Assessment of milk production and marketing systems, and evaluation of the productive performances of crossbred dairy cows in Bona Zuria district of Sidama Zone, Southern Ethiopia

MSc Thesis

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HAWASSA UNIVERSITY

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Assessment of milk production and marketing systems, and evaluation of the productive performances of crossbred dairy cows in Bona Zuria district of Sidama Zone, Southern Ethiopia

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APPROVAL SHEET- 1

This is to certify that the thesis entitled "**Assessment of milk Production and Marketing systems, and evaluation of the productive performances of crossbred dairy cows in Bona Zuria District of Sidama Zone**", submitted to partial fulfillment of the requirements for the degree of Master of Science in Agriculture with a specialization in Animal Production of the Graduate Program of the School of Animal and Range Sciences, Hawassa University. The thesis is a record of original research carried out by **Kassu Tsegaye Woldetsadik**, I.D. No. SGS/ 142/06 under our supervision and no part of the thesis has been submitted for any other degree or diploma. The assistance and the help received during the course of this investigation have been duly acknowledged. Therefore, we recommend that it will be accepted as fulfilling the thesis requirements.

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APPROVAL SHEET -2

We, the undersigned, members of the Board of Examiners of M.Sc Thesis Open Defense Examination, have read and evaluated the Thesis prepared by Kassu Tsegaye Woldetsadik and examined the candidate. This is therefore to certify that the thesis be accepted as fulfilling the Thesis requirement for the Degree of Master of Science in Agriculture (Animal Production).

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DEDICATION

This work is dedicated to my family.

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Place: College of Agriculture, Hawassa University, Hawassa

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LIST OF ABBREVIATIONS AND ACRONYMS

AFS	Age at first service
AFC	Age at first calving
AI	Artificial insemination
ANOVA	Analysis of variance
ANRS	Amhara National Regional State
AOAC	Association of Analytical chemists
ARC	Agricultural Research Council of United Kingdom
CFSI	Calving to first service interval
CI	Calving interval
CSA	Central Statistical Authority
DO	Days open
DODM	Digestible organic dry matter
ETB	Ethiopian birr
FAO	Food and Agriculture Organization
FGD	Focus group discussion
GDP	Gross Domestic Product
IGAD	Intergovernmental Authority on Development
ILRI	International livestock research institute
IPS	International project service
LIVES	Livestock and Irrigation value chains for Ethiopian smallholders
ME	Metabolizable energy
MJ	Mega joule
MOA	Ministry of Agriculture
NDF	Neutral Detergent fiber
NGOs	Non-governmental Organizations
NSC	Number of service per conception
SAS	Statistical Analysis system
SE	Standard error
SNNPRS	Southern Nation Nationalities and People Regional States
SPSS	Statistical Package for Social Sciences

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Assessment of milk production and marketing systems, and evaluation of the productive performances of crossbred dairy cows in Bona Zuria district of Sidama Zone, Southern Ethiopia

BY

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ABSTRACT

The study was conducted in Bona District of Sidama Zone in Southern Nation Nationalities and People Regional States (SNNPRS), Ethiopia, with objectives of assessing the milk production & marketing systems, and evaluation of the productive performances of crossbred dairy cows. The study had two parts: cross sectional survey and monitoring. Multi-stage stratified sampling technique was employed to select targets. Bona district was selected purposively based on its potential for dairy commodity by the Livestock & Irrigation Value Chain for Ethiopian Smallholders (LIVES) Project through the involvement of stakeholders. The district was stratified into two based on the distance from the woreda town, market orientation, improved breed availability, and production and consumption systems. These were urban/peri-urban and rural production systems. Each production system was further stratified into PAs where urban/peri-urban system has 7 while Rural had 21 PAs. The number of PAs selected from each production system was about 20% (2 from urban/peri-urban and 4 from rural). For cross sectional survey (part I) a total of 150 households (25 from each PA) were selected and individually interviewed from six kebeles(2 from urban/peri-urban and 4 from rural kebeles). Questionnaires were used to collect data on milk production, processing and marketing systems, and challenges hindering dairy development in the study area. Selection of farms for monitoring study (Part II) was based on the outcome of the cross sectional survey. Hence, about 10% of the dairy farms, which had crossbred dairy cows with parity 2-5 and at mid stage of lactation were purposively selected from both production systems. Thus, total number of farms and dairy cows monitored was 20 (10 from urban/peri-urban and 10 from rural.) The farms were further stratified into three based on herd size as small, medium and large. The overall mean number of indigenous and crossbred cattle in the study area was 4.14 and 2.96 TLU, respectively. Highland zebu, local×Jersey and local x Holstein Friesian crossbreds were the dominant cattle breeds. The major farming activity across the sampled households was dairy production. The major livestock feed resources included natural pasture, crop residues and crop aftermaths. Although the major source of water for cattle were rivers, wells and ponds, watering frequency was higher for crossbred cattle compared to locals. About 72% of sampled households keep their cattle within family house while 58% keep either in corrals or separately built barn. Milking and milk processing was mainly (70.9-80.8%) accomplished by women's while decision on breeding was made by *males (95%). The dominant (92.7%) form of pre-weaning milk feeding was partial suckling. The average age at first calving, calving interval and lactation length based on household survey was 53.98±0.19, 25.88±0.13 and 8.9±0.08 months, respectively, for indigenous cows,*

and 36.98±0.20, 16.04±0.13, and 10.0±0.60 months, respectively, for crossbred dairy cows across both production systems. Although both controlled and free mating were practiced, about 25.3%, 32.5% and 42.2% of sampled households use artificial insemination, bull service and combination of both, respectively. Milk and butter were found to be marketed mainly through informal marketing systems. Feed shortage, overstocking, disease, shortage of improved dairy cattle breeds and distance to marketing points were listed by the sampled households as the major constraints hindering dairy development in the study area. The overall mean (±SE) milk yield of crossbred dairy cows of monitored dairy farms was 5.89±0.21 litres, where it was significantly higher ($p<0.05$) for urban/peri-urban dairy farms than rural farms. Milk yield was also affected by parity where cows in second and third parity had significantly higher ($P<0.05$) milk yield than those in fourth and fifth parity. The mean body condition score of large farms were significantly ($P<0.05$) higher than that of the medium and small sized farms. Cows in urban/peri-urban farms were significantly ($P<0.05$) heavier than that of rural farms. In general, this study showed that despite the untapped cattle population and conducive agro-climate for dairy development, the performance of dairy production in the study district was low and milk marketing system was undeveloped due to many constraints such as capacity, technological, organizational and institutional related constraints. Therefore, coordinated effort is required to address the constraints across the different stages of dairy commodity value chain development.

Key words*:- Bona district: milk production: milk marketing: Dairy farm monitoring*

1. INTRODUCTION

Ethiopia possesses the largest livestock population in Africa. Estimates for farmer holding in rural areas indicate that the country has about 56.71 million heads of cattle, 29.11 million goats, 29.33 million sheep, 2.03 million horses, 7.43 million donkeys, 0.4 million mules, and 1.16 million camels (CSA 2014/15). The livestock sector contributes to about 15–16% of the GDP, and 35-49% of agricultural GDP excluding the values of draught power, transport and manure, and contributes to the livelihoods of about 37–87% of the Ethiopian population (ILRI, 2010). A study conducted by IGAD showed that the value of the animal draught power input into arable production is about a quarter (26.4%) of the value of annual crop production, and if the value of draught power services is included, the sector contributes up to 45% of agricultural GDP (Behnke and Metaferia, (2011). In Ethiopia dairy production depends mainly on indigenous livestock genetic resources; more specifically on cattle, goats, camels and sheep. Cattle have the largest contribution (81.2%) of the total national annual milk output, followed by goats (7.9%), camels (6.3%) and sheep (4.6%), (CSA 2009). Despite its potential for dairy development, productivity of indigenous livestock genetic resources in general is low, and the direct contribution it makes to the national economy is limited. A recent report by CSA (2014/15) indicated that the total production of cow milk is about 3.07 billion liters, and this translates to an average daily milk production/cow of 1.35liters/day. As a result the per capita milk consumption of the country is only 19.2 kg (MoA, 2012)., which is much lower than Africa and world per capita average of 27 kg/year and 100 kg/year, respectively (CSA, 2014/2015).

Sidama is one of the zone of Southern Nations and Nationalities Peoples Regional State (SNNPRS), which has been targeted for high value livestock commodity development by Livestock and Irrigation value chains for Ethiopian smallholders (LIVES) Project,(Kettema, 2013). Bona Zuria is one of the consistently surplus agricultural products producer districts in Sidama zone (kettema, 2013). It is believed to have high potential for dairy, which has been identified by the stakeholders as a priority commodity in the district (CSA, 2007). There is also an increasing demand for milk as a result of urbanization and increasing population growth in the area. Small scale enset based dairy farming is the predominant production system in the mid to highlands of Bona (CSA, 2009). Among the many problems faced by these milk producers, feed shortage in terms of quality and quantity, poor production & reproduction performance are considered to be of major importance. It is, therefore, imperative to assess the challenges and constraints hindering dairy development in the area. Identifying the challenges and opportunities for the success of the milk enterprises in the district is crucial. Besides, dairy product marketing study is essential to provide vital and valid information on the operation and efficiency of milk product marketing system for effective research, planning and policy formulation. This study was, therefore, undertaken to characterize dairy production and marketing systems and identify major constraints/challenges hindering dairy development in the study area.

The specific objectives of this study, therefore, were:-

- To characterize milk production systems and identify the major problems, challenges and opportunities of milk production in Bona Zuria district.
- To assess the milk marketing systems and identify the major constraints and opportunities for milk marketing in the area.
- To evaluate feed allocation and performance of dairy cows of smallholder dairy producers in the study area.

2. LITERATURE REVIEW

2.1. Overview of dairy Production in Ethiopia

Dairy production is an important component of livestock production in Ethiopia. It is an important sources of food, income and creates job opportunity for many people in urban and rural settings. However, despite its huge number, the performance of subsector 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 1.35 liters 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, 2014/2015; MOA, 2012). According to the report of the Central Statistical Agency (CSA, 2010) the indigenous cattle breeds accounted for 99.1%, while the hybrids and pure exotic breeds counted for about 0.72% and 0.09%, 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 trace the ownership of improved dairy animals, it is estimated that state and private farms own a total of 128,745 grade and pure female dairy animals of which the small holders sector owns 32,204 crosses and improved female dairy cattle (CSA, 2010). 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 1,120-2,500 liters over 279-day lactation (Mohamed *et al.*, 2004).

2.2. Dairy production systems in Ethiopia

In Ethiopia dairy production systems can be broadly categorized into urban, peri-urban and rural milk production systems. The urban and peri-urban systems are located in urban and

peri-urban areas of major cities and towns (Mohamed *et al.,* 2004). The peri-urban milk system includes smallholder and commercial dairy farmers in the proximity of Addis Ababa and other regional towns. This sector controls most of the country's improved dairy stock. The rural dairy system is part of the subsistence farming system and includes pastoralists, agro pastoralist, and mixed crop livestock producers mainly in the highland areas (Mohamed *et al.*, 2004).

Dairy production system can also be categorized into three based on market orientation, scale, and production intensity. These are traditional small holders, privatized state farms, and urban and peri urban systems (Gebre *et al.,* 2000). The traditional smallholder system, roughly corresponding to the rural milk production system described above. It contribute to about 97 percent of the total national milk production and 75 percent 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 peri-urban milk production system, the third production system, includes small and large private farms in urban and peri-urban areas concentrated in the central highland plateaus (Felleke and Geda, 2001). This sector is commercial and mainly based on the use of grade and crossbred animals that have the potential to produce 1120-2500 liters over 279-day lactation. This 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)

2.3. Feed resources and nutrient requirement of dairy cattle

2.3.1. Feed resources

The urban and peri-urban dairy operations depend mainly on the natural pasture hay as a source of roughage feed in the central highlands of Ethiopia (Fekede *et al.,* 2013). The major roughage feed resources for dairy animals across all the different production systems include natural pasture/grasslands, grass hays, crop residues and non-conventional feed resources (Asaminew and Eyassu, 2009*;*Yitay*et al.,* 2009; Azage *et al*., 2013). The crude protein content of pastures most often is lower than 7%, which could not support maintenance requirements of ruminants (McDonald *et al*., 2002). Good grass and legume hays are adequate for maintaining most classes of livestock, particularly those in a non-productive state (Streeter*et al.,* 2006). Therefore, dairy cows which depend on poor quality basal feeds will not express their full genetic potential. According to Azage *et al*. (2013), agro-industrial by-products such as bran, middling, oil seed cakes and molasses are fed as supplement to crossbred dairy cows in urban and peri-urban areas.

2.3.2. Nutrient requirement of dairy cattle

Nutrition has a profound influence on productive and reproductive performance of dairy cattle. Because of high metabolic rate and requirement for milk secretion, lactating cows have special demand for nutrient supplement (Indetie, 2009). In practice milk yield and composition are influenced mainly by the dietary supplies of energy and protein (Tadesse *et al*., 2003). Energy and protein, of feeds are central in determining nutritional adequacy and feeding levels for different classes of stock (Streeter, 2006). Rations should be formulated to ensure that the animal consumes the desired amount of nutrients in a day (Adugna, 2008).

2.3.2.1. Protein

Protein is an expensive component and overfeeding should be avoided to minimize the cost. In addition, extra energy, which would otherwise be used for milk production, is used to remove the extra protein (nitrogen) from the body in the form of urea in the urine (Lukuyu *et al.*, 2012). For instance, on average 10 kg daily milk produced require 860 g/day of CP for a standard 500 kg body weight cow and 40 g butterfat concentration in the milk (ARC, 2004). Any protein not required by the cow is excreted in the urine as urinary urea, a consequence of urea nitrogen recycling and the removal by the kidney of any urea not recognized by the animal as necessary for rumen function (Lock and Van Amburgh, 2012).

2.3.2.2. Energy

Quantitatively, energy is the most important nutrient considered during the formulation of dairy cow rations usually needed to produce milk (Lukuyu *et al.*, 2012). Mesfin *et al*. (2013) investigated that dairy farmers home-mixed concentrate for lactating crossbred dairy cows in peri-urban dairy production system of central Ethiopia, contained 10.8 MJ/kg DM of ME.

The most important nutritional requirement of the animal is energy for maintenance and demand for energy depends on breed, live-weight, sex and physiological state (pregnancy, lactation) of the animal (Streeter, 2006). Energy deficiency causes extension of the interval from parturition to recovery of ovarian cyclicity and activity of corpus-luteum (Patton *et al.*, 2007). Further, state of negative energy balance lower the fertility of growing follicles leading to lower conception rate (Diskin *et al*., 2003). As reviewed by Remppis *et al.* (2011), continuing negative energy balance causes decreasing milk yield, fertility problems, and incidence of metabolic diseases.

2.3.2.3. Calcium and phosphorus

Calcium (Ca) and phosphorus (P) are closely correlated for building the skeletal structure. The dietary P concentration needed to meet dietary requirements varies widely with feed intake, breed, body weight, growth rate and physiological state (Chantiratikul *et al*., 2009). Feeding a calcium-deficient diet may delay uterine involution and depress fertility. A lactating cow producing 10 kg of milk per day require 30 g Ca/day as recommended by ARC. Regarding P requirement cows producing 10 kg milk per day require 28 g P/day and 1.65 g p/day is recommended per kg of milk yield. The Ca: P ratio is also recommended 1:1 to 2:1 (Funston,2007).

2.4. Reproductive and productive performance of dairy cattle in Ethiopia

Reproductive efficiency of a herd is an important component of dairy cattle productivity in Ethiopia. Economic losses because of poor fertility can be attributed to the cost of prolonged calving interval, increased insemination costs, reduced returns from calves born and forced replacements in the event of culling. A delay 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).

2.4.1. Age at first service (AFS)

Age at first effective service is one of the most important fertility properties in dairy cattle. It has direct impact on age at first calving since duration of gravidity 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 gravidity. Age at first effective service is determined within defined time limits. Bottom limit is date of birth, and top limit date of conception (Novaković *et al.*, 2011).

Age at first breeding coupled 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. Rearing 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 (Head, 2002). 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.

2.4.2. Age at first calving (AFC)

Age at first calving is the earlier measure of reproductive performance in dairy cattle; only after first calving production cycle commences (Dabdoub, 2009). The age at first calving changes the heifer from a non-producing expensive item into an income generating cow. Early AFC reduces unproductive period and a higher the AFC will be the additional rearing cost of the animal (Panja and Taraphder, 2012).

Age at first calving is closely related to generation interval and, therefore, influences response to selection. Under controlled breeding, heifers are usually mated when they are mature enough 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 (Dayyani *et al.*, 2013).

2.4.3. Calving interval (CI)

Calving interval is a time elapsed between two consecutive successive parturitions. Average calving interval of indigenous cattle breeds and their 50% crosses were 431.5 and 429 days.

Likewise, Yifat et al. (2012) reported that cross breeds have slightly shorter calving intervals than indigenous in Tatesa Cattle Breeding Center (622.6 days). Another study supporting this verdict reported in North Showa zone indicated that indigenous breeds have larger calving interval (748.2 day) than crossbreds (660 day) (Mulugeta and Belayneh, 2013). However, in contradiction of the expectation, shorter calving interval in higher inheritance level, and longer calving interval 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).

2.4.4. Days open

Days open, the number of days between calving to conception, influences 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 induces a delay in first ovulation after calving (or a low oocytes quality) and increase in embryo mortality incidence with interval from calving to conception that increases over 120-130 days (Rossi *et al*., 2008). Leroy *et al*. (2010) reviewed and concluded that the lack of estrus events during the early postpartum period in dairy cows attributed to negative energy balance. Report also indicates the magnitude and duration of the prepartum energy status (i.e., negative energy balance) has a detrimental effect on subsequent reproductive and productive performances in high producing dairy cows (Nishany *et al*., 2013). The degree and duration of energy deficit during this early postpartum period is positively correlated with the number of days to first estrus (Leroy and Bols, 2009).

2.4.5. Number of service per conception (NSC)

NSC is one of the measurements for reproductive efficiency. It expresses the fertility level of the dairy herds. It is simple and easy to calculate and understand and 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 Alemam, 2008). The number of service 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". As previously mentioned, estrus detection accuracy may significantly influence conception rate. It should be noted that even though estrus 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 service 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 1-2 services showed conception rate 61% and animals with 3 and more than three services showed conception rate was 50%. Conception rate was

significant Increased in both parity 3 and parity 4 than nulliparous, but cows with age group 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 insignificant effect of parity number on number of services per conception. Similar results also were reported by Hammoud *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.

2.4.6. Average milk yield and lactation length of dairy cattle in Ethiopia

Average milk production of indigenous cattle per cow is very low. Milk production potential of indigenous cattle such as Boran, Arsi and Fogera is low and it ranges from 494-809 kg per lactation. For instance, average milk production per cow per day in Western Gojam Zone is about 1 litter per day, resulting in an estimated milk production of 46,710,335 liters 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 (Ibid). This is basically due to the fact that these animals have been selected primarily for survival trait 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 indigenous cattle increased in correspondence of exotic blood level. For example, the average lactation length of indigenous 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 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 increment trend in lactation length as blood level increased, they could not reach 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).

2.5. Factors affecting production and reproduction performance of dairy cattle

2.5.1. Factors affecting production performance of dairy cattle

Performance of dairy animal is judged from the milk it produces during a specified period of lactation. Variations were observed in lactation milk yield from lactation to lactation in the same animal. The main reason of 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 determining 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).

2.5.1.1. Climate

The climate in a certain geographical area, particularly temperature and relative humidity, greatly influence the production potential of the animals (McManus *et al*., 2011). In lactating cows body heat production is associated with increases 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 combination 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 avert 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 solely rely upon evaporative cooling in the form of sweating and panting (West, 2003).

2.5.1.2. 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 dying 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*. (2004a), Komatular *et al*. (2010) and Zewdu *et al.* (2013) reported that the lactation milk yield was significantly affected by parity.

2.5.1.3. Lactation season

Various reports indicated 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. Lateef *et al.* (2008) 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 variation in animal performance in tropics is expected to be primarily 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 availability 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 confronted with the dry and second scarcity of fodder period (November- December) as they approached peak lactation.

2.5.2. Factors affecting reproduction performance of dairy cattle

The 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 delay on postpartum resumption of ovarian activity due to longer CFSI, poor expression of estrus by the cow, failure to detect estrus by herd attendant or both are also the major causes for poor reproduction 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 and 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).

2.5.2.1. Breed

Crossbred 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 estrus for shorter period than temperate breeds may be due to the reason for poorer calving rate and NSC of local cows. Azage,(1981), indicated that crossbred cows required 0.12 and 0.24 fewer numbers of inseminations per conception than local breed cows in the highland and lowland stations, respectively. Local breed cows inseminated with Jersey semen required 0.35 more number of 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 decreased 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 author's 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 improvement of non-genetic factors.

2.5.2.2. Nutritional factors

Nutrition has the major limiting impact on productive and reproductive performance in all animals. It also plays a major role on enhancing reproductive efficiency of dairy cows. Energy and protein are the major nutrients required in the greatest amounts and should be in the top most priority to optimize 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 nutrient should not be over-fed as this may also impairs the reproduction. Environmental factors, especially nutrition, determine prepubertal 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 will reduce the interval from birth to first calving, probably because heifers that grow faster cycle earlier and express overt estrus. Energy deficiency, particularly in postpartum cows, is most likely the major feeding factor involved in poor reproductive performance of dairy herd (Ben Salem *et al*., 2006). It results from the feeding of poor quality forages, which is most cases is coupled with inadequate supplementation. The end result is that follicular growth and developments leading to first ovulation are affected and that cows in most negative energy balance are more likely to remain anoestrus. Hammoud *et al*. (2010) reported that lower energy balance in first lactation cows was associated with delayed

intervals to first ovulation. Similar results also reported by Murray, (2003) who reported that measures of fertility get poorer according to lactation number with slight decreases from first to second and to third lactation. West *et al*. (2003) stated that follicular development begins during early lactation and the metabolic conditions associated with net energy balance may affect ovarian follicular development and reduce oocyte quality and lower concentrations of plasma progesterone possibly reflecting reduced luteal viability impaired synthesis progesterone or altered clearance of progesterone by the liver. 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 (Msangi *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).

2.5.2.3. Management factors

Management factors such as accuracy of heat detection, timing of insemination, proper insemination techniques, semen quality, proper semen handling and skills in pregnancy diagnosis have been reported to decrease the NSC (Shiferaw *et al*., 2003). Poor estrus detection by herdsman, poor estrus 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 delays age at first service and calving.

2.6. Dairy marketing systems in Ethiopia

Marketing includes all activities performed in moving commodities from the producer to the consumer (Woldemichael, 2008). It also includes all the exchange activities of buying and selling; all the physical activities performed to give the commodity increased utility; and all the auxiliary activities such as financing, risk bearing and disseminating information to participants in the marketing process. It involves the transfer of ownership of products through buying, selling, pricing, and renting and physical movement as well as transformation of the commodity into more usable forms through transportation, handling, storage, processing and packaging. Therefore, marketing involves sales, locations, sellers, buyers and transactions (Sintayehu *et al*, 2008).

2.6.1. Formal versus informal milk marketing systems

Milk marketing is an incentive for farmers to improve production. It stimulates production, raise milk farmers' income and living standards and create employment in rural areas (Asaminew, 2007). Provision of improved and sustainable milk marketing arrangements in villages is therefore important in the aspiration for advancement of the sector. The Ethiopian milk marketing system is not well developed. This can be reflected from the fact that only 5% of milk produced in rural areas is marketed as liquid milk. This has resulted in difficulties of marketing of fresh milk where infrastructure especially transportation facilities are extremely limited and market channels have not been developed. In the absence of an organized rural fresh milk market, marketing in any volume is restricted to the urban and peri-urban areas

(Getachew, 2003). Mohamed *et al*. (2004) reported that milk products in Ethiopia are channeled to consumers through both formal and informal milk marketing systems. The informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighborhood and sale to itinerant traders or individuals in nearby towns.

2.6.2. Dairy marketing channels and outlets

Marketing outlet is the final market place to deliver the milk product, where it may pass through various channels. A network (combination) of market channels gives rise to the market chain. Marketing survey in Hawassa, Shashemane and Yirgalem depicted that milk producers sold milk through different principal marketing channels (Woldemichael, 2008). These included:

• **Producer-consumer (P-C) channel**- involves direct sales to individual consumers accounting for 21%, 4.7% and 23.7% of total milk marketed per day in Hawassa, Shashemane and Yergalem, respectively.

• **Producer → Retailer → Consumer:** The channel represents average of 43% of milk marketed per day in the milk shed. This channel represents for 16%, 38%and 76.6% of total milk marketed per day in Hawassa, Shashemane and Yergalem, respectively.

• **Producer → Semi-whole seller → Retailer →Consumer**: This channel was identified to be operational only in Hawassa where milk semi-whole sellers undertake both retailing and whole selling activities.

• **Producer → Cooperative →Consumer:** This channel was exceptional for Shashemane and Hawassa where milk cooperatives are found and accounts for 0.81% and 10.67% of total milk marketed per day in Hawassa and Shashemane, respectively.

3. MATERIAL AND METHODS

3.1. Description of the study area

This study was conducted in Bona Zuria district of Sidama Zone in Southern Nation Nationalities and People Regional States (SNNPRS). Bona zuria is located at 127 km East of Hawassa, the capital of the SNNPRS. The area lies within the Rift Valley, with altitudes ranging from 1700 to 2400 meters above sea level (masl). It receives an annual rainfall of 700–950 mm, and has an annual temperature range of 11–22^{o}C. The study woreda has a total area of 33,720 hectare of land. The total population of the study woreda is 121,236 of which 61,001 are male while 60,235 are female (CSA, 2007). The woreda comprises 28 kebele administrations of which 7 kebeles are urban and peri-urban, while 21 kebeles are rural. More than 90% of the population earns their living from agriculture and livestock rearing and the rest (less than 10%) earn a living from petty trade and other livelihood activities. There are two cropping seasons. These are Belg (starting from February to May) and Maher (starting from June to September). The kebeles in the district are categorized as Woinadega (89%) and Dega (11%). Enset, maize, teff and haricot bean are the major crops in the Woreda while wheat, barley, sweet potato and sugar cane are grown in small amounts and banana, avocado and potato are grown in a very small amount. Coffee and chat are the major cash crops grown in the woreda (Bona Zuria Woreda agricultural office annual reports 2014).

3.2. Sampling techniques

This study has 2 parts. The first part of the study was devoted to assess milk production and marketing practices and identify major challenges/constraints hindering dairy development while the second part of the study was dairy herd monitoring that aimed at generating

quantitative data on feed allocation and production performance of dairy cows of small holder dairy farms.

3.2.1. Assessment of milk production and marketing

Multistage stratified sampling techniques was used to select targets for this part of the study. First, Bona woreda was selected for Dairy commodity value chain development based on its potential for dairying by LIVES project. The district was stratified into 2 production sub-systems based on its distance from the woreda town, market orientation, improved breed availability, and production and consumption systems. These were urban/peri-urban and rural production systems. The total number of kebeles in urban/peri-urban and rural dairy production system in the Woreda was 7 and 21, respectively. About 20% of these PAs (n=6) (2 from urban/peri-urban and 4 from rural kebeles) were selected from both production systems for this study. For household survey, the number of households selected from each kebele was proportional to size (about 10% of the total households were selected randomly from a list of farmers registered as milk producers of the respective kebeles) of which 40-50% were females (both female headed households and women's within male headed households) since the average number of milk producers per kebele in Bona zuria district is 250 (Bona District Office of Livestock & Fisheries Annual Report, 2016). Then the total number of households interviewed for this study were 150 (25 per kebele). The households were selected using random sampling method. The target sampling population was defined as all households in the study area who have dairy cattle and produce milk for home consumption or for market.

3.2.2. Monitoring on-farm feed allocation and production performance of dairy cows

This part of the study was devoted to generate in-depth information on feed allocation, milk production and body weight change using sampled households/dairy farms. Thus, 4 PAs (2 from urban/peri-urban and 2 from rural) were selected from the ones used for cross sectional survey information (Part I). Based on the record available from the Bona district Office of Livestock & Fisheries annual report (2016) there were about 102 and 97 dairy farmers keeping crossbred cows in urban/per urban and rural sites of the district, respectively. Thus, 10% of the farms/households (10 from urban/per-urban and 10 from rural production system) were selected for monitoring based on proportion to size sampling technique. Then, the list of households with crossbred dairy cows was collected from the respective PAs. This was followed by identification of 20 households (10 From urban/peri-urban and 10 from rural dairy system) which had at least one lactating cow randomly. The target dairy farms having crossbred (Friesian X Zebu) dairy cows, parity ranged from 2–5, at mid stage of lactation were selected for the study purposively. The farms were further stratified into small, medium and large sized dairy farms based on the number of crossbred cows they possess (ILRI, 1996). Accordingly, dairy farms owning less than 2 crossbred cows were considered as small, 2 to 7 as medium-sized farms, and more than 7 crossbred cows as large sized farms. The total number of milking cows monitored were 20 (2 production system * 3 herd sizes).

3.3. Data collection

3.3.1. Types and source of data

This study used both qualitative and quantitative data collected from primary and secondary sources. Primary data was collected through focus group discussions, household survey and field measurement from dairy cows, (from urban/peri-urban and rural milk producer

households) and key informant interviews who had better knowledge and skill on the subject. Secondary data was collected from woreda office of agriculture, office of marketing, rural job opportunity creation office, gender office and other relevant institutions. Pertinent information was also gathered from research reports, books, internet sources, government publications, journals etc. Data on the first part of the study (assessment of milk production and marketing, and identification of challenges and constraints) was collected using focus group discussion, key informants interview and household survey, while data on monitoring part of the study was collected through field measurements.

3.3.1.1. Focus group discussion

Focus group discussion was undertaken in each of the 6 selected kebeles to discuss on the dairy production practices and marketing systems, and major challenges/constraints and opportunities for dairy development in the area.

The discussion was based on the checklist and facilitated by researchers. There were 6 FGDs (one per kebele) and the number of participants per FGD was 12. The outcome of the FGD also enabled to refine the questionnaire to be used for household survey.

3.3.1.2. Key informant interview

Key informant interview was conducted to gather relevant information from those who were knowledgeable and have better experience in the subject. The interview also extended to value chain actors and service providers such as traders, processors, input suppliers, service providers and others who contribute to dairy value chain in the area.

3.3.1.3. Household survey

The questionnaire was used to collect primary data from selected respondents. The questionnaires were pre-tested and essential amendments were made. The questionnaires were edited for its validity, consistency and clarity based on a pre-test result. The following data was collected through the questionnaires:-livestock species, type and number by physiological stage, age and sex; feed resources, feeding calendar, reproduction and management; artificial insemination; health and breed improvement practices and challenges, milk and milking practices; available local milk breed productivity and livestock disease incidences of the study area, handling, processing, consumption and marketing of milk and milk products, dairy cattle housing, manure managements, type of dairy extension service they are getting, and major constraints and opportunities for milk production and marketing systems were addressed in the questionnaires.

3.3.1.4. Field measurement

3.3.1.4.1. Feed allocation and feed intake of crossbred cows

The feed allocated for the crossbred dairy cows during monitoring study were natural pasture in a form of grazing or hay, crop residue (green maize stover, enset leaf, sugar cane tops, banana leaf, green grass, elephant and desho grass), concentrate mixture, wheat bran and katikall atella. In urban/peri-urban production system only stall feeding was practiced while in rural production system both stall feeding and grazing were practiced. The amount of feed offered and refused by type to the cow was weighed using a portable spring balance and recorded per farm on weekly bases. Samples were collected based on type of feeds offered. Feed samples of the same type was bulked together and thoroughly mixed and subsamples

were taken for analysis. Barn was cleaned twice a day. The manures from the cattle were an important source of organic fertilizer or compost particularly for enset farming.

3.3.1.4.2. Milk yield performance of cows

Milk yield was recorded once a week for a period of three months. It was recorded for individual animals both in the morning and evening milking and the sum of which was taken as the individual milk yield per cow per day.

3.3.1.4.3. Estimation of body weight and Body condition score

Heart girth of milking cows used for monitoring was measured, in the morning before feed was offered, at two weeks interval using a plastic measuring tape for three months. The hearth girth of the animals were measured on standing position by the researcher. Bodyweight of the cow was estimated from heart girth measurement using the following formula

Y= 4.833697X – 423.405235 (R2=0.86; CV=10%)

Where Y= estimated body weight in kg and X= heart girth in cm

The regression equation was developed at International Livestock Research institute ILRI, Debrezeit Research Station using the body measurement (heart girth) and actual weight of crossbred dairy cows (Yoseph, 1999).

Body condition of cows was scored on scale of 1-5, where 1=emaciated, 5= over conditioning and determined concurrently with the weight estimate of the cows (Edmondson *et al*., 1989).

3.4. Feed sampling and chemical analysis

Representative feed samples were taken from the different monitored farms. Wet feed materials were allowed to lose moisture under shade before transportation. The air dried samples were taken to Hawassa University Nutrition Laboratory for chemical composition

analysis. Upon arrival at the laboratory, the feed samples were allowed to dry at 65^{o}C to a constant weight in a forced draft oven. Oven dried and air dried samples were ground to pass through 1mm sieve and analyzed for DM and ash contents according to the standard methods of AOAC (2005). The N content of the samples was determined by the micro-kjeldahl method and CP calculated as N×6.25. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined based on the method described by Van Soest and Robertson (1985).

From Digestible Organic Matter (DOM), metabolizable energy was calculated according to MAFF (1984) as cited by Lonsdale (1989) as follows:

ME = 0.015 x DODM

3.5. Statistical analysis

The data generated from the survey part of the study was described using descriptive statistics in Statistical Package for Social Science (SPSS) version 16.0 while the data collected from monitoring part of the study were analyzed using the General Linear Model (GLM) procedure of SAS (2008). The model was:- $Y_{ijkl} = \mu + A_i + B_j + (AxB)_{ij} + D_k + C_l + e_{ijkl}$

Y_{ijkl}=Response variable (milk yield, body weight, body condition)

μ= overall mean

A_i= fixed effect of the ith production system

B_j= fixed effect of jth herd size

$(AxB)_{ij}$=interaction effect of production system and different herd size

D_k=fixed effect of parity

C_l=fixed effect of genotype

e_{ijkl}= random error.

4. RESULTS

4.1. Socio-economic characteristics of households

4.1.1. Household characteristics

Out of the total interviewed dairy cattle producers (N = 150), 84% were male and the rest (16%) were female household heads. The overall mean family size (Mean±s.e) as well as average age (Mean±SE) of respondents in the studied households was 5.96 ± 0.23 persons and 43.03 ± 0.66 years, respectively. The highest mean family size was found in rural (7.03 ±0.26 persons) as compared to that of urban/peri-urban with (3.82 ± 0.27 persons). There was no significant variation in respondents‘ age found in rural (42.90 ± 0.82 years) and that of urban/peri-urban dairy production systems (43.12 ± 1.11 years). The overall proportion of illiterate, elementary school and high school level of farmers was 4.6%, 53.4% and 19.3% , respectively (Table 1).

Table 1. Household characteristics

	Production systems		
	Urban/peri-urban	Rural	Overall mean
Variables	Mean±SE	Mean±SE	Mean±SE
Family size	3.82±0.27[b]	7.03±0.26[a]	5.96±0.23
Age of respondents (year)	43.12±1.11	42.9±0.82	43.03±0.66
Sex of respondents (%)			
• Male	82	85	84
• Female	18	15	16
Education of respondents (%)			
• Illiterate	-	7	4.6
• Read and write	-	19	12.7
• Elementary school	72	44	53.4
• High school	18	20	19.3
• Diploma and above	10	10	10

4.1.2. Land holding per households in the study area

The overall mean crop land, grazing land, forage land and wood land holding per households in the study area were 0.81ha, 0.48ha, 0.09ha and 0.05ha, respectively (Table 2). Total land holding per households in urban/peri-urban(0.68ha) and rural (1.73ha) production systems were significantly different (P<0.05).

Table 2. Land holding per sampled households (ha)

	Production systems		
	Urban/peri-urban (n=50)	Rural (n=100)	Overall (N=150)
Variables	Mean±SE	Mean±SE	Mean±SE
Crop land	0.36±0.05	1.04±0.54	0.81±0.05
Grazing land	0.27±0.31	0.59±0.35	0.48±0.03
Forage land	0.11±0.02	0.09±0.01	0.09±0.01
Wood land	0.05±0.01	0.06±0.01	0.05±0.01
Total land holding	0.68±0.07[b]	1.73±0.06[a]	1.38±0.06

N=number of respondents; s.e=standard error; [a-b] means with different superscripts for the same variable across the same row are significantly different (P<0.05).

4.1.3. Livestock holding per households in the study area

The livestock species kept in the area include cattle, poultry, small ruminants and equine. Cattle are the dominant livestock type in the study area. The overall mean numbers of local and crossbred cattle in the study area were 4.14 and 2.96 TLU per household, respectively. The total livestock holding per households in urban/peri-urban and rural production systems were 8.02 TLU and 8.13 TLU, respectively (Table 3).

Table 3. Livestock holding per sampled households (TLU) in the study area

	Production systems		
	Urban/peri-urban (n=50)	Rural (n=100)	Overall (N=150)
Livestock type	Mean±SE	Mean+SE	Mean+SE
Total cattle(TLU)	7.08±0.75[b]	7.11±0.43[a]	7.10±0.59
Local cattle(TLU)	3.88±0.32[b]	4.39±0.26[a]	4.14±0.29
Crossbred cattle(TLU)	3.20±0.43[a]	2.72±0.17[b]	2.96±0.30
Sheep(TLU)	0.14±0.02	0.16±0.01	0.15±0.01
Goats(TLU)	0.15±0.05	0.12±0.01	0.13±0.03
Equines(TLU)	0.65±0.05	0.74±0.04	0.70±0.04
Total livestock (TLU)	8.02±0.87[b]	8.13±0.49[a]	8.08±0.67

N=number of respondents; s.e=standard error; [a-b]means with different superscripts for the same variable across the same row are not significantly different ($p>0.05$).

4.1.4. Farming activity of the respondent households in the study area

Majority of the respondents were primarily involved in milk production (78%) followed by poultry production (14.7%) and shoat production (7.3%). The primary sources of livelihood of the farmers in the study area are given in (Table 4). The majority of farmers (57.7%) reported livestock and crop production as the most important source for their livelihood followed by crop, livestock and off-farm activities (16.1)%, livestock and off-farm activities (11.6)%, livestock production only (14.6%).

Table 4. Household livestock farming and income sources in the study area

Variables	Urban/peri-urban(%)	Rural(%)	Overall(%)
Livestock farming			
• Milk production	87	60	78
• Poultry production	34	6	14.7
• Small ruminant production	6	7	7.3
Income sources			
• Livestock production only	18	13	14.6
• Livestock and crop production	26	74	57.7
• Livestock and off-farm activity	30	2	11.6
• Crop, livestock and off-farm activity	26	11	16.1

4.1.5. Extension service to dairy development

The sampled milk producers had information access related to milk production from extension agents and non-governmental organization (62.7%) but also from other sources such as previous family experience (3.3%), neighbor and/or relative (2.7%), radio and TV (4%), while the rest (27.3%) use their own experience (Table 5).

Table 5. Major sources of information for milk production obtained by sampled households

Sources	Urban/peri-urban(%)	Rural(%)	Overall(%)
BOA/DA and LIVES	60	64	62.7
Their own experience	26	28	27.3
Ancestor experience	4	3	3.3
Neighbor and /or relative	2	3	2.7
Radio and TV	8	2	4
Total	100	100	100

4.2. Dairy cattle husbandry practices in the study area

4.2.1. Involvement of family members in milk production

Milk production activities in the study area were done by both male and female members of the family and children above six years of age (Table 6). Cattle herding and feeding is mostly undertaken by boys and girls between 6 and 14 years of age. About 15% and 3.7% of the boys in the age range of 5–10 years were involved in cattle herding and feeding, respectively. Milking, milk processing, cleaning and selling of milk and butter is performed by female. All cows are hand milked, and milking of cows is mostly (70.9%) done by women. However, men milk the cows when the wife is not around. On the other hand, women are responsible for milk processing, barn cleaning and sale of milk and milk products. Men have greater contribution in breeding decision. Processing of the sour milk into butter is done by the wife (80.8%) and/ or daughters and in few cases by hired labor (2.7%). As long as there is sufficient family labor, hired labor is kept to the minimal.

Table 6. Involvement of family members in milk production.

	Percent of responsible family members				
Activity	Men	Women	Male children	Female children	Hired labour
Herding	12	3	47	15	23
Feeding	27.6	8.5	44.5	3.7	15.7
Caring of calves	11.4	32.5	28.7	17.5	9.9
Milking	12.6	70.9	4.2	8.5	3.8
Milk processing	1.5	80.8	2.6	12.4	2.7
Barn cleaning	1.3	63.6	6.5	22.7	5.9
Sale of milk products	5.5	63.9	8.4	18.0	4.2
Breeding decision	95.5	4.5	-	-	-

4.2.2. Feed resources

This study showed that the major sources of feed for livestock in the study area are natural pasture (57.5%), crop-residues (26.3%) , and crop-aftermaths (16.2%). According the respondents, livestock production system in Bona district is heavily dependent on grazing from natural pasture and crop stubble. These feed resources are generally poor in quality and their productivity and supply is seasonal, particularly a critical problem during the dry season.

4.2.2.1. Feeding calendar

Feeding calendar of the study area is shown in Table 7. The major feed resources from October to February were cereal residues, Enset leaf and after math grazing, while it was grazing during the other months (February to September). However, about 53.3% of the respondents reported that they face feed shortage mainly during the dry season (October to January) due to poor availability of feed from the grazing land. On the other side, about (34%) of the sampled households reported that they face feed shortage from Fabruary to September. while about (12.7%) reported that they face feed shortage year round. The farmers strategies used to cope with the feed shortage in the months were supplementing livestock with any available dry crop residues and Enset leaves, sugar cane and banana residues.

Table 7. Relative feed availability of the major feed resources over the months of the year

Feed type	Months of the year											
	J	F	M	A	M	J	J	A	S	O	N	D
Natural pasture (private)	-	x	X	xx	xx	xx	xx	x	x	-	-	-
Maize stover	x	-	-	-	-	-	-	-	x	xx	xx	xx
Teff straw	x	x	-	-	-	-	-	-	-	xx	xx	xx
Enset leaves	xx	xx	xx	-	-	-	-	-	-	-	x	x
Aftermath	x	xx	-	-	-	-	-	-	-	xx	xx	xx

– =Less available; x = fairly available; xx = better available;

4.2.2.2. Major constraints of dairy developments in the study area

In urban/peri-urban and rural production systems shortage of feed, Low productivity of dairy cattle and overstocking were considered as most important constraints of dairy development ranked first, second and third by households with different index value, respectively.

Table 8. Major constraints of dairy development ranked by sampled households in the study area

	Urban/peri-urban (N=50)				Rural (N=100)			
	Rank				Rank			
Constraints	1	2	3	Index	1	2	3	Index
Shortage of feed	34	7	12	0.43	73	12	5	0.41
Low productivity of dairy cattle	5	27	9	0.26	16	61	7	0.30
Overstocking	8	12	23	0.24	7	18	82	0.23
Disease	3	4	6	0.07	4	9	6	0.06

Index = [(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for each constraints to feed]/[(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for all constraints to feed].

The main problems related to improved forage availability are lack of awareness (22%), lack of seed (32%), lack of land (43.3%) and poor adaptability (2.7%). Lack of awareness (15.3%), high price (34.7%) and shortage of supply (50%) are main problems related to concentrate feeding in the study area. The main problems of crop residue low availability are shortage of production (78%) and shortage due to utilization for other purpose other than feed (22%).

Table 9. Major problems for poor feed availability in the study area

Variables	N	Percent
Problems of forage availability		
• Lack of awareness	33	22
• Lack of seed	48	32
• Shortage of land	65	43.3
• Poor adaptability	4	2.7
Problems of concentrate availability		
• Lack of awareness	23	15.3
• High price	52	34.7
• Shortage of supply	75	50
Problems of crop residue availability		
• Shortage of production	117	78
• Utilization for other purposes	33	22

4.2.3. Water source and watering frequency of dairy cattle in the study area

The major source of water for livestock in the study area included rivers, wells and pond water. The survey result also showed that the overall mean watering frequency of local and crossbred cows were 1.52 and 1.83 times per day, respectively, and this was not significant ($p>0.05$). Similarly, the overall mean watering frequency of local and crossbred calves were 1.21 and 1.11 times per day, respectively.

Table 10. Watering frequency of Local and crossbred cows and calves in the study area.

	Watering frequency (per day)		
	Urban/peri-urban(n=50)	Rural(n=100)	Overall(N=150)
Cattle type	mean±s.e	Mean±s.e	mean±s.e
Local cows	1.55±0.14	1.52±0.10	1.52±0.08
Local calves	1.27±0.10	1.19±0.05	1.21±0.05
Crossbred cows	1.89±0.14	1.79±0.08	1.83±0.07
Crossbred calves	1.04±0.04	1.17±0.06	1.11±0.04

N=number of respondents; SE= standard error

4.2.4. Cattle housing systems in the study area

According to the survey result, about 52% of the households keep their dairy cattle within family house (Table 11). Cattle houses in rural areas were constructed from locally available materials; mainly grasses and woods. The floor of livestock houses were made of earthen material and house was roofed temporarily using grasses. The report from the households in the study area indicates that cattle dung is disposed from house in drainage system, labor and use of family members. In addition, in all cases of the study area calves and small ruminants were housed separated from other cattle.

Table 11. Dairy cattle housing system in the study area

House type	Urban/peri-urban(%)	Rural(%)	Overall mean(%)
Share same house with family	20	68	52.0
Corral	-	32	21.3
Separate house from family	80	-	26.7
Total	100	100	100

4.2.5. Calf rearing practices in the study area

The major calf raring systems practiced in the study area were restricted partial suckling and bucket feeding (Table 12). Bucket feeding was practiced with households who own crossbred cows only; whereas partial suckling was mainly practiced with households who own local zebu cows. In the study area, all the respondents exercise weaning, of which, 68.7% practice partial weaning and the rest (31.3%) employ abrupt weaning. The major reason for termination of suckling (weaning) were cow refusal (4.7%), decision by the owner (89.3%) and refusal of calf (6%).The methods of pre-weaning milk feeding were partial suckling (92.7%) and bucket feeding (7.3%). The main reason for weaning calves was to prepare the cow for mating (20%), to get more milk (68%) and give rest time for next calving (12%). The systems of weaning calves as reported by milk producers were isolation of calves from cows (7.3%) and smearing of teats with manure (92.7%).

Table 12. Calf rearing practices in the study area

Calf rearing practices	N	Percent
Types of weaning		
• Partial weaning	103	68.7
• Abrupt weaning	47	31.3
Reason for weaning calves		
• To get more milk	102	68
• Prepare cow for mating	30	20
• Give rest time for next calving	18	12
Systems of weaning calves		
• Isolation and herding separately	11	7.3
• Protection from suckling without isolation	139	92.7
Methods of pre-weaning milk feeding		
• Bucket feeding	11	7.3
• Partial suckling	139	92.7

4.3. Reproductive and productive performances of cows in the study area

The average age at first service of local and crossbred heifers were 44 months and 26.98 months, respectively (Table 13). The average age at first calving of local and crossbred heifers were 53.98 months and 36.98 months, respectively .The average calving interval of local and crossbred cows were 25.88 months and 16.04 months. The mean daily milk yield of local and crossbred cows in the study area were 1.65 litre/day and 4.23 litre/day, respectively. The average lactation length of local and crossbred cows were 8.9 and 10 months, respectively.

Table 13. Reproductive and productive performances of dairy cattle in the study area.

Variable		Production systems		
		Urban/peri-urban(n=50)	Rural(n=100)	Overall(n=150)
Breed	Parameters	mean±s.e	mean±s.e	mean±s.e
Local	AFS(month)	44.25±0.45	43.91±0.20	44±0.18
	AFC(month)	54.25±0.45	53.88±0.20	53.98±0.19
	CI(month)	25.95±0.26	25.84±0.15	25.88±0.13
	LL(month)	8.93±0.09	8.82±0.16	8.90±0.08
	NSC	1.86±0.11	1.82±0.18	1.85±0.09
Crossbred	AFS(month)	27.15±0.45	26.90±0.21	26.98±0.20
	AFC(month)	37.15±0.45	36.90±0.21	36.98±0.20
	CI(month)	16.17±0.15	15.86±0.24	16.04±0.13
	LL(month)	10.10±0.08	9.86±0.11	10±0.06
	NSC	2.02±0.10	2.11±0.11	2.06±0.07

N=number of respondents; AFS=age at first service; AFC=age at first calving; CI=calving interval; LL=lactation length; NSC=number of service per conception.

Table 14. Daily milk yield of dairy cows in the study area.

Breed	Stage of lactation	Urban/peri-urban(n=50)	Rural(n=100)	Overall(n=150)
		mean±s.e	mean±s.e	mean±s.e
	Early	2.75±0.17	2.33±0.10	2.44±0.09
Local	Mid	1.56±0.16	1.42±0.08	1.46±0.07
	Late	1.19±0.11	0.98±0.07	1.04±0.06
Overall		1.84±0.12[a]	1.56±0.07[b]	1.65±0.06
	Early	5.93±0.19	5.89±0.20	5.91±0.14
Crossbred	Mid	3.84±0.20	3.74±0.18	3.78±0.13
	Late	3.01±0.10	2.94±0.11	2.99±0.08
Overall		4.23±0.17	4.23±0.14	4.23±0.11

n=number of respondents; s.e=standard error

4.4. Dairy cattle breeds in the study area

The major cattle breeds of the study area included Local (highland zebu), Local×Jersey and Local x Holstein Friesian crossbreds (Table 15). According to the respondents, cattle with blood level of <50%, 50-75%, and >75% were identified in Bona district.

Table 15. Number of crossbred cattle owned by sampled households in the study area

Parameter		Cattle type			
Production system	Blood Level	Cows	Heifer	Bulls	Calves
	<50%	20	6	-	14
Urban/peri-urban	50-75%	34	15	3	9
	>75%	12	10	2	38
Rural	<50%	36	27	-	29
	50-75%	17	13	-	8
	>75%	3	7	-	22

4.5. Dairy cattle breeding systems in the study area

Two types of breeding methods (natural mating using bulls and artificial insemination) were reported in the study area. Both free mating and controlled mating using bulls were also practiced. About 25.3%, 32.5% and 42.2% of respondent in the study area use artificial insemination, bull service and both AI and bull service for dairy cattle breeding, respectively. Lack of access, shortage of liquid nitrogen and semen, and lack of skilled AI technicians were ranked as first, second and third important constraints to access AI in the study area (Table 16).

Table 16. Major constraints for access to artificial insemination ranked by households

	Urban/peri-urban (n=50)				Rural (n=100)			
	Rank				Rank			
Constraints	1	2	3	Index	1	2	3	Index
Lack of access	29	4	5	0.33	76	8	8	0.42
Shortage of liquid nitrogen and semen	6	28	2	0.25	10	71	5	0.30
Lack of skilled AI technician	8	12	5	0.18	6	12	69	0.18
Low conception rate	5	3	26	0.16	5	3	13	0.06
Distance to AI station	2	3	12	0.08	3	6	5	0.04

Index = [(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for each constraints to artificial insemination]/[(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for all constraints to artificial insemination].

4.6. Major cattle disease in the study area

The major cattle diseases prevailing in the study area, according to the respondents, were respiratory diseases, pasteurolosis, skin disease, tuberculosis, blackleg, foot and mouth disease. The main reported problems related to access for animal health service delivery were lack of veterinary drugs (34.7%), in- frequent animal health service (11.3%), distant to animal health centers (7.3%), lack of skilled animal health technicians (12.7%), lack of laboratory

services (20.7%), and lack of timely vaccination of their animals (13.3%).The major reported sources of veterinary services were government (51.2%), private (6.1%), NGOs (13.4%) and both government and NGOs (29.3%) (Table 17).

Table 17. The animal health problems reported by households in the study area

Problems	Urban/peri-urban(%)	Rural(%)	Overall(%)
Lack of veterinary drugs	42	31	34.7
In-frequent animal health service	16	9	11.3
Distant to animal health center	6	8	7.3
Lack of skilled animal health technician	10	14	12.7
Lack of laboratory services	20	21	20.7
Lack of timely vaccination	6	17	13.3
Total	100	100	100

Table 18. Source of veterinary services as reported by household in the study area

Sources	Urban/peri-urban(%)	Rural(%)	Overall(%)
Government	34.4	62	51.2
Private	9.4	4	6.1
NGOs	34.4	-	13.4
Both government and NGOs	21.8	34	29.3
Total	100	100	100

4.7. Handling practices of milk and milk utensils

4.7.1. Milking and milk handling practices in the study area

This study indicated that 54.7% of the respondents practice suckling before milking, while 43.3% of them exercise suckling before and after milking in the rural production systems. The majority of the respondents clean their milk utensils once per day (79.3%) followed by twice

(15.3%) and three times (5.4%) per day. The shelf life of milk and milk product increased by smoking of container (67.3%), boiling after collection (8%) and salting(24.7%) in rural production sytems while the shelf life of milk and milk product in urban/peri-urban production system increased by smoking of container (77.1%), boiling after collection (5.4%) and salting (17.5%).

Table 19. Milking and milk handling practice

Parameters	Urban/peri-urban (%)	Rural (%)
Types of milking practices		
• Milking without suckling	-	2
• Few suckle before and after milking	53.3	43.3
• Suckling before milking only	46.7	54.7
Frequency of cleaning milking equipment's		
• Once per day	32.7	79.3
• Twice per day	67.3	20.7
Methods used to increase shelf life of milk and milk products		
• Smoking of container	77.1	67.3
• Boiling after collection	5.4	8
• Salting	17.5	24.7

4.8. Consumption and utilization of milk products in the study area

Whole milk, sour milk, butter, buttermilk and cheese were among the common milk products produced and consumed in the study area. Milk is consumed after boiling (14%), souring (62.7%) and raw (23.3%) (Table 20). Butter is used for various purposes like cooking (24.7%), cosmetic purposes, especially by the female members of the household (25.3%), and sale (50%). Buttermilk is used for animal consumption (21.6%), human consumption (53.7%) and production of cheese (24.7%) in the study area.

Table 20. Consumption and utilization of milk products as reported by sampled households

Variables	Urban/peri-urban(%)	Rural(%)	Overall(%)
Milk consumption systems			
• Boiling	24	9	14
• Souring	62	63	62.7
• Raw	14	28	23.3
Purpose of using butter			
• Cooking	34	20	24.7
• Sale	44	53	50
• Cosmetic purposes	22	27	25.3
Purpose of using buttermilk			
• Human consumption	58	52	53.7
• Animal consumption	22	21	21.6
• Production of cheese	20	17	24.7

4.9. Marketing of milk and butter in the study area

Milk producers of Bona district not only consume milk products, but also sell the milk and butter to consumers, retailers and traders. According to the respondents, the reported milk buyer type were consumers (68%) and traders (32%) while the reported butter buyer type were consumers (79.3) and retailers (20.7%). The reported modes of payment for milk purchase were cash (88.7%), cash in advance (4%) and contract (7.3%). The reported milk outlets were farm gate/homestead (7.3%), market place (76%) and door to door delivery (16.7%) while the reported butter outlets were market place (77.3%) and door to door delivery (22.7%).

Table 21. Reported milk and butter buyers, mode of payment and milk outlet in the study area

Milk buyer type	**N**		**Percent**	
Consumers	102		68	
Traders	48		32	
Butter buyer type	**N**		**Percent**	
Consumers	119		79.3	
Retailers	31		20.7	
Mode of payment	**N**		**Percent**	
Cash on the spot	133		88.7	
Cash in advance	6		4	
Contract	11		7.3	
Milk product outlets	Milk		Butter	
	N	Percent	N	Percent
Farm gate/homestead	11	7.3	-	-
Market place	114	76	116	77.3
Door to door delivery	25	16.7	34	22.7

4.9.1. Determinant of price, demand and supply of milk production in the study area

During the survey period (February to June 2015), the average price of buttermilk in the area was 8.48 ETB per liter with minimum and maximum price of 7 ETB and 10 ETB per litre, respectively (Table 22). The average price of butter was 144 ETB per kg with a minimum and maximum price of 90 ETB and 180 ETB per kg, respectively. From this study it was noted that various factors affect the price, demand and supply of milk products in the study area.

Table 22. Price of milk and butter and distance to market points

Variables	N	Min	Max	Mean	SD
Price of whole milk per liter (ETB)	62	15	18	16.48	1.10
Price of butter per kg (ETB)	94	90	180	144	23
Distance travelled to sell milk (Km)	62	1	5	2.94	1.42
Distance travelled to sell butter (Km)	94	1	5	3.46	1.17

N=number of respondents; SD= standard deviation.

4.10. Constraints of milk production and marketing in the study area

4.10.1. Milk production constraints

Among the constraints feed shortage, lack of improved breed and poor managements were considered as the most important problems ranked first, second and third with different index values, respectively. This study revealed that in both production systems farmers stressed lack of feed to be the most important limiting factor for productivity of their cattle, and indicated the importance of improving their feeding regime as an essential step towards any improvement program.

Table 23. Major milk production constraints ranked by households

Parameters	Urban/peri-urban(N=50)				Rural(N=100)			
	Rank				Rank			
	1	2	3	Index	1	2	3	Index
Shortage of feed	39	3	2	0.42	83	11	9	0.47
Lack of improved breed	2	34	8	0.27	5	76	17	0.31
Poor management	2	6	29	0.16	5	4	50	0.12
Limited veterinary service and AI	3	5	7	0.09	3	5	18	0.16
Disease outbreak	4	2	4	0.07	4	4	6	0.06

Index = [(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for each constraints to milk production]/[(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for all constraints to milk production].

4.10.2. Milk and butter marketing constraints

Among all the constraints of milk and butter marketing in the study area lack of awareness related to milk and milk product marketing, distance to marketing points and fluctuation of prices were considered as the major problems ranked first, second and third by households in urban/peri-urban and rural production systems with different index values, respectively.

Table 24. Milk and butter marketing constraints ranked by sampled households

Parameters	Urban/peri-urban(N=50)				Rural(N=100)			
	Rank				Rank			
	1	2	3	Index	1	2	3	Index
Lack of awareness	31	13	6	0.42	65	21	14	0.42
Distance to marketing points	16	28	6	0.37	30	61	9	0.37
Fluctuation of price	3	9	38	0.22	5	18	77	0.21

Index = [(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for each constraints to milk and butter marketing]/[(3 × number of households ranking as first + 2 × number of households ranking as second + 1 × number of households ranking as third) for all constraints to milk and butter marketing].

4.11. Chemical compositions of commonly used feed stuffs

The list of major feed types commonly used in the study area and its chemical composition is presented in Table 25. Among the supplements, CP content was higher for *katikall atella* followed by formulated commercial concentrate and wheat bran while the composition of other nutrients are comparable. Among the basal diet, CP was higher for sugarcane tops and enset leaf while it was lower for maize stover. Green maize stover also contained the highest fiber fraction (NDF=73.5% & ADF=56.8%) than any other feed types commonly used in the study area.

Table 25. Chemical composition of commonly used feed stuffs in the study area.

Feed type	DM%	Ash%	CP%	NDF%	ADF%	DOMD%	ME MJ/kg DM
Natural pasture**	90.2	5.8	7.25	76.5	49.2	43.3	6.5
Concentrate feeds							
Wheat bran*	92.7	6.6	16.8	42.9	26.1	78.5	11.8
Formulated commercial Concentrate*	94.8	5.6	17.6	40.7	26.3	82.3	12.3
Katikall atella***	93.8	5.7	21.0	42.6	29.3	84.2	12.6
Roughage feeds							
Green maize stover*	91.3	7.6	4.2	73.5	56.8	47.2	7.1
Elephant grass*	92.9	5.36	12.2	59.8	36.2	62.3	9.3
Green grass*	89.2	5.27	11.5	62.3	39.1	57.3	8.6
Desho grass*	93.6	3.86	11.3	61.2	32.8	53.7	8.1
Banana leaf ***	91.8	5.9	12.6	57.6	36.9	49.8	7.5
Sugarcane tops*	90.6	5.9	13.7	67.6	37.9	69.3	10.4
Enset leaves**	92.4	5.2	13.5	59.4	43.7	68.2	10.2

*Feed used in both urban/peri-urban and rural production systems; **Feed used only in rural production system; ***Feed used only in urban/peri-urban production systems.

4.12. Mean feed dry matter and nutrient intake by crossbred dairy cows

The mean supplemental feed dry matter and nutrient intake of the monitored crossbred cows in urban/peri-urban and rural production systems are presented in Table 26. The mean supplement dry matter intake for crossbred dairy cows was higher for urban/peri-urban (2.8 kg/day) compared to rural dairy production system (1.8 kg/day). Similarly, the mean CPI from the supplement was higher for urban/peri-urban (460 g/day) than rural (132 g/day) dairy system, while the mean ME intake from the supplement was similar for both production systems. On the other hand, feed dry matter and nutrient intakes were higher for dairy cows in large sized farms compared to cows in medium and small sized herds.

Table 26. Mean feed dry matter and nutrient intake of crossbred dairy cows in the study area

Parameters	RDMI kg/day	SDMI kg/day	TDMI kg/day	RCPI g/day	SCPI g/day	TCPI g/day	RME Mj/day	SME Mj/day	TME Mj/day
Production systems									
Urban/peri-urban	10.1	2.8	12.9	1052	460	1512	28.2	87.6	115.8
Rural	-	1.8	-	-	132	-		85.8	-
Herd size									
Small	-	0.6	-	-	265	-	-	84.9	-
Medium	-	2.2	-	-	283	-	-	77.4	-
Large	-	2.8	-	-	340	-	-	97.7	-
Mean±s.e	-	1.8+0.7	-	-	296±7.8	-	-	86.7±5.9	-

RDMI=Roughage dry matter intakes; SDMI=Supplement dry matter intake; TDMI=Total dry matter intakes; RCPI=Roughage crude protein intakes; SCPI=Supplement crude protein intakes; TCPI=Total crude protein intakes, TME=total metabolizable energy intakes, RME= roughage metabolizable energy intake; SME=supplement metabolizable energy intake; Kg=kilogram; g=gram; s.e=standard error

4.13. Herd dynamics of monitored farms in the study area

Herd dynamics of crossbred dairy herds in urban/peri-urban and rural dairy farms in Bona Zuria Wereda is given in Table 27. There were changes in the herd number during the study period. The main sources of herd changes were birth, sell and death. The overall change/balance of herd was 9.1% less for urban/peri-urban system while it was 6.4% higher for rural dairy production system. Although the contribution of birth to herd dynamics was 8.1%, it was counter balanced by higher number of sell (13.2%) in urban and peri-urban system.

Table 27. Herd dynamics of monitoring dairy farms in the study area

Herd dynamics	Production systems									
	Urban/peri-urban					Rural				
	Small	Medium	Large	Total	%Change	Small	Medium	Large	Total	%Change
	n(%)	n(%)	n(%)	N		n(%)	N(%)	n(%)	N	
No of animals in herd at start of monitoring	17(17)	30(30)	52(53)	99		16(15)	30(27)	64(58)	110	
Calve born	1	2	5	8	8.1	3(25)	2(16.7)	7(58.3)	12	10.9
Sell										
• Cows	0	0	6(100)	6	6.1	0	0	0	0	0
• Calves	1(14)	2(29)	4(57.1)	7	7.1	0	0	3(100)	3	2.7
Death										
• Cows	1(33)	0	2(66.7)	3	3.1	0	0	1(100)	1	0.9
• Calves	0	1(100)	0	1	1.0	1(100)	0	0	1	0.9
Balance at end of the monitoring	16(18)	29(32)	45(50)	90		18		67	117	
Total change	-1(5.9)	-1(3.3)	-7(13.5)	-9	**9.1**	+2(13)	+2(6.7)	+3(4.7)	+7	**6.4**

Numbers in bracket indicate percentage contribution to herd change.

4.14. Milk yield of crossbred dairy cows

The overall mean daily milk yields of crossbred dairy cows in urban/peri-urban and rural dairy farms are shown in Table 28. The average daily milk yield of crossbred dairy cows was 5.89±0.21 litres per cow per day, and it was significantly different ($p<0.05$) between production systems, herd size group and parity. The mean daily milk yield was higher for dairy cows in Urban/peri-urban system than rural, for large sized farms than medium and small, and for younger (parity 2-3) than older dairy (parity 4-5) cows. However, there was significance difference ($p<0.05$) in mean milk yield among the different blood groups. The

interaction between the production system and herd size showed no difference (P>0.05) in milk yield.

Table 28. Means ±SE daily milk yield (litter) of crossbred dairy cows in the study district.

Parameters	N	Milk yield (litre) Mean±SE
Production systems		
• Urban/peri-urban	10	6.41±0.31[a]
• Rural	10	5.36±019[b]
Herd size		
• Small	6	5.62±0.40[b]
• Medium	8	5.95±0.31[a]
• Large	6	6.07±0.40[a]
Blood level		
• <50%	9	5.34±0.21[b]
• 50-75%	5	6.26±047[a]
• >75%	6	6.38±0.40[a]
Parity		
• 2	8	6.28±0.42[a]
• 3	6	5.95±0.24[a]
• 4	3	5.57±0.07[b]
• 5	3	5.03±0.54[b]
Prod system X Herd size		NS
• Urban/PU X Small	3	6.14+0.39
• Urban/UP X Medium	4	6.48+0.35
• Urban/ UP X Large	3	6.59+0.39
• Rural X Small	3	5.09+0.39
• Rural X Medium	4	5.43+0.35
• Rural X Large	3	5.54+0.39
Overall mean	20	5.89±0.21

[ab] Means with same letter for the same parameter within the same column are significantly different; SE= standard error, NS=not-significant; the mean values were compared in columns

4.15. Body Weight and Condition Score of Crossbred Dairy Cows

The body weight change and body condition score of dairy cows during the monitoring period of 90 days are presented in Table 29. There was significance difference (p<0.05) in daily body weight change of cows between urban/peri-urban and rural production systems. The overall average daily body weight of cows in urban/peri-urban production system was 509.08±1.52 kg, while it was 495.63±3.04 kg for cows in rural production system.. The interaction between

the production system and herd size on body weight showed significant difference ($p<0.05$) in body weight. There was also significance difference ($p<0.05$) in body condition score of dairy cows between urban/peri-urban and rural production systems. The average body condition score of cows in urban/peri-urban production system was 3.63±0.07, while it was 2.70±0.05 for cows in rural production system..

Table 29. Body weight and body condition score of crossbred dairy cows in the study area

Parameters	Body weight (kg)		BCS	
	N	Mean±SE	N	Mean±SE
Production systems				
• Urban/peri-urban	10	509.1±1.52^{a}	10	3.6±0.07^{a}
• Rural	10	495.6±3.04^{b}	10	2.7±0.05^{b}
Herd size				NS
• Small	6	494.1±4.26^{b}	6	3.1±0.20
• Medium	8	502.4±3.65^{a}	7	3.2±0.18
• Large	6	510.5±1.91^{a}	7	3.2±0.07
Blood level				
• <50%	9	496.01±3.37^{b}	9	2.7±0.04^{b}
• 50-75%	5	504.7±3.83^{a}	5	3.3±0.25^{a}
• >75%	6	509.9±1.80^{a}	6	3.7±0.09^{a}
Parity				
• 2	8	511.1±1.23^{a}	8	3.6±0.14^{a}
• 3	6	503.8±0.69^{a}	6	3.1±0.19^{b}
• 4	3	494.1±1.23^{b}	3	2.7±0.16^{c}
• 5	3	484.4±2.57^{b}	3	2.7±0.05^{c}
Prod system X Herd size				NS
• Urban/PU X Small	3	500.8±1.77^{b}	3	3.5±0.09
• Urban/UP X Medium	4	509.1±1.59^{a}	4	3.6±0.08
• Urban/ UP X Large	3	517.3±1.77^{a}	3	3.7±0.09
• Rural X Small	3	487.4±1.77^{c}	3	2.6±0.09
• Rural X Medium	4	495.7±1.59^{b}	4	2.7±0.08
• Rural X Large	3	503.8±1.77^{a}	3	2.8±0.09
Overall mean	20	502.4±2.26	20	3.2±0.12

N = number of monitored cows PU=peri-urban; SE=Standard error, NS=not significant; ^{ab} means within columns are significantly different ($p<0.05$); BSC= body condition score, the means were compared across the columns.

4.16. Correlation among feed intake and performance traits of crossbred dairy cows in the study area

The association among feed intake and performance traits of crossbred dairy cows across the production systems in the present study was positive (Table 30). Feed dry matter intake (DMPI) has strong and significant (p<0.01) association with CPI (r=0.99) and moderate association with MY (r=0.48) and BW (0.59). Similarly, CPI had moderate and significant association with MY & BW (r=0.51-0.61). Body weight had significant and moderate association with MY (r=0.58; p<0.05).

Table 30. Coefficient of correlation among dry matter and nutrient intake, milk yield, body weight and body condition score of crossbred dairy cows in the study area.

	SDMI	SCPI	MY	BW
SDMI	1	0.99**	0.48*	0.59*
SCPI	0.99**	1	0.51*	0.61*
MY	0.48*	0.51*	1	0.58*
BW	0.59*	0.61*	0.58*	1

*Correlation is significant at 0.05 level; **Correlation significant at the 0.01 level; SDMI=supplement dry matter intake; SCPI= supplement crude protein intake

5. DISCUSSION

5.1. Socio-economic Characteristics of Households

5.1.1. Household Characteristics

The average household size observed in this study was smaller than 7.71 persons per family reported for Mecha and Bahir Dar Zuria districts (Asaminew, 2007) and 8.73 persons per household reported for household in Bale highlands (Solomon, 2004). In contrast, the present findings was nearest to 6.62 reported for Meiso district, Eastern Ethiopia (Kedija, 2008).

Education is an important entry point for empowerment of rural communities and an instrument to sustain development. In this context, educational level of the farming households may have significant importance in identifying and determining the type of development and extension service approaches. The role of education is obvious in affecting household income, adopting technologies, demography, health, and as a whole the socio-economic status of the family as well (Kerealem, 2005). The majority of urban/peri-urban and rural dairy producer household heads were literate with educational level ranging from elementary school up to high school. The results in general indicate that most of dairy cattle owners in the study area are literate; indicating that with good extension and training program they can improve their dairy production and marketing systems which are mainly based on traditional system currently.

5.1.2. Land and livestock holding

The overall mean land holding size per households in the study area was 1.38ha (0.68ha for urban/peri-urban production systems and 1.73ha for rural production sytems) which is lower than the national average land holding size of 1.77ha (CSA, 2013). It is also less than the land

holdings of 2.0 to 5 ha for 32.6% and 16.2% of the smaller farmers in the country and SNNPRS, respectively (CACC 2003) and greater than 1.1 ha in Shashemene-Dilla area (Yigrem et al., 2008). Low land holding has negative implications on household income and livestock production. It was also revealed that 93% of the total cattle population was local zebu cows which is different from what was reported (99.5%) by Fiseha (2009) in the Bure district. The average number of cattle in the current study is smaller than what Dawit Asseffa (2013) reported for Adami Tulu Jiddo Kombolcha (8.27 TLU cattle) .

5.1.3. Extension service to dairy development

This study revealed that the contact between extension serve agents and dairy producers was weak and infrequent. The sampled milk producers had information access related to milk production from extension agents and non-governmental organization but also from other sources such as previous family experience, neighbor and/or relative, radio and TV, while the rest use their own experience. This survey showed that informal knowledge flow plays 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 form of indigenous knowledge. This again indicated the necessity of taking indigenous knowledge into consideration in each and every modern milk development intervention.

5.2. Dairy cattle husbandry practices in the study area

5.2.1. Involvement of family members in milk production

Household members were participating in various dairy cattle management practices in the studied area and this was dependent not only on the sex and age of the family members, but also on the type of the activities. The selling and purchasing of cattle was mostly the

responsibility of males commonly older than 15 years of age. This group was also responsible for breeding, healthcare and feeding activities whereas their female counterparts were responsible for milking, making and selling dairy products and feeding cattle. Males and females under 15 years of age were given responsibilities mainly for feeding. Young females were also involved in helping older women in dairying activities. There is an agreement between the findings of this study with that of Asfaw (2009), which stated that most of the time females are responsible for dairy farm operations such as milking cows, cleaning of milk containers, milk storing and preserving etc.

5.2.2. Feed resources

Livestock feeds are the major inputs in any milk production activity (Sintayehu *et al*., 2008). The types of feeding systems noted from this study were private grazing and stall feeding. This study also indicated that the major sources of feed for livestock in the study area are natural pasture, crop-residues, and crop-aftermaths. Natural pasture (grazing) and crop residues are the major feed resources used as a basal diet for dairy production in rural and peri-urban dairy systems (Azage et al., 2013). Crop residues, natural pasture and aftermath grazing were the major feed resources for dry season, in their descending order. In general crop residues and natural pasture are the major feed resources of the area which agree with the report of Tolera et al. (2012) who indicated that natural pasture and crop residue to be the major feed resources for highlands of Ethiopia. Currently with the rapid increase in human population and increasing demand for food, grazing lands are steadily shrinking due to the conversion of grazing lands to crop lands, and are restricted to the areas that have little value of farming potential. Concentrates are rarely used with the exception of those milk producers who keep crossbred cows. This finding is in line with the report of Asaminew (2007) and

Seyoum et al. (2007) who indicated that the major basal feed resources for cattle in Bahir Dar and Mecha districts and the highlands of Ethiopia, respectively, are natural pasture, crop residue and stubble grazing.

5.2.2.1. Feeding calendar

This study showed that there was extreme feed shortage during the months October to January. Although crop residues are available its utilization is limited due to poor quality, and the experience of feed quality enhancement through treatment was poor. Although farmers store crop residues for dry season, the way of storage is not generally appropriate. Silage making is not known in the area and also hay making is not practiced. Relatively feed is in good supply during the months of June to September mainly due to better growth of pasture.

5.2.2.2. Feed related constraint in the study area

The main feed related constraints prevailing in the study area are low productivity of natural pasture, shortage of feed, overstocking and disease. The reported feed related constraints in this study are consistent with the reports of Belete (2006) in Fogera district and Asaminew (2007) in Mecha and Bahir Dar Zuria districts. The dominant crop residues in the study area are enset leaf and the by-products of its processing, maize stovers, teff straw, banana residue and wheat straw. The majority of the respondents practice storing feed for times of feed shortage. There was no respondents who exercise urea treatment. To overcome the seasonal shortage of feed, the respondents practice various coping mechanisms like storage of crop residues and supplementation with enset leaf, sugarcane and enset corm. Furthermore, concentrate and improved forage supplementations are practiced by few respondents especially those who own crossbred cows in Bona town.

5.2.3. Cattle housing practice in the study area

In Bona district, milk producers either keep their cattle on private grazing lands/homestead or in the house. Tethering of cattle in the homestead and nearby farmlands is practiced to take advantage of fertilization of their back yards through rotational manuring. The dung is used to fertilize the crop land. Most farmers house their cattle in the dry as well as wet seasons, although some of them did not house cattle in both seasons. This practice is in agreement with the results of Belete (2006) in Fogera district. The purposes of housing in the study areas are to protect cattle from theft and from extreme weather conditions. With regard to housing of crossbred cattle most of the milk producers keep their cattle in separate house. This finding is in line with the finding of Asaminew (2007) at Mecha and Bahir Dar zuria district.

5.2.4. Calf rearing

According to survey result, calves were grazed and housed separately from the dams except when calves were used to stimulate milk let-down. Traditional hand milking was the only type of milking practiced in the district. Washing of teats before milking was not practiced and they believe that during calf suckling for milk letdown, the teats got washed by the saliva of calf and, therefore, it was not as such important to wash the teats before milking ignoring hygienic case for the calf. Milking was mainly done by women. Traditionally, calves were allowed to suckle their dams before (to initiate milk letdown) and after milking (to drain whatever was left in the udder). As the farmers indicated, milking frequency was done mostly twice a day and this also depended on feed availability and body condition of the calf. Calf rearing practice is one of the most important husbandry practices, which sustain milk herd through supplying replacement stock. Report by Gebre Egziabher et al. (2000) also emphasized that calf suckling resulted in higher milk yield and long lactation length of the dam, higher pre-

weaning gain of the calf, and higher weaning weight. Even though, colostrum is regarded as the corner stone of calf rearing, the importance of colostrum to newborn calves has not been understood for many years by small holder farmers in the study area. Some farmers do not have the habit of providing colostrum immediately after calving mainly due to the belief that colostrum causes drying of faeces (mecoin), tongue disease, diarrhoea, and stomach-ache in newly born calves. Therefore, awareness should be created on the importance of colostrum for the newly born calves. This finding is in line with a study that showed 40-70% of two-three day old calves in dairy farms do not receive ideal levels of protection through colostrums feeding (Tadesse et al., 2005). The main reported reason for weaning calves was to prepare the cow for mating, to get more milk and give rest time for next calving. The systems of weaning calves as reported by milk producers were isolation of calves from cows and smearing of teats with manure. Similar results were also reported by Kedija (2008).

5.3. Reproductive and productive performance of cows in the study area

The average ages at first service (AFS) reported for local Zebu heifers (44 months) in this study is similar with what Gidey (2001) reported for fogera heifers (44±8months) at Andassa Livestock Research Centre, while the reported result (26.98 month) for crossbred heifers is found to be less (35.7±0.4).

The AFC obtained in the present study for both local and crossbred cows is shorter than the result reported by Asaminew (2007) that the average AFC for the local cows is 57.12 months whereas the average AFC for crossbred cows was 37.6 months in Bahir Dar milk shed area. Average AFC obtained in the current study is shorter than the finding of Fisseha (2007) with the overall mean of AFC 43.13 ±1.7 months for Holstein Frisian cows in Alage. The AFC of

this study for local zebus is almost similar with what was reported by Mukassa-Mugerwa et al (1989) for local zebus (53.0 months) but is less than the AFC reported by Gidey (2001) for fogera cows (54.6 months). The result depicted for crossbred cows (36.98 months) was higher than what was reported by Albero (1983) for Fresian x Zebu cows (29.1 months). This variation might be due to the difference in the level of management and other inputs as this figure is an on-farm finding in contrast to that of Albero (1983).

The reported average number of services per conception (NSC) of local and crossbred cows was 1.85 and 2.06 respectively. According to Mukassa - Mugerwa (1989), cows with values of NSC greater than two (2), are regarded as poor. However, the higher NSC in crossbred cows (2) might be attributed to the low efficacy of artificial insemination (AI) services for various reported reasons like lack of skilled AI technician, non-synchronization of heat and insemination and lack of effective frozen semen in the district.

The reported CI in this study are almost similar to the estimates of Mukassa-Mugrewa et al. (1989) (25 months) in zebu cattle. The calving interval of current study was much higher than the value reported by McDowell (1971) for Horro breed (12.2 months); Swensson et al. (1981) for Arsi breed (12.9 months) but; lower than the value reported by Gidey (2001) for Fogera breed (18.6 months) and higher than reported by Goshu (1981) for Barka breed (11.8 months).

The lactation length in the current study was higher than the average lactation length of local cows (7.29 months) at Meiso district (Kedija, 2008). The lactation length of the indigenous cows observed in this study is higher than the national average (7 months) (CSA, 2005), while the lactation length in crossbred cows observed in this study is slightly shorter than the lactation length of 11.7 months reported for crossbred cows in the Central Highlands of

Ethiopia (Zelalem and Ledin, 2001). The overall mean milk yields per cow per day of local and crossbred cows were 1.65 and 4.23 litres, respectively. This result for local cows is higher than the average milk yield per cow per day (1.24 litres) of local cows in Meiso district of Oromia Regional State (Kedija, 2008). In general, the higher average daily milk yield per cow and the variation in lactation length in the present study might be attributed to the difference in agro-ecology, nature of research (on-farm and on-station) and breed of animals characterized.

5.4. Breeds and breeding methods in the study area

The current study showed that both natural mating and artificial insemination are practiced in the study area. With respect to natural mating, bulls can be used for either free mating or controlled mating. In controlled mating systems, heat detection and timing of service is carried out by the farmer and each cow is mated once or twice during each heat period. During the breeding season some farmers mate their cows and heifers by the superior bulls owned by themselves or their neighbors. Most of the farmers bred their cows by any bull available in the herd when their cows come to heat. The use of unselected bulls could have negative implication on productivity of the herd and disease transmission such as brucellosis. The majority of the respondents prefer natural mating to artificial insemination for their own reasons that artificial insemination has high chance of resulting in the birth of male calves, and the belief that natural (bull) service has high degree of conception.

5.5. Major disease of Cattle

The major reported cattle diseases prevailing in the study area were respiratory diseases (pneumonia), pasteurolosis, skin disease, tuberculosis, blackleg and foot and mouth disease. This finding is in line with the finding of Asaminew (2007) at Mecha and Bahir Dar zuria

district. According to animal health technician the occurrence of these diseases is serious in the district. On average farmers travel about 2 km and a maximum of 5 km to get to an animal health centre. A milk producer on average spends about 4.85 ETB per head for control of ecto-parasites such as ticks. The average cost per head for controlling endo-parasites is about 2.68 ETB per head. The major reported sources of veterinary services were government, private, NGOs and both government and NGOs. This survey result is agreed with the finding of Adebabay (2009) at Bure district.

5.6. Handling practices of milk and milk utensils

5.6.1. Milking and milk handling practices

To extend the shelf life of milk and milk products, milk producers of Bona district exercise smoking for milk, spicing for cheese, and washing for butter. Woira (Olea africana), Girar (Acacia spp.), Tid (Juniperus procera) and Girawa (Vernonia spp) are used for smoking of milk and milk product containers. This result is in agreement with study of Lemma (2004) reported that Olea africana was the most frequently used plant for smoking milk vessels followed by Juniperus procera. This result also agreed with the result of Sintayehu et al (2008) who reported that milking utensils were smoked with different aroma producing plants like Olea africana and Juniperus procera. Even though washing hands and milking vessels is used as hygienic practices, washing of udder before and after milking is exercised only by those households who have crossbred milking cows in urban/peri-urban production sytems. The current study agreed with the report of Lemma (2004) who indicated that udder of the cow is washed before milking only by few farmers who have crossbred dairy cows. 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, and plastic buckets. Gourd is the major

container used for milking and storing of milk products in the rural areas of Bona district, especially by smallholder farmers. In small towns of Bona district and Bona town, plastic buckets are used for milking and as milk storage equipment, whereas, clay pot and gourd are used for churning. This result also agreed with the result of Sintayehu et al (2008) types of containers used for storage and processing of milk products in both urban and rural areas.

5.7. Consumption and utilization of milk products in the study area

This study showed that, milk produced and consumed is obtained from cows (from both local and crossbred cows) and there was also report of milk utilization from sheep and goats. This result is not in accordance with the finding of Asaminew (2007) at Mecha and Bahir Dar zuria district. Among family members, children (babies of less than one year of age) have the privilege to drink whole milk.

5.8. Marketing of milk and butter in the study area

Milk producers of Bona district not only consume milk products, but also sell the milk and butter to consumers, retailers and traders. The income gained from the sale of milk products is used to purchase farm inputs like feed, fertilizer and improved crop varieties, food and non-food items like education materials for their children as well as house construction. This finding is in line with the finding of Asaminew (2007) at Mecha and Bahir Dar zuria district.

5.8.1. Marketing systems

The survey results depicted that milk and butter in the study area were found to be marketed mainly through informal marketing systems. Milk price in the areas was found to vary considerably depending upon festival and holydays, fasting and non-fasting period as well as

dry and rainy season. This finding is in line with the finding of Adebabay (2009) at Bure district.

5.8.2. Milk and butter marketing channel and chain

Marketable milk commodities in the area include whole milk, butter, ergo (fermented whole milk) and buttermilk. From this survey, different butter and milk market participants were identified in marketing functions between producer and the final consumer. Milk producers and consumers were key participants in the milk market. Similarly, milk producers, itinerate traders and consumers were key participants in the butter market. The number of intermediaries in a given marketing channel has a bearing effect on both producer and consumer milk prices. This result is similar with the finding of Adebabay (2009) at Bure district. The survey result also identified that there were different types of milk marketing channels.

Producer →Consumer: This channel accounts for about 68% of total milk marketed per day in Bona district.

Producer → trader →Consumer; this channel accounts 32% of the total milk marketed in the district.

The major butter marketing channels identified during the survey period are:

Producer →Consumer: This channel is found to involve the direct sale of butter to consumers in the immediate neighborhood and local market places. The channel was the shortest in terms of intermediaries and smallest in terms of volume of butter and value. Those consumers who usually purchase butter for cosmetics purpose rather than cooking.

Producer → Retailer →Consumer: This channel is exercised at Bona town Monday and Thursday markets. In this channel retailers buy butter from the market and sell in the same market to make some profit.

Producer → trader →Consumer; this channel accounts 52% of the total butter marketed in the district.

5.8.3. Determinant of price, demand and supply of milk production in the study area

From this study it was noted that various factors affect the price, demand and supply of milk products in the study area. These included season (dry versus wet), distance to market points, fasting periods, festival and holidays. The results of this study are similar to the findings of Sintayehu et al. (2008). During the wet season due to better availability of feeds there is an increase in milk yield and in turn other milk products per household and per animal compared to the dry season, hence, the better supply to the destination market. Fasting periods are the second indispensable determinants of demand, supply and thus price of milk and butter in Bona district. The price of butter and milk were highly affected by fasting periods of especially Orthodox Christians. For instance, the price of one liter of skimmed milk was 18 ETB in non-fasting periods. Whereas, during fasting periods the price of a litre of skimmed milk was about 15 ETB in Bona town markets. During this period, a high proportion of fresh whole milk was processed into butter. However, during periods of various festivals and holidays, milk products especially butter is highly demanded and thus commands higher prices in market. During festivals and holidays the price of a kg of butter is about 180 ETB. This fact is similar to what Sinayehu et al. (2008) has noted in his survey in Shashemane and Dilla areas of Southern Ethiopia. The most inevitable determinant of demand, supply and price of milk products is distance to market points. On average distance travelled to sell milk and butter

were 2.94km and 3.46km respectively. Especially, rural milk producers of Bona district have no habit of fresh milk selling due to long distance to marketing points; rather, they process it into butter. During survey period, average transport cost per round trip to sell milk and butter were 19.68 and 22.29 ETB respectively. This result agreed with the finding of Adebabay (2009) at Bure district.

5.9. Constraints of milk production, processing and marketing in Bona district

Milk production provides the opportunity for small holder farmers to use land, labor, and feed resources and generate regular income. In this respect, support services in terms of accessing adequate land, organizing input supplies (improved genetic material, feeds, AI, drugs), provision of credit, extension and training services, production and entrepreneurial skills development, sound market opportunity and linkage are the key elements of success for the milk industry (Sintyehu et al., 2008). However, milk producers in the study area suffer from a number of difficulties and challenges that are antagonistic to the success desired in the milk industry. Milk production and marketing in the milk shed was found to be constrained by various factors related to production, processing and marketing.

5.9.1. Milk production constraints

Lack of clean water was found to be problem of the study district. Limited and unsafe veterinary and artificial insemination services and poor milk cattle management system had negative impact on milk production system of the area. This fact is similar to what Sinayehu et al. (2008) has noted in his survey in Shashemane and Dilla areas of Southern Ethiopia. Even though access to credit is crucial to the commercialization of smallholder agriculture, the survey result highlighted that milk producers have little or no access to milk credit. Besides,

lack of skills in different aspects of milk activities was among the other problems encountered. This study revealed that in both production systems farmers stressed the lack of feed to be the most important limiting factor for productivity of their cattle, and indicated the importance of improving their feeding regime as an essential step towards any improvement program. Private grazing was the most important feeding system in the area. However, communal grazing land was decreasing from year to year due to expansion of crop fields, over grazing and human population growth. Seasonal scarcity of feed was mentioned as one of the critical problems in cattle production in the area. In addition, during the dry season both quantity and quality of the pasture herbage declined and failed to met nutrient requirements for good performance. This result is agreed with the finding of Adebabay (2009) at Bure district.

5.9.2. Milk and butter marketing constraints

There are a number of highlighted constraints that hamper further development of milk sector in Bona district. Given the current production level the milk producers in the study area had market problems. In this case, the less possibilities of improved milk production technology, under developed milk market and absolute absence of milk processing plants in the area might have contributed to problems currently prevailing in the study area. The seasonal fluctuation in demand of milk product was found to be the major bottleneck in both milk production and marketing in the study area. Milk producing households also reported that seasonality of demand and supply of milk was one of their vital problems in milk production and marketing. With regard to marketing of milk products in the studied district, distance to marketing points, lack of training related to milk product marketing and fluctuation of price was considered as a problem. This result is similar to the findings of Sintayehu et al. (2008) in Shashemane, Dilla area of Southern Ethiopia. In the same work it has been stated that for the seasonality in

demand for milk and milk products, processing technologies which could extend the shelf life of milk products may resolve the problem. For potential milk areas, where there is no market access, a milk collection scheme through establishment of milk marketing groups may alleviate the problem. Moreover, market-oriented milk extension trainings that cover a wide range of marketing and socio-economic issues should be provided to extension officers to enable them link these skills and knowledge to efficient production through improving farmer's access, understanding and utilization of market in formation. This finding is similar with the finding of Adebabay (2009) at Bure district.

5.10. Feed chemical composition, dry matter and nutrient intakes

The CP content of wheat bran (16.8%) in the present study was less than 21%, while the ADF (26.1 %) content was lower than 31.6 % and the NDF content was higher than 41.5% reported by Fayo (2006). The chemical composition of almost all feed stuff which was laboratorial analyzed was above the set value of NDF (33%) and ADF (18%) percentages level by NRC (1989).

Dairy cattle require nutrients for maintenance, growth, production and reproduction. The overall mean total daily dry matter intake observed for urban/peri-urban dairy farms in the present study was (12.9 kg/day) was higher than 9.50 kg (Yoseph, 1999) reported for cross bred dairy cows in Addis Ababa milk shed and 11.2 kg/day reported for urban dairy farms in Shashemene (Girma et al., 2014). However, the contribution of supplement to total dry matter intake in the same production system in the present study was only 21.7%, which is by far lower than 69.6% reported for urban dairy farms in Shashemene (Girma et al., 2014). On the other hand the basal diet (roughage) had about 70% contribution to total crude protein intake while the contribution of supplement was 30% in the present study. Contrary to this, the contribution of basal feed to total crude protein intake for urban/peri-urban dairy farms in the

present study was 13% while it was 87% for the supplement in Shashemene (Girma et al., 2014). Although it is difficult to compare basal and total feed dry matter, crude protein and energy intakes between urban and peri-urban dairy farms due to difference in feeding systems (dairy farms in rural areas practice grazing compared to stall feeding in urban farms), feed dry matter and crude protein intakes were higher for the former compared to latter dairy farms.

5.11. Milk Yield of Crossbred Dairy Cows

The mean milk yield obtained in the present study was lower than 10.2±1.59 to 15.90 ± 2.36 litres per day reported for dairy cows in the urban production system of Shashamene-Dilla milk shed (Sintayehu *et al.*, 2008). Previous report in central Ethiopia showed that the average milk yield in large peri-urban farms was 8.92 liters (Yoseph, 1999), which was higher than the present values. The present result is also lower than 8.3 and 7.3 liters of milk reported for urban and peri-urban farms, respectively, in North Western part of the country ((Yitaye, 2008). The present finding was also lower than the national average of 6.5 liters reported for crossbred dairy cow (Feleke and Geda, 2001). The lower daily milk yield in the current study compared to literature could be due to difference in the nutrient content of feeds, feed allocation, and genetic makeup of the cows. The average daily milk yield in the current study varied among parities. Consistent with the present findings, Epaphras *et al*., (2004) reported that dairy cows in the third and more parity were no longer better producers compared to those in their second parity. The older age may contribute to reduced milk production through turnover rate of secretary cells, with higher numbers dying compared to the newly produced active secretary cells which in turn actively replaced by fat secreting tissue cells.

5.12. Body Weight and Condition Score of Crossbred Dairy Cows

The present findings showed that body weight of cross bred dairy cows across all the farm scale was significantly different ($P<0.05$). Large farms were better in body weight than that of the medium and smaller one, which was in agreement with Fayo (2006) who reported that dairy cows in large farms were heavier (520$\pm$10.36 kg) than those in medium farms (476$\pm$11.89 kg). This might be due to the fact that large farms have better resources for on-farm feed production and purchase from outside. Although body condition score was affected by parity of cow, it was within the recommended range (2.5 to 3.5) suitable for dairy cows (Richard and Jeffrey, 1993).

6. SUMMARY, CONCLUSION AND RECCOMANDATION

This study assessed milk production & marketing system, and evaluated the productive performances of crossbred dairy cows in urban/peri-urban and rural production systems in Bona Zuria districts of Sidama zone. The district was stratified into 2 based on proximity to district town, market orientation etc. as Urban/peri-urban and Rural production systems. A total of 6 PAs (2 from urban/peri-urban and 4 from rural) and 150 households (25 from each PA) were selected purposively based on the number of households who own crossbred dairy cattle for cross sectional survey to generate information on dairy production & marketing systems and major challenges hindering dairy development. For evaluation of the performance of crossbred dairy cows through longitudinal study (monitoring) a total of 4PAs (2 from each of the urban/peri-urban and rural dairy production systems) were considered from those PAs involved in cross sectional survey. A total of 20 households who had crossbred (Friesian X Zebu) dairy cows, parity ranging from 2-5 and at mid stage of lactation were selected for monitoring feed allocation, milk yield, heart girth measurements and body condition scores of cows.

The number of cows monitored from each farm was one (n=20 crossbred dairy cows). The dairy farms were stratified into three based on the herd size as small sized farm (less than 2), medium farms (2 to 7) and large farm (more than 7 crossbred cows). The overall mean family size per household in the study area was 5.96 ± 0.23. The average (Mean ± SE) crop land holding per household in the study area was 0.81 ± 0.05 ha. The average pasture land size of the sampled households was 0.48 ha, and ranged from of 0.125-1.25 ha. The average number of cattle per household was 7.10 TLU. Feed types commonly used in this areas includes

natural pasture, wheat bran, Agricultural by-products such as crop residues mainly enset residue, maize stover, teff straw, banana leaf, sugarcane tops and crop aftermaths. Concentrates mixtures are rarely used with the exception of those milk producers who keep crossbred cows. Feed shortage commonly observed during dry season of the year in all study sites. Rivers , springs, wells, pond and tape water were the major sources of water for dairy cattle in the study area. The majority of milk producers reported that they keep their cattle in share same house with family (52%) followed by separate house from the family (26.7%). Calf rearing practice is one of the most important husbandry practices, which sustain milk herd through supplying replacement stock. According to the respondents, cattle with blood level of about <50%, 50-75% and greater than 75% were identified. Two types of breeding practices viz: natural mating and artificial insemination are common in the study area. Lack of access, shortage of liquid nitrogen and semen, and lack of skilled AI technicians were considered as the most important constraints of access to artificial insemination in the study district. The average ages at first service (AFS) of local and crossbred heifers were, 44 months and 26.98 months, respectively. The reported average age at first calving (AFC) of local and crossbred heifers were, 53.98 months and 36.98 months, respectively. The reported average number of services per conception (NSC) of local and crossbred cows was 1.85 and 2.06 respectively. The result of this study depicted that the calving intervals (CI) of local and cross cows were 25.88 months and 16.04 months, respectively. The overall average lactation lengths of local and crossbred cows were 8.9 and 10 months, respectively. The main reported animal health problems were lack of veterinary drugs, less frequent animal health service, distant to animal health centers, lack of skilled animal health technicians, lack of laboratory services, and lack of timely vaccination of their animals. The majority of households in the study area sell buttermilk and butter. In urban/peri-urban production systems feed shortage, lack of

improved breed and poor managements were considered as the most important constraints of milk production ranked first, second and third by the households in the study area, respectively while lack of training related to milk and milk product marketing, distance to marketing points and adulteration of milk and butter were considered as the major constraints of milk and butter marketing ranked first, second and third by households in both production systems, respectively.

The overall daily milk yield in the study area was 5.89 ± 0.21 liters, where urban/peri-urban dairy production system had significantly ($P<0.05$) higher milk yield than rural production system. Milk yield was also affected by parity level where cows in second and third parity had significantly higher milk yield than those in fourth and fifth parity. Cows in urban/peri-urban farms were significantly heavier ($P>0.01$) in body weight than those in rural farms, particularly, those cows in large sized farms were significantly ($P<0.05$) better in body condition and heavier in weight than those in small herd sized farms.

In conclusion, from this study it was noted that the existing milk production systems(mainly extensive) & marketing (mainly informal) systems are interwoven by many constraints related to feed, nutrition, health, breed, breeding practice, handling, processing and marketing of products predominates in the study district.

In general, this study showed that despite the untapped cattle population and conducive agro-climate for dairy development, the performance of dairy production in the study district was low and milk marketing system was undeveloped due to many constraints such as capacity, technological, organizational and institutional related constraints. Therefore, coordinated effort is required to address the constraints across the different stages of dairy commodity value chain.

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8. APPENDICES

Appendix 1 Table 5. Conversion for livestock number to Tropical Livestock Unit

Livestock species	TLU conversion factor
Local oxen/bulls	1.1
Crossbred oxen/bulls	1.9
Local cows	0.8
Crossbred cows	1.8
Local heifers	0.5
Crossbred heifers	0.7
Local calves	0.2
Crossbred calves	0.4
Chicken	0.02
Sheep	0.1
Goats	0.1
Horses	0.8
Mules	0.7
Donkeys	0.5

Source: Gryseels (1988) and Bekele (1991), TLU=Total Livestock Unit

Appendix 1 Table 6. ANOVA tables for private pasture land holdings among production system in the study area

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1.080	1	1.080	9.291	.003
Within groups	17.204	148	0.116		
Total	18.284	149			

Appendix 1 Table 7. ANOVA tables for total land holding per households among production systems in the study area.

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6.092	1	6.092	15.172	.000
Within groups	59.424	148	.402		
Total	65.516	149			

Appendix 1 Table 8. ANOVA tables for total livestock holding per households in TLU among production systems in the study area.

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.484	1	2.484	.661	.418
Within groups	556.566	148	3.761		
Total	559.050	149			

QUESTIONNAIRE USED

This questionnaire is to be completed by farmers; the respondents are kindly requested to complete this questionnaire. The information gathered will be used for partial fulfillment of Master degree in animal production from Hawassa University.

Name of enumerator____

Date____________________ PA ______________________________

I-Farm household Characteristics

1-Name of the household head____________________

2-Age of household head________________________

3-Sex of household head 1-Male 2.Female

4- Marital status 1. Married 2.Single 3.Widow 4.Divorced 5.other_____________________

5- Educational status of the household

1. Illiterate 2. Read and Write 3. Elementary school 4.High school 5. Diploma and above

6-Total farm size of the household (ha)

1. Grazing land________ (ha)
2. crop land (both annual and perennial)_____________(ha)
3. Improved forage land_______________(ha)
4. Fallow land__________________(ha)
4. Woodland_______________ (ha)
5.Total land holding __________(ha)

7. Which crops do you produce?

1. Maize ______________(ha)
2. Teff ________________(ha)
3. Wheat _____________ (ha)
4. Barley _____________ (ha)
5. Haricot bean ______________(ha)
6. Enset ________________(ha)

II. Milk Production Systems

1. What is your major farming activity?

1. Livestock production 2. Crop production 3. both livestock and crop production
4. Other (specify):______________________

2.If both livestock and crop production, which one is more important to you (please rank)

____

3. Is livestock important to you? 1. Yes 2. No

4. If yes, please list the reasons of keeping livestock (list and rank them)

s/n	Importance or reasons of keeping livestock	Rank the importance or reasons of keeping livestock
1		
2		
3		
4		
5		
6		

5. Among livestock species which one is more important for you (please list and rank)

s/n	List of livestock species	Rank the importance	s/n	List of livestock species	Rank the importance
1			6		
2			7		
3			8		
4			9		
5			10		

6. Do you produce milk? 1. Yes 2. No

7. If yes, for what purpose do you produce milk? 1. Home consumption 2.market3. for both
   4. Others (specify):____________________________

8. If yes, from which species of animals do you produce? 1. Cattle 2. Goats 3. Sheep
   4. Others:_____________________________________

9. If from other than cattle, please rank the contribution of each.____________________

10. What is your major livestock farming? 1. Cattle production 2. Small ruminant production
    3. Poultry production 4. Honey production 5. Other:____________________________

11. Which part of your farming contributes most of your families' income?
    1. Livestock production only 2. Crop production only 3. Livestock and crop production
    4.Livestock and off-farm activity 5. Crop and off-farm activity 6. Livestock, crop and off-farm activity.

12. How long have you been engaged in milk production? ________
    1.1-5 years 2. 6-10 years 3. 11-15 years 4. >15 years

13. Livestock ownership & demography.

s/n	Type	No	s/n	Type	No	s/n	Type	No
1	Cows		6	Steers (uncastrated males above 2 years old not used for breeding)		11	Horses	
	• Indigenous			• Indigenous				
	• Crossbred			• Crossbred				
2	Oxen			Calves		12	Donkey	
	• Indigenous			Male				
	• Crossbred			• Indigenous				
3	Heifers (> 2 years			• Crossbred		13	Mules	
	• Indigenous			Female				
	• Crossbred			• Indigenous				
4	Breeding bulls			• Crossbred				
	• Indigenous		8	Sheep				
	• Crossbred			• Indigenous				
5	Yearlings (1-2			• Crossbred				
	Male		9	Goats				
	• Indigenous			• Indigenous				
	• Crossbred			• Crossbred				
	Female		10	Chickens				
	• Indigenous			• Indigenous				
	• Crossbred			• Crossbred				

A. Feeds and Feeding

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).

Classes of feeds		1	2	3
1. Improved forages	Grasses			
	Legumes			
2. Crop residues				
3. Crop aftermath				
4.Mineral sources				
5. Supplements (concentrates)				
6. others				

2. What do you feed animals at different months

Feeding management	Months											
Grazing own pasture	J	F	M	A	M	J	J	A	S	O	N	D
Grazing communal land												
Grazing on crop residue												
Crop aftermath grazing												
Zero grazing												
Weeds from crop farms												
Enset leave grazing												

3. Is there a problem of feed shortage for milk cows? 1. Yes 2. No

4. If yes, when? ___________

5. If yes, how do you cope up with feed shortage in your locality? __________________
6.What are the major feed related constraints of livestock production (List and rank them)

s/n	List of constraints	Rank
1		
2		
3		
4		
5		
6		

7. What are the main problems in the area of improved forage use for milk cows?
1. Unawareness 2. Lack of seed 3. Lack of growing land 4. Poor adaptability
5. Shortage of improved forage in the area 5. Combination of them (specify)
6. Other (specify) __________
8. What are the main problems in the area of concentrate feed use for milk cows?
1. Unawareness 2. Lack of access 3.Costly 4. Combination of them (specify)
5. Shortage of supply 6. Others (specify) ___________________
9. What are the main problems in the area of crop residue use for milk cows?
1. Shortage of production 2. Utilization by other livestock type
3. Shortage due to Utilization for other purpose other than feed
4. Combination of them (specify) _______5. Others (specify) ______________
10. Which cop residue is your dominant feed? 1. Teff straw 2. Barley straw 3. Rice straw
4. Maize stalk 5. Inset residue 6. Other (specify):__________________________
11. What is the major source of feed to your livestock? 1, natural grazing 2. Improved forage
3. Crop residue 4. Crop aftermath 4. Other (specify):______________________________
12. To which classes of cattle do you give relatively more feed than grazing in time of Sever feed
shortage? 1. Milking cows 2. Milking + pregnant cows 3. Pregnant cows 4. Dry cows
5. Draught oxen 6. Others (specify) _____________________
13. In what form are you using the natural grazing lands you have?
1. Continuous grazing 2. Rotational grazing 3.Cut-and-carry system 4. Other (specify):____
14. How do you get feed (all kind of feeds) for your livestock?
1. Produce on farm 2. Purchase from outside 3. Produce and purchase
4. Other (specify): ____________
15. Do you conserve feeds to feed milk cows in times of feed shortage? 1. Yes 2. No
16. If yes, how do you conserve? 1. Hay making 2.Silage 3.other:________________
17. If no, Why not____________________________
18. Do you supplement your lactating animals? 1. Yes 2. No
19. If yes, mention the types of feeds that you supplement_____________________________
20. How do you provide supplementary feeds?
1. Separately 2. Group feeding 3. Others (specify) __________
21. How frequently do you provide supplementary feeds for your lactating animals?
1. Once a day 2.twice a day 3.As available
22. What is the source of water for your animals? 1. River 2. Tap water 3.Spring
4.Pipe water 5. Bore well 6. Other (specify) __________
23. How frequently do you provide water for your cattle?
1. Free access 2. Once per day 3.Twice per day 4. Every other day
24. What is your water related problem?
1. Scarcity/unavailability 2. Parasites 3.Impurities 4. Distance
25. Do you provide mineral supplement to your animals? 1.Yes 2. No

26. If yes, please list the type of supplement (including traditional ones) ________________
27. How frequently do you provide salt?1. Free access at any time 2. Daily 3.every other day
4. Once per week5. Less than every two weeks 6. Others (specify) _____

B. Calf Rearing Practices

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

	Local	Crossbred
1. Male	_________	_________
2. Female	_________	_________

3. If yes, which type of weaning do you exercise?
1. Partial weaning 2. Abrupt weaning 3. Other (specify) _____________
4. Who weans the calf mostly?
1. The cow refusal 2. Owner 3.Refusal of the calf due to lack of milk 4. Others (specify)
5. If the owner does weaning, explain the reason?
1. To get more milk 2. Prepare the cow for mating 3. Give rest time for next calving
4. Combination of them 5. Others (specify) ______________________________
6. System of weaning exercised by the owner?
1. Isolation and herding separately 2. Protection from sucking without isolation
3. Other (specify) _______________
7. What method do you use for pre-weaning milk feeding?
1. Bucket feeding (for local, cross or both) 2. Partial suckling (for local, cross or both)
3. Other (for local, cross or both) ___________
8. Do you provide colostrums for your newborn calf? 1. Yes 2. No
9. If no, why____________________________________
10. For how long is the newborn calf supplied with milk (In months)?
1. Local _____________ 2. Crossbred _____________
11. For how long newborn calves stay indoors until they start grazing?
1. Local ______ Cross _________.
12. Do you provide supplementary feed to newborn calf till they start grazing? 1. Yes 2. No
13. If yes, mention the type of feed and form of feeding?

Type of feed		Form of feeding (group or individual)
1. Local	________________________	___________________________
2. Crossbred	_______________________	___________________________

C. Housing, Facilities and Management

1. How do you house your animals?1. in the same house with family 2. Separate from family house 3. Other (specify): ___________
2. If separate, what type of house?1. Corral 2. Well-built house with shelter and wall

3. Only shelter 4. Specify (other): ___________

3. Specify the area of the barn you have (m^2) _____.

4. Frequency of cleaning the barn

1. Three times a day 2.Two times a day 3.Once a day 4. Others (specify) ____

5. How do you dispose the cattle dung from the barn? 1. Draining system 2. Labor

6. Frequency of disposing manure from the barn

1. Once per day 2. Twice a day 3. Three times a day. 3. three times and above

8. What type of herding management do you have for your milk cattle?

	Local cows		Crossbred cows		Calves	
Management type	Day Time	Night time	Day Time	Night time	Day Time	Night time
1. Grazing						
2.Tethering						
3. Stall feeding						
4. Others (specify)						

9. If they graze for how long they stay in grazing (hours per day)?

	Dry season	Rainy season
Crossbred cows	_________________	_________________
Local cow's	_________________	_________________
Crossbred calves	_________________	_________________
Local calves'	_________________	_________________

D. Breed, Breeding and Reproduction

1. Do you keep crossbred milk cow/s? 1. Yes 2.No

2. If yes, when did you start keeping crossbred milk cattle? ______________________

3. Source of crossbred heifer(s): 1. Government ranches 2. NGOs 3.Market 4. Relatives

4. Merit and demerit of crossbred cattle compared with local cattle.

	Merit	Demerit
1.	___________________________	_____________________________
2.	___________________________	_____________________________
3.	___________________________	_____________________________

5. Which breed of milk cows do you like to keep in the future? 1. Local 2. Crossbred

6. Why do you select it? ____

7. What is the average age at first calving (year)? a. Local _______b. Crossbred ________

8. In which month/season of the year cows come into heat?

Season	Month(s)
Dry	________________________

Rainy ________________________

9. What is the average age at first mating for female (in years)?
   1. Local____________ 2. Crossbreeds______________
10. What is the average age at first effective service for male (in years)?
   1. Local____________ 2. Crossbreeds____________
11. Calving interval of a milking cow? (in months)
   1. Local__________2.Crossbred__________
12. What is the average lactation length for milking cows (in months)?
   1. Local _________ 2. Crossbred _________
13. Do you select superior males and females for breeding? 1. Yes 2. No
14. If yes, how do you select breeding cows?
   1. Pedigree history 2. Physical appearances 3. Growth rate 4. Age at first calving
   5. Calving interval 6. Mothering ability 7. Others (specify) _____
15. If yes, how do you select breeding males?
   1. Pedigree history 2. Physical appearances 3. Growth rate 4. Service efficiency
   5. Combination of the above (mention) 6. Others (specify) ______
16. Which breed sire mostly you use for natural mating?
   1. Crossbred 2. Local 3.Both equally 4. Unknown
17. What is/are your criteria(s) to mate heifers?
   1. Age 2. Size 3.Both age and size 4.Whenever they manifest estrus
   4. Decision for extended period of calving interval
18. What type of breeding practices do you use for milk cows?
   1. Natural (bull service) 2. Artificial insemination (AI) 3. Both
19. If you use AI, what is the source of it?
   1. Government recruited technicians' 2. NGO's 3. Private 4. Others (specify) ____
20. Which method do you prefer and why? 1. Natural (bull service) 2. Artificial insemination
21. Is there a problem of AI? 1. Yes 2. No
22. If yes, why?
   1. No access 2. Unwillingness of AI technicians' 3. Shortage of liquid nitrogen and semen
   4. Others (specify) ________________
23. Do you have your own breeding bull? 1. Yes 2. No
24. If yes, breed type_________________
25. If yes, how does it give service?
   1. Own herd only 2. Own and neighbor herd freely 3. Others (specify) ____________
26. If no, where is your source for the bull?
   1. Neighbor 2. Rent from neighbor 3. Bull services (Rent) 4. Others (specify) ______
27. Is mating seasonal? 1. Yes 2. No
28. If yes, why? 1. Due to feed shortage in some months 2. Planned for heat period and time of calving 3. Other (specify) ______
29. If your mating is natural as well as seasonal or planned, how cows and bulls are protected from mating out of the season?1. Isolation 2. Others (specify) __________

30. What are the peaks mating months of the year? (Mention in descending order)

1. __________ 2. __________ 3. __________

31. How long (in years) a milk cow and bull stays in a herd for breeding in their lifetime?

	Cow	Bull
1. Local	____________	_________
2. Cross	___________	________

32. What is the source of your replacement breeding bull?

1. Own herd 2. Another herd 3.Purchase 4. Other (specify) ____________________

33. How many calving are most likely to occur in the cow lifetime

1. Local ______ 2. Crossbreeds _______

34. When do you mate the cow after calving (in days)?

1. Local __________ 2. Crossbreeds ________

35. What is the average number of service per conception?

1. Local cows____ 2. Crossbreed cows____

36. Do you practice culling? 1. Yes 2. No

37. If yes, what is the main reason of culling?

1. Disease 2. Age 3.Infertility 4.Low milk yield 5. Financial constraint
6. Feed shortage 7. Others (specify) _________________

38. If you cull milk cattle due to financial constraint, which is your priority for culling?

1. Milking cow 2. Bull 4. Heifer 5. Male calves 6. Female calves 7. Pregnant cow
8. Infertile/cows with low milk yield 9. Others (specify) ______________________

39. Of the above you mentioned which breed you mostly cull?

1. Locals. Why? ____
2. Crossbreeds. Why? ____

E. Milk cattle Diseases and Treatments

1. Describe major disease you have experienced in your milk cattle during the last year in order of importance.

Local name of diseases	Symptom	Month of occurrence
1.__________	_____________	________________________
2.__________	_____________	________________________
3.__________	_____________	________________________
4.__________	_____________	________________________
5.__________	_____________	________________________

2. What do you do when your animal is sick?

1. Keep of waiting 2. Culling 3. Consult veterinarian 4. Others (specify)

3. Do you have access to veterinary services? 1. Yes 2. No
4. Is there a problem with animal health services? 1. Yes 2. No
5. If yes, please mention_______________________________
6. Do you use any control measures for ecto-parasites of milk cows? 1. Yes 2. No
7. If yes, specify:

Method	Frequency	Cost per treatment/ head
1. ____________________	_____________	_____________________
2. ____________________	_____________	_____________________
3. ____________________	_____________	_____________________

8. How do you control internal parasites?

Method	Frequency	Cost per treatment/ head
1. ____________________	_____________	_____________________
2. ____________________	_____________	_____________________
3. ____________________	_____________	_____________________

9. Is there a problem of calving difficulties? 1. Yes 2. No

F. External input services for milk producers

1. Have you ever participated on milk production training? 1. Yes 2. No
2. If yes, specify the training type and the institution which organized the training
____
3. Is there any extension service given for livestock especially milk development? 1. Yes 2.No
4. Do you think that there is a need for external input (assistance) which helps the milk Production?____
5. Are you a member of milk collection group/ cooperative? 1. Yes 2. No

6. If yes, benefits and obligations (e.g. obtain credit, inputs, and guaranteed sales outlet).
____
7. Are you a member of saving association or group? 1. Yes 2. No
8. If yes, what kind of savings do you have? ___________________________________

G. Milk production, consumption, processing and marketing

1. Milk yield and frequency of milking for milk cows (select the possible frequency of milking and indicate the average milk yield).

Period of lactation		Time and amount of milk produced			Remark
		1. Morning	2. Mid day	3. Evening	
Local	Early lactation				
	Mid of lactation				
	Late lactation				
Crossbred	Early lactation				
	Mid of lactation				
	Late lactation				

2. Type of milking practices
   1. Milking without suckling 2. Few suckle before and after milking
   3. Suckling before milking only 4. Others (specify) ______________________________
3. Do you practice complete milking practice? 1. Yes 2. No
4. Do you wash udder of milking cows? 1. Yes 2. No
5. Do you milk your animals in the absence (death) of their calves? 1. Yes 2. No
6. If yes, how? ____
7. What are your milking equipments? ____
8. How frequently you clean your milking equipment? _______________________
   1. Once per day 2. Twice per day 3.3 times per day 4. Others (specify) ___
9. Do you use disinfectants for milk equipment? 1. Yes 2. No
10. If yes, mention the type of disinfectant you use to disinfect______________
11. What methods do you use to increase the shelf life of milk and milk products?
    1. Smoking of containers 2. Boiling before collection 3.Salting 4. Others (specify)
12. How many kg of butter you get from one churning? _____________________

Type of cow	Amount of milk churned at a time (lit)	Amount of butter produced (kg)	Amount of cheese produced (kg)
1. Local			
2. Crossbred			

13. How much milk, butter and cheese produced per week (In kg)?

	Produced	used for home consumption	Sold
Milk	______________	________________________	_____________
Butter	______________	________________________	_____________
Cheese	_______________	________________________	_____________

14. At which season/month(s) do you fetch the maximum and minimum price from the sale of milk and milk products?

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

15. What factors affect the price of milk and milk products? ________________________
16. For what purpose do you mostly use the money that you get from the sale of milk and milk products 1. Farm inputs 2.Food and non-food items 3.House construction 4. Teach children
    5. other________________
17. Would you mention the transport cost of milk products (for a double trip of a sell)?
    ____
18. Please specify the frequency of selling milk products in a month. ____________
19. Is there any period that you have problem of marketing your milk products? 1. Yes 2. No
20. If yes, which months? 1. Fasting month's 2. In any month of the year 3.Specify
21. Have you ever experienced spoilage of milk and milk products due to lack of market?
    1. Yes 2. NO
22. What are the plants used for smoking milking equipment? ______________
23. What is the purpose of smoking? __________________________________
24. Milking hygienic practice
    a. Washing1. Wash hands and milk vessels 2. Wash udder before milking
    3. Wash udder before and after milking 4. No hygiene
    b. Use of towel 1. Use of individual towel 2.Use of collective towel 3. With bare hand
25. Do you process milk? 1. Yes 2. No
26. If yes, what are your reasons to process milk? _____________________________
27. Shelf life of fermented milk (ergo) _______________________________________
28. Do you use milk for a purpose other than drinking (e.g. medicinal value?) 1. Yes 2. No
29. If yes, what type of milk for what type of diseases? ________________________
30. Do you produce butter? 1. Yes 2. No
31. What type of churn do you use? 1. Gourd 2. Clay pot 3. Other:________________
32. Uses of butter 1. consumption 2. For market 3.ointment 4. Other (specify)
33. Uses of buttermilk 1. Consumption 2.For market 3. For cottage cheese making
    4. Animals 5. Other (specify):_______________________________________
34. For how long can you store butter with minimum spoilage? ______________
35. What methods do you use to minimize spoilage of butter? ________________
36. How is milk consumed? 1. in its raw state 2. After souring 3. After boiling
37. Which milk products do you use for family consumption?
    1. Fresh milk 2.Fermented milk 3.Buttermilk 4.Cottage cheese
38. Did you encounter sickness due to consumption of contaminated milk? 1. Yes 2. No.

39. What are the major constraints of milk production (List and rank them).

s/n	Constraints of milk production	Rank
1		
2		
3		
4		
5		

40. What are the constraints of milk and butter marketing? (List and rank them)

s/n	Constraints of milk and butter marketing	Rank
1		
2		
3		
4		
5		

41.What is the trend of milk production in the last 5 years?
1. Increased 2. Decreased 3. No change

42. In what way shall the government contribute to bring development in milk enterprise?

____

H. Gender, Labor sources and Environment

1. Which gender plays a great role in milk production? 1. Male 2. Female 3. Both almost equally

2. Do you use daily laborers for milk production? 1. Yes 2. No

3. If no, reasons for not hiring labors for milk production
1. Have enough labors 2. Too expensive 3. No labor for hiring 4. Other specify

BIOGRAPHICAL SKETCH

The author was born in Bona Zuria district of Sidama Zone in 1990 G.C. He attended his primary and junior secondary education at Gobecho Primary and Junior Secondary School from 1996-2003 G.C. He had also attended his secondary School from 2004-2007 G.C. at Aleta Wondo Secondary and preparatory School. After completion of secondary school education he joined Dilla University of Agriculture in 2008 G.C and graduated with BSc degree in Animal Science and Range land management in 2010 G.C. After graduation he was employed by Bona Zuria Woreda of Agriculture where he worked for 3 year as Animal production and Forage development expert. Finally, after three years of working experience he joined Hawassa University in 2014 G.C to pursue his graduate studies in Animal Production through the financial support obtained from Livestock and Irrigation Value chain for Ethiopian Smallholders Project (LIVES).