ASSESSMENT OF DAIRY FARMING IN THREE DISTRICTS OF OROMIA REGION, CENTRAL ETHIOPIA: MANAGEMENT, REPRODUCTIVE AND PRODUCTIVE PERFORMANCE

BY

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A THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES

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IN TROPICAL ANIMAL PRODUCTION AND HEALTH

JUNE 2012

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As Thesis Research advisors, I here by certify that I have read and evaluated this Thesis prepared, under my guidance, by Kefelegn Seyoum entitled 'assessment of dairy farming in three districts of Oromia region, central Ethiopia: management and breeding practices. I recommend that it be submitted as fulfilling the thesis requirement.

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DEDICATION

This thesis is dedicated to my beloved father, Seyoum Abebe, whom I lost on 17 April 2009. May God rest his soul in peace!

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ABBREVIATIONS

AWOARD	Ada'a Woreda of Agricultural and Rural Development
ADLI	Agricultural Development Led Industrialization
AFC	Age at First Calving
AFS	Age at First Service
CI	Calving Interval
CSA	Central Statistical Authority
CADU	Chilalo Agricultural Development Project
EARO	Ethiopian Agricultural Research Organization
ILCA	International Livestock Centre for Africa
MASL	Meters Above Sea Level
N	Sample size
SPDDPP	Selale Peasant Dairy Development Pilot Project
SDDP	Small-Holder Dairy Development Project,
SE	Standard Error
UNRRA	United Nations Relief and Rehabilitation Administration
WADU	Wolayta Agricultural Development Project

ABSTRACT

A cross sectional study was conducted with the aim of assessing dairy farming, with special emphasis on management, breed and breeding practices in three districts of Oromia region, central Ethiopia. The study covered 151 dairy farms from the three districts namely Adama, Lume and Ada'a. Data on farm management variables, feed resources and breed and breeding practices were collected by means of questionnaire together with farm inspection in a one visit interview. The main sources of feed for farms of Adama, Lume and Ada'a were crop residues and commercial feeds and supplements with the respective proportions of 100% to crop residues in all the farms and 98%, 92% and 98% to that of commercial feeds & supplements. It is conclude that high cost and scarcity of feeds are the major constraints of the dairy farms in the study areas, three types of breeds (local, cross and exotic breeds) and two types of breeding practices (Artificial insemination and natural mating) had recognized. According to the respondents the cross breed type and artificial insemination breeding practices were the predominant in all the farms of the study areas. The mean daily milk yield, lactation length, ages at first calving, numbers of services per conception and calving interval for local, cross and exotic breeds were 2.68, 10.70 and 10.57 liters, 6.52, 9.82 and 9.93 months, 51.85, 31.87 and 33.87 months, 1.56, 2.33 and 2.40 and 18.68, 15.56 and 14.36 months respectively for the dairy farms of Adama, 2.00, 11.88 and 10.30 liters, 6.84, 9.03 and 8.90 months, 49.15, 33.74 and 35.60 months, 1.57, 2.25 and 2.45 and 20.71, 15.76 and 15.67 months respectively for the dairy farms of Ada'a and to that of Lume dairy farms all these traits for indigenous and cross breeds were 2.33, and 11.11 liters, 6.91 and 9.88 months, 51.00 and 39.59 months, 1.45 and 1.98 and 20.41 and 17.38 months respectively. There was significant variation between the three districts for the results of age at first calving of cross breeds which might be due to the difference in the level of management. Daily milk yield and lactation length were also significant ($p \leq 0.05$) for bred types. Cross breed cows under all farms had a relative good reproductive and productive performance. Therefore establishment of new ones to cross breed cows should be encouraged by the government and nongovernment institutions with better technical assistance and recommended capacity building of farm owners.

Key words: Adama, Ada'a, Breeding, Lume, management, Production

1. INTRODUCTION

The important roles of livestock in the developing countries within the agricultural sector in contributing to rural livelihoods and particularly those of the poor are well recognized. Livestock and their products are estimated to make up about one third of the total value of agricultural gross output in the developing countries, and this share is rising from time to time. The livestock subsector plays a vital role as source of food, income, services and foreign exchange to the Ethiopian economy, and contributes to 12 % and 33% of the total and agricultural GDP, respectively, and accounts for 12–15% of the total export earnings, (Ayele *et al.,* 2003). In addition, there are other non-monetary contributions of livestock to the households namely draft power, fuel, manure and transportation which could significantly increase the impact of livestock once incorporated into this sector.

Though, Ethiopia is one of the countries of sub-Saharan Africa which has the largest livestock population and is ranked to be the first in Africa and ninth in the world; yet its contribution to the economy is limited and remained to be quantitative boosting (Amha, 2008). Population in Ethiopia is growing at a rate of 2.9% per year while the urban population increases at the rate of 4.4%. Therefore, this increment in population and the income of them in the future is expected to be increased which will allow them to take liquid milk. Dairy production is an important issue in Ethiopia's livestock- based society where livestock and their products are important source of food and income. Even though this is the fact, dairying has not been fully exploited and promoted in the country still now (Sintayehu *et al*., 2008*)*.

The country holds large potential for dairy development due to its large livestock population, the favorable climate for improvement and the relatively disease-free environment. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of the dairy sector can contribute significantly to poverty alleviation. Like other sectors of the economy, the dairy sector in Ethiopia has passed through three phases; these include the imperial regime, characterized by almost a free market economic system and the emergence of modern commercial dairying (1960-1974), the socialist Derg regime that emphasized central economic system and state farms (1974-1991), and the

current phase under the structural adjustment program and market liberalization (1991 to present), following the economic and political policy in the country. In the most recent phase, characterized by the transition towards market-oriented economy, the dairy sector appears to be moving towards a takeoff stage. Subsequently, several macro and sectoral economic policy changes were implemented. The federal government launched a national development strategy namely, Agricultural Development Led Industrialization (ADLI) and this seeks to bring about an improvement in the livestock sector by enhancing the quality and quantity of feed, improved extension services, increasing livestock health services and improved productivity of local cows by artificial insemination while preserving the indigenous breeds (Mohamed *et al.*, 2007). Efficient milk production is a key to sustainable development of dairying.

Justification of the Study

Most previous researches done on dairy production system have been situated in the central highland areas of Ethiopia including the capital city, and very little work has been done to identify overall management practices, feed & feeding systems, breed and breeding practices in different areas of the country at a time. As a result of this, there have been faced a problem for identifying further research gaps, recommendations and to plan the equivalent technical assistance to the dairy subsector. In addition to this whether there have been variations or not between different areas of the country for such conditions were not been fully identified. For this reason, this study were been, therefore, initiated to assess the dairy farm management practice, feed & feeding systems, breed and breeding practices in three districts of Oromia region namely Ada'a, Lume and Adama. Therefore the objectives of this study were:

- To assess the housing, feeding and breeding practices (management) at dairy farms in three districts of Oromia region namely Adama, Lume and Ada'a
- To study/see/ the reproductive and productive performance of dairy cows in the study areas.

2. LITERATURE REVIEW

2.1. Dairy production system in Ethiopia

The Ethiopian dairy production system can be distinguished into four major systems, these are: Pastoralism, Highland Smallholder, Urban and pre-urban (small and medium dairy farms in backyards in and around towns and cities) and Intensive dairy farming (Ketema and Tsehay, 1995).

2.1.1. Pastoralism

Even though, information on both absolute numbers and distribution vary, it is estimated that about 30% of the livestock population are found in the pastoral areas (Ketema and Tsehay, 1995).

The pastoralist livestock production system which supports an estimated 10% of the human population covers 50-60% of the total area mostly lying at altitudes below 1500m a.s.l. pastoralism is the major system of milk production in the low land. However, because of the rainfall pattern and related reasons shortage of feed availability milk production is low and highly seasonally dependent (Ketema and Tsehay, 1995).

Where animals are kept by pastoralists they do not provide inputs for crop production but are the very backbone of the life for their owners, providing all of the consumable, saleable outputs and, representing a living bank account and form of insurance against adversity. In the lowlands, the livelihoods of the pastoralists wholly depend on the milk obtained from cattle, goats and camels. In the lowlands, pastoralists derive well over 90% of their cash income from livestock (Azage *et al.*, (1998).

2.1.2. The highland smallholder milk production

The Ethiopian highlands possess a high potential for dairy development. In the highland areas agricultural production system is predominantly subsistence smallholder mixed farming, with crop and livestock husbandry typically practiced within the same management unit. In this

farming system all the feed requirement is derived from native pasture and a balance comes from crop residues and stub grazing (Ketema and Tsehay, 1995).

The majority of milking cows are indigenous animals which have low production performance with the average age at first calving is 53 months and average calving intervals is 25 months. Cows had three to four calves before leaving the herd at 11-13 years of age, the average caw lactation yield is 524 liters for 239 days of which 238 liters is for human use while 286 liters is suckled by the calf. But also a very small number of crossbred animals are milked to provide the family with fresh milk butter and cheese (Desta, 2002).

2.1.3. Urban and peri-urban milk production

This system developed in and around major cities and towns which have a high demand for milk. The main feed sources are agro-industrial by products (Oil Seed Cakes, Bran, etc) and purchased roughage. The system comprises small and medium size dairy farms located mainly in the highlands of Ethiopia. Farmers use all or part of their land for home grown feeds. Generally, the primary objective of the production system is to sale milk as a means of additional cash income (Ketema and Tsehay, 1995).

2.1.4. Intensive Dairy Farming

This is a more specialized dairy farming practiced by state sector and very few individuals on commercial basis. Most of the intensive dairy farms are concentrated in and around Addis Ababa and are basically based on exotic pure bred stock. The urban, peri-urban and intensive dairy farmers produce *2%* of the total milk production of the country (Ketema and Tsehay, 1995).

The dairy sector in Ethiopia can also be categorized based on market orientation, scale, and production intensity. Doing so identifies three major production systems: traditional smallholders, state farms, and urban and peri urban systems (Gebre Wold *et al.,* 2000) The traditional smallholder system, roughly corresponding to the rural milk production system that

produces 97 percent of the total national milk production and 75 percent of the commercial milk production. This sector is largely dependent on indigenous breeds of low-productive zebu cattle, which produce about 400-680 kg of milk /cow per lactation period. The state dairy farms, now being privatized or in the process of privatization, use grade animals (those with more than 87.5 percent exotic blood) and are concentrated within 100 km distance around Addis Ababa. The urban and peri-urban milk 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 Wold *et al.*, 2000 and Holloway *et al.*, 2000).

2. 2. Consumption patterns

Ethiopia has a huge livestock resource but the country is not self-sufficient in animal products and is a net importer of dairy foods. The overall milk consumption in Ethiopia is very low, even compared with other least developed African countries. The annual per capita milk consumption was 19–20 litres in 1993/1994 (Kassahun and Fekadu 2009).

Fellke and Geda (2001) estimated that 68 percent of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese and yogurt while the rest is given to calves and wasted in the process. Butter produced from whole milk is estimated to have 65 percent fat and is the most widely consumed milk product in Ethiopia. Of the total milk produced, around 40 percent is allocated for butter while only 9 percent is for cheese. Traditional butter, which ferments slowly at room temperature, can keep for a year or longer, offering rural consumers a readily storable, long-lived dairy product.

The consumption of milk and milk products vary geographically between the highlands and the low lands and level of urbanization. In the lowlands, all segments of the population consume dairy products while in the highlands the major consumers include primarily children and some vulnerable groups of women. The limited statistical data available on potential milk demand

suggest that demand for milk will increase, at least in the urban centers and among the people with high purchasing power. The demand for milk depends on many factors including consumer preference, consumer's income, population size, price of the product, price of substitutes and other factors. Income is a key driver of levels of milk consumption. As individual's income rises there is a greater proportional rise in their expenditures on dairy products (Land O'Lakes, 2010) Population in Ethiopia is estimated to grow at 2.9 percent per year while the urban population increases at a rate of 4.4 percent. Therefore, increase in population growth and consumer income in the future is expected to increase liquid milk consumption. The rural population is estimated to be 85 percent of the total population and its milk consumption largely depends on livestock holding. In the mixed highland regions, it is estimated that 50 percent of households own cattle; of which 56 percent are dairy cattle. Consequently, most households have access to milk. Similarly, in the lowlands more than 80 percent of the households own cattle, significant number of small ruminates and camel. In this area, it is likely that all households consume milk (Felleke and Geda, 2001).

2.3. Historical events of dairy development in Ethiopia

According to Ahmed *et al.* (2003), in the first half of the 20th century, dairying in Ethiopia was mostly traditional. Modern dairying started in the early 1950s when Ethiopia received the first batch of dairy cattle from United Nations Relief and Rehabilitation Administration (UNRRA). With the introduction of these cattle in the country, commercial liquid milk production started on large farms in Addis Ababa and Asmara (Ketema, 2000).

Government intervened through the introduction of high-yielding dairy cattle in the highlands in and around major urban areas. The government also established modern milk processing and marketing facilities to complement these input-oriented production efforts. In 1960, UNICEF established a public sector pilot processing plant at Shola on the outskirt of Addis Ababa in order to enhance growth of the dairy sector. The plant started by processing milk produced by large farms. The plant significantly expanded in a short period and started collecting milk from smallholder producers in addition to large farms. This led to further expansion of large dairy farms. During the second half of the 1960s, dairy production in and around Addis Ababa areas

began to develop rapidly and the expansion in large private dairy farms and the participation of smallholder producers with indigenous cattle facilitate establishment of milk collection centers (Ahmed *et al.*, 2003). Subsequently, different dairy development projects were launched in different parts of the country. The distribution of exotic dairy cattle, particularly the Holstein Friesian, in different parts of the country, especially around the major urban areas, also contributed to the further development of dairying in Ethiopia.

2.4. Dairy cattle breed improvement activities in Ethiopia

Dairy cattle breed improvement program in Ethiopia was launched during the war between Ethiopia and Italy with importation of exotic dairy cattle. Later on, the First Livestock Development Project (1958-63) created the Dairy Development Agency (DDA) that was concerned mainly with the development of commercial dairy farms in Addis Ababa. Crossbreeding has been started by the Institute of Agricultural Research, through the establishment of an on-station Dairy Cattle Crossbreeding Program, using Friesian, Jersey and Simmental sires that were crossed with the local Horro, Boran and Barka dams with the aim of testing the productivity of crossbred dairy cows with different levels of exotic blood (Desta, 2002).

The Chilalo Agricultural Development Project (CADU), an integrated project established jointly by the Ethiopian and Swedish Governments, in Arsi region initiated intensive small scale dairy development in Ethiopia in 1967/68. The Wolayta Agricultural Development Project (WADU) was also established latter in 1971 and funded by the World Bank, basically applied the CADU program. The livestock breed improvement program under MOA that was an integral part of the National Livestock Development Projects, has also contribution to the establishment of dairy cattle improvement ranches in different parts of the country. The focus of the program was on increasing the milk productivity of local breeds through crossbreeding and distribution of F1 heifers to farmers. In 1987 a FINNIDA funded project of the MOA started to improve dairy cattle productivity at the highlands of Ethiopia through the establishment of the Selale Peasant Dairy Development Pilot Project (SPDDPP) introduced crossbred dairy cattle and improved management skills with the objective to increase the living standard of small-holder farmers. Since 1995, the Small-holder Dairy Development Project, (SDDP), that can be considered as the continuation of the pilot project with the same objectives

but broader spectrum of activities operated in the different parts of the country. The project had been distributing crossbred dairy cows and pure-bred Friesian and Jersey breeding bulls and introduced improved methods of fodder production in the project areas. the genetic improvement activities for dairy production in Ethiopia were constrained by a number of factors. Climatic stress in the form of erratic and inadequate rainfall; low fodder yield potential and high price for concentrate and susceptibility to a wide variety of serious diseases detrimentally affect the productivity of genetically improved dairy cattle specially the upgraded ones. Poor education and management expertise of farmers have also been hindrances in the implementation and maintenance of genetic improvement programs (Desta, 2002)

2.5. Dairy cattle breeding methods

The present livestock breeds in the world are the results of both natural selection and human intervention. Natural selection operates to provide reproductive ability and continuity of the fittest while human intervention is to change one or more traits of animals that the owner thinks desirable under his environment. Farmers wishes to make livestock more efficient in using available resources to produce human food and other agricultural products (Sendros and Tesfaye, 1997 and Rendel, 1991).The following are the commonly used dairy cattle breeding methods:

2.5.1. Selection within breeds: *pure breeding*

The goal is to build additive genetic gains into the population by identifying individual superior genotypes and preferentially multiplying them in the next generation (Payne and Hodges, 1997). There are reports of successful implementation of local breed improvements through selection in the tropics like the case of Sahiwal breed in India (Trail and Gregory, 1988).but traits like milk yield and fertility are poorly inherited; therefore, selection should include some form of progeny test and pedigree information (Payne and Wilson, 1999)

2.5.2. Crossbreeding: *mating parents of two or more different breeds together*

The basic objective of crossbreeding of high performing cattle breeds with tropical breeds is to produce crossbreds with an expected additive genetic merit being the mean of both parental breeds. The non-additive genetic effect which is observed as heterosis or hybrid vigor is the amount by which merit in crossbreds deviate from the additive component (Kinghorn, 1999) and is fully exploited only when non-related breeds are crossed. Payne and Hodges (1997) indicated that hybrid vigor becomes greater when the difference in the parental genetic make-up is high. Many reports on the performance of crossbred cattle indicated that crossbreeding results in performance improvement only until 50% inheritance of Bos taurus genes. Syrstad (1985) and Vaccaro (1990) have also concluded that further upgrading more than 50% Bos Taurus inheritance has negative effects on age at first calving, calving interval, survivability and herd life. Furthermore, Madalena (1993) reported that performance declined in back crosses as the Holstein-Friesian gene fraction departed higher or lower than 50%. Cunningham (1991) indicated that the possible explanation for the low productivity of F2 is the idea that blocks of genes giving favorable epistatic effects in the parental breeds and the F1 may be broken up in the F2 and subsequent generations.

2.6. Dairy cattle breeding practices

2.6. 1. Natural mating

The use of bulls for natural service remains widespread even in areas where artificial insemination has proven to be very efficient. Many farmers believe that pregnancy rates are higher when a bull is used. The use of natural service may be indicated when personnel are inefficient to perform the tasks associated with heat detection and the techniques of artificial insemination (AI), when long term genetic gain is of minor importance and when local conditions do not provide the infrastructure necessary for successful AI (Deseta, 2002)

Naidoo et al. (1981) reported in Mauritius that natural mating was more effective than AI with 91% of calving intervals being less than 14 months compared with only 49 % from AI. The

work of Hailmariam et al. (1994) also indicated that the calving interval of Boran cows served by Boran bulls were shorter compared to those cows served by AI.

2.6. 2. Artificial insemination

AI is an essential technique in breeding programs with progeny testing. AI provides the opportunity to choose sires that are proven to transmit desirable traits to the next generation and minimizes the risk of spreading sexually transmitted diseases and genetic defects. Despite the wide application and success of AI throughout the developed world, the success rate in African and other developing countries is still low owing to a number of technical, system related, financial and managerial problems. Among the technical constraints are poor heat detection skills, communication and transport problems that hamper timely insemination, poor semen collection and storage technology and handling procedures that affect semen quality, and inefficiency of AI technicians. Other system related problems include small herds, disperse locations, limited production intensity and unaffordable cost. Due to the poor financial capabilities of the countries means of communication and infrastructure are insufficient. It would also be difficult for the countries to bear costs for the production of liquid nitrogen and purchase of necessary equipments (Deseta, 2002)

2.7. Productivity of dairy cows in Ethiopia

2.7.1. Reproductive Performance

The reproductive performance of the breeding female is probably the single most important factor that is a prerequisite for sustainable dairy production system and influencing herd/flock productivity due to, all forms of output milk, meat, traction, fuel as well as provision of replacement animals. Reproductive performance is influenced by feed, genetics, diseases and a huge variety of management practices (ILCA, 1990; Perera, 1999).

Reproductive performance is one of the major factors other than milk production that affect productivity and profitability of a dairy herd. Reproductive performance is a biologically crucial phenomenon, which determines the efficiency of animal production. The production of milk and reproductive stock is not possible unless the cow reproduces. It has been indicated that genetic improvement virtually of all traits of economic importance is closely related to reproduction rate (Kiwuwa, 1983). Poor reproductive performance is caused by failure of the cow to become pregnant primarily due to anoestrus (pre- pubertal or post-partum); failure of the cow to maintain the pregnancy; and calf losses (Mukasa, 1989; Perera, 1999). This causes delays in age at first calving and long calving interval.

2.7.2. Age at first service

It is the age at which heifers attain body weight, body condition and sexual maturity for accepting service for the first time. It influences both the productive and reproductive life of the female through its effect on her lifetime calf crop. Age at first service is influenced by genotype, nutrition and other environmental factors. Alberro (1983) reported an earlier age at puberty for F1 Friesian crosses than for indigenous zebu breeds. Age at first service was reported to be 44.8 months for Fogera breeds (Giday, 2001); 40.2 months for white Fulani and 21.7 months for crossbreds (Fulani X Friesian) in Nigeria (Knudeson and Sohael, 1970). In addition, age at first service reported in Ethiopia include about 53 months for highland Zebu (Mukasa-Mugeraw *et al.*, 1989), 55 months for Horro cattle (Mulugeta *et al.*, 1991), 53.9 months for Boran cattle inseminated artificially (Ababu, 2002) and 34.4 months for Ogaden cattle (Getinet, 2005). Nutritional status is one of the variables influencing the onset of puberty, which has been relatively well-defined (Schillo *et al.*, 1992). Moreover, irregularities in feed supply and differences in management systems may bring about variations in age at first service in different areas (Gebeyehu *et al.*, 2005).

2.7.3. Age at first calving (AFC)

Age at first calving determines the beginning of the cow's productive life and influences her lifetime productivity (Ojango and Pollott, 2001). Age at first calving has a significant influence on the total cost of raising dairy replacements with older calving heifers being more expensive to keep than younger ones (Tozer and Heinrichs, 2001). Estimated age at first calving for Ethiopian cattle ranges from 35-62 months (McDowell, 1972; Kiwuwa *et al.*, 1983; Alberro, 1983; Mekonnen and Goshu, 1987; Mukasa-Mugerwa, 1989; Mulugeta *et al.*, 1991; Hailemariam and Kassamersha, 1994; Ababu, 2002). There are different factors that advance or delay age at first calving. The time taken by an animal to attain puberty and sexual maturity depends among others on the quality and quantity of feed available, which affects growth rate. There has been substantial evidence that dietary supplementation of heifers during their growth will reduce the interval from birth to first calving (Kayongo-Male *et al.*, 1982), probably because heifers that grow faster will cycle earlier and exhibit behavioral estrus. Breed difference among cattle had also significant effect on age at first calving (Mukasa-Mugerwa, 1989).

Acceptable and optimum performance of age at first calving under improved smallholder system in the tropics is less than 30 and 36 months, respectively (Perera, 1999). Heritability of age at first calving is generally low, indicating that this trait is highly influenced by environmental factors such as feed and health (Mukasa-Mugerwa, 1989). For instance, age at first calving of Borana cattle ranged between 45.5-51.1 months (IAR, 1991). But under better management in Kenya, the Borena breed calved remarkably at earlier age of 34-36 months. Age at first calving for Fogera breed was reported to be 47.61 months (Addisu, 1999).

Age at first calving in pastoral and agro-pastoral areas with indigenous cattle is 4 years (IPS, 2000) and as the same result reported by Mulugeta (1990) were 4-5 years. In the Borana pastoral system cows have their first calf at 4 to 4.5 years of age (Coppock, 1994). These figures are higher than mean of 3.6 year for *Bos indicus* found in a number of traditional systems reviewed by Mukasa-Mugerwa (1989). Workneh and Rowland (2004) reported that age at first calving for pastoral and agro pastoral production system of Oroia region in general is 51 and 48.4 months, respectively.

2.7.4. Days open

An increase in the number of days between calving and conception also known as days open, influences profitability of the dairy industry. This influence is partly attributed to factors such as increased breeding cost, increased risk of culling and replacement costs, and reduced milk production (de Vries and Risco, 2005). Days open is influenced by breeds of cattle. Mekonen (1987) reported that mean days open for pure Fogera and F1 Friesian X Fogera were about 151 and 151 days, respectively, whereas, ¾ Friesian X Fogera crosses had about 361 days.

Days open affects lifetime production and generation interval (Ababu, 2002). Days open should not exceed 80 to 85 days, if a calving interval of 12 months is to be achieved (Peters, 1984; Enyew, 1992). This requires re-establishment of ovarian activity soon after calving and high conception rates. Kefena (2004) also reported mean length of days open to be about 200 days for Boran crossbred cows. Nutritional deficiencies coupled with heavy internal and external parasite load under extensive management systems, and allowing calves to suckle their dams may all interfere with ovarian function, thereby prolonging the days open (Short *et al.*, 1990; Hafez, 1993). The effect of low level of nutrition on extended postpartum period due to weight loss was noted by Gebreegziabher *et al.* (2005). Moreover, Tadesse and Zelalem (2004) reported that increasing the level of protein supplementation from low (2 kg/day) to high (4 kg /day) reduced post partum interval from 159 to 100 days. Cows that are over conditioned at calving or those that lose excess body weight are more likely to have a prolonged interval to first oestrus, which could result in longer days open (James, 2006).

2.7.5. Calving interval of cows (CI)

Calving interval refers to the period between two consecutive calving and is a function of a day's open and gestation length. Since gestation length is more or less constant for a given breed, the number of days open becomes the sole variable of calving interval. Long open periods, and hence the long calving intervals, generally reflects problems associated with management but may also given some indication of the condition of the cow's reproductive organ. Calving intervals have low heritability and can be improved through nutrition and early breeding (Mulugeta, *et al.*, 1991).

In order to maintain optimum economic benefits under modern intensive dairy systems, it is generally accepted that the CI should be around one year. However, under many dairy systems in tropical countries a one-year CI is often difficult or impossible to achieve and, in some situation, even undesirable. In Ethiopia, zebu cattle raised under traditional management in the highlands, calving interval averaged 26 months (Perera, 1999). The overall calving interval of cows in Oromia region is 18.6 months. In pastoral and agro-pastoral areas shorter calving intervals of 15.5 months than 19 months, respectively have been reported (Workneh and Rowland, 2004). In Zebu cattle, calving interval is estimated to range from 12 to 22 months with annual calving rate of 50-60% (Mukasa-Mugerwa, 1989).

The relative importance of factors that affect reproductive performance vary in the different smallholder farming systems. For instance, under extensive free grazing system nutritional fluctuation due to seasonal shortage cause delays in puberty and the post-partum cycle (Perera, 1991) and calving interval in the Borana are strongly influenced by the environment, as 90% of the conceptions and births occur either in the longer or shorter rains. The shorter calving interval in lowland could be due to the reduced period of anoestrus; as high producing animals sacrifice more of their body stores to support milk production and the next conception is thus delayed (Mulugeta, 1991).

2.7.6. Lactation Length and Milk Yield

Indigenous breed of cows are generally considered low milk producers. However, they are the major source of milk in Ethiopia that account for 97 % of the total milk production in the country (Abaye *et al.,* 1991). Milk yield has remained extremely low with national average of 1.09 liter/day/cow (Dagenae and Adugna, 1999). Similarly, Lemma *et al.* (2005) reported that the average milk yield of local Arsi cows was 1.0 liter/head/day. For Fogera cattle the overall average estimate lactation yield was 506.78 liters, which is very low due to poor genetic make up and shortage of feed and poor management conditions (Mulugeta, 2005) and also shorter lactation length (Gebeyehu, 1999).

Milk production per day per head is very low and this is further affected by relatively short lactation length and extended post-partum anoestrus resulting in low production efficiencies

(Azage and Alemu, 1997). The mean milk off-take of cattle in Maasai pastoralists in the wet and dry seasons was 1.09 and 0.79litres/cow/day (Semenye, 1987). The indigenous (or traditional) mixed farming and pastoral/agro pastoral systems rely mainly on local breeds, which produce 400-680 kg of milk per cow per lactation period of less than seven months (Siegefreid and Brhan, 1991).

The average milk yield of local cows found in Somalia region is less than two liters per day which could reach up to 488 liters over a 249 days lactation period in all pastoral areas elsewhere (IPS, 2000). Kiwuwa *et al.* (1983) reported that Arsi and Zebu cattle as averaged 869 kg of milk over 287 days of lactation. Mukasa-Mugerwa *et al.* (1989) noted that Zebu cattle under traditional management yield about 524 liters over 239-days lactation period, which is about 2.2 liters per day. According to CSA (1996), an average lactation length of cows in private holding ranged from 5- 7 months. Lemma (2005) however reported a longer lactation length of 9.5 months for local cows in the East Showa zone of Oromia

2.8. Dairy feed resources in Ethiopia

According to Alemayehu (1985), the major livestock feed resources in Ethiopia are classified into three categories; those are grazing and browsing on natural pastures, crop residues and agro-industrial by-products and cultivated pasture and forage–crop species

Natural pasture and browses: Availability and quality of native pastures vary with altitude, rainfall, soil type and cropping intensity. The total area of grazing and browsing in Ethiopia is estimated at 62,280 million hectares, of which 12% is in the farming areas (more than 600 mm rainfall) and the rest around the pastoral areas Azage *et al.,* (2009).

Natural pastures which provide more than 90% of the livestock feed are very poorly managed in both ecological zones in Ethiopia. In the mixed farming mid-altitude areas, better soils are used for cropping and the main permanent natural pasture lands are found on the upper slopes of hills and seasonally water logged areas. In the lowlands where pastoralism is practiced most

of the land except for rivers, swamps, lakes and deserts contains natural pasture which may be associated with woodland in the wetter areas Azage *et al.*, (2009).

Considering the country as a whole, grazing lands contribute 53% of the total land area. Even though the amount of grazing area seems to be large, the yield and quality of the pasture is very low. Due to poor management and overstocking, natural pastures in both ecological zones are highly overgrazed resulting in serious land degradation, loss of valuable species and dominance by unpalatable species (Alemayehu 1985).

In subhumid mid-altitude areas, natural pastures are dominated mainly by *Hyparrhenia* species, which tend to grow fast and become stemmy and fibrous within short period of time thus losing their palatability and feed value. In these areas, the overgrazed pastures are dominated by unpalatable *Sporobolus* and *Pennisetum* species. Herbage growth is luxuriant during the wet season and this gives large bulk of herbage during the dry season, which is burnt to encourage re-growth in subsequent rains. In semi-arid mid-altitude zones, rainfall is the major factor influencing primary productivity (Alemayehu 1985). Because of diversity of climate, a number of forage species, mainly grasses are found in both ecological zones.

Natural grasslands of the highland areas are rich in legume species, while grasslands of the mid-altitude and lowland zones have lower proportion of legume. The proportion tends to decrease with decrease in altitude. The less abundant native legumes of the lower altitude have sprawling growth.

Crop residues: Cereal straw from teff, barley and wheat is the largest component of livestock diet in the intermediate and highland areas of Ethiopia. Straw is stacked after threshing and fed to animals during the dry season, as are pulse–crop residues (e.g. horse beans, chickpeas, haricot beans, field peas and lentils). At lower altitudes in the highland areas maize, sorghum and millet stovers occur to a greater extent than at higher altitudes. Teff is grown at intermediate altitudes and barley replaces wheat at the higher altitudes, where pulses are also grown to a great extent. The nutritive value of teff straw is equivalent to medium-quality hay and the residue of other cereal crops is only of poor to fair quality (Alemayehu 1985).

2.9. Major constraints for dairy development system in Ethiopia

The livestock sub-sector in general and the dairy sub-sector in particular do not create a contribution to the national income considering with its size. The reasons for this are numerous and include both technical and non-technical constraints (FAO, 1995).

2.9.1. Technical constraints

Some of the major technical constraints are animal health diseases, feed and nutrition and genotype

Animal health: Animal health and improved management is also one of the major constraints of dairy development in Ethiopia which cause poor performance across the productive system. Many of the problems result from the interaction among the technical and non-technical constraints themselves e.g. poorly fed animals develop low disease resistance, fertility problem, partly because the animal health care system relies heavily on veterinary measures, poor grazing management systems continue to cause high mortality and morbidity (e.g internal parasites), many of the disease constraints which affect supply are also a consequence of the non-technical constraints e.g. insufficient money to purchase drugs or vaccines. (http://www.fao.org/docrep)

Feed and nutrition: In highland zones, high population growth and density are causing the shortage of grazing land on which livestock production by small holders depends. In the lowland areas, the shortage of feed and water during the dry season forces animals and livestock keepers to trek long distances in search of food. The quality of feed also deteriorates during the dry season in both the mixed farming and pastoral system

Genetics: The genetic of Ethiopia's livestock have involved largely as a result of natural selection influenced by environmental factors. This has made the live stock better conditioned to with stand feed and water shortages, disease challenges and harsh climates. But the capacity for the high level of production has remained low (FAO, 1995).

2.9.2. Non-technical constraints

The non-technical constraints of dairy development generally include a variety of socio-economic and institutional considerations, which is also most causes and be common constraints to other agricultural sector of the country.

Human population: The high rate of population increase (2.9-3 % per annual) is reckoned to affect livestock development. The demand for livestock products directly related with the annual population growth which the livestock production is lag behind with the rate of population growth (1.1 %) (ILCA, 1993) Moreover, high population growth has forced people to cultivate more and use more land. The necessity to extend the cropping areas to support the increasing population in the highlands, the carrying capacity of the land is stretched beyond its limits, which resulted in law production performance of the livestock.

Livestock population: One of the serious constraints to the livestock development in Ethiopia rest on the importance attached to the economic functions of the livestock found in various agro-ecological zones, overall, livestock in Ethiopia are used as input function, asset and security function.

Farming methods in Ethiopia have remained unchanged for centuries, cultivation is carried out using oxen drown traditional ploughs in the highland; this demands high dependency on animal power (as an input function). High population growth has forced people to plough more land, which in turn demand more ploughing capacity Therefore, to fulfill this demand more ploughing capacity requires for the presence of a higher cattle herd, which created pressure on grazing land and ultimately poor economies of peasant farm. The other economic benefit of livestock, as a source of additional income consideration as assets and security are also important, and due to low productive indigenous stock these functions requires to maintain large herd and demand additional area of grazing land. In the law lands the pastoral nomads maximum benefit from livestock through milk and meat (The output function): Furthermore, in order to overcome low productivity of their livestock and recurring draught large number of stock is maintained as security function as well (Tesfaye, 1991).

3. MATERIALS AND METHOD

3.1. Description of the study areas

The study was carried out in three districts of Oromia region namely Ada'a, Lume and Adama which are located in central part of Ethiopia and 45 km, 65 km and 90 km southeast of Addis Ababa respectively.

Ada'a is found in 9^0 North latitudes and 39^0 05' East longitudes. The altitude of Ada'a ranges from 1500 - 2300 m above sea level (asl). It has mean annual rainfall of 866 mm. The annual minimum and maximum temperature ranges from 7.9 to 28 °C (IPMS, 2005). Based on figures from the Central Statistical Agency (2005), Ada'a has an estimated total human population of 231,385. The district has a total livestock population of 263,463 which comprises 160,697 cattle, 22,181 sheep, 37,510 goats, 1,660 horses, 38,726 donkeys and 2,689 mules (CSA, 2001).

Lume is found in 8^0 35' North latitudes and 39^0 10' East longitudes. The altitude of Lume ranges from 1500 - 2300 m asl. It has mean annual rainfall of 860 mm. The annual minimum and maximum temperature ranges from 8 to 29.2 °C (IPMS, 2005). Lume has an estimated total human population of 140,030 (CSA, 2005). The district has a total livestock population of 120,915 which comprises 65,992 cattle, 11,832 sheep, 22,023 goats, 434 horses, 19,829 donkeys and 805 mules (CSA, 2001).

Adama is found in 8^0 20' North latitudes and 39^0 15' East longitudes. The altitude of Adama ranges from 1500 - 2000 m asl. It has mean annual rainfall of 854 mm. The annual minimum and maximum temperature ranges from 8.5 to 32 °C (IPMS 2005). Adama has an estimated total human population of 261,341 (CSA, 2005). The district has a total livestock population of 162,713 which comprises 78,935 cattle, 20,544 sheep, 37,042 goats, 719 horses, 24,760 donkeys and 713 mules (CSA, 2001).

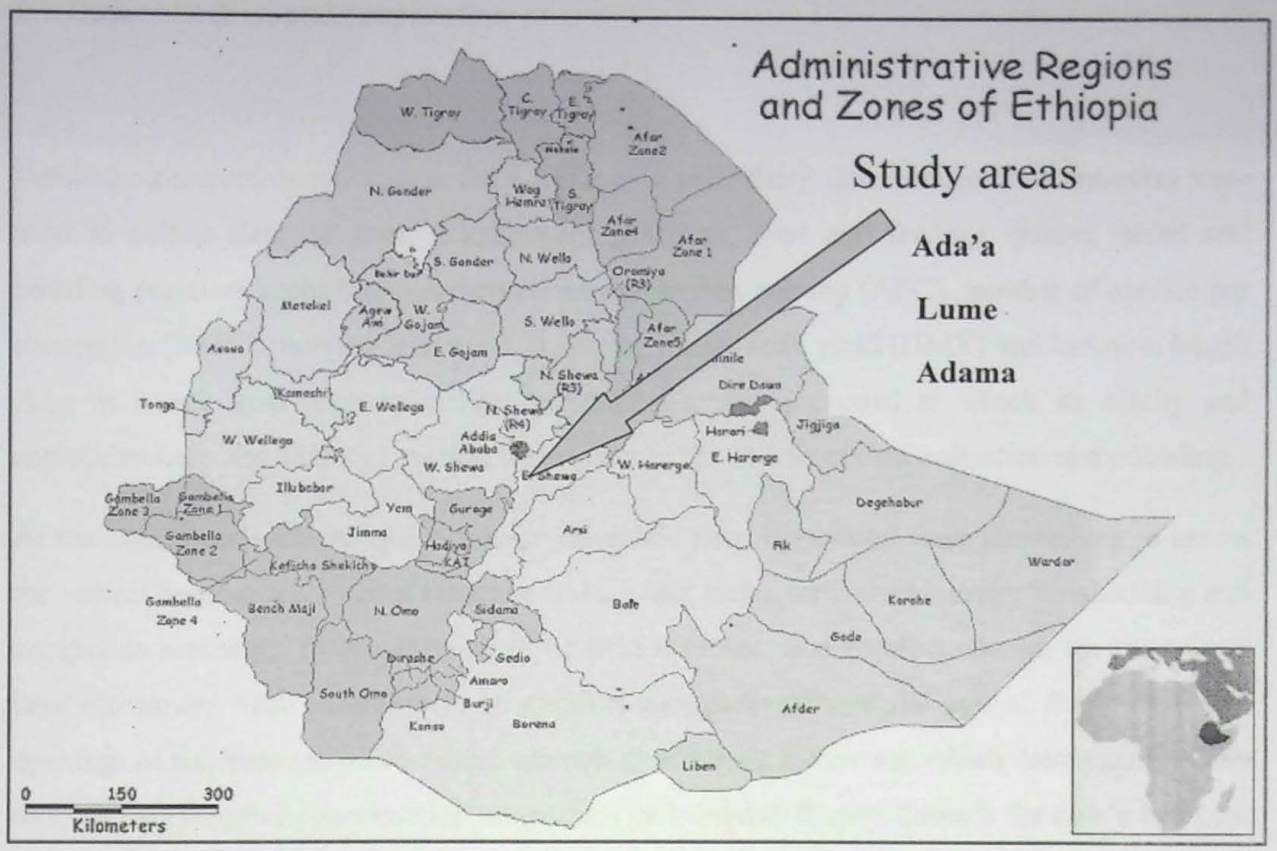


Figure1: Geographical location of the study areas.

3.2. Sample size and sampling procedures

Two stage sampling technique was used to screen out the representative sample units. Firstly a total of 30 peasant associations (PAs) from three districts (10 PAs from each district) were randomly selected. And secondly based on the sample frame obtained from the list of registered members of each PA, households who owned dairy farms from each district Agricultural office and using the formula recommended by Arsham (2007) for sample size determination in survey studies a total of 151 dairy cattle holding households (50 households from each of Adama and Lume and 51 households from that of Ada'a) were chosen using random sampling technique and individually interviewed using a detail structured questionnaire.

3.3. Data collection and preparation

Detailed structured questionnaire for interview to each dairy farm owners (see annexes) were used to collect data on farm management practices, feed and feeding system, breed and breeding practices including parameters like age at first calving (AFC), number of service per conception (NSPC), calving interval (CI), average daily milk yield (DMY) and lactation length (LL) in a one visit interview. The questionnaire was pretested to check its clarity and appropriateness and care and caution were taken in the course of data collection and encoding.

At the same time with the questionnaire interview farm inspection were carried out to assess the animal housing for its roof structure to be water proof, sufficient enough for shedding and acceptable neatness, floor condition to be skid resistant and comfort enough for the animal hoof movement, wall condition to be comfort enough to prevent the animal from wind and openings of the house to be ventilated enough to allow air movement which were examined by looking for excessive condensation on the roof and running fingers through the cow's hair coat for the presence of moisture. Animal examination for breed type, reproductive /health/ problem/if any/. Feed storage, feeding and watering trough handling for the type of feed, source and the feed storage system of the farm and the neatness and spacing of the feeders and waterers were observed

3.4. Data analysis

The data collected were entered in to Microsoft Excel (MS-Excel, 2007) and analyzed using SPSS statistical software (SPSS, 2007 version 16.0). The results were explained using descriptive statistics and one way ANOVA for possible explanation of statistical significance between variables with 95% confidence interval and 5% precision that is, P value of less than 0.05 were considered to be significant.

4. RESULTS

4.1. Dairy cattle housing system

Table 1 describes the housing system of dairy cattle in the study areas. Almost all of the farms kept all the dry and physiological lactating cows, male and female calves and heifers together in the same barn. The dairy housing system in most of the farms was with roof; though the roofing material varies from hard plastic sheet to corrugated iron sheets, but with simple soil floor type in most of the two study area farms /Adama and Lume/ whereas most of the farms in Ada'a were with concrete and stone slab floor type (Table 1). The general farm hygiene to those had fallen under good status was 43.4%, 46.2% and 48.1% to the farms of Adama, Lume and Ada'a respectively. The management and labor force in most of the farms were largely from the family with the exception to some commercial dairy farms those used professional or nonprofessional employees for their farm management and labor force.

Table1: Housing system of dairy cattle in the study areas.

Practices % farms	District		
	Adama (n=50)	Lume (n=50)	Ada'a (n=51)
Roof type of the House			
With roof	66.7	76	98
Without roof	33.3	24	2
Floor type			
Concrete	27.45	30	48
Stone slab	3.9	10	12
Simple soil	68.6	60	40
Type of livestock structure			
Traditional	78.4	70	56
Improved	21.6	30	44
Drainage			
Good	23.5	25.3	26.4
Satisfactory	41.2	42.4	43.6
Poor	35.3	32.3	30
General farm hygiene			
Good	43.4	46.2	48.1
Satisfactory	37	31.8	33.7
Poor	19.6	22	18.2

n=number of respondents

4.1.1. Feed resources and feeding systems

In the study areas, dairy animals were fed a variety of feed stuffs (Table 2) depending largely on the availability. The feed resources were categorized in to four classes: Foraging/grazing, crop residues, commercial feeds & supplements and non-conventional feeds like liquor residues and left over foods.

Table 2: Major feeding systems practiced and proportional utilization of feed resources in dairy farms of the study areas.

Variables	District		
	Adama (n=50)	Lume (n=50)	Ada'a (n=51)
Feeding systems, % farms			
Intensive	43.14	36	26
Semi intensive	29.4	16	24
Extensive	27.45	48	50
Main feed types, % farms			
Grazing/ Foraging	21.6	44	48
Crop residue (Sorghum and maize stover, wheat and teff straw)	100	100	100
Commercial feeds and concentrates (bran, maize germ, seed cakes & husks, mineral supplements/common salt)	98	92	98
Non conventional feeds (*Attella*: local brewery and liquor residue, chat, vegetable and fruit waste, leftover food)	13.7	14	38

n=number of respondents

In the study areas, three types of feeding systems were practiced. These were completely intensive (with common and individual stall feeding), semi-intensive and extensive feeding systems. Most of the feeding systems in Lume and Ada'a were extensive where as to that of Adama, it was intensive.

None of farms used commercial mineral leaks except common salt, which was usually added to supplements. Foraging and grazing was practiced by 21.6%, 44% and 48% farms of Adama, Lume and Ada'a respectively. Crop residues were used in all of the dairy farms present in the districts. Similarly, commercial feeds & supplements were also utilized almost in all of the three district farms. Out of different verities of crop residues, almost all of the farms used wheat and teff straw and from that of commercial feeds & supplements seed cakes & husks, bran and common salt as supplement were the most abundantly utilized sources of feeds. The utilization of nonconventional feeds was 13.7%, 14% and 38% for the farms of Adama, Lume and Ada'a respectively.

As described in (table 3) all the dairy farm owners in the three districts ranked the constraints associated with feeds and their utilization in the same way by giving attention to high cost and scarcity of feeds being the major constraints in the districts.

Table 3: Constraints associated with feeds and their utilization in dairy farms of the study areas.

Constraints,	District		
	Adama /Ranked by farms/	Lume / ranked by farms/	Ada'a /Ranked by farms/
High cost of feeds	1st	1st	1st
Scarcity	2nd	2nd	2nd
Lack of improved feeds	3rd	3rd	3rd
Poor quality feeds	4th	4th	4th
Pasture & fodder disease	5th	5th	5th
Poor conservation method	6th	6th	6th

4.2. Breed and breeding practices

From this survey local, cross and exotic bred types were recognized. According to the respondents the cross breeds are predominant in all the three districts (Table 4). And two types of breeding practices viz: natural mating and artificial insemination are common in the study areas.

Table 4: Proportion of farms using different breeds and breeding practices in dairy farms of the study areas.

Breeds and breeding practices (% farms)	District		
	Adama (n=50)	Lume (n=50)	Ada'a (n=51)
Breed type			
Local/ indigenous breed	23.53	30	6
Cross breed	47	48	44
Exotic breed /Pure Holstein Friesian(HF) & Jersey(J)//	17.65	-	6
Mixed	11.76	22	44
Indigenous and cross breed	9.8	16	28
Indigenous and exotic breed /Pure HF and J/	-	2	12
Cross and exotic breed/Pure HF & J/	1.96	4	4
Method of breeding			
Using only artificial insemination(AI)	29.4	36	40
Using natural mating	25.5	32	8
Using both AI and natural mating	45.1	32	52

n=number of respondents

4.2.1. Reproductive and productive performance of dairy cows

In dairy cattle age at first calving, calving interval, number of service per conception, milk yield per lactation and lactation length are the most important traits. Because, these are the factors those determine the reproductive efficiency and productive performance of a breeding cow.

Table 5: Reproductive and productive performance of dairy cows in the three study areas.

Parameters	District		
	Adama	Lume	Ada'a
	Mean ± SD	Mean ±SD	Mean ±SD
	Nl=32,Nc=49 and Ne=15	Nl=42,Nc=63 and Ne=1	Nl=30,Nc=75 &Ne=11
Age at first calving/AFC/in months			
Local/indigenous breed	51.85 ± 8.67	51.00 ± 10.10	49.15 ± 10.74
Cross breed	31.87 ± 7.42	39.59 ± 12.76	33.74 ± 6.45
Exotic breed/pure line HF and J/	33.87 ± 11.32	38.00 ± 0	35.60 ± 6.02
Calving interval/CI/ in months			
Local/indigenous breed	18.68 ± 5.84	20.41 ± 9.55	20.71 ± 7.61
Cross breed	15.56 ± 5.63	17.38 ± 6.02	15.76 ± 5.50
Exotic breed/pure line HF and J/	14.36 ± 3.75	0	15.67 ± 5.10
Number of service per conception			
Local/indigenous breed	1.56 ± 1.08	1.45 ± 0.86	1.57 ± 0.90
Cross breed	2.33 ± 1.43	1.98 ± 1.41	2.25 ± 1.34
Exotic breed/pure line HF and J/	2.40 ± 1.18	1	2.45 ± 1.44
Lactation length in months			
Local/indigenous breed	6.52 ± 3.28	6.91 ± 3.38	6.84 ± 2.43
Cross breed	9.82 ± 2.91	9.88 ± 4.02	9.03 ± 2.58
Exotic breed/pure line HF and J/	9.93 ± 1.33	0	8.90 ± 2.73
Daily milk yield in liters			
Local/indigenous breed	2.68 ± 1.97	2.33 ± 1.72	2.00 ± 1.00
Cross breed	10.70 ± 3.84	11.11 ± 4.07	11.88 ± 5.03
Exotic breed/pure line HF and J/	10.57 ± 5.08	0	10.3 ± 4.37

SD = Standard deviation, Nl = Total number of local breed cows observed, Nc = Total number of cross breed cows observed and Ne = Total number of exotic breed cows observed

4.2.1.1. Age at first calving

The average age at first calving (±SD) of local, cross and exotic bred heifers was 51.85 ± 8.67, 31.87 ± 7.42 and 33.87 ± 11.32 months for those of the farms of Adama and 49.15 ± 10.74, 33.74 ± 6.45 and 35.60 ± 6.02 months for those of the farms of Ada'a respectively. And to the farms of Lume the average age at first calving (±SD) for local and cross bred cows was 51.00 ± 10.10 and 39.59 ± 12.76 months respectively.

4.2.1.2. Number of service per conception

The average number of service per conception (±SD) of local, cross and exotic bred cows was 1.56 ± 1.08, 2.33 ± 1.43 and 2.40 ± 1.18 for those of the farms of Adama, and 1.57 ± 0.90, 2.25 ± 1.34 and 2.45 ± 1.44 for those of the farms of Ada'a respectively. And to the farms of Lume the average number of service per conception for local and cross bred cows was 1.45 ± 0.86 and 1.98 ± 1.41 respectively.

4.2.1.3. Calving interval

The result of this study depicted that the mean calving interval (±SD) of local, cross and exotic bred cows was 18.68 ± 5.84, 15.56 ± 5.63 and 14.36 ± 3.75 months for farms of Adama and 20.71 ± 7.61, 15.76 ± 5.50 and 15.67 ± 5.10 months for farms of Ada'a respectively. And to the farms of Lume the calving interval (CI) for local and cross bred cows was 20.41 ± 9.55 and 17.38 ± 6.02 months respectively.

4.2.1.4. Estimated daily milk yield and lactation length

Since the research was based on a one visit interview, it was not possible to record milk yield at intervals of lactation stages. Rather farmers were asked for the quantity of milk they milked from their cows during the previous full time lactation length. In addition, the values for

lactation length were recorded in months since most of the farmers did not have records and it was difficult to them to recall the lactation length in days.

The average daily milk yield (±SD) of local, cross and exotic bred cows was 2.68 ± 1.97, 10.70 ± 3.84 and 10.57 ± 5.08 liters for the dairy farms of Adama, and 2.00 ± 1.00, 11.88 ± 5.03 and 10.3 ± 4.37 liters for the dairy farms of Ada'a respectively. And to the dairy farms of Lume the average daily milk yield of local and cross bred cows was 2.33 ± 1.72 and 11.11 ± 4.07 liters respectively.

The overall average lactation length (±SD) of local, cross and exotic bred cows was 6.52 ± 3.28, 9.82 ± 2.91 and 9.93 ± 1.33 months for the dairy farms of Adama, and 6.84 ± 2.43, 9.03 ± 2.58 and 8.90 ± 2.73 months for the dairy farms of Ada'a respectively. And to the dairy farms of Lume the overall lactation length of local and cross bred cows was 6.91 ± 3.38 and 9.88 ± 4.02 months respectively.

In almost all of the reproductive and productive performance of exotic breeds in Lume district, values were not been described as done to traits of this breed in the other two districts for the reason that only a single dairy cow was found in that district /Lume/.

5. DISCUSSION

The aim of this study was to assess the dairy farm management, breed and breeding practices found in the three districts of central Ethiopian. The farm hygiene of those that had fallen under good status was 43.4%, 46.2% and 48.1% to the farms of Adama, Lume and Ada'a respectively. This result was similar to the status of farm hygiene of small and large scale dairy production system conducted by Adebabaye (2009) with the exception to the medium scale dairy production system in which their general farm hygiene had fallen to the satisfactory status. Here in the management and dairy husbandry system a better and improved dairy farm management system had been seen in Ada'a as compared to the rest two districts of the study areas; more over Lume dairy farms have also a better improvement in such management systems as compared to Adama dairy farms. This variation that crossponed with close proximity to the capital city might probably as a result of better chance for the commercialization of dairy products to the city that generates a more better income than the rural market price and this intern forced the dairy farm owners to keep their dairy cows in a better way. In accordance to the respondents' feed utilization, crop residue was practiced in all of the farms present in the three districts. Similarly, commercial feeds and supplements were also practiced almost in all of the three district farms. The utilization of nonconventional feeds was 13.7%, 14% and 38% for the farms of Adama, Lume and Ada'a respectively. This high utilization of crop residues, commercial feeds and supplements and to a lesser extent nonconventional feeds in these dairy farms was similar to the study results described by Deseta (2002) and Hussen (2007). Almost in all the farms milking cows fed uniformly. None of the farms were fed their dairy cows based on their physiological status. Feeding system for lactating and non-lactating cows should be based on their physiological status, as the feed requirement varies with the status they are in. for instance, cows in their first lactation require more feeds for body growth in addition to their lactation needs. In general factors associated with a negative energy balance have been suggested as causes of reproductive failure. High yielding and cows in the early lactation require high energy diet. However, excessive energy intakes during late lactation and dry periods can lead to "fat cow" problems. Cows that are

over-conditioned have a high incidence of retained placenta, more uterine infections and more cystic ovaries. They also have more metabolic disorders, which again can result in poor reproductive and productive performance (McClure, 1970). Body condition scoring is, therefore, recommended to assess the nutritional status of dairy cows during the reproduction cycle (Radostits *et al.*, 1999).

The management and labor force in most of the farms were largely from the family with the exception to some commercial dairy farms those used professional or nonprofessional employees for their farm management and labor force. This type of management and labor force distribution within the family and employees in dairy farms was also conducted by Asaminew and Eyassu (2009). The limited management and labor force distribution within the family for most of the dairy farms might probably due to the unsatisfactory income generation of most dairy farms for employing laborers for managing such dairy farms.

From this survey local, cross and exotic bred types were recognized. According to the respondents, the cross breeds are predominant in all the three districts. And the two types of breeding practices (natural mating and artificial insemination) are common in the study areas. This result was in agreement with the study of Megersa *et al.* (2011). Breeding bulls in the study areas used for two breeding systems (free mating in the range or controlled mating). In the former system, however heat detection is carried out by the bull and cows in heat are usually mated several times during each heat period that increases the number of service per conception. In controlled mating system, 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 out of those prefer natural mating as breeding means, mate their cows and heifers by the superior bulls owned by themselves or their neighbors. And most of them bred their cows by any bull available in the herd when their cows come to heat. And this might have a contribution for the sluggish breed improvement in the country. Based on the availability, majority of the respondents (43%) were used both artificial insemination and natural mating for breeding their cows, but in comparison within the two breeding systems artificial insemination was preferred better by the farm owners (35.13%) to bull service (21.8%). This result also similar to the result depicted by Hussen (2007)

The results of this study for age at first calving of local/indigenous/ breeds is nearly similar to the results of McDowell (1971) which values 50 months for Horro breeds but much higher than the results of Goshu (1981) that averaged 30.3 months for Barka breeds and also slightly less than the results of Mukassa *et al.* (1989) that valued 53 months for high land zebus. The results of this study in particular that of cross and exotic breed heifers of Adama and Ada'a dairy farms are also nearly similar to the result of Zewdie (2010) which valued 33.6 months. Whereas the result observed in dairy farms of Lume is slightly higher than the result described before, but nearly similar to the optimum performance of age at first calving under improved smallholder systems in the tropics which was described by perera (1999) that valued 36 months. Significant variation for age at first calving of cross bred dairy cows had observed between the study areas but not to that of indigenous and exotic breed. This significant variation ($p<0.05$) between the three districts for the results of age at first calving of cross breeds might be due to the difference in the level of management. Hence, heritability of age at first calving is generally low, indicating that this trait is highly influenced by environmental factors such as feed and health (Mukasa *et al.*, 1989).

According to Mukassa *et al.* (1989), values of number of service per conception greater than 2 are regarded as poor. Even if, this is so the values of the present study were not as much as high as to that of the study result of him. The results observed for number of service per conception for local breeds are nearly similar to the study result of Hilemariam and Kassa (1994) that valued 1.81. And the results of this study to that of cross and exotic breeds is less than the result observed by Mekassa *et al.* (1989) which was 4.91 (Table 5). And as the results of this study for number of service per conception indicates, there is no significant variation ($p>0.05$ for indigenous, cross and exotic breeds) between the three districts for each breed types.

In order to maintain optimum economic benefits under modern intensive dairy systems, it is generally accepted that the CI should be around one year. However, under many dairy systems in tropical countries a one-year CI is often difficult or impossible to achieve. It seems for this reason that the values of this study are also more than one year. The results of this study for calving intervals of local breeds is lower than that of the study result of Mukassa *et al.* (1989) for high land zebus that averaged 25 months, but higher than the results of Mc Dowell (1971)

for Horro breeds (12.2 months), Sweenson *et al.,* (1981) for Arisi breeds (12.9 months), and Hilemariam and Kassa (1994) for Borna breeds (15.5 months). And to that of cross and exotic breeds the result is in the range that Kiwuwa (1983) and Abdunasir (2000) describe which is within the range of 14.6-18.5 months (Table 5). A little bit variation in the values but, (not significant $p>0.05$ for indigenous, cross and exotic breeds) had seen between the study areas, these difference in values might come from variation that results from different farming systems which can bring variation in calving interval that has effect up on reproductive performance. For instance, under extensive free grazing system nutritional fluctuation due to seasonal shortage cause delays in puberty and the post-partum cycle (Perera, 1999).

In this study, breed had a significant effect on daily milk yield and lactation length of cows ($p<0.05$ for both values) as tabulated in Annex 8b). This is in agreement with previous reports of Kiwuwa *et al.* (1983); Abdinasir (2000) and Desta (2002) from Ethiopia in which it was shown that indigenous Zebu breeds had a significantly lower milk yield than their crosses with Holstein Friesian. The daily milk yield for those of the dairy farms of cross breeds in Ada'a and Lume are similar to the result of MOA & FINNIDA (1996) for Borena and Arisi breeds crossed with Friesian that averaged 11.76 liters per day and that of Adama's dairy farms, the result is much more similar to the results of Tesefaye (1995) for Barka breeds crossed with Friesian that valued 10.03 liters. Similarly the result for lactation length in the three districts for local breeds is greater than the result observed for Barka breeds by Goshu (1981) which valued 4.3 months and for borena breeds by Beyene (1982) that averaged 5.2 months; but is less than the results observed by Beyene (1982); kiwuwa *et al.* (1983) and Goshu (1981) for Horro breeds (9.5 months), Arisi breeds (9.1 months) and Fogera breeds (11.77 months) respectively. And these different recorded values might probably due to variation in environmental conditions including management and variations in their genetic constitution.

6. CONCLUSION AND RECOMMENDATION

The management and labor force in most of the farms were largely from the family with the exception to some commercial dairy farms those used professional or nonprofessional employees for their farm management and labor force. However, there had no separate housing for each animal group based on their physiological status, age and sex; the farm hygiene of most of the study area dairy farms had fallen under good status. In accordance to the respondents, all the farms largely depend on crop residues and commercial feeds and supplements as the source of feeds. Even if, all the farms depend on these feed sources high cost and scarcity of feeds are the major constraints associated with feeds and feed utilization of dairy farms in all the study areas. From the survey, three types of breeds (local, cross and exotic breeds) and two types of breeding practices (Artificial insemination and natural mating) had been recognized. And the cross bred type and artificial insemination breeding practices are relatively the predominant in all the farms of the study areas. As observed in the result there was no significant difference for traits of calving interval, number of service per conception, daily milk yield, lactation length and age at first calving for indigenous and exotic breeds between the three districts. There was significant variation ($p<0.05$) between the three districts for the results of age at first calving of cross breeds. Daily milk yield and lactation length for bred types also significantly varied ($p<0.05$). This might be due to the difference in the level of management. And cross breed cows under all farms relatively had good reproductive and productive performance. Based on these conclusions the following recommendations are forwarded:

Alternative feed resources that substitute the commonly used dairy feeds should be enriched for the dairy farms to reduce high cost and scarcity of feeds.

Animals should be housed and fed based on their physiological status, age and sex to maximize their productivity and to reduce or alleviate some of the prevailing problems.

Though, the three types of breeds are existing in the study areas, cross bred cows under all farms relatively had good reproductive and productive performance, therefore, establishment of new ones to cross bred cows should be encouraged by the government and nongovernment institutions with better technical assistance and recommended capacity building of farm owners.

The use of artificial insemination that has been seen in most of the dairy farms should be strengthened; hence it is the better choice for improving the existing dairy breeds in the study areas.

7. REFERENCES

Ababu, D. (2002): Evaluation of performance of Borana cows in the production of crossbred dairy heifers at Abernosa ranch Ethiopia. MSc. Thesis, Alemaya University. Dire Dawa, Ethiopia

Abdinasir, I. (2000): Smallholder Dairy Production and Dairy Technology Adoption in the Mixed Farming System in Arsi highland, Ethiopia. PhD. Dissertation, Humboldt University, Berlin, Germany

Adebabay, K. (2009): Characterization of Milk Production Systems, Marketing and On- Farm Evaluation of the Effect of Feed Supplementation on Milk Yield and Milk Composition of Cows at Bure District, Ethiopia

Alberro, M. (1983): Comparative performance of F1 Friesian X Zebu heifers in Ethiopia. *Animal Production Science.* 37: 247-252.

Amha, K. (2008): An Integrated Urban, Peri-Urban and Rural Dairy Development Program in Tigray, Draft Document Livestock Development Consulting Group.

Arsham, H. (2007): Perturbed Matrix Inversion with Application to Linear Programs Simplex Method. Applied Mathematics and Computation, 188: 801-807.

Asaminew T. and Eyassu S. (2009): Smallholder Dairy Production System and Emergence of Dairy Cooperatives in Bahir Dar Zuria and Mecha Woredas, Northwestern Ethiopia.

Ayele, S., Assegid, W., Jabbar, A., Ahmed, M. and Belachew, H. (2003): Livestock marketing in Ethiopia: A review of structure, performance and development initiatives. Socio-economic and Policy Research Working Paper 52. ILRI (International Livestock Research Institute), Nairobi, Kenya

Azage, T. and Alemu, G., Wold, G. (1998): Prospects for peri-urban dairy development. In: ESAP (Ethiopian Society of Animal Production), Fifth National Conference of Ethiopian Society of Animal Production, held in Addis Ababa, Ethiopia, 15-17 May 1997. Pp. 28-39.

Azage, T., Million, T., Alemu, Y. and Yosef, M. (2000): Market oriented urban and periurban dairy systems. Urban Agricultural Magazine (The Netherlands). pp. 23-24.

Azage, T., Tesfaye M., Tesfaye, D., Worku, T. and Eshete, D. (2009): Transhumance cattle production system in North Gondar, Amhara Region, Ethiopia: Is it sustainable?

Barlow, R. (1981): Experimental evidence for interaction between heterosis and environment in animals. *Anim. Breed. Abstract. 49(11)*, 715-737.

Beyene, K. (1982): Estimation of additive and non additive genetic effects for growth, milk yield and reproduction traits of crossbred (Bos taurus X Bos indicus) cattle in the wet and dry environment in Ethiopia. PhD. Thesis, Cornell University. Ithaca, New York

CSA, (2005): Federal Democratic Republic of Ethiopia Agricultural Sample Survey. Livestock and Livestock Characteristics Bulletin, Volume II, Central Statistical Authority, Addis Ababa, Ethiopia

Coppock, D. (1994): The Boran Pleatue of Southern Ethiopia: Synthesis of Pastoral Research, Development and Change, 1980-91. ILCA systems study. No.5, ILCA, Addis Ababa, Ethiopia. p 393.

Cunningham, E. (1991): Breeding programs for improved dairy production in tropical climates; In: Animal Husbandry in Warm Climates. Proceedings of the International Symposium on Animal Husbandry in Warm Climates. EAAP publication, *no. 55*, 25-27 October 1990, Viterbo, Italy

Cunningham, E. and Syrstad, O. (1988): Crossbreeding Bos indicus and Bos taurus for milk production in the tropics. FAO animal production and health paper, *68*.

Desta, K. (2002): Analyses of Dairy Cattle Breeding Practices in Selected Areas of Ethiopia. PhD. Dissertation, Humboldt University of Berlin, Germany

De Vries, A. and Risco, C. (2005): Trends and seasonality of reproductive performance in Florida and Georgia dairy herds from 1976 to 2002. *Journal of Dairy Science. pp*3155–3165.

Enyew, N. (1992): Reproductive performance of local and crossbred dairy cattle at the Asella livestock farm. MSc. Thesis Alemaya University, Dire Dawa, Ethiopia.

EAAP, Kallithea (1985): Commission on Animal Genetics, Session II: Strategies for genetic improvement in tropical and subtropical conditions of developing countries. 36th annual meeting.

Ethiopian Agricultural Research Organization (EARO 1) (2001): Back ground paper on developing animal breeding policy. A working paper. January, 2001.

Ethiopian Agricultural Research Organization (EARO 2) (2001): Livestock breeding policy. A working paper. January 2001.

Fekadu, G. (1990): Pastoral nomadism and rural development. In: Ethiopia: Rural Development Options.

Felleke, G. and Geda, G. (2001): The Ethiopian dairy development policy: A draft policy document. Addis Ababa, Ethiopia: Ministry of Agriculture/ AFRDRD/AFRDT. Food and Agriculture Organization/SSFF. p 105.

Food and Agriculture Organization (FAO) (1995): Strategies for market orientation of small scale milk producers and their organizations: Proceedings of a Workshop Held at Morogoro, Tanzania, 20 - 24th March, 1995

Gebeyehu, G., Asmare, A. and Asseged, B. (2005): Reproductive performance of Fogera cattle and the Friesian and their crosses in Andassa ranch, Northwestern Ethiopia.

Livestock Research for Rural Development. http://www.cipav.org.co/lrrd/lrrd17/12/cont1712.htm. (Accessed on June 18, 2009).

Gebregziabher, G., Azage, T., Diedhion, M. and Hegde, B. (2005): Days to first service, conception rate and service period of indigenous and crossbred cows in relation to postpartum body weight change at Bako, Ethiopia. *Ethiopian Journal of Animal production* 5(1): 83-90.

Gebre Wold, A., Mengistu, A., Demeke, S., Bediye, S. and Tadesse, A. (2000): Status of dairy research in Ethiopia. In: The role of village dairy co-operatives in dairy development. Smallholder Dairy Development Project (SDDP) Proceeding, Ministry of Agriculture (MoA). Addis Ababa, Ethiopia. PP.73-81.

Getinet, M. (2005): On station *Ex-situ* phenotypic characterization of Ogaden cattle breed at Alemaya University. MSc. Thesis. Alemaya University Dire Dawa, Ethiopia.

Goshu, M. (1981): Evaluation of indigenous strains for milk production. In: Summary of Animal Production Research (1968-1980). December, 1981, Addis Ababa University, Debre Zeit Agricultural Research Center.

Hafez, E. (1993): Reproduction in Farm Animals. 6th edition Lea and Febiger, Philadelphia, USA. PP. 237-261.

Hailemariam, M. and Kassamersha, H. (1994): Genetic and environmental effects on age at first calving and calving interval of naturally bred Boran (zebu) cows in Ethiopia. *Animal Production, 58*: 329-334.

Holloway, G., Nicholson, C., Delgado, S., Staal and Ehui, S. (2000): Agro-industrialization through Institutional Innovation Transaction Costs, Cooperatives and Milk-market Development in the Eastern African Highlands. *Agricultural Economics.* 23: 279-288.

Hussen, k. (2007): characterization of milk production system and Opportunity for market orientation: a case study of Mieso district, oromia region, Ethiopia

International Livestock Centre for Africa (ILCA) (1990): Network (ALPAN), Network paper No 24. Addis Ababa, Ethiopia

International Livestock Centre for Africa (ILCA) (1992): Annual Report and Programme Highlights, International Livestock Centre for Africa, Addis Ababa, Ethiopia

International Livestock Centre for Africa (ILCA) (1993): Market-oriented smallholder dairying.

James, F. (2006): The effect of nutritional management of the dairy cow on reproductive efficiency. *Animal Reproduction Science.* 96 (2006): 282-296.

Kassahun, M. and Fekadu, B. (2009): Consumption pattern of milk and milk products in Ada'a woreda, East Shoa Zone, central Ethiopia

Kayongo-Male, H., Karue C. and Mutiga, E. (1982): The effect of preconception supplementation on the productivity of dairy heifers grazed on medium quality pasture under East African conditions. *Bulletin of Animal Health and Production in Africa.* 30: 65-72.

Kefena, E. (2004): Analysis of longevity, productive herd lifetime milk production of Boran crossbred cows with various level s of exotic inheritance in the central highlands of Ethiopia. MSc. Thesis, Alemaya University, Dire Dawa, Ethiopia

Ketema, H. and Tsehay, R. (1995): Dairy production systems in Ethiopia. In: Proceedings of a workshop entitled: Strategies for Market Orientation of Small Scale Milk Producers and their Organizations. 20-24 March, 1995, Morogoro, Tanzania.

Ketema, H. and Tsehay, R. (2004): Milk production systems in Ethiopia. Ministry of Agriculture, Addis Ababa, Ethiopia

Kinghorn, B. (1999): Key issues in breeding program design. In: Animal Breeding: Use of new technologies. pp. 141-150.

Kiwuwa, G., Trail, J., Kurtu, Y., Getachew, W., Anderson, F. and Durkin, J. (1983): Crossbred dairy cattle productivity in Arsi region, Ethiopia. Arsi Rural Development Unit and International Livestock Research Center for Africa, Addis Ababa, Ethiopia

Knudeson, P. and Sohael, A. (1970): A study of the performance of a mixed Friesian X zebu herd in a tropical environment. *Journal of Tropical Agriculture.* 43:189-203.

Land O'Lakes (2010): The next stage in dairy development for Ethiopia Dairy Value Chains, End Markets and Food Security

Lemma, F., Fekadu, B. and Hegde, P. (2005): Rural Smallholders Milk and Dairy ProductsProduction, Utilization and Marketing Systems in East Shoa Zone of Oromia. In: Proceedings of the 12th Annual Conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 12-14, 2004. PP. 17-28.

Madalena, F. (1993): A simple scheme to utilize heterosis in tropical dairy cattle. World Animal Review-*74-75-1993/1-2.*

McDowell, R. (1971): Feasibility of commercial milking with cattle indigenous to the tropics. Cornell International Agricultural Development Bulletin No. 21. Cornell University, Ithaca, New York, USA. pp.22

McDowell, R. (1972): Improvement of Livestock Production Under Warm Climates. WH

Freeman, San Fransisco, California, USA. p 711.

Megersa, M., Ashenafi F., Anteneh, W. and Tariku, J. (2011): Herd composition and characteristics of dairy production in Bishoftu Town, Ethiopia

Mekonnen, H. and Goshu, M. (1987): Reproductive performance of Fogera cattle and their Friesian crosses. *Ethiopian Journal of Agricultural Science.* 9(2): 95-114.

Mesfin, T. (1991): Dairy Development in Ethiopia, the source Base and Development Constrains.

Ministry of Agriculture (MOA) and FINNIDA. (1996): Selale peasant dairy development pilot project, Ethiopia. A report of evaluation study in blue series.

Ministry of Agriculture (MOA) SDDP. (1995): A brochure on the activities of the Small-holder Dairy Development Project in Ethiopia

Mohamed, A., Ehui S. and Yemesrach A. (2007): Dairy Development in Ethiopia.

Mukasa-Mugerwa, E. (1989): A review of reproductive performance of female Bos indicus (Zebu) cattle. ILCA, Monograph No. 6. International Livestock Center for Africa, Addis Ababa, Ethiopia. p 134

Mulugeta, K., Tesfaye, K. and Gebre-Egziabher, G. (1991): Some productive and reproductive performance of Horro cattle at Bako Research Centre. Proceedings of the fourth National Livestock Improvement Conference. 13-15. Nov. 1991, Addis Ababa, Ethiopia. PP.78-82.

Naidoo, G., Hulman, B. and Preston, R. (1981): Effect of artificial insemination or natural mating on calving interval in dual purpose herd. Tropical Animal Production and Health, *6: 2*.

Ojango, J. and Pollott, G. (2001): Genetics of milk yield and fertility traits in Holstein- Friesian cattle on large-scale Kenyan farms. *Journal of Animal Science.* 79:1742–1750.

Payne, W. and Hodges, J. (1997): Tropical cattle: origins, breeds and breeding policies. First edition. Blackwell Science. pp 319.

Payne, W. and Wilson, R. (1999): An introductory to animal husbandry in the tropics. Fifth edition. Blackwell Science. pp 803

Perera, O. (1999): Management of reproduction. In: small holder dairying in the tropics. ILRI (International Livestock Research Institute), Nairobi, Kenya. p 462

Peters, A. (1984): Reproductive activity of the cow in the postpartum period. 1. Factors affecting the length of the postpartum a cyclic period. *British Veterinary Journal.* 140:76-83.

Peters, K. (1991): Selection and breeding strategies for production in warm climates. In: Animal Husbandry in Warm Climates. Proceedings of the International Symposium on Animal Husbandry in Warm Climates. *EAAP publication no. 55*, 25-27 October 1990, Viterbo, Italy

Rendel, J. (1991): Animal breeding and genetics. Part IV. A lecture note. Swedish University of Agricultural Sciences, Department of Animal Breeding and Genetics, *S-750 07 Uppsala*, Sweden

Schillo, K. K., Hall J., and Hileman, S. (1992): Effects of nutrition on season and onset of puberty in the beef heifer. *Journal of Animal Science.* 70:3994-4005.

Selale Dairy Development Project (SDDP)-Oromia Agricultural Office (1999): An introductory remark presented in honor of the visit of the section by the Federal Minister of Agriculture. May 21, 1999.

Sendros, D. and Tesfaye, K. (1997): Factors to be considered in the formulation of livestock breeding policy. In: Proceedings of the Fifth National Conference of ESAP. 15-17 May, 1997, Addis Ababa, Ethiopia. pp. 13-27

Sintayehu, Y., Fekadu, B., Azage, T. and Berhanu, G. (2008): Dairy production, processing and marketing systems of Shashemene–Dilla area, South Ethiopia. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 9. ILRI (International Livestock Research Institute), Nairobi, Kenya

Sjoberg, K. (1985): National livestock breeding policy for Ethiopia, Animal Breeding and Feed Resources Department, MOA, Addis Ababa, Ethiopia

Short, R. Bellows, R., Staigmillor, R., Berdinelli J. and Custer, E. (1990): Physiological mechanisms controlling anoestrus and infertility in postpartum beef cattle. *Journal of Animal Science.* 68: 799-816.

Swensson, C., Schaar, J., Brannang, E. and Meskel, L. (1981): Breeding activities of the Ethio Swedish integrated rural development project. III: Reproductive performance of Zebu and crossbred cattle. World Animal Review, *38*: 31-36.

Syrstad, O. (1985): Dairy merits of various Bos taurus x Bos indicus crosses.

Tadesse, B. and Zelalem, Y. (2004): Feeding noug '*Guizotia abyssinica*' cake as protein source

to lactating Borana X Jersey crossbred cows: performances in milk yield, reproduction and feed efficiency. In: Farm animal biodiversity: status and prospects. Proceedings of the 11th Annual Conference of the Ethiopian Society of Animal Production (ESAP). 28-30 August 2003, Addis Ababa, Ethiopia. PP. 375-385.

Tesfaye, A. (1990): Livestock development in the peasant sector of highland of Ethiopia: Some policy issues and implications. In: African Livestock Policy Analysis.

Tesfaye, K. (1995): Smallholder dairy in Ethiopia. In: Future of Livestock Industries in East and Southern Africa. Proceedings of a Workshop. 20-23 July, 1992, Kadoma Ranch Hotel, Zimababwe

Tsehay, R. (2002): Small-scale milk marketing and processing in Ethiopia. In: Smallholder dairy production and market opportunity and constraints. Proceeding workshop held at NDDB(National Dairy Development Board), Anand, India, 13-16 march 2001. pp.352-367

Vaccaro, L. (1990): Survival of European dairy breeds and their crosses with zebus in the tropics. Animal Breeding Abstracts, *Vol. 58, No. 6*: 475-494.

Workneh, A. and Rowlands, J. (2004): Design, execution and analysis of the livestock breed

survey in Oromiya regional State, Ethiopia. OADB (Oromiya Agricultural Development Bureau), Addis Ababa, Ethiopia, and ILRI (International Livestock Research Institute), Nairobi, Kenya. p 260.

Zewdie, w. (2010): livestock production systems in relation with feed availability in the highlands and central rift valley of Ethiopia, Msc. Thesis Haramaya university, Haramaya, Ethiopia

ANNEXES

Questionnaire for dairy cow owners

Farmer's Name: .....

Address.....

Woreda: .....

Peasant Association: .....

Farmer Number (Code No.): .....

Level of education: .....

Age: .....

Sex: .....

Family status: .....

Role of the respondent in the family.....

Annex1: Questionnaire format for collecting data on breed and breeding practices

Owner's name	Address	Code No. of the cow	Breed type			Breeding practices		
			Exotic bred	Cross bred	Local bred	Natural mating	Artificial insemination (AI)	Both natural mating & AI
		1						
		2						
		3						
		1						
		2						

Annex 2: Questionnaire format for collecting data on reproductive and productive performance of dairy cows in the study areas

Owner's name	Address	Code No. of the cow	Age at first calving in months	Calving interval in months	Number of service per consumption	Lactation length in months	Daily milk yield in liter
		1					
		2					
		3					
		1					
		2					
		1					

Annex 3: Questionnaire format for collecting data on Housing system of dairy cattle

Farm ID. No.	Address	Housing		Floor type			Drainage			General farm hygiene			Type of live stock structure	
		With roof	Without roof	Concrete	Simple soil	Stone slab	Good	Satisfactory	Poor	Good	Satisfactory	Poor	Traditional	Improved
1														
2														
3														

Annex 4: Questionnaire format for collecting data on Major feed and feeding systems practiced in the study areas

S. N	Type of feeding systems	Type of feeds	Farm reference number /code/																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1																						
2																						
3																						
4																						

Annex 5: Questionnaire format for collecting data on Constraints associated with feeds and feed utilization in the study areas.

Farm reference number /code/	Address	Constraints associated with feeds and feed utilization /Ranked 1-6/					
		High cost of feeds	Scarcity	Lack of improved feeds	Poor quality feeds	Pasture& fodder disease	Poor conservation method
1							
2							
3							
4							
5							

Annex 6: Questionnaire format for collecting data on division of labor for different activities

Activity	Performer				
	Family member				Emplo yer
	husband	wife	daughter	son	
Herding & watering					
Barn cleaning					
Milking					
Milk selling					
Live animal selling					
Feed collection					
Transporting sick animals to vet. clinic					

Annex 7a: Statistical comparison of reproductive and productive performance of dairy cows: Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Mini	Max
						Lower Bound	Upper Bound		
Age at first calving of local breeds	Adama	26	51.8462	8.67037	1.70040	48.3441	55.3482	33.00	69.00
	Lume	25	51.0000	10.09950	2.01990	46.8311	55.1689	33.00	69.00
	Ada'a	26	49.1538	10.73571	2.10545	44.8176	53.4901	33.00	69.00
	Total	77	50.6623	9.80549	1.11744	48.4368	52.8879	33.00	69.00
Age at first calving of cross breeds	Adama	46	31.8696	7.41652	1.09351	29.6671	34.0720	21.00	59.00
	Lume	46	39.5870	12.76031	1.88141	35.7976	43.3763	25.00	93.00
	Ada'a	70	33.7429	6.45090	.77103	32.2047	35.2810	24.00	57.00
	Total	162	34.8704	9.39151	.73787	33.4132	36.3275	21.00	93.00
Age at first calving of exotic breeds	Adama	15	33.8667	11.31918	2.92260	27.5983	40.1350	21.00	57.00
	Lume	1	38.0000	.	.	.	.	38.00	38.00
	Ada'a	10	35.6000	6.02218	1.90438	31.2920	39.9080	27.00	45.00
	Total	26	34.6923	9.27262	1.81851	30.9470	38.4376	21.00	57.00
Number of service per conception of local breeds	Adama	32	1.5625	1.07576	.19017	1.1746	1.9504	1.00	5.00
	Lume	42	1.4524	.86115	.13288	1.1840	1.7207	1.00	4.00
	Ada'a	30	1.5667	.89763	.16388	1.2315	1.9018	1.00	4.00
	Total	104	1.5192	.93457	.09164	1.3375	1.7010	1.00	5.00
Number of service per conception of cross breeds	Adama	48	2.3333	1.43413	.20700	1.9169	2.7498	1.00	7.00
	Lume	63	1.9841	1.40841	.17744	1.6294	2.3388	1.00	6.00
	Ada'a	75	2.2533	1.33653	.15433	1.9458	2.5608	1.00	6.00
	Total	186	2.1828	1.38678	.10168	1.9822	2.3834	1.00	7.00
Number of service per conception of exotic breeds	Adama	15	2.4000	1.18322	.30551	1.7448	3.0552	1.00	4.00
	Lume	1	1.0000	.	.	.	.	1.00	1.00
	Ada'a	11	2.4545	1.43970	.43408	1.4873	3.4217	1.00	6.00
	Total	27	2.3704	1.27545	.24546	1.8658	2.8749	1.00	6.00

Cont....

Annex 7a: Statistical comparison of reproductive and productive performance of dairy cows: Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Mini	Max
						Lower Bound	Upper Bound		
Calving interval of local breeds	Adama	19	18.6842	5.84097	1.34001	15.8690	21.4995	12.00	29.00
	Lume	29	20.4138	9.54507	1.77248	16.7830	24.0445	12.00	48.00
	Ada'a	14	20.7143	7.61000	2.03386	16.3204	25.1082	12.00	36.00
	Total	62	19.9516	8.06008	1.02363	17.9047	21.9985	12.00	48.00
Calving interval of cross breeds	Adama	34	15.5588	5.63104	.96571	13.5941	17.5236	12.00	29.00
	Lume	40	17.3750	6.02426	.95252	15.4483	19.3017	12.00	36.00
	Ada'a	58	15.7586	5.50059	.72226	14.3123	17.2049	12.00	36.00
	Total	132	16.1970	5.70715	.49674	15.2143	17.1796	12.00	36.00
Calving interval of exotic breeds	Adama	11	14.3636	3.74894	1.13035	11.8451	16.8822	12.00	24.00
	Lume	0	.	.	.	.	.	.	.
	Ada'a	9	15.6667	5.09902	1.69967	11.7472	19.5861	12.00	24.00
	Total	20	14.9500	4.33438	.96920	12.9214	16.9786	12.00	24.00
Daily milk yield of local breeds	Adama	28	2.6786	1.97303	.37287	1.9135	3.4436	.50	8.00
	Lume	36	2.3333	1.71760	.28627	1.7522	2.9145	.20	7.00
	Ada'a	11	2.0000	1.00000	.30151	1.3282	2.6718	1.00	4.00
	Total	75	2.4133	1.73377	.20020	2.0144	2.8122	.20	8.00
Daily milk yield of cross breeds	Adama	49	10.7041	3.83503	.54786	9.6025	11.8056	2.00	20.00
	Lume	57	11.1053	4.07380	.53959	10.0243	12.1862	3.00	24.00
	Ada'a	45	11.8778	5.03076	.74994	10.3664	13.3892	2.00	25.00
	Total	151	11.2053	4.30669	.35047	10.5128	11.8978	2.00	25.00
Daily milk yield of exotic breeds	Adama	14	10.5714	5.07959	1.35758	7.6386	13.5043	2.00	20.00
	Lume	0	.	.	.	.	.	.	.
	Ada'a	10	10.3000	4.37290	1.38283	7.1718	13.4282	3.00	17.00
	Total	24	10.4583	4.69948	.95928	8.4739	12.4428	2.00	20.00

Cont....

Annex 7a: Statistical comparison of reproductive and productive performance of dairy cows: Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Mini	Max
						Lower Bound	Upper Bound		
Lactation length of local breeds	Adama	28	6.5179	3.28149	.62014	5.2454	7.7903	1.00	12.00
	Lume	33	6.9091	3.37605	.58770	5.7120	8.1062	3.00	17.00
	Ada'a	19	6.8421	2.43272	.55810	5.6696	8.0146	3.00	12.00
	Total	80	6.7563	3.11082	.34780	6.0640	7.4485	1.00	17.00
Lactation length of cross breeds	Adama	48	9.8229	2.91089	.42015	8.9777	10.6682	6.00	19.50
	Lume	52	9.8846	4.02153	.55769	8.7650	11.0042	2.00	24.00
	Ada'a	67	9.0299	2.57998	.31519	8.4005	9.6592	1.00	15.00
	Total	167	9.5240	3.19052	.24689	9.0365	10.0114	1.00	24.00
Lactation length of exotic breeds	Adama	14	9.9286	1.32806	.35494	9.1618	10.6954	7.00	12.00
	Lume	0	.	.	.	.	.	.	.
	Ada'a	10	8.9000	2.72641	.86217	6.9496	10.8504	6.00	12.00
	Total	24	9.5000	2.04302	.41703	8.6373	10.3627	6.00	12.00

Annex 7b: Statistical comparison of reproductive and productive performance of dairy cows

		Sum of Squares	df	Mean Square	F	Sig.
Age at first calving of local breeds	Between Groups	98.452	2	49.226	.505	.605
	Within Groups	7208.769	74	97.416		
	Total	7307.221	76			
Age at first calving of cross breeds	Between Groups	1526.537	2	763.268	9.576	.000
	Within Groups	12673.741	159	79.709		
	Total	14200.278	161			
Age at first calving of exotic breeds	Between Groups	29.405	2	14.703	.159	.854
	Within Groups	2120.133	23	92.180		
	Total	2149.538	25			
Calving interval of local breeds	Between Groups	44.858	2	22.429	.338	.715
	Within Groups	3917.997	59	66.407		
	Total	3962.855	61			
Calving intervals of cross breeds	Between Groups	80.501	2	40.250	1.240	.293
	Within Groups	4186.378	129	32.453		
	Total	4266.879	131			
Calving intervals of exotic breeds	Between Groups	8.405	1	8.405	.434	.518
	Within Groups	348.545	18	19.364		
	Total	356.950	19			
Number of service per conception of local breeds	Between Groups	.315	2	.158	.178	.838
	Within Groups	89.646	101	.888		
	Total	89.962	103			
Number of service per conception of cross breeds	Between Groups	3.947	2	1.974	1.027	.360
	Within Groups	351.837	183	1.923		
	Total	355.785	185			
Number of service per conception of exotic breeds	Between Groups	1.969	2	.985	.586	.564
	Within Groups	40.327	24	1.680		
	Total	42.296	26			
Daily milk yield of local breeds	Between Groups	4.080	2	2.040	.673	.514
	Within Groups	218.362	72	3.033		
	Total	222.442	74			
Daily milk yield of cross breeds	Between Groups	33.230	2	16.615	.895	.411
	Within Groups	2748.905	148	18.574		
	Total	2782.136	150			
Daily milk yield of exotic breeds	Between Groups	.430	1	.430	.019	.893
	Within Groups	507.529	22	23.069		
	Total	507.958	23			
Lactation length of local breeds	Between Groups	2.502	2	1.251	.126	.881
	Within Groups	761.995	77	9.896		
	Total	764.497	79			
Lactation length of cross breeds	Between Groups	27.411	2	13.706	1.352	.262
	Within Groups	1662.368	164	10.136		
	Total	1689.779	166			
Lactation length of exotic breeds	Between Groups	6.171	1	6.171	1.511	.232
	Within Groups	89.829	22	4.083		
	Total	96.000	23			

Annex 8a: Daily milk yield and lactation length variations between the three breed types (indigenous, cross and exotic breeds): Descriptive

		N	Mean	Std. Devai	Std. error	95%confidence interval for mean		Mixi	Maxi
						Lower bound	Upper bound		
Daily milk yield	indigenous breeds	75	2.413	1.7338	.2002	2.014	2.812	.2	8.0
	cross breeds	151	11.205	4.3067	.3505	10.513	11.898	2.0	25.0
	exotic breeds	24	10.458	4.6995	.9593	8.474	12.443	2.0	20.0
	total	250	8.496	5.4839	.3468	7.813	9.179	.2	25.0
Lactation length	indigenous breeds	80	6.7563	3.11082	.34780	6.0640	7.4485	1.00	17.00
	cross breeds	167	9.5240	3.19052	.24689	9.0365	10.0114	1.00	24.00
	exotic breeds	24	9.5000	2.04302	.41703	8.6373	10.3627	6.00	12.00
	total	271	8.7048	2.32291	.20185	8.3074	9.1022	1.00	24.00

Annex 8b: Daily milk yield and lactation length variations between the three breed types (indigenous, cross and exotic breeds); ANOVA

		Sum of squares	df	Mean square	F	Sig.
Daily milk yield	between groups	3975.715	2	1987.858	139.785	.000
	Within groups	3512.536	247	14.221		
	Total	7488.251	249			
Lactation length	between groups	430.983	2	215.491	22.645	.000
	Within groups	2550.276	268	9.516		
	Total	2981.259	270			

DECLARATION

This thesis is my original work, has not been presented for a degree in any other university and all sources of material used for the thesis have been duly acknowledged.

By



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