a day D/Three times in day

3. How far the water points from your home_____Kms round trip.

4. Do you think availability of water is a major constraint during the dry period? A/ Yes B/ No

5. If the answer is yes, how did you alleviate the problem? A/ by digging the ground water B/ By going long distance to the river C/ Other means _____

6. What is your water related problem? A. Scarcity/unavailability B. Parasites Impurities D. Distance

11. Health

No	Type of Disease	Symptoms	Susceptible age group blood level	Source of occurrence

1. What are the major dairy cattle diseases in your locality? List their local name and signs and symptoms of the disease?

2. Kind of veterinary service and Distance from home (in Km)

A. Government veterinarian _____

B. Privet veterinarian _____

12. Marketing

1. What do you use to bring agricultural inputs from the source?

A. Transport car B. Own cart C. Equines D. others

2. How many hours will you spend to reach to the nearest input market from your home?

3. How do you evaluate the facilities related to road and transportation means in relation?

4. Do you have access to the market for your produce? A. Yes B. No

BIOGRAPHICAL SKETCH

The author was born on the January 29, 1985 G.C in Oromia region north Shewa Zone, Hidhabu Abote district, to his father Mr. Tolcha Dadi and his mother Mrs.Yesh Tulu. He attended his elementary school at Ejere town general Tadesse Birru School and completed his secondary education at Gebre Guracha Senior Secondary Schools, in kuyu districts. In 2002, he completed secondary school education successfully, passed the Ethiopian Schools Leaving Certificates Examination (ESLCE) and joined Agarfa TVET College in 2002/2003 to pursue his Diploma study and graduated with a diploma in Agriculture (Animal Science) in August 2005. After graduation, he was employed at Debre Libanos district livestock and fisher office in October 2006. After serving for four years of service, he rejoined the School of Graduate Studies of Ambo University in October 2009 to pursue his BSc study in Animal science and graduate with BSc degree in animal Science in April 2014. After BSc graduation, he was employed by expert of livestock and fisher office at Debre Libanos districts. During his stay at the livestock and fisher, he also served as unit leader of input and supply of livestock and fisher office. In October 2018/19, he got the chance to join Hawassa University, College of Agriculture to pursue his MSc study in Animal Breeding and Genetics program.