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COLLEGE OF VETERINARY MEDICINE AGRICULURE

STUDY ON MILK PRODUCTION AND INFLUENCING FACTORS IN ADA'A DAIRY COOPERATIVE

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STUDY ON MILK PRODUCTION AND INFLUENCING FACTORS IN ADA'A DAIRY COOPERATIVE

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ABBREVIATION

AFC	Age at first calving
AFM	Age at first mating
AI	Artificial incrimination
BCS	Body condition score
CACC	Central Agricultural Census Commission
CADU	Chilalo Agricultural Development Unit
CI	Calving interval of cows
CMT	California Mastitis test
CSA	Central Statistical Agency
DZARC	Debre Zeit Agricultural Research Center
EARO	Ethiopian Agricultural Research Organization
FAO	Food and Agriculture organization
FINNIDA	Finish International Development Agency
FMD	Foot and mouth disease
GDP	Gross domestic product
HH	Household
IAR	Institute of agricultural research
ILCA	International Livestock Centre for Africa
kg	Kilogram
km	Kilometre
LL	Lactation Length
LSDP	Large scale dairy production
masl	Meters above sea level
mm	Millimetre
MOA	Ministry of Agriculture
MS	Microsoft Excel
MSDP	Medium scale dairy production
NAIC	National Artificial Insemination Center
NGOs	Non Governmental Organizations
No	Number
off	Offspring

OR	Odds ratio
SCC	Somatic cell count
SD	Standard Deviation
SDDP	Selalle Smallholder Dairy Development Project
SPDDPP	Selalle Peasant Dairy Development Pilot Project
SPSS	Statistical Package for Social Sciences
SSDP	Small scale dairy production
TLU	Tropical Livestock Unit
UNICEF	United Nation International Children's Emergency Fund
UNRRA	United Nations Relief and Rehabilitation Administration
US	United State
USD	United State Dollar
WMT	Wisconsin Mastitis Test

ABSTRACT

A study was conducted at the Ada'a Dairy cooperative on Study on milk production and influencing factors in Ada'a dairy cooperative from September 2011 to January 2012.The objectives of the study were to assess milk production system and determine the prevalence of mastitis among lactating dairy cows in Ada'a dairy cooperative smallholder farms. Survey was made using semi-structured questionnaire, farm visit, animal examination and CMT test. A total of 90 smallholder dairy farms and all milking cross bred dairy cows on selected farms were included in the study. From total population (900 members) 10 % was selected for study sample.76.7% dairy farms were male headed and 57.8 % of the respondents had >10 years dairy experience and 55.6 % of the respondents used dairy farming as a main income source. There was an average herd size of 6.25 cattle per household of which 3.12 crossbred cows. Most dairy activities were done by family members. Animals were permanently housed and stall feeding system was practiced. The first, second and third ranked feed sources were concentrate (63.3 %), crop residue and poultry waste (32.2 %). 51.1% of smallholders used artificial insemination for breeding. The average age at first mating and calving of crossbred cows were 20.82 and 29.93 months respectively. The average milk yield was 10. 67 litre/day. Milking hygiene was generally poor with no milking sequence between mastitic cow and non mastitic once and udder drying and teat dipping practices. Mastitis and lumpy skin diseases were the first (41.1 % and second (22.2 %) ranked diseases. The first (55.6 %), second (17.8 %) and third (12.2 %) ranked problems of milk production were feed shortage, lack of space and lack of AI service. Prevalence of mastitis at cow level was 60.8 % out of which 15.2 % and 45.6 % were clinical and sub clinical cases, respectively. The quarter level prevalence was 40 % out of this 3.6% (clinical) and 36.4% (sub clinical), respectively, out of 868 quarters examined, 31 was blocked. The quarter level of mastitis prevalence was high in right rear (43.2 %). Prevalence of mastitis varied significantly in (teat lesion, previous exposure to mastitis and udder swelling) (P= 0.000), parity (P= 0.024), age (P= 0.04) and body condition score (P= 0.002). No significant association (P= 0.634) between mastitis occurrence and lactation stage. Generally it can be conclude that milk production is a livelihood source for most smallholders in Ada'a dairy cooperative. However, due to poor husbandry, milking practices and lack of skills on record keeping for accurate decision making on chronically mastitic cows the over all prevalence of mastitis was high.

Key words: *Ada'a, Cooperative, Crossbred cow, Dairy, Mastitis, Prevalence, Production, Risk factors, smallholder and survey*

1. INTRODUCTION

Ethiopia, with 49.3 million heads of genetically diverse cattle, has the largest population in Africa (CSA, 2009). Cattle production plays an important role in the economies and livelihoods of farmers and pastoralists. Cattle produce a total of 3.2 billion litres of milk and 0.331 million tonnes of meat annually (FAO, 2005; CSA, 2008).

According to the Food and Agriculture Organization, 42% of the total cattle heads for the private holdings are milking cows. Milk produced from these animals provides an important dietary source for the majority of rural as well as a considerable number of the urban and peri-urban population. However, milk production often does not satisfy the country's requirements due to a multitude of factors. Disease of the mammary glands known as mastitis is among the various factors contributing to reduced milk production (Fekadu, 1995).

The major constraints for the development of peri-urban dairying and the development of livestock industry in general have been summarized as policy, socioeconomic, institutional, technical and technological (Azage, and Alemu, 1998). Animal diseases are among the technical and technological constraints for the peri-urban and urban dairy production systems (Azage and Alemu, 1998; Behailu, 2002). Peri-urban and urban dairies are intensive production systems, which keep high-grade cows and have improved management practices. This is usually associated with increased susceptibility to disease, poor survival rate and poor reproductive performance (Eneyew *et al.,* 2000). Reproductive inefficiency, young mortality and some cattle diseases like mastitis, lameness, pneumonia and ketosis are the major health problems in intensive dairy production (ILCA, 1994).

Mastitis is an inflammation of the udder resulting from the invasion of pathogenic micro organisms, and it is the most costly or expensive disease in dairy cattle industry (Greer and Baker, 1992). Mastitis in dairy cows causes a loss in milk production, which is the most important and the best single food (Woods, 1986). Mastitis reduces milk and milk products in all dairy producing countries of the world (International Dairy Federation, 1999). In addition to heavy losses in milk quality and quantity, it also causes irreversible damage to the udder tissue and less occasional fatalities (Radostits *et al.,* 2000). Mastitis can lead to the reduction of offspring to a given production system due to the insufficient milk production resulting in

starvation. In general, mastitis is a complex disease dealing with, the interaction of micro-organisms and the cow's anatomy and physiology, dairy husbandry and management, milking equipment and procedures and environment (Woods, 1986).

In the livestock development policy to improve the per capita milk consumption, improvement of the genetic potential of the indigenous zebu through breeding with high-grade exotics was included (Asfaw, 1997). And in the years to come a significant percentage of dairy cattle population in Ethiopia would be improved breeds, which are susceptible to most diseases including mastitis. According to (Lemma *et al.*,2001) of the major diseases of crossbred cows in Addis Ababa milk shed mastitis was the second most frequent disease next to reproductive diseases.(Mungube *et al.*, 2005) estimated the economic losses from mastitis in the urban and peri urban areas of Addis Ababa, Ethiopia, to be US $ 58 per cow per lactation. The prevalence of clinical and sub clinical mastitis in Ethiopia range from 1.2 to 21.5% and 19 to 46.6%, respectively (Hussein *et al.*, 1997, Bishi, 1998, Kassa *et al.*, 1999; Lemma *et al*, 2001, Workineh *et al.*, 2002; Kerro and Tareke, 2003).

Like most developing countries, Ethiopia's increasing human population, urbanization trends and rising household incomes are leading to a substantial increase relevant in the demand for livestock products, particularly milk and meat. In order to meet the growing demand for milk in Ethiopia, milk production has to grow at least at a rate of 4 percent per annum (Azage, *et al.*, 2001) Bridging this wide gap calls for the design of appropriate and sustainable dairy development strategies based on socio-economic, institutional and agro-ecological circumstances that build on the demand of consumers and the needs and opportunities of producers (Azage, *et al.*, 2003).

The study was conducted in Ada'a district, which is near to Addis Ababa that has a large number of local and cross breed dairy cows to supply milk and milk products to the market because of road accessibility and short distance to Addis Ababa. Ada'a dairy cooperative is found in Debre Zeit town and one of the milk suppliers for Addis Ababa and surrounding towns. Eshetu, (2008) reported that the total livestock population of the district in 2007 was 291,539 of which both local and crossbred cows accounted (11.68%). This cooperative is included in peri urban and urban dairy production system, have large number of crossbreed dairy cows therefore, has a potential to supply large volume of milk to the consumers hence, have its own contribution to increase milk supply to the market through introduce

technological intervention, improved husbandry system and enhance the participation of milk producing farmers. How ever, the studies shows that milk productivity was less compare to the numbers of cross bred cows in the cooperative. According to Azage, *etal.,* (2007) there were over 3000 dairy cows in the cooperative and collect over 8,000 litres milk per day and the other report indicated that the dairy stock in Ada'a dairy cooperative has 3000 with an estimated supply of 8000 litres of milk per day, the daily supply of milk from each farmer ranges from 2 litres to 40 litres per day, about 10 litres on average (Eshetu, 2008). Low milk production in this cooperative may due to different production factors such as health problems like mastitis; Mastitis reduces milk and milk products in all dairy producing countries of the world (International Dairy Federation, 1999). Milk productivity of small holders may increase if the husbandry, health management and milking practice of the small holders improved therefore, evaluation of the husbandry practices and making information available on the prevalence of mastitis and associated economic loss, give recommendation about management practices, control and prevention methods of the disease and identify the major constraints of the milk production are one step forward for improving milk production of the dairy cooperative.

Therefore the objective of the study was for:

- Asses milk production
- Determine the prevalence of mastitis among lactating cows in Ada'a dairy cooperative small holder farms.

2. LITERATURE REVIEW

2.1. History 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 the Addis Ababa area began to develop rapidly as a result of the expansion in large private dairy farms and the participation of smallholder producers with indigenous cattle facilitated by establishment of milk collection centres (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.

2.2. Dairy production systems in Ethiopia

Based on location or scale of market orientation and production intensity as criteria, three major dairy production systems were reported in Ethiopia (Azage and Alemu, 1998; Hizkias, 2000; Tsehay, 2002; Yoseph *et al.,* 2003; Zegeye, 2003; Dereje *et al.,* 2005, Sintayehu *et al.,* 2008). These are traditional smallholders, peri-urban and urban dairy production systems.

2.2.1.Traditional smallholder dairy production systems

The traditional smallholder system is part of the subsistence farming system, which includes pastoralists, agro-pastoralists and mixed crop-livestock producers (Tsehay, 2002). It roughly corresponds to the rural milk production system and supplies 97% of the total national milk production and 75% of the commercial milk production. This sector is largely dependent on low producing indigenous breeds of cattle, which produce about 400-680 kg of milk/cow per lactation period (Alemu, *et al.,* 2000). The milk produced is mainly consumed by the household in the traditional system.

Pastoralist dairy production system

According to Zegeye, (2003) pastoralism as a system mainly operating in the rangelands where the peoples involved follow animal-based life styles, which requires of them to move from place to place seasonally based on feed and water availability. For food, pastoralists mainly depend on milk, and their accumulated wealth and savings are in the form of live animals. Milk production under the systems is strictly seasonal and range condition-dependent being surplus in the wet season and restricted in the dry season. Getachew and Gashaw, (2001) reported that the lowland accounts for 27% of the milk produced. Because of the erratic rainfall pattern and related reasons, resulting in shortage of feed, milk production per unit is low and highly seasonal. More milk will be produced in the wet season where pastoralists would mostly conserve in Borana as *Ititu* and convert the surplus milk into butter, and trade off to the highlanders in the peripheral markets for grain. In the pastoral areas, milk production is the major activity as food and income source, where the livelihood of the semi-nomadic transhumance population is dependent on livestock (Coppock, 1994). The same author also identified that cattle dominate the population (55.4% of the TLU) followed by camel (15.3%), goats (13.7%) and sheep (6.4%)

About 30% of the livestock population in Ethiopia are found in the pastoral areas. These areas comprise 50% of the total land area of the country and have altitudes below 1500m.a.s.l. Pastoralism is the major dairy production system in the lowland. Livestock doesn't provide inputs for crop production but are the very backbone of their owners providing all of the consumable and saleable out puts and regarded as insurance against adversity. Milk production is dependent on season due to the rainfall pattern that influences feed availability

(Ketema and Tsehay, 1995). Animals are consequently important in the social value system that promotes flexibility in resource use (Kedija *et al.*, 2008).

Agro pastoralist dairy production system

Agro-pastoralists are segments of the pastoral society who promote opportunistic crop farming to improve food security. Traditionally its one way of maintaining ownership rights over the use of land. It enables the production of crops to be used by both humans and livestock. Cultivation is practiced in pastoral area depending on rainfall (Beruk and Tafesse, 2000).Compared with similar African systems, densities of people and livestock to human ratios suggest that preconditions now exist to force a widespread shift to agro-pastoralism on the plateaus where the environment permits and in the absence of other development opportunities. A shift to agro-pastoralism could allow some Boran to procure more food energy and still restrict sales of animals for grain purchases so that herd capital can be retained for other purposes (Coppock, 1994).

Crop - livestock dairy production system

Smallholder livestock production system in mixed crop–livestock farming refers to livestock production that takes place in arable areas or areas with arable potential in the business of subsistence system (Payne, 1990). It is usually practiced in semi-arid, sub-humid and humid agro ecological zones of the world. Crop production both for subsistence and cash generation is the major activity of this system, with livestock playing a supportive role (Jahnke, 1982).There is a strong linkage within the system between crop and livestock production. Crops provide by-products and unmarketable surpluses which livestock convert into high value products. Livestock help clear stubble, trample wet fields, and provide manure and draught power for cultivation. In these systems livestock serve as living banks for capital accumulation and provide milk and proteins. The system is labor-intensive, with some dependence on capital and land (rented, share-cropped or owned), and is receptive to new technology (Camoens, 1985). Partial or total confinement is the common livestock management technique. Sources of animal feed are farm-grown pastures, crop by-products and residues, grasses around settlements, communal grazing lands, cut-and-carry feed from forest and irrigated canals and concentrates.

2.2.2. Peri-urban dairy production systems

This system is found in the outskirts of the capital city and regional cities and mostly concentrated within a radius of 100 km around Addis Ababa, which includes dairy farms ranging from smallholder to commercial farmers (Felleke and Geda, 2001). The system comprises small and medium sized dairy farms that own crossbreed dairy cows. Dairy farmers use all or part of their land for forage production. The primary objective of milk production in this system is generating additional income to the household (Hizkias and Tsehay, 1995; Azage *et al.,* 2000).

The producers may or may not hove access to cultivable or pastureland and some of them are usually left their few animals for grazing on the roadside. Animals they keep ranged from 50% crosses to high-grade Holestien Friesian (Zegeye, 2003). The main sources of feed are agro-industrial by products (e.g. brewery waste and oilseed cakes), cultivated fodder crops and crop residues (Nell, 1992).

2.2.3.Urban dairy production system

It consists of dairy farms ranging from smallholder to specialized businessmen owned farms, which are mainly concentrated in major cities of the country. These dairy farms have no access to grazing lands (Yitay *et al.,* 2007) and basically keep exotic dairy stocks (Azage *et al,* 2000). Currently, a number of smallholder and commercial dairy farms are emerging mainly in and around the capital Addis Ababa (Felleke and Geda, 2001; Azage, 2004) and most regional cities towns (Ike, 2002; Nigussie, 2006).

By the virtue of their location, producers are not expected to have access to agricultural or pasture land, as the operation takes place within cities and as a result, they are forced to buy their feed Based on the scale and level of operations, this production system could be subdivided into small scale and large scale and used 100% zero grazing (Zegeye, 2003).

According to Tsehay, (2002) urban milk production system inside and around Addis Ababa consists of 5167 small, medium and large dairy farms producing about 35 million liters of milk annually. Out of the total volume of milk produced in and around Addis Ababa, 73%, 10%, 9.4%, 7.6% were marketed, left for HH consumption, goes to calves and processed in to

butter and *ayib* (Ethiopian cottage cheese), respectively (Azage and Alemu, 1998). Although some farmers produce good quality milk, hygienic quality and composition of most milk marketed in such production systems is poor (Tsehay, 2002). Moreover, price is high even when quality of milk is low. No standards and quality control mechanisms or dairy policy exist to safeguard consumers.

2.3.Characteristics and type of cattle owned by dairy producer

2.3.1. Livestock holding and herd structure

Livestock ownership varies depending on the type of production system, wealth status and the overall farm production objectives. The average cattle herd size per household for smallholder farmers in the highlands reported were 7.1 cattle in North West Shewa Zones (Agajie *et al.* 2002), 17.9 cattle around Debre Birhan (Ahmed, 2006) and 4 cattle at Akaki and Lemu, Central Ethiopia (Bayush, 2008). In the mixed crop livestock production system of Central Rift Valley the average cattle herd size reported was 15.5 cattle per household (Lemma *et al,.* 2005). Yoseph *et al.* (2003) reported an average herd size of 26.5 in urban and peri-urban production systems. In mixed farming system of the Highlands and mid-altitudes of Ethiopia where crop production is important; cattle are the most important livestock species for cultivation, threshing and manure production (Getachew *et al.,* 1993). Gryseels and Goe, (1984) also reported that most farmers in the central highlands of Ethiopia own two oxen, a cow, few sheep and a donkey. Households with larger landholdings keep more animals because they need more draught power to cultivate the land, and this also enables them to produce more straw that helps to support a greater number of animals (Bayush *et al.,* 2008).

Table.1 presents summary of values of livestock holdings per household in the Central Highlands of Ethiopia. Cattle comprised most of the livestock herd while sheep are the second most important species of livestock in most of the areas. Abdinasir, (2000), MOA and FINNIDA, (1996) and Niftalem, (2000) indicated that family size has a significant effect on livestock herd size. Abdinasir, (2000) report showed that the mean values for cattle herd size at Bilalo and Lemmu areas were 8.57 TLU and 10.38 TLU respectively. According to his work the herd was dominated by oxen that comprised 43.2% followed by cows that comprise 30.3% of the herd. A similar result was found by Tekalign *et al.* (1993) who reported that

oxen and cows comprise 43.87% and 21.93% of the herd at Ada'a, respectively. According to the final report of the MOA and FINNIDA, (1996) on the activities of the Selale Peasant Dairy Development Pilot Project, cows comprised only 11.2% of the cattle herd at Selale area. Abdinasir, (2000) indicated that herd size increases significantly with household size, cultivated area and grazing area.

Table 1. Livestock herd composition (TLU) per household in central high land of Ethiopia

Area	Cattle	Sheep	Goat	Horse	Ass	Source
Ada'a	4.42	1.55	1.00	0.05	0.98	Tekalign *et al.*(1993)a
Baso	5.02	10.69	0.12	1.12	1.81	Tekalign *et al.* (1993)a
Bilalo	8.75	0.54	0.10	1.33	0.23	Abdinanasir (2006)b
Lemmu	10.38	0.31	0.05	1.86	0.23	Abdinanasir (2006)b
Selale	10.70	7.2	0.20	0.70	1.40	MOA and FINNDA(1996)

a= 'Asses' refers to asses or mules, b= values in TLU

2.3.2. Livestock housing

The traditional livestock husbandry practiced across the Ethiopian highlands is similar. Livestock are kept in a *'kraal'* during the night. During the day time, they are herded on communal pasture, private grazing lands or in stubble depending on the season (Getachew *et al,* 1993). Improved type of housing using barns constructed from locally available and cheap materials is being practiced mainly by urban and peri-urban small holder dairy farmers owning crossbred dairy cattle.

2.3.3. Livestock feed and feeding system

Exposure of dairy cows to health problem and physiological stress results in lower production, much longer calving intervals, as well as problems in fertility (Brock, 1999; Tsehay, 1999). A dairy cow requires feed for body maintenance and growth, the growth of the calf and for milk production. The dairy cattle should be fed a balanced ration in various nutrients which include proteins, carbohydrates, fats, minerals, vitamins and water. The animal feed can be a concentrate like grain, bran, oil seed cake etc or it can be roughage which includes grass, hay, straw and others production of milk in any given dairy herd is

influenced by environmental factors, of which feed is the most important variable, and the genetic make up of the herd. In availability of feed of adequate quality and quantity probably limits the milk production potential of cows with good milk producing ability more than any other single factor and is the most serious constraint to improved dairying (Belachew *et al,* 1994; Staal & Shapiro, 1996).

2.3.4. Breeding system

In Ethiopia, the crossbreeding of improved European with indigenous zebu cattle breeds was introduced in the 1930's by Italians. However, wide-scale cattle crossbreeding activities were started later by the Institute of Agricultural Research (IAR) and Chilalo Agricultural Development Unit (CADU) using Holstein- Friesian, Jersey, and Simmental sires that were crossed with the local Horro, Borana and Arussi dams (Brännäng *et al.,* 1980; EARO, 2001).(MoA ranches also played significant role in heifer distribution), since then, governmental and non-governmental organizations have made various efforts to improve the dairy sector by establishing dairy cattle improvement ranches and distributing crossbred F^1 heifers to smallholder farmers (EARO, 2001; Kelay, 2002). For example, in 1987 a project known as the Selalle Peasant Dairy Development Pilot Project (SPDDPP) was established and introduced crossbred dairy cattle and improved management skills in the highlands of Ethiopia. This pilot project was later continued with a new project called the Selalle Smallholder Dairy Development Project (SDDP), which had the same objectives but a broader range of activities encompassing other parts of the country (Kelay, 2002).

Ethiopian cattle are of indigenous breeds while the population of exotic and cross breed cattle is small and is mainly found in the urban and peri urban areas of the country. Even if the milk production potential of the exotic cows is superior to the local breeds, the indigenous breeds have evolved and adapted over many centuries to the climate, altitude, available feed supply, endemic diseases and parasites. The local breeds posses survival traits exhibited by small size, low milk production, slow maturing rate, moderate levels of immunity, tolerance to the prevalent disease organisms and parasites, excellent mothering and foraging ability, heat tolerance and minimal water requirement (Sendros and Tesfaye, 1997).

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 AI, when long term genetic gain is of minor importance and when local conditions do not provide the infrastructure necessary for successful AI (Wattiaux, 1998).

Appropriate attention should be given to factors affecting fertility of bulls that include unbalanced nutrition (under feeding and over feeding) and diseases. Adequate nutrition is vital, since it hastens puberty and body development. It is also important to keep in mind that overfeeding can lead to reduced libido (Sprott and Field, 1998). Bulls should also be tested for venereal diseases like Brucellosis, Trichomonosis and Vibriosis that affect fertility and culled if they react positively. In addition, prevention measures like vaccination and deworming should be undertaken against other diseases that influence fertility indirectly (Sprott *et al.,* 1997).

Artificial insemination

AI is an essential technique in breeding programs with progeny testing. According to Wattiaux, (1998) 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. So far artificial insemination using frozen semen has played an important role in increasing genetic progress by upgrading the reproductive rate of the male. It increases the selection intensity since less bull is needed and this is the basis for selection progress. Zumbach and Peters, (2000) estimated that 1820 cows can be inseminated by a bull using deep frozen semen.

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 (Azage *et al,* 1995). 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 affordable 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. The financial problem is further aggravated by the poor management of AI operations (FAO, 2000).

2.3.5. Access to land and labour

Land and labour are important inputs in a dairying enterprise. Accessibility to urban land for urban agriculture is curtailed by intense competition from other urban land uses such as housing and industrial development (RUFA, 2001). But urban dairy farming is better off in such regards compared say to urban market gardening as the animals tend to be stall- fed and production takes place in the residential units as evidence from the survey reveals. It is also important to note that usually poor households and newest arrivals in a city often do not have access to land to practice urban agriculture (Smith, 1991). Although land constraints have always been there in an urban area, it is surprising to see that urban dairy farming is practiced in very crowded sections of the city. The fact that urban dairy farming is practiced in all the 'Weredas' of Addis Ababa can be a very good testimony. However, clear spatial variations are observable in the distribution of the dairy farming enterprises. For example, Asrat, (1996) indicated that the concentration of the enterprises increases from the centre to the border and even from the periphery, the density of dairy enterprises is least marked in the north. The high density in the periphery is said to be related to the availability of open land for grazing.

2.4. Reproductive and productive performance of cows

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. This causes delays in age at first calving and long calving interval (Mukasa-Mugrwa, 1989; Perera, 1999).

2.4.1. Age at first calving (AFC)

First calving makes the beginning of a cow productive life and influences both the production and reproduction life of the female, directly through its effect on her life time calf crop and milk production and indirectly it is influence on the cost invested for up-bringing (Mukasa-Mugerwa, 1989) and it is influenced by the time of conception (Perera, 1999).

Under controlled breeding system, heifers are usually mated when they are mature enough to withstand the stress of parturition and lactation. This increases the likelihood of early conception after parturition. In traditional production systems, however, breeding is often uncontrolled and heifers are bred at the first opportunity. This frequently results in longer subsequent calving intervals. The average age at first calving in Bos indicus cattle is about 44 months, compared with about 34 months in Bos taurus and Bos indicus x Bos taurus crosses in the tropics (Mukasa-Mugerwa, 1989). Similar study indicated that average AFC was 47.61 and 40.46 months for Fogera and F^1 heifers, respectively (Addisu and Hegede, 2003). According to the research conducted at Abernosa Ranch with Borana x Holstein- Friesian (F1 crossbred airy cows) show delayed age at first conception (53.9 months) (Ababu *et al.,* 2006).

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 behavioural estrus. Breed difference among cattle had also significant effect on age at first calving (Mukasa-Mugerwa, 1989).

2.4.2. Calving interval of cows (CI)

Calving interval refers to the period between two consecutive calving and is a function of a days 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).

2.4.3. Milk yield

According to (FAO, 1993), the main source of milk in Ethiopia is the cow, constitute 83.4% of the total annual milk output. (Zegeye, 2003) also stated that cattle are the main source of milk even though very little or no consideration given to improve their milk production capabilities. As a result, their genetic potential for milk production as seen at present is low. However, their adaptability and survival under the traditional management system is excellent when compared with the introduced exotic cattle species.

According to Lemma *et al.* (2005), average milk off-take of local Arsi cows was about 1.0 liter/head/day. Brokken and Senait, (1992) reported that average daily yield of local cows was about 2 liters, compared with about 6 liters for crossbred cows. A study conducted at Holetta dairy farm indicated that average lactation yield and annual milk yield for Holestien Friesian cattle were 3357.9 kg and 2783.1 kg, respectively (Mureja *et al.,* 2002). According to MOA,

(1997), it was indicated that productivity of indigenous cows is low and yield about 230 kg of milk per lactation. Research findings on Ethiopian indigenous cattle breeds indicated that milk yield ranged between 500 and 700 litters. Even under a research centre management condition, average milk yield did not exceed 500 liters (Zelalem *et al.,* 2006). The other research findings reported that Barca cattle type produced the lowest for both total milk (672 kg) and annual milk yield (673kg) (Million and Tadelle, 2003).

Milk production is affected by genetic and environmental factors. Among the environmental factors, the quantity and quality of available feed resources are the major ones. Inadequate level of nutrition has been found to be the most important factor influencing length of post partum anoestrus in cows grazing tropical pasturelands (Topps and Oliver, 1993). The milk production potential of indigenous cattle breeds is very low. However, milk production potential of temperate breeds under improved management in tropical environments is higher than that of indigenous breeds (Syrstad and Ruane, 1998). The estimated daily milk yield for crossbred cows reported include: 7.3 kg/day/cow for Holstein Friesian- Boran crosses in the Highlands of Ethiopia (Demeke *et al.,* 2000).

The lactation milk yield and days in milk of indigenous, crossbred and exotic cattle in Ethiopia reported by previous researchers are compiled in (Table 2). The milk production potential of indigenous breeds of cattle is very low. In addition, milk production potential of temperate breeds in the tropical environments is higher than the indigenous breeds, but this yield is still far below the genetic potential. Therefore, crossbreeding of the indigenous breeds with temperate exotic breeds has been practiced in the country, since the establishment of the IAR, with the aim of making use of the high genetic potential for milk production of exotic breeds and the adaptability to the local environment of indigenous breeds. The average lactation yield for indigenous cows is 524 litres for 239 days (Tesfaye, 1995) reported that the average milk yield for crossbred dairy cows ranges from 518.8-1448 kg depending on the breed type. The milk produced is mainly consumed by the household in the traditional system while most of the milk is sold to generate income in the market oriented system.

Table 2. Milk production performance of indigenous, crossbred and exotic cattle in Ethiopia

Breed		lactation		Location	Source
		Milk yield	Lengths(days)		
Indigenous	Boran	494	155	On station	Beyene. 19 84
	Horro	559	285	On station	Beyene. 1984
	Arsi	809	272	On station	Kiwuwa *et al*, .1983
	Barka	552a	128a	On station	Goshu.1981
	fogera	613	353a	On station	Goshu.1981
Cross bred Friesian	Boran	1554	350	On farm	MOAand FINNIDA(1996)
	Arsi	1040	350	On farm	MOAand FINNIDA(1996)
	Arsi	1977	356	On station	Kiwuwa *etal*, .1983
	Arsi(25-62.5%)	1547	366	On farm	Abdinaser (2000)
	Arsi(>75%)	2924	361	On farm	Abdinaser (2000)
	Barka	1488	301	On farm	Teafaye (1995)
Jersey X	Barka	970	257	On farm	Teafaye (1995)
	Arsi	1741	334	On station	Kiwuwa *etal*, .1983
Exotic	Friesian	3796	323	On station	Mogos and Baaes,1998
	Jersey	1619	276	-	EARO, 2001

a = first lactation

2.4.4. Lactation length (LL)

A study conducted on milk production characteristics of Holstein Friesian Cattle at Holetta dairy farm indicated that the average lactation length is 351 days (Mureja *et al.,* 2002). The other research on Horro cows in Ethiopia indicated that lactation length of a cow was on average six months, which is very short ones (Mulugeta *et al.,* 1993). Research findings on Ethiopian indigenous cattle types indicated that lactation length is less than 100 days of lactation period under average to good management conditions in the Ethiopian context (Zelalem *et al.,* 2006).

2.5.Factors influencing dairy production in Ethiopia

In Ethiopia animal production systems are primarily based on native pasture and crop residues (Firew, 2007). Crop residues including cereal straws of teff, barley, wheat, oats and cereal

stover from maize, sorghum and millet and haulms from pulse crops including peas, beans, lentils, chick peas and vetch are very important feed resources (Rihirahe, 2001). However, the feed supply is seasonal and the shortage of green grass is one of the major causes of drastic deterioration of livestock nutrition (Rihirahe, 2001; Firew, 2007).

Three factors, viz. genetic make up; nutrition and management decide the productivity of an animal. Improvements of genetic make up only contribute up to 30% to production, while the 70% is dependent on nutrition and management. Unfortunately, indigenous animals are low milk producers because of the shortage of nutrition. Poor nutritive values of feeds lower the production capacity and fertility potential of animals. If fed well, indigenous cows could be produced 20-25% more milk (Sethumadhavan, 2004).

Poor nutrition in addition to causing low rates of production and reproduction also increases susceptibility of livestock to diseases and subsequently mortality. Biologically, about two-thirds of the improvement in livestock productivity is often attributed to nutrition since animal production is basically a conversion of feed into animal products. In economic terms, feed cost accounts for about 70% of the total cost of livestock production indicating the feasibility of livestock enterprises is a function of the type of feed and feeding system (Wambugu, 2001).

2.5.1. Cattle genotypes

Ethiopia has large number of cattle population however, has relatively limited numbers of exotic dairy cattle and their crosses. Less than 1% of the 34.5 million cattle population of Ethiopia are exotic or crossbred dairy cows (Muriuki and Thorpe, 2002). Although it was difficult to trace the ownership of improved dairy animals, it is estimated that private farms own a total of 128,745 grade and pure female dairy animals of which the smallholders sector owns 32,204 crosses and improved female dairy cattle. The indigenous zebu breed produces about 400–680 kg of milk/cow per lactation compared to grade animals that have the potential to produce 1120–2500 litres over 279-day lactation. Genetic improvement has been recognised in the design and implementation of the development projects in the country during the last four decades With the exception of SDDP, the production and distribution of crossbreed heifers, the provision and distribution of dairy stocks, the provision and strengthening of AI services, and/or bull service were major components of the development

projects implemented between 1967 and 1998. Through the effort of these projects, Ethiopia has built up a herd of 120 thousand exotic cattle. So far, only one government institutions, the National Artificial Insemination Centre (NAIC) collect semen from bulls and give for regions.

2.5.2. Feed resource

The major feed resources in the highlands are natural pasture, crop residues and stubble grazing (Alemayehu, 2004). The availability of feed resources in the highlands depends on the intensity of crop production, population pressure, the amount of rainfall, and distribution pattern of rainfall and seasons of the year (Mohammed-Saleem and Abate, 1995). Pasture growth is a reflection of the annual rainfall distribution pattern (Seyoum *et al.,* 2001). However, with the decline in the size of the grazing land and degradation through overgrazing and the expansion of arable cropping, agricultural by-products have become increasingly important (Alemu *et al.,* 1989; Abate and Abiye, 1993; Getnet, 1999; Alemayehu, 2004).

Native pasture is the major source of feed for ruminants both in the area of mixed farming system and pastoralist, although it is neither quantitatively nor qualitatively adequate to support profitable animal production (Seyoum *et al.,* 1997). In addition, teff and wheat straws are also important sources of livestock feed in the highland vertisol areas. Barley and oat straws are also important in areas where they are produced. Straw supplementation is commonly restricted to work-oxen and lactating cows. At present, the production of improved pasture and forages is insignificant and the contribution of agro-industrial by-products is also minimal and restricted to some urban and peri-urban farms (Alemayeu, 2005). Molasses, obtained from the sugar industry in Ethiopia, is being used mainly by beef producers and to some extent by dairy producers in and around the major cities.

2.6. Mastitis

Mastitis is the most important and expensive disease of dairy industry (Alert, 1995). In dairy cattle it results in severe economic losses from reduced milk production, treatment cost, increased labour, milk withheld following treatment and premature culling (Miller *et al.,* 1993). It is recognized that if this disease is diagnosed in early stages, the greater portion of this loss can be avoided. It is undoubtedly the most important disease with which the dairy

industry is encountered. Mastitis is characterized by physical, chemical and bacteriological changes in the milk and pathological changes in the glandular tissue of the udder. The most important changes include discoloration, presence of clots and presence of large number of leukocytes. The bacterial contamination of milk from the affected cows render it unfit for human consumption and provide a mechanism of spread of diseases like tuberculosis, sore-throat, brucellosis, leptospirosis etc. and has zoonotic importance. Mastitis occurs when white blood cells (leucocytes), are released into the mammary gland, usually in response an invasion of bacteria of the teat canal. Milk secreting tissue and various ducts throughout the mammary gland are damaged due to toxins by the bacteria. Mastitis can also occur as a result of chemical, mechanical, or thermal injury. Globally the losses due to mastitis amount to about 53 billon dollars annually (Ratafia, 1987). Compared to developed countries mastitis is a major problem in the dairy industry of developing countries.

Definitions

- Sub clinical mastitis

No swelling of the udder is detected nor are there observable abnormalities in the milk. Special screening tests, however, such as the California Mastitis Test (CMT), Wisconsin Mastitis Test (WMT) and the catalyse test will show changes in the milk. This type of mastitis is referred to as "hidden."

- Clinical mastitis

Clinical mastitis was defined by the diagnosis of abnormal changes acute, local, and systemic in the body, udder and milk with concurrent decrease of at least 25% in daily milk production. Changes in the udder included pain, swelling, warmth, and abnormal appearance of milk e.g. watery, clots, flakes or blood.

2.6.1.Aetiology

Most commonly, mastitis begins as a result of penetration of the teat duct by pathogenic bacteria (Jubb and Kennedy, 1993). However, some viral diseases like Pseudo cowpox, Herpes Mamillitis, Cowpox, Papilloma, Foot-and-Mouth disease and Vesicular Stomatitis

affecting the epithelium of the teat orifice are mentioned to result in or predispose to mastitis (Hillerton *et al.,* 2001). Although variation exists on the type and isolation rate of mastitis pathogens from country to country, the most commonly incriminated and reported causes of mastitis include Staphylococcus aureus, Streptococcus agalactiae, Streptococcus species other than Streptococcus agalactiae, coagulase negative Staphylococci species, Escherichia coli, Micrococcus species, Corynebacterium species, Bacillus species, Pasteurella species, Klebsiella species, Mycoplasma species and Nocardia species (Sears *et al.,* 1991; Aarestrup *et al.,* 1995; Miltenburg *et al.,* 1996; Hussien *et al.,* 1997; Wilson *et al.,* 1997; Sergeant *et al.,* 1998; Workineh *et al.,* 2002). Wilson *et al.* (1997) collected milk samples from 108,312 dairy cows from 1991 to 1995 in New York and Pennsylvania and found that over 75% of the intra mammary infections were caused by Streptococcus agalactiae, other Streptococcus species, Staphylococcus auras and coagulase negative staphylococcus species. This result indicated that these pathogens were predominant causes of bovine mastitis.

2.6.2.Economic significance of mastitis

Assessing a dollar value to losses due to mastitis is nearly impossible, although several attempts have been made. From the literature 140-200 USD/cow/year is lost due to mastitis with approximately 8% being due to discarded milk, 8% treatment costs, 14% to death and premature culling, and 70% to reduced milk production (Woods, 1986). Investigation showed that annual milk sales from herds with high levels of sub clinical udder infection were 20% less than similar herds with low levels of sub-clinical mastitis (Francis, 1985). Various reports indicate substantial production losses (5% or more) begin when the somatic cell count/SCC/ increases above 300,000.The higher the cell count, the greater the loss and with a count of around 1x 106 creating a loss of approximately 20% or more (Woods, 1986). Sub clinical mastitis is the greatest source of economic losses. On average about 40% of all cows in the Study conducted in New York and Pennsylvania in 1997, indicated a financial milk loss per lactation as a result of specific pathogen based on 305-day mean estimate with a milk value of USD 13.00/cwt.

Ethiopia, there is limited information on the economic loss due to mastitis. However, the few data available indicate that the loss is significant. Mungube, (2001) estimated the economic loss from mastitis in the urban and peri urban areas of Addis Ababa. He used milk production losses, treatment costs, withdrawal and culling losses as parameters for calculating losses.

This loss was found to be 210.8 birr per cow per lactation. In this study, loss due to culling, milk loss, treatment, and withdrawal contributed 49%, 38.4%, 9.3% and 3.3% to the total mastitis losses, respectively. Milk production losses contributed 38.4% of the total losses, sub clinical mastitis contributing 94% and clinical mastitis 6% of the milk losses. Sub clinical mastitis contributed 36.1% of the total losses, which is primarily due to, reduced milk production. (Bishi, 1998) also reported the economic losses from clinical and sub clinical mastitis to be approximately 270 Ethiopian birr per cow per lactation.

3.MATERIALS AND METHODS

3.1. Study area

The study was conduct in Debre Zeit and the town is located about 45 kilometres south east of Addis Ababa. The altitude is about 1900 above sea level and at 8.44 ^{O}N latitude and 39.02 ^{o}E longitudes. The area has a modal rain fall pattern with a long rain season from June to October and short rain season from March to May. The average annual rainfall and average maximum and minimum temperature for the area are 1100mm, 28.3 ^{o}C and 8.9 ^{o}C, respectively, (DZARC, 2003).

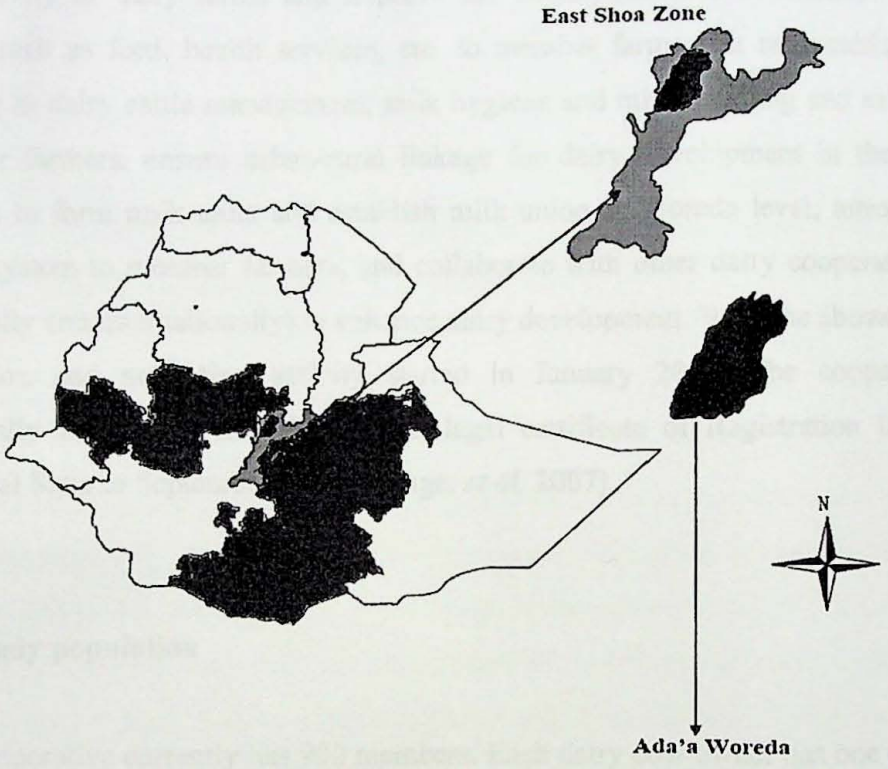


Figure 1. Map of the study area

Source: Ada'a Woreda Agriculture and Rural development office

3.2.Ada'a cooperative

The Ada'a dairy cooperative was established to respond to this huge demand-supply variation in milk and milk products in Addis Ababa is one of the major suppliers of milk and milk products to Addis Ababa city and represents two of the production sub-systems. These are composed of both the urban dairies in primary towns and peri-urban dairy farms in secondary towns. The cooperative was established in September 1998 with 34 founding members who purchased a single share of 100 Birr each and an additional Birr 10 for registration fee. The initial capital of the cooperative was only 3,400 Birr. The main objectives of the cooperative during its formation were to minimize the high transaction cost for the sale of milk and reduce price fluctuations over season, particularly during fasting, reduce wastage of products due to poor handling procedures and lack of processing facilities, increase production and productivity of dairy farms and improve the overall incomes of member farmers, supply inputs such as feed, health services, etc. to member farmers at reasonable prices, provide training in dairy cattle management, milk hygiene and milk handling and milk processing to member farmers, ensure urban-rural linkage for dairy development in the Woreda, assist farmers to form milk units and establish milk union at Woreda level, introduce saving and credit system to member farmers, and collaborate with other dairy cooperatives (nationally, regionally and internationally) to enhance dairy development. With the above objectives, milk collection and marketing activity started in January 2000. The cooperative, although informally established in 1998, got its legal certificate of Registration from the Oromia Regional State in September 2000. (Azage, *et al,* 2007)

3.3. Study population

The cooperative currently has 900 members. Each dairy cow owner has one or more lactating local, Holstein-Friesian and cross-bred cows. All members of the cooperative which had one and above one cross and/or local dairy cows in Debre Ziet and its surrounding area constituted the study population.

3.4.Study design

3.4.1. Sampling and sample size determination

The Ada'a Dairy Cooperative has a total of 900 members engaged in dairy farming. Our sample size considered 10% of the total that constituted 90 smallholder dairy farms.

To determine the study participants from the population first a list of members currently producing milk was obtained from the cooperative office. There were a total of 300 smallholders supplying milk to the cooperative at the time of this study. To get the study sample a systematic selection by considering every 3rd members from the sample frame list of the members. All lactating dairy cows in selected 90 farms was involved in the study to examine clinical and sub clinical mastitis.

3.5. Data collection

A cross-sectional survey by way of questionnaire, farm visit, animal examination and CMT test were conduct from September 2011 to April 2012.

3.5.1.Questionnaire survey

The questionnaire was semi-structured closed type for its major part was pre-tested prior to it full administration. The questionnaire focuses on information regarding farm attributes and cow attributes. The cow attributes include age, parity, previous history of mastitis, teat lesion, thick infection and other relevant information related farm attributes include herd size and herd structure, farm hygiene and hygienic practices before, during and after milking, management (feed resources and feeding system, water source and watering frequency, husbandry and herd health problems) and reproduction (breeding system, major productive and reproductive performance, major dairy cattle health problems). Data on labour source (family labour versus employee), recording systems and culling reason were collected.

3.5.2. Farm visit

A one time farm visit simultaneously with the questionnaire survey was conducted in each study farm. Production factors inspected/measured during the farm visits were housing condition; drainage system of the barn, ventilation, cleanness of the barn, feed storage condition, milking hygiene practice and space for manure disposal.

3.5.3. Animal examination

Udder attachment, parity number, any physical abnormalities such as swelling of the udder, presence of teat lesions, anatomical malformations and tick infestation on the udder were recorded. The milk was examined for its colour, odour consistency.

The Body Condition Scoring (BCS) was determined according to (Richard, 1993) standards for scoring body condition of cross bred cows is indicated in (Annex 1).

3.5.4. CMT screening

CMT test was conducted in all milking cows of each household. The California Mastitis test was carried out according to the method described by (Quinn *et al.*, 1999). The time choose for milk sample collection was before milking udder especially teats was cleaned and dried before sample collection. Teats were dip with 70% ethyl alcohol and allow drying for at least 30 seconds before the milk sample was collected. A separate pledge of cotton was used for each teat .The first few stream of milk was discard and squirt of milk, about 2 ml from each quarter were placed in each of four shallow cups in the CMT paddle. An equal amount 2 ml CMT of the commercial reagent was added to each cup. A gentle circular motion was apply to the mixtures, in a horizontal plane for 15 seconds. Then the result was score from Grade 0-3. Score 0 (Negative or milk fluid and normal), Score T (Trace or slight (minor) precipitation), Score1 (Weak positive or Distinct precipitation but no gel formation) Score 2 (Distinct positive or Mixture thickens with gel formation) and Score 3 (Strong positive or Viscosity greatly increased and strong gel formation). CMT result interpretation format for sub clinical mastitis is indicated in (Annex 2).

Categories of variables measured or inspected

Data on each sampled cow was collected, variables considered were age, parity, stage of lactation, (early, middle and late), quarter location (front/rare), body condition score, lactation stage, the presence or absence of tick or lesion on udder skin or teat. The stage of lactation was categorized in three levels as 1- 90 days post partum (early lactation), 91- 180 days (middle lactation) and days greater than 181 (late lactation). Body condition score was grouped in to 6 based on standards for body condition scoring of lactating cows. Age of the animals determined from by interviewed the farm owners and categorized as young adult (2.5 to 5 years), adult (6-8 years) and, (above 8 year). Parity was also categorized as few (< 3 calves), moderate (3-5 calves) and many (>5 calves). Additionally, management factors such as housing and milking were recorded.

3.6. Statistical analysis

The data collected on qualitative as well as quantitative variables was coded, edited and entered into Microsoft Excel (MS-Excel, 2007) computer program and was analyzed for descriptive statistics using (SPSS 2007) version 16 statistical software. Odds ratio (OR) was calculated to assess the risk levels of categories under each risk factor as the ratio of the odds of disease occurring among cows exposed to a factor and the odds of disease occurring among cows not exposed to a factor. Chi square test and correlation were used to see the possible association and correlation of animal factors and husbandry practices with mastitis prevalence with 95% confidence interval and 5% degree of freedom that is, P value of less than 0.05 is consider to be significant.

4. RESULT

4.1. Demographic characteristics of smallholder dairy farmers

Among the investigated households (24.4%) were female headed while the remaining (75.6%) respondents were male headed households. The average age of the household heads were 51.92 years (51.92±12.652) and it ranged from 27 - 80 years. The average family size was 6.27± 2.374 person per household; females were slightly outnumbering males (3.33 females to 3.07 males). Family compositions in sex and age categories were presented in (Table 3).

Table 3. Family size and family age structure of sample households in Ada'a dairy cooperative

Variables	N= 90		
	Minimum	Maximum	Mean+ SD
Family size	1	12	6.27±2.374
Female	1	9	3.33±1.854
Male	1	7	3.07±1.445
Age structure			
<15 years	1	9	1.74±1.224
16 – 60 years	1	10	4.42 1±1.993
> 60 years	1	3	1.29±0.524

SD= standard deviation, N = number of respondents

Majority (36.7 %) of the respondents were literate who attend Secondary school, (21.1%) elementary school, (6.7%) above secondary however, (24.1%) and (11.1%) were illiterate and read only, respectively.

Members of the cooperative, who are living in Debre Zeit (Bishoftu) town, have no access to grazing and plantation of improved animal feeds whereas few respondents (13.3 %) who are living in the peri-urban areas (Kebele 15) have on average 0.13 hectare for crop and 0.03 hectare for improved forage.

Majority of the respondents were primarily involved in milk production (55.6 %) and use milk production as a main income source and 44.4 % use as an additional income. Only (3.3 %) used crop farming as a main occupation. Most participants (57.8%) had a long time dairy experience >10 years and only (1.1%) had 1-3 year in milk production with a maximum of 45 years. The main occupation and dairy experience of the respondents were described in (Table 4).

Table 4. Main occupation and dairy experience of the respondents in Ada'a dairy cooperative (%)

Variables	N	%
Main Occupation		
Crop farming	3	3.3
Mixed farming	9	10
Dairy production	50	55.6
Civil servant and NGO employers	22	24.4
Small trade	6	6.7
Total	90	100
Dairy experience		
1 -3 year	1	1.1
4 – 6 year	14	15.6
7 – 10 year	23	25.6
> 10 year	52	57.7
Total	90	100

N= number of respondents

4.2. Livestock holding

Average live stock composition of the house holds were reported in (Table 5). The average number of cattle per household was 5.64, with minimum and maximum of the 1 and 26, respectively. The average numbers of crossbred cows were 3.12 $\pm$ 2.374 per household.

Table 5. Average herd structure and composition per households in Ada'a dairy cooperative

(N=90)

Type of livestock	Minimum	Maximum	Mean	SD
Crossbred cow	1	15	3.12	2.374
Crossbred heifer	1	9	1.68	1.350
Crossbred bull	1	2	1.31	0.480
Crossbred calf	1	6	1.60	1.010
Sheep	1	15	5.06	4.130
Local oxen	2	6	2.89	1.537

N= number of respondents, SD= standard deviation

4.3. Animal husbandry and management system

4.3.1. Labour use and animal husbandry

Division of labour among family members with respect to cattle husbandry in Ada'a dairy cooperative described in (Table 6). Family members were the major source of labour to households; Milking was done mainly by wife (39.2%) Moreover, cleaning barn (39.2%), caring calf (41.65 %) and stall feeding of animals (37.6%) were undertaken mostly by wife. Breeding decision, purchasing and selling cattle were performed by husband and wife. Females had good participation in decision making of house hold affairs. 47.6% and 42.15% of male and female were participated on purchasing cattle respectively.

Table 6. Division of labour among family members in Ada'a dairy cooperative (N= 90)

	Responsible family members (%)				
Activity	Husband	Wife	Son	Daughter	Hired
Barn Cleaning	9.7	39.2	14.8	11.1	25.1
Calf rearing	10.05	41.65	11.50	11.65	24.7
Animal feeding	12.2	37.6	12.85	11.94	25.5
Milking	11.55	39.5	9.05	10.4	28.6
Breeding decision	43.7	39.85	9.85	3.3	3.3
Purchasing cattle	47.6	42.15	6.50	3.3	-
Selling cattle	47.6	44.85	5.35	2.2	-

(44.4%) and (26.7) respondents were cleaned the barns two and three times a day respectively. However 22.2 % and 5.5 % were cleaned the barn one time and more than three times a day respectively.

4.3.2. Housing practices

The purpose of housing was to protect cattle from extreme weather conditions. Most of the respondents (98.9%) had animal barns and only (1.1%) not practiced any housing, only use simple enclosure for new born calves. Majority of milk producers reported that they kept their crossbred cattle in isolated pen (77.8 %) and (21.1 %) simple fenced type of house.

Floor, roof and wall types of barns in Ada'a dairy cooperative were reported in (Table 7). Most barns constructed from concrete floor (67.8%). The major roof type was corrugated iron sheet 88.9% and 66.7%.of the wall was made from plastered with mud. From farm visit 36.7% of barns were properly cleaned; the cows are free from bedding of manure on their udder and other body parts, there is no extreme bad odder on the barn and feed residue and manure properly remove. The drainage systems of 38.9% barns were constructed properly and can easily remove urine and manure and keep the animal space dry and there was no accumulation of manure on the space that the cows were lay down.

Table 7. Floor, roof and wall type of barns in Ada'a dairy cooperative

Variables	N	%
Floor type		
Concrete	61	67.8
Stone	20	22.2
Soil	8	8.9
Roof type		
Corrugated iron sheet	80	88.9
Grass	5	5.6
Plastic	3	3.3
Wood	1	1.1
Wall type		
Concrete	9	10.9
Mud	60	66.7
Open type	4	4.4
Corrugated iron sheet	12	13.3
Concrete& semi open	2	2.2
Wood	1	1.1
Plastic	1	1.1

N= number of respondents

4.3.3. Feeding and watering practices

All participants (100%) used stall feeding, major sources of feeds for cattle in Ada'a dairy cooperative were concentrate, hay, crop-residues, poultry waste and non-conventional feed stuffs such as '*atella*'/brewery by-product from locally produced '*tella*'. Concentrate, crop residue and poultry waste were the first (63.3%), second and third (32.2 %) ranked feed types respectively. Only 24.4% of the respondents practiced hay as animal feed source. 2.2 % respondents were plant improve forage (Alfalfa and Elephant grass) respondents who living in peri urban of the district. Animal feed type and crop residue source in Ada'a dairy cooperative were reported in (Table 8).

All respondents (100%) purchased concentrate feeds from feed processing factory, large feed processing farm (Alema) and the cooperative (Ada'a dairy cooperative) in Debre Zeit town. Most of the respondent (86.7 %) purchase crop residue from farmer and only dairy producers who live in peri urban of the town (13.3 %) (Kebele 15) cultivating different crops and used crop residues as an animal feed source.

Crop residue was the second feed source of dairy cows in addition to concentrate feeds, all participants used crop residue as a major feed for all age class of cattle (lactating, dry cows, bull and calves). The availability and cost of crop residue vary in season and it associated with farmers' crop harvesting time. The respondents ranked crop residue source based on availability in the market or access of supplying by farmers. The first (98.9%), second (43.3%) and the third (14.4%) rank of crop residue sources were wheat, barely and *teff*, respectively. Most of the respondents (58%) treat the crop residue through mixing with concentrate and (32%) feeding crop residue without treatment or given finally after feeding concentrate in dry form.

Table 8. Animal Feed type and crop residue sources in Ada'a dairy cooperative (N= 90)

Variables	Ranks							
	1		2		3		4	
	N	%	N	%	N	%	N	%
Feed type								
Concentrate	57	63.3	29	32.2	3	3.3	1	1.1
Crop residue	33	36.7	57	63.3	-	-	-	-
Poultry waste	-	-	1	-	29	32.2	6	6.7
Brewery by-product	-	-	1	-	8	8.9	5	5.6
Hay	-	-	-	-	19	21.1	3	3.3
Crop residue source								
Wheat	89	98.9	1	1.1	-	-	-	-
Barely	-	-	39	43.3	6	6.7	-	-
Teff	1	1.1	27	30	13	14.4	-	-
Oat	-	-	1	1.1	3	3.3	-	-

N= number of respondents

About 70 % the respondents reported that feed shortage was major problems for milk production, after a few years ago feed shortage become a serious problem in Debre Zeit (Bishoftu) town and the problem raise from time to time. (45.6 %) of respondent reported that feed shortage was a serious problem through out the year and some (25.6 %) respondents reported that September – December was the main feed shortage period associated to feed shortage small holders mitigated through purchase of concentrate (72.7%), conservation of crop residue (7.2%), and feeding vegetable by product (1.1%). From farm visit observation respondents used different types of feeding trough and watering utensils, most of them used concrete, plastic and wood. About 27.8% of the respondents had clean feed trough.15.6% have medium type and 28.9 % was poor. Majority of diary farms (75%) have good feed storage system; the feed was stored on a dry condition in the house/shade and separate from other household materials.

Water source and watering frequency

Watering frequency of cross bred cows' was shown in (Table 9). All respondents (100%) use pipe water for hygienic and watering of animals. 97.8 % of the milk producers were watering

their animals in different frequency and 2.2 % given water in the form of liquid feeds (mixed *atella*, concentrates, crop residue and water). Above 52% watered their cross bred cows two times a day both in dry and wet seasons respectively. some (8.9%) of milk producers in Kebele 08 reported that water scarcity is one problem for dairy production, and the respondents get water only in the midnight both in dry and wet seasons.

Table 9. Watering frequency of dairy cows in dry and wet per day in Ada'a dairy cooperative (%)

Frequency of watering	Dry period		Wet period	
	N	%	N	%
Once a day	21	23.3	25	27.8
Twice a day	47	52.2	48	53.3
Freely (adlibitum)	2	2.2	1	1.1
every two day	1	1.1	1	1.1
every three day	2	2.2	2	2.2
Three times a day	15	16.7	11	12.2

N= number of respondents

4.3.4. Breed and breeding system

All sample house holds had at least one cross breed cows; most respondents were purchased from dairy farm (63.3 %) and from ILCA (22.2%), market (8.9%) and ILRI (5.6%). Most of the respondents were replaced their herd through its own farm (85%) and some proportions 5.6% replace by purchase and about 8.9% replaced through purchasing and from own farm. Milk producers used two types of breeding methods, the type of breeding method and source of bull are shown in (Table10).The majority of the respondents (51.1 %) prefer artificial insemination because of lack of bull service, lack of labour and to avoid transmission of reproductive diseases from the breeding bull at the time of mating and reduce the cost, labour and space for managing breeding bull only 11.1% of members used cross bull and 37.8% both AI and cross bred bull.

About 5.6 % of the study participants had breeding bull however; most respondents (44.4 %) were getting service from open mating. All households getting AI service from Ada'a dairy cooperative, Associated to AI service respondents reported that the main problems were lack of access of the service at the necessary time, non-effectiveness of the service.

Table 10. Reproduction methods and bull source in Ada'a dairy cooperative

Variables	N	%
Reproduction method		
AI	46	51.1
Cross bull	10	11.1
AI and cross bull	34	37.8
Bull source		
Own	5	5.6
Neighbour	4	4.4
Open mating	36	40

N = number of respondent

4.3.5. Calf management

Calf rearing practice is one of the most important husbandry practices, which sustain milk herd through supplying replacement stock. Separation of new born calves were not a common practice; from the total participants only 30% had a separate calf pen, majority (70%) were kept their calves on one corner of the main barn among other large cows. There were two types of calf feeding; bucket feeding and suckling. Most respondents separate new born calf immediately after calving and given the colostrums and milk through bucket however, some of them left one or two teats for the calf. From the total respondents' majority (81 %) of the participants exercise bucket feeding, (13.3%) suckling and (4.4%) both bucket feeding and suckling. All study participants had given adaptation (supplementary) feed after two weeks of calving (Wheat bran, crop residue, and hay).

The average weaning age of the female calf was 3.07±1.022 months with the minimum and maximum of 1 and 6 months respectively. Before weaning the female calf consumed an average 3.26 ±1.140 litre per day with the minimum and maximum of 1 and 6 months respectively. All participants give different feeds (wheat bran, crop residue, and hay) two weeks after calving.

4.3.6. Milking practices

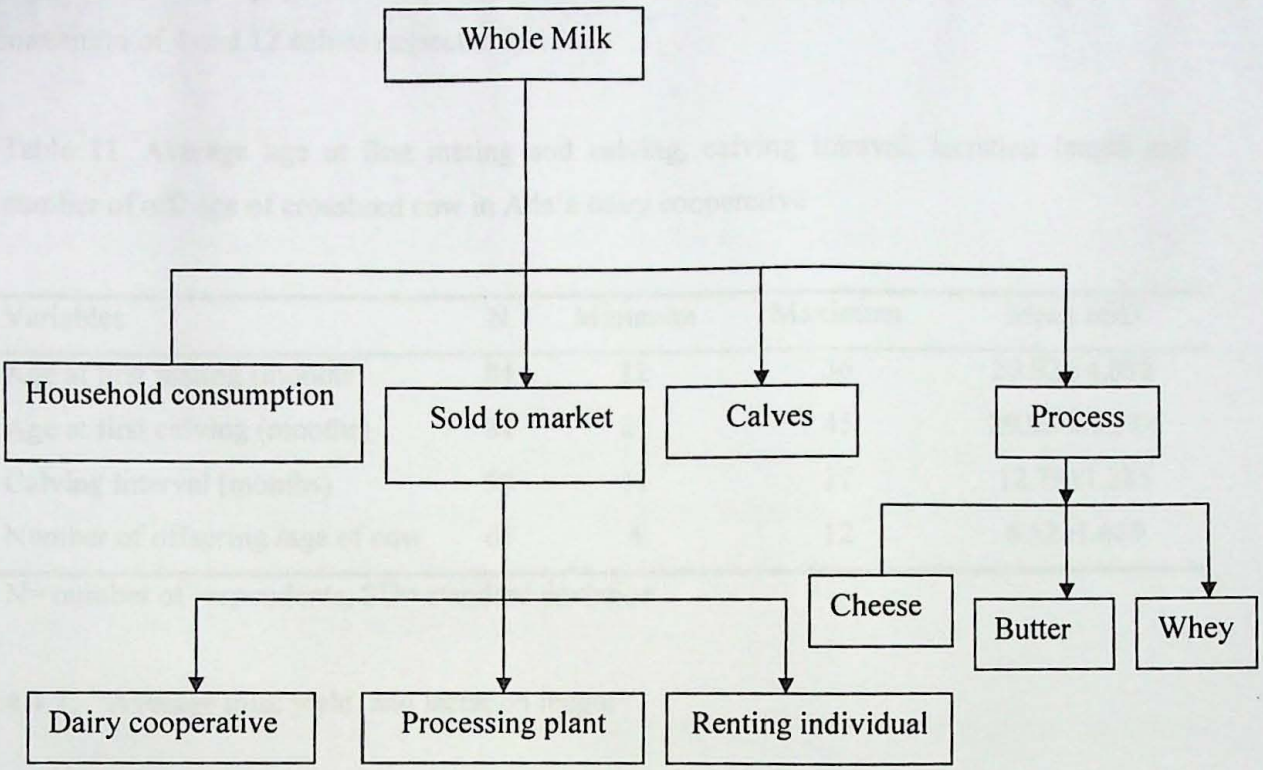
All study participants were used hand milking and milking frequency was two times a day at early morning and early evening. Washing and drying of teat before and after milking is one of hygienic practices in dairy production. About 98.9 % of the respondents reported that the milker washed the cow teat before milking and 1.1 % of the respondents had not teat washing before milking due to water problems. However, in most diary farms milkers not followed proper milking procedures, after milking no respondents' practiced washing and dipping the teats through disinfectant. Furthermore, most of the respondents no practice of milking mastitis cow at the last order of milking. Only 10% of the respondents milking mastitic cow at last order and 45.5% of milking without any order and 30% of the respondents report during milking milkers wash their hands between cows, 55.6% without hand washing between cow and about 14.4 % respondents had only one cow in the dairy farm.

Milk producers were washed the teats on milking cows through cold water, warm water and both cold and warm water (46.7 %), (34.4 %) and (17.8%), respectively. There was no a trend on teat and hand drying before milking by most milk producers, only (10%) milk producers' exercise teat drying before milking however, all study farms which practiced teat drying milkers used the same towel for all lactating cows. Majority of the respondents (90 %) used plastic utensils, (6.7%) aluminium and (2.2%) both aluminium for milking and transporting milk. About 91.1 % of the respondents cleaned the milking and transporting materials with Detergent and cold water (8.9%) with Detergent and warm water. Smoking of milking and transporting equipments was not usual practice in milk producers however; about 30% of the respondents smoked milk storage and processing equipments when only used milk for household consumption, the type of plant used as a smoking was known as *woyra*.

Milk utilization pattern of the respondents are described in (Figure 2). All (100%) study households were primarily produced milk for sell however; from the total 73.3 % of the respondents utilize milk for supply to dairy Cooperative, for calf and house hold consumption, 18.9 % for supply dairy Cooperative and calf. (6.6%) deliver for processing plant, dairy cooperative and for calf, and (1.1%) only for dairy cooperative. From the total participants only 3.3 % processed milk in to milk products such as butter, cheese and whey, and sold butter and cheese for the consumers.

The dairy cooperative had 13 milk collection centres in both urban and peri urban thus members supply milk on the nearest milk collection centre. Most of the respondents (46%) were going a short distance to transport milk (10 – 100 m), 26% medium distance (101 – 200 m) and 18% long distance (> 200m). Most participants transport milk through human labour however, few respondents who supply large amount of milk used simple hand cart to transport milk in to the collection centre.

Figure 2. Flow diagram of milk utilization pattern in Ada'a dairy Cooperative



4.4. Reproductive and productive performances

4.4.1. Reproductive performance

The average ages at first mating, calving of crossbred cows, calving interval, Lactation length and number of offspring / life time are shown on (Table 11). From the milk producers 84 were known the age at first mating and calving of their dairy cows because they purchase after calving calves. The households reported that the average age at first mating (AFM) and

average age at first calving (AFC) of crossbred cows were and 20.82± 4.078 and 29.93 ± 3.914 months respectively. Weaning age and amount of milk consumed before weaning had not statistically significant association (r = 0.068, P= 0.441, P = 0.42, r = -0.9) with Age at first mating (AFM).The average calving interval (CI) of cross bred cows was12.79± 1.285 months.

The average lactation lengths of crossbred cows in Ada'a dairy cooperative was 10.67±1.24 months with the minimum and maximum of 9 and 15 months respectively. From 90 respondents about 60 were culling their dairy cows on the dairy experience. The mean number of offspring per life time of crossbred cow was 6.52 with the minimum and the maximum of 4 and 12 calves respectively.

Table 11. Average age at first mating and calving, calving interval, lactation length and number of off/ age of crossbred cow in Ada'a dairy cooperative

Variables	N	Minimum	Maximum	Mean ±SD
Age at first mating (months)	84	12	36	20.82± 4.078
Age at first calving (months)	84	21	45	29.93 ± 3.914
Calving interval (months)	90	11	17	12.79±1.285
Number of offspring /age of cow	61	4	12	6.52±1.689

N= number of respondents, SD= standard deviation

4.4.2. Average milk yield and lactation length

As indicated in table 12, an average amount of milk yield /day at first, second, and third lactation stages were 16.06±3.967 litre, 11.51±3.623 litre and 5.43±2.171 litre, respectively. The overall cow milk yield/day was 11.17± 2.902 litres. The average lactation length of dairy cows was 10.67±1.24 months.

Table 12. Reported daily milk yield and lactation length of cows in Ada'a dairy cooperative

	N= 90		
Stage of lactation	Mean ± SD	Minimum	Maximum
peak period milk production(lit)	16.06±3.967	5	25
mid period milk production (lit)	11.51± 3.623	5	24
lean period milk production (lit)	5.43 ± 2.171	2	13
Average (lit)	11.17±2.902	4	19
Lactation length (months)	10.67±1.24	9	13

N= number of respondents, SD = standard deviation

4.5.Common diseases

Major animal diseases in Ada'a dairy cooperative are summarized in (Table 13). The first (41.1%) and second (22.2%) major health problems ranked by respondents were mastitis and lumpy skin disease respectively.

Majority of respondents (98.9 %) used private health service, 1.1 % owners, all respondents had not periodical health follow up, 100 % of the participants getting health service when animals' sick, vaccination and calving problem. The cooperatives give the AI and vaccination (vaccine purchased by milk producers),

Dehorning was practiced by only 12.2% of participants. Only 5.6% respondents' practiced hoof trimming but, the majority (94.4%) had not hoof trimming practices hence, lameness was shown on 15.6% dairy farms (On 16 dairy cows). Tick infestation was not a problem on most dairy farms, only on 2.2 % farms tick problem was shown.

Table 13. Prevalence of dairy animal diseases in Ada'a dairy cooperative

Variables	Ranks					
	1		2		3	
	N	%	N	%	N	%
Mastitis	37	41.1	5	5.6	1	1.1
Hypocalcaemia	15	16.7	3	3.3	4	4.4
Lump skin disease	11	12.2	20	22.2	2	2.2
FMD	4	4.4	7	7.8	5	5.6
Reproductive problem	3	3.3	5	5.6	2	2.2
Lameness	-	-	2	2.2	1	1.1

N= number of respondents

4.6.Culling practices

From the total respondents 77.8 % of households had culling practice. Age and disease were the first (30%) and second (13.3 %) ranked culling reasons milk producers of their cross bred cows respectively (Table 14).

Table 14. Culling reasons of cross bred dairy cows in Ada'a dairy cooperative

Culling reasons	Ranks					
	1		2		3	
	N	%	N	%	N	%
Age	27	30	12	13.3	3	3.3
Disease problem	24	26.7	12	13.3	2	2.2
Lack of Place	8	8.9	5	5.6	3	3.3
Production loss	4	4.4	5	5.6	1	1.1
Reproduction problem	6	6.7	5	5.6	3	3.3
Labour shortage	2	2.2	-	-	-	-
Feed shortage	2	2.2	2	2.2	-	-
Financial requirement	-	-	2	2.2	2	2.2

N= number of respondents

4.7. Record keeping

Record keeping in modern dairying is an importance scheme for any decisions making and to assess the profitability of the dairy farm. Most of the respondents were literate and at least

they can record the necessary productive and reproductive performance of the dairy cattle and give appropriate decision. However, only 16% of respondents had record keeping schemes, they record some reproduction parameters such as mating day, calving date using informal sheets.

4.8. Waste management

About 81.2% of the respondents used manure as a fuel; however, (11.1%) use electric power through biogas. Few houses holds (6.7%) fuel and fertilizer and only (1.1%) used as a fertilizer. As indicated in table 25, lake of space was the second rank milk production problem in the study area to undertake different dairy activity. One of the important issue in the study area was lack of waste disposing space, most of the respondents (58.9%) had not adequate space for disposing of manure and urines because most of the respondents had very small land, it is difficult to manage milk production in small land at this reasons the milk producers had not to collect manures properly from the surrounding of the barn. According to the respondents the problem becomes aggravate during summer because of rain fall they can not manage wastes and cause a conflict with the neighbours.

4.9. **Prevalence study**

A total of 217 lactating cows were tested for mastitis using CMT and 521, 60, 85, 124, and 47 quarters were negative, trace, weak positive, distinct positive and strong positive respectively.

Prevalence of mastitis at cow level was 60.8% (132 animals out of 217) out of which clinical and sub clinical cases were 15.2 %(33 cows out of 217) and 45.6 %(99 cows out of 217), respectively. Total prevalence of mastitis at quarter level was 40 % (347/868) out of which sub clinical was 36.4 %(316/868) and clinical 3.6 % (31/ 868). Out of 868 quarters examined, 31(14.2 %) were blocked (Table 15).

Table 15. Prevalence of clinical and sub clinical mastitis at cow and quarter level of cross breed lactating cows in Ada'a dairy cooperative.

	Cross bred cows			
Types of mastitis	No. of cows examined	positive	Negative	Prevalence %
Sub clinical mastitis	217	99	85	45.6
Clinical mastitis	217	33	184	15.2
Overall prevalence	217	132	85	60.8
Quarter level	868	347	521	40

The quarter level of mastitis prevalence was high in right rear (43.2 %) and right front quarter (41.5 %) than left rear (37.7 %) and left front (35.4 %), the prevalence of mastitis in quarter level is described in (Table 16).

Table 16. Prevalence of mastitis in quarter level in Ada'a dairy cooperative

Mastitis test result	Quarters							
	RF		RR		LF		LR	
	n	%	n	%	n	%	n	%
Negative	127	58.5	123	56.7	136	62.7	135	62.2
weak positive	20	9.2	27	12.4	21	7.7	17	7.8
distinct positive	34	15.7	30	13.8	27	12.4	33	15.2
strong positive	8	3.7	12	5.5	14	6.5	13	6
Trace	21	9.7	16	7.4	14	6.5	9	4.1
Blind	7	3.2	9	4.1	5	2.3	10	4.6
Total	217	100	217	100	217	100.0	217	100.0

RF= right front, RR= right rear, LF= left front, LR= left rear and n= number of teat quarter

Prevalence of mastitis varied significantly in teat lesion (χ^2 = 24.17, P = 0.000), udder swelling (χ^2= 20.7, P = 0.000) and previous exposure of mastitis (χ^2= 13.1, P=0.000) (Table 17). All examined animals with teat lesion and udder swelling are positive for mastitis. Thus both factors have significant effect on occurrence of mastitis. Cows having previous exposure to udder infection were 4.2 times more likely (OR= 4.2) to be re-infected than those never exposed.

Table 17. Association between teat lesion, previous history and udder swelling with occurrence of mastitis in ada'a dairy cooperative

Risk factor	No. of cows examined	Total positive	%	χ^2	p- value	OR(95%CI
Teat lesion				24.17	0.000	
Present	32	32	100			-
Absent	185	100	54.1			-
Total	217	132	60.8			
Previous history				13.1	0.000	
Exposed	48	40	83.3			4.2(1.82, 9)
Not Exposed	169	92	54.4			1
Total	217	132	60.8			
Udder swelling				20.7	0.000	
Present	28	28	100			-
Absent	189	104	55			-
Total	217	132	60.8			

OR= odds ratio

There was significance association (χ^2 = 1.813, P= 0.04 and χ^2 = 7.203, P=0.027) between age group and parity to mastitis occurrence respectively. Older cows 2 times greater risk in developing udder infection (OR, 2; CI = 0.7, 5.4) than in younger cows (OR, 1.0); and in cows with many calves (OR = 4 CI = 1.6, 10.6) than in those with moderate calves (OR, 1.0), (Table 18).

Table 18. Association between age and parity with occurrence of mastitis in adaa dairy cooperative

Risk factor	No. cows examined	Total No. cow positive	Total %mastitis positive	χ^2	P-value	OR(95%CI)
Age				1.813	0.04	
Young (2.5-5yr)	117	69	58			1
Adult (6- 8 yr)	68	42	61.7			1.1 (0.37, 3.3)
Old (>8 yr)	23	17	74			2 (0.7,5.4)
Total	208	128	61.5			
Parity				7.203	0.027	
Few(< 3 calf)	106	68	64.1			1.8(1, 3.4)
Moderate(3-5 calf)	72	36	50			1
Many (> 5 calf)	30	23	76.7			4(1.6, 10.6)
Total	208	127	61.5			

OR= odds ratio.

Prevalence of mastitis showed significance variation with regard to body condition scores on a scale of 1 to 5. Higher prevalence was found in cows with a body condition score 1, while the lowest prevalence was found in cows with body condition score of 2. Prevalence of mastitis varied significantly in body condition score (χ^2: 1.015; P= 0.002). Cows with body condition score 1 were 2 times more likely (OR= 2, CI = 0.5, 8.2) to be infected in mastitis than those cows in body condition 2 (OR=1). A statistically no significance association (χ^2: 0.91; P = 0.634) was found between lactation stage and mastitis prevalence, with higher prevalence in cows with relatively mid and late lactation stage for 63.3% and 61.1 % lactation. The association between body condition score and lactation stage reported in (Table 19)

Table 19. Association between body condition score and lactation stage with occurrence of mastitis in ada'a dairy cooperative

Risk factors	No. animal examine	Total No. animals positive	Total positive %	χ^2	p-value	OR(95% CI)
Body condition Score				1.015	0.002	
1	11	8	72.7			2 (0.5, 8.2)
2	72	42	58.3			1.0
3	122	74	60.6			1.1 (0.6, 2)
4	12	8	66.7			1.4 (0.4, 4.5)
Total	217	132	60.8			
Lactation Stage				0.912	0.634	
Early (1-90 days)	30	16	53.3			1
Mid (91-180 days)	79	50	63.3			1.5(0.8,2.7)
Late (>181days)	108	66	61.1			1.4(0.7, 2.7)
Total	217	132	60.8			

4.8. Constraints and opportunities

4.8.1. Constraints to milk production

As indicated as in table 26 respondents ranked that feed, space and AI service were the first (55.6 %), second (17.8%), third (12.2 %) milk production constraints in this study. Major constraints of milk production in Ada'a dairy reported in (table 20)

Table 20. Major constraints of milk production in Ada'a dairy cooperative (N= 90)

Major constraints	Ranks							
	1		2		3		4	
	N	%	N	%	N	%	N	%
Feed shortage	50	55.6	19	21.1	2	2.2	1	1.1
Lack of Space	19	21.1	16	17.8	2	2.2	1	1.1
Lack of Health service	15	16.6	8	8.9	6	6.7	7	7.8
Lack of AI service	5	5.6	7	7.8	11	12.2	2	2.2
Low Milk cost	2	2.2	5	5.6	3	3.3	15	16.6
Lack of Labour	-	-	4	4.4	3	3.3	-	-
Disease problem	8	8.9	7	7.8	3	3.3	1	1.1
Health service cost	-	-	-	-	5	5.6	2	2.2
Scarcity of Water	5	5.6	1	2.2	1	1.1	1	1.1

N= number of respondents

4.8.2.Opportunities of milk production

The respondents reported that even though there were many problems associated to urban dairy production they have opportunities for milk producers in DebreZeit. Most respondents (55.5%) reported that the opportunity of milk production is the establishment of the dairy cooperative in Debre Zeit (Bishoftu) town, members in urban and peri urbans of the district supply milk at any seasons even during the fasting period so; there was no market problem through out the year. In addition to Ada'a dairy cooperative processing plants purchased milk however, the households confirmed that associated to milk marketing milk cost was one factors for development of milk production. The members were Supply milk for the cooperative by 7.00 birr per litter so; they have not gain a good profit from dairy production.

About 22.2% of the respondent reported that milk production opportunity in Adaa Diry Cooperative is distance of milk collection centre; due to the opening of milk collection centres(13 collection centre) most of them are supplied their milk to the nearest milk collection centre without travelling a long distance, this may save time, labour of the milk producers.

5. DISCUSSION

Among the investigated households (24.4 %) were female headed while the remaining (75.6%) respondents were male headed households. The result is in agreement with Sintayehu, *et al.*, (2008) in Shashemene –Dila, southern Ethiopia, The role of education is obvious in affecting household income, adopting technologies, demography, health, and as a whole the socio-economic status of the family as well (Kerealem, 2005). Most (36.7 %) of the respondents were literate who attend Secondary school, (21.1%) elementary school and (6.7%) above higher education. According to Sintayehu, *et al.*, (2008) in Shashemene –Dila, southern Ethiopia, with respect to educational status of the household head, the majority of urban dairy producers were literate beyond elementary school. The average family size per house hold in Ada'a dairy cooperative was 6.27 persons per family. The present result is smaller than Asaminew, (2009) who found an overall mean size of 7.71 persons per family in Mecha and Bahir Dar Zuria districts and (Solomon, 2004) who found that the overall mean household size in Bale highlands to be 8.73 persons per household. However, higher than the national average (5.2), reported by (CACC, 2002). In this regard, the smallest family size reported in this study has a negative implication on the labour sources of dairy activities. In contrast, this result also nearest to what Kedija, (2008) has found, i.e., an overall mean family size of 6.62 in Meiso district in Eastern Ethiopia

The average age of the household heads were (51.92±12.652) years and it ranged from 27-80 years. This study is in agreement to the finding of Eshetu, (2008) who found the average age of house hold 51 years in Ada'a dairy cooperative. According to the respondents about 55.6 % members of the cooperative used milk production as main income source, Mulisa, *et al.*, (2011) reported that in Bihoftu town; livelihoods of 68.1% of interviewed smallholder dairy farmers solely depend on the income they generate from dairy sector. This result shows that due to different milk production factors (high feed cost, lack of space and low milk price) the sustainability of milk producer in dairy production may become decrease therefore; milk producers may find other job opportunity to increase the household income and/ or the previous study was done on Bishoftu it includes both members and other non member milk producers this may the reasons of why the present study is less from the previous once.

Most participants (57.8%) had a long time dairy experience >10 years. Similar study by Sintayehu, *et al.*,(2008) in Shashemene –Dila, southern Ethiopia, reported that the majority of dairy farms were established about 15 years ago, and the proportion of farms established during the last 6–10 years in the rural areas of Shashemene, Awassa, and Dilla areas were 32, 20, 24, and 27.6%, respectively. The present study indicated that majority of the study participants had long years of dairy experience, this may create good awareness about improved milk production system; husbandry and milking practices and other related practices to make decision appropriately.

Average numbers of crossbred cows were 3.12 $\pm$ 2.374 per household is greater than Adebabaye, (2009) in Bure district, the average numbers of crossbred cows were 2.6 per household and less than Asaminew, (2007) what average number of cows/household reported in Bahir Dar Zuria (10.32 cows) and Mecha (9.37).The average cross bred number in this study is less compare to the previous study this may due to increase of urbanization the lands become over crowded and difficult to disposing of wastes and storing feeds properly and lack of labour because of this respondents may can not enlarge the herd size.

In this study family members were the major source of labour to dairy activity. Similar report by Sintayehu, *et al.*, (2008) in Shashemene –Dila, southern Ethiopia and Yoseph *et al.*, (2003) in Addis Ababa, most smallholder dairy production systems of Ethiopia, family members are the major source of labour for any dairy activities. Emebet and Zeleke, (2008) in lowland areas of Eastern Ethiopia reported that in lowland areas of eastern Ethiopia also emphasized that the management and labour source in SSDP were largely from family.

Breeding decision, purchasing and selling cattle were performed by husband and wife. Females had participation in decision making of house hold affairs. On purchasing and selling of cattle female participation were 42.15% and 44.85% respectively. According to Yoseph *et al.*, (2003) in Addis Ababa and Sintayehu, *et al.*, (2008) in Shashemene –Dila, southern Ethiopia cattle purchasing, selling and breeding activities were mainly operated by adult males. The good participation of females in dairy activity may due to 24.4% of dairy farms were female headed they were single, divorced, widowed females can decide on dairy activates and household affairs by themselves in addition most of them are educated (36.7%) and may have access to get trainings on gender this may increase female participate in the study area.

Milking was done mainly by wife (39.2%). This finding is in agreement to the findings of (Kedija, 2008) who found in Meiso district that milking is primarily undertaken by women and (Adebabaye, 2009) in Bure district 36.9% of women was participate in milking.

Majority (88.9%) of the barn had corrugated iron sheet roof type. This finding is different from what was reported by (Mulisa, *et al.*, 2011) in Bihoftu town, most of the farms in small scale of production (78.8%) kept their dairy cows under cow shed roofed with corrugated sheets of materials. The greater proportion of the present report from the previous study on the same area is the previous study was done on Bishoftu town dairy farms it includes all milk producers (Ada'a cooperative members and others) this may the reasons why the present one is different and the respondents may preferred this type of roof to protect their animals from environmental stress such as heat, direct sun light and heavy rain fall and can give long time service with out repairing.

Most barns (67.8%) were constructed from concrete floor, (88.9%) barns had corrugated iron type of roof. 66.7% of the walls were plastered with mud. This result is different from report made by (Gebremichael, 2008), which was 43.4, 63.65 and 79.5% for small, medium and large scale dairy farms in Addis Ababa, respectively and (Mulisa, *et al.,* 2011) the majority of smallholders in Bishoftu town had concrete floor of 52.2. the high percent of the current result is the previous study on the same town was it includes members of Ada'a dairy cooperative and other milk producers and/or the respondents may favour concrete floor due to easy for cleaning and giving comfort for animals.

Concentrate, crop residue and poultry waste were the first (63.3%), second and third (32.2%) ranked feed type in the study area. This result is not agreed with Teferee, (2003) about (48%) was depending only on grazing in the central highlands. Mulisa, *et al.,* (2011) reported that in Bishefu the feeding system of dairy cattle (78.8%) of the interviewed households were stalls and in agreement with Zinnesh *et al.* (1996) and Teferee, (2003) in Addis Ababa, due to increasing of urbanization the urban lands become over crowded and difficult for dairy production; there is no any grazing land and enough waste disposing area therefore, milk producers fed their cattle only through purchasing different available feeds this may have negative impact on the sustainability and development of milk production in the study area.

All respondents (100%) purchased concentrate feeds from private feed processing factory, large farm (Alema) and the cooperative (Ada'a dairy cooperative). Most of the respondent (87.6 %) purchased crop residue from farmers and only dairy producers who live in peri urban of the town (13.3 %) cultivating different crops and use the crop residues as an animal feed in addition, (14.5 %) used non conventional feeds like *Atella* (brewery by-product). This result is close to Sintayehu, *et al.,* (2008) in Shashemene –Dila, southern Ethiopia, dairy producers in the urban areas mainly used purchased roughage and concentrate feeds along with non-conventional feeds like *attella.*

24.4% of the respondents used hay as animal feed, this result is lower than Sintayehu *et al.,* (2008) in Shashemene –Dila, southern Ethiopia, Hay stacking for the dry period was also practised by 35.8% of the urban dairy producers and Yoseph *et al.,* (2000) reported that this practice as the most common feed resource in intra-urban and peri-urban dairy farmers around Addis Ababa milk shed. In this study due to lack of land for hay making, low accessibility to purchase from market and high cost majority of milk producers had not hay feeding practice.

Out of the total respondents about 70 % reported that feed shortage was a major problem for milk production. Teferee, (2003) reported that animal feed problem is identified by all the dairy farming households (100 %) in selected area of Addis Ababa.

All respondents (100%) use pipe water for hygienic and watering of animals. According to Belete *et al.,* (2010) in Fogera Woreda farmers used different water sources for their cattle, out of the total respondents, 48.8% use water from wells, 47.2% from rivers, 3% from Lake Tana, 2.3% from ponds and 0.2% from tap water. The present indicates that even if water scarcity was shown in some respondents all had access to get clean water for hygienic and drinking for dairy cows.

Majority of the respondents (above 52%) watered their cross bred cows two times a day both in dry and wet seasons. This result is nearest to Adebabay, (2009) in Bure District. The mean reported watering frequencies of local and crossbred calves were 2.44 and 2.5 times per day, respectively, (Teferee, 2003) in Addis Ababa and different from report of Belete *et al.,* (2010) in Fogera Woreda farmers cattle are watered once a day between noon and 2 pm.

Based on their choice respondents used different types of feeding trough and watering utensils, most of them used concrete, plastic and wood. This result is in agreement with Sintayehu, *et al.*(2008), depending on the type of milk production systems feed troughs and watering utensils made up of wood, plastic and concrete in Shashemene –Dila, southern Ethiopia.

5.6 % of study participants had breeding bull; most respondents (44.4 %) were getting bull service from open mating through paid for dairy producers who give bull service. This result is slightly greater than the report of Emebet and Zeleke, (2008) in lowland areas of Eastern Ethiopia, none of the SSDP had breeding bulls mainly due to shortage of space and difficulties of management including shortage of feed. The insufficient numbers of breeding bull in the study area is similar to the report of Emebet and Zeleke, (2008).

The majority of the respondents (51.1 %) prefer artificial insemination due to lack of bull service, lack of labour, to avoid transmission of reproductive diseases from the breeding bull at the time of mating and reduce the cost, labour and space for managing breeding bull. Similar study reported by Sintayehu, *et al.,* (2008) in Shashemene –Dila, southern Ethiopia in the urban system half of (50%) of the households used AI as a sole source of genetic improvement. Due to lack of bull service, lack of labour and transmission of different reproductive diseases from breeding bull at the time of mating few respondents use breeding bull as a source of reproduction method. The present finding is agreement with Teferee, (2003) breeding through AI is advantageous in reducing the cost of keeping bulls and in reducing the risks of acquiring venereal diseases.

About 30% of respondents had a separate pen for new born calves however, on 70% of the dairy farms after calving the calf kept on one corner of barn. This report is nearest to Emebet and Zeleke, (2008) in lowland areas of Eastern Ethiopia, in SSDP all dairy cattle were managed together and calves kept in one corner of the same house or separately in another house.

There were two types of calf feeding, majority (81%) of the participants exercise bucket feeding, (13.3%) suckling and (4.4%) both bucket feeding and suckling. All study participants had given adaptation (supplementary) feed after two weeks of calving (Wheat bran, crop residue, and hay). The present result is less than Emebet and Zeleke, (2008) in lowland areas

of Eastern Ethiopia, SSDP 94 % of calves were bucket feed and only 6% of calves were allowed to suckle. Almost all farms practice supplementary feeding to the calves starting from the age of three weeks.

All study participants were used hand milking and milking frequency was two times a day at early morning and early evening. About 98.9 % of the respondents reported that the milkers washed the cow teat before milking however, after milking no any respondents' practice washing and dipping the teats through disinfectant after milking. Only 1.1% of respondent was not washing teats before milking due to scarcity of water. In most diary farms milkers not followed proper milking procedures. This finding is the similar to Sintayehu, *et al*., (2008) in Shashemene –Dila, southern Ethiopia, high percentage of milking twice a day is similar to the milking frequency practised in many parts of the country. Asaminew and Eyasu, (2009) reported that the majority of the respondents in Bure district do not follow sanitary milking practices, all respondents reported that they wash their hands and milk vessels before milking cows however, washing of udders and use of towel to clean the udder was not practiced by the majority of the farmers. Moreover, milkers dip their fingers into the vessel containing milk and moistening teats of the cows to facilitate milking. This practice may cause microbial contamination of the milk from the milkers hand and thus farmers need to be given training on sanitary milking practices and basic milk hygiene. The milk producers wash their hand and teat before milking however, dip their finger in to the vessel to moisturize the teats.

There was no a trend of teat and hand drying before milking by most milk producers, from the total participants only 10% milk producers' exercise teat drying before milking however, milkers used the same towel for drying of all lactating cows in the herd. Benta and Habtamu, (2011) reported that in Bantu and its Environs about 91.3% of the farms does not at all use towel for drying udder and teat. Udder and teat disinfection is not practiced in all study farms. It is believed that the managerial factors (housing and milking practices) play a significant role in the incidence of mastitis. In most sampled dairy farms observe the milk producers had not given attention about hygienic management of milk in milking procedures.

Majority of the respondents (90%) used plastic utensil for milking and transporting milk respectively. Similar finding was reported by Sintayehu, *et al*., (2008) the majority (92%) of urban producers used plastic milk utensils. This type of utensil may preferred by most respondents due to easily cleaned and simple to transport milk and available on the market.

All study households were primarily produced milk for sell and about 55.6% of the respondents used milk production as a main source of income. This shows that dairying has been considered as a business in the study area. This result is different from Sintayehu, *et al.*, (2008) in Shashemene –Dila, southern Ethiopia. The majority proportion of households (74.2%) in the urban milk production system produced milk primarily for sale.100% milk sellers in the present study was due to all respondents produce milk for mainly selling however, from the total participants about 55.6% of them are sold to use as a main income sources of their house hold necessities but 44.4% were sold milk production and selling to use as additional income.

The average weaning age of the female calf in Ada'a dairy cooperative was 3.07 months with the minimum and maximum of 1 and 6 months respectively. This result is less than Adebabay, (2009) average weaning age of cross bred cow in Bure District was 8.1 months. The short month of weaning age in the present study was due to all respondents were produce milk for selling because of different costs for manage their dairy cows (feed, medicinal and other costs) therefore, they give milk for an average 3 months by supplemented different feeds after two weeks of age after calving.

The households reported that the average age at first mating of crossbred cows was 20.82± 4.078 months. This finding is shorter than AFC of 3.37 years reported by Asaminew and Eyasu, (2009) in Bure District. In current study weaning age and amount of milk consumed before weaning had not show significant association (r = 0.068, P= 0.441, P = 0.42, r = -0.9) with Age at first mating (AFM). Even the milk producers are milk sellers they give colostrums and milk for female calves before weaning because of most respondents replaced their herd from own farm.

The average age at first calving (AFC) of crossbred cows was 29.93 ± 3.914 months respectively. The result is similar to Alberro, (1983) reported that the minimum AFC was 29.1 months for F1 Friesian-Zebu cows and nearest to the finding of Negussie *et al.*, (1998) 28.5 months and the 29.2 months reported for crosses of Jersey and Arsi and Friesian and Arsi, respectively, at Assela, Ethiopia and less than report of Gryseels and Boodt, (1986) that average AFC was 32.3 months for 50% crosses and 33.9 months for 75% crosses at Debre Zeit farms. The variation of age at first mating in different area is due to difference in management practices, breeds, geographical location, and level of production

The Average lactation length of crossbred cows was 10.67±1.24 months with the minimum and maximum of 9 and 15 months, respectively. This result is nearest to the result of Adebabay, (2009) the overall average lactation lengths of crossbred cows were 10.1 in Bure District and slightly shorter than the lactation length of 11.7 months reported for crossbred cows in the Central Highlands of Ethiopia (Zelalem and Ledin, 2001).

The average calving interval (CI) of cross bred cows was 12.79± 1.285. The present finding is less than from Bekele *et al.*, (1991), 487 and 525 days at Abernossa Ranch Haile-mariam *et al.*, (1993) and 552 days Shiferaw *et al.*, (2003) 475 days in the central highland of Ethiopia comparable to Negussie *et al* (1998) in Assella livestock farm Arsi, Ethiopia, Average CI is 351 to 398 days. The shorter calving interval in this study may milk producers had interested to replace the herd from own farm thus they were mating their cow at early after calving.

The Average number of offspring per life time of crossbred cow was 6.52±1.689. The current result is larger than the result of Ababu *et al.*, (2004) a recent study of smallholder farmers in Ethiopia showed that 50%, 75% and 87.5% Holstein Friesians crosses on the average produced 4.7, 3.4 and 2.0 calves, respectively. The current result indicated that smallholders are cull their cross bred cow after giving an average six calves.

The overall mean milk yield of cross bred cows in Ada'a dairy cooperative was 11.17±2.902 litters per day. The present result is greater than Belay *et al.*, (2012), the average milk production of crossbred per day was 8.52±3.04 litres per cow in Jima town and the findings of Adebabay, (2009) who reported that the average daily milk production of crossbred cows was 8 litres in Bure district and reported by Asaminew and Eyasu, (2009) and Yitaye *et al.*, (2007) which was 7.8 ± 0.19 and 7.8 ± 0.19 litres, respectively. This result indicted that cross bred cows in the study area may have good productive performance even if the feed shortage was the major problems for milk production; average milk yield is high compared to the previous studies in other study area.

The first (30%) rank prevalent disease was mastitis. This result is in agreement to Teferee, (2003) out of the investigated dairy farming households most of them are reported that mastitis as a major cause of animal health problem in Addis Ababa.

Age and disease were the first (30%) and second (13.3 %) ranked culling reasons of cross bred cows respectively. Emebet and Zeleke, (2008) reported that in eastern Ethiopia, financial requirements, feed shortage and health problems were stated as the major reason for culling of dairy animals in SSDP.

Majority of respondents (98.9 %) used private health service when their cattle were sick or when during calving problems, most respondents had not periodical health follow up, the cooperative give the AI and vaccination (vaccine purchased by milk producers), Adebabay, (2009) in Bure District the major reported sources of veterinary services were government (61.4%), private (4.2%), NGOs (5.4%) and both government and NGOs (12.7%). The present result indicates that the milk producers in the study area had not get enough health service; mostly they get health service from private health providers through pay high cost for veterinarian and medication cost, non governmental bodies was not involved in animal health service on the study area, this may the reasons for high prevalence of mastitis and other health problems on the study farm.

Record keeping in modern dairying is an importance scheme for any decisions making and to assess the profitability of the dairy farm. However, only 16% of respondents had record keeping schemes, they record some reproduction parameters using informal sheets. Most of the respondents were literate and they can record the necessary productive and reproductive performance of the dairy cattle and give appropriate decision. Sintayehu, *et al.,* (2008) reported that in Shashemene –Dila, southern Ethiopia, Only 21.2 and 6% of the urban and mixed crop–livestock producers, respectively, were found recording some reproduction parameters using informal sheets. Emebet and Zeleke, (2008) in lowland areas of Eastern Ethiopia, keeping of production and reproduction records were practiced in 54.6% in SSDP. The current report indicated that milk producers were may not given attention for record keeping of productive and reproductive performance of the dairy herd however, to increase the profitability they should be take a training and create awareness about significance of record keeping and other related practices (hygienic practices culling reasons, disease control and prevention and profit analysis methods).

Overall mastitis prevalence in Adaa dairy Cooperative at cow was 60.8 %. This finding is close to the reports of (Biru, 1989) (63.4%), (Tolla, 1996) (61.11%), and (Zerihun, 1996) (68.1%) and less than (Mekibib *et al.,* 2010) (71.0%) in Holeta town, central Ethiopia and

(Bishi, 1998) (69.8%) in Addis Ababa however, greater than the report of Biffa, (1994) (33.0%), in Wolaita Sodo, (39.5%), Geressu, 1989) in Debre-Zeit, (Tolossa, 1987) (53.5%) in around Kallu Province and (Haile, 1995) (53.35%) in South Wolo.

There is no significant difference (P> 0.05) between in female and male headed house holds on the prevalence of mastitis, this show that mastitis is a problem of all diary farms which is managed by male and female house hold. There was no a trend on teat and hand drying before milking by most milk producers, from the total participants only (10%) milk producers' exercise teat drying before milking however, all respondents which practiced teat drying milkers used the same towel for all lactating cows, after milking no any respondents' practice washing and dipping the teats through disinfectant in addition, only 10% of the respondents milking mastitic cow at last order the remain was milking without any order, it is believed that management factors (housing and milking practice) have a significance on mastitis (Quinn, *et al.,* 2002).This result is similar to 91.3% of the farms don't all use towels for drying and teat and this is similar to only 13.5% diary farms milked these cows at last (Benta and Habtamu, 2011), in Bantu and its Environs. This trend may raise the prevalence of mastitis by direct transmission of bacteria from infected cow through milker hand and drying towel.

There is significant association between ventilation of the barn ($P < 0.05$) and prevalence of mastitis. Hunderra *et al.,* (2005) reported that there was a significant difference ($P < 0.01$) in ventilation of dairy farms in Sebeta, this show that risk factors can contribute to increasing prevalence of mastitis in the herd.

The difference in overall prevalence of mastitis in the present study and other results could probably be due to difference in farm management practices, breeds, geographical location, level of production and study method and instruments employed by investigators (Radostits *et al.,* 2000). To reduce this prevalence the milk producers should be take a training to improve milking hygiene and other husbandry practices.

Clinical and sub clinical result during this study period were calculated at 15.2 % and 45.6 %, respectively. This finding is comparable to clinical mastitis result of Hunderra *et al.,* (2005) 16.11% and higher than sub-clinical mastitis 36.67%. Biffa, (1994) (15.1%) and Radostits and Blood, (1994) (10 %) on clinical bovine mastitis was comparable and lower than the present

result, respectively. Prevalence of sub clinical mastitis reported in this finding (45.6 %) was, however, greater than reported by Biffa *et al.,* (2005) (23%) in southern Ethiopia and less than Abaineh, *et al.,* (2002) 47.5% in Modjjo farms in central Ethiopia.

There is significant variation ($P < 0.05$) in prevalence of clinical (15.2 %) and Sub clinical mastitis (45.6 %). The prevalence of sub clinical mastitis reported in this study was less than from report by Abaineh, (2002) (65%) in Fiche, Mekibib *.et al.,* (2010) (48.6%) in Holeta town and greater than Hunderra *et al.,* (2005) 36.67 % in Sebeta. This study showed higher proportion of sub clinical mastitis compared to clinical form and this result is similar with several reports, Workneh *et al.,* (2002) and Kerro *et al.,* (2003), Hunderra *et al.,* 2005) and Abera *et al.,* (2010). It was generally concluded that sub clinical mastitis is far higher than clinical mastitis (Robertson, 1985). Sub clinical mastitis has been reported to be higher than clinical mastitis owing to the defence mechanisms of the udder, which reduces the severity of the disease (Bradley, 2002). In most developing countries including Ethiopia, the sub clinical form of mastitis received little attention and efforts have been concentrated on the treatment of clinical cases (Hussein, 1997). According to Mungube *et al.,* (2005) losses associated with sub clinical mastitis in cross bred cows in the central highlands of Ethiopia was found to be US$38 for each cow per lactation.

Prevalence of mastitis in quarter level was 40 % (347/868) out of which sub clinical was 36.4 % (316/868) and clinical was 3.6 % (31/ 868). This result is comparable to the finding of Mekibib *et al.,* (2010) over all quarter prevalence of 44.8 % and 37 % report of Nessru *et al.,* (1997). However, greater than Biffa *et al.,* (2005) and Almaw, (2004) reported the higher quarter prevalence of 28.2% and 17.9%, respectively. The greater percent of quarter level prevalence is the milk producers were not give attention for milking hygiene, they may not treat clinically infected teat, culling of chronically mastitic infected cows and milking of all cows without proper milking procedure, this may source of transmission disease causing pathogens from infected to non infected one and can increase quarter level mastitis prevalence.

The relative high prevalence of mastitis in right rear quarter (43.2 %) and right front quarters (41.5 %). This study is comparable with Hunderra, *et al.,* (2005) the relative high prevalence of mastitis in right front quarter (37.7%).This may be due to greater production capacity of

hind quarters, (Schalm, 1971), the likelihood of faecal and environmental contamination of hind quarters and ease of first grasping by maker's hand in case of right front quarter.

Of the 868 quarters examined, 31(3.6%) were blind. The presence of blind teat is an indication of a serious mastitis problem on the respective farms and of the absence of a culling program that can serve as a means to remove a source of these mammary pathogens for other cows. The high occurrence of mastitis induced blind mammary quarter 31/868 (3.6%), which has a paramount and direct impact on the dairy economy at least through reducing the amount of milk produced, signifies the importance of the problem. Lack of screening tests and treatment of sub clinical mastitis and inadequate follow up of clinical and chronic cases were believed to be the major reasons for the development of quarter's blindness. Though induced by persistent challenges of the mammary glands by microbial pathogens, it remains hidden and result in gradual destruction of the mammary tissues that ultimately causes non- functional quarters (Biffa *et` al.,* 2005).

Prevalence of mastitis varied significantly in teat lesion (χ^2= 24.17, P= 0.000), previous exposure of mastitis (χ^2 = 13.1, P= 0.000) and udder swelling (χ^2= 20.7, P= 0.000) this result is comparable with the report of Biffa *etal.* (2005) udder/teat injuries ($P < 0.001$), and previous exposure to udder infection ($P < 0.001$) showed significant influence on prevalence of mastitis. Cross bred cows have large udders which can easily be injured and the presence of injury is a predisposing factor for the occurrence of mastitis in Bantu and its Environs (Benta and Habtamu, 2011) in addition high prevalence of mastitis associated with teat injuries (100%) reported in this study suggests unsatisfactory udder and health management. Previously infected cows were at greater risk of being re-infected, suggesting that repeated challenges of the mammary tissues with micro-organisms coupled with other stress factors could put the glands at greater risks of re-infection (Biffa *etal.,* 2005)

There was significance association (χ^2 =1.813, P= 0.04 and χ^2= 7.203, P= 0.027) between age and parity to mastitis occurrence; The increased prevalence of mastitis with age and parity reported in the present study is in agreement with the report of Biffa *et al.*, (2005) and Mekibib *et al.,* (2010) who indicated an increase in the prevalence as lactation number and age increase. The age-multi farious high prevalence relationship is explored to be due to all increase in teat potency and degree and frequency of previous exposure in multi-farious old cows (Harmon, 1994; Radostits, 1994).

A statistically no significance association (χ^2: 0.91; P = 0.634) was found between lactation stage and mastitis prevalence. This indicates that in all stage the prevalence of mastitis was the same this may due to lack of proper milking procedure is able to increase the incidence of mastitis.

6. CONCLUSION AND RECOMENDATIONS

Milk production plays a great role in the livelihood of the milk producers for Ada'a dairy cooperative members, most of them used as a main source of income. Despite these advantages, shortage of animal feeds, lack of space, lack of AI, health service and disease prevalence are the fore front problems of milk producers. Inadequate hygienic condition of dairy environment, poor milking procedure, poor animal health service and lack of proper attention to health of the mammary gland, absence of appropriate decision for chronic mastitis carrier cows and lack of timely follow up and test of milk and clinical signs of the disease were important for the high prevalence of mastitis factors in the study farms. The overall prevalence of mastitis in the present study (60.8%) was very high even compared with other studies in the same area. Absence of identification causative agents of the disease and culling chronic mastitic cows appeared to have contributed a lot to this alarming situation. Based on the above findings the following points are recommended.

- The housing conditions of milking cows, in most cases were overcrowded, which creates favourable conditions for disease spread including mastitis. Thus, extension service should assist smallholders with proper housing conditions with respect to space, ventilation and good sanitation.

- Smallholders should be advised to regularly test their dairy cows for mastitis and cull the once with chronic cases.

- Training opportunities on hygienic milking procedures should be made available and accessible to smallholder dairy producers.

- Treating mastitis cases after identification of causative agent(s) and determining its antimicrobial sensitivity will contribute a lot for the effectiveness of the treatment.

- Smallholders are currently facing acute problems with respect to animal feed shortage, AI and animal health services. Thus concerned government bodies should pay due attention to these problems and find ways and means to support the smallholders.

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8. ANNEXES

Annex 1. Parameters of Body condition scoring of cross bred cows, (According to Richard) (1993)

Score	Description
0	Emaciated animal with an apparent subcutaneous, spinous process in the lumbar region feel sharp
1	Spinous process is sharp, but less than in the score zero. There is some subcutaneous fat on these processes and on the point of the hip
2	Individual spinous processes are still fairly sharp to touch and ribs cannot be seen individually.
3	Spinous processes can be felt, but have surrounded feel and ribs cannot be seen individually
4	Individual spinous processes can only be felt with firm pressure and point of hip are covered with fat and rounded
5	Spinous processes cannot be felt even with firm pressure, animal has a blocky appearance.

Annex 2. Interpretation of CMT findings for sub clinical mastitis (Source: Quinn *et al.* 1999)

Score	Interpretation	Visible reaction
0	Negative	Milk fluid and normal
T	Trace	Slight (minor) precipitation
1	Weak positive	Distinct precipitation but no gel formation
2	Distinct positive	Mixture thickens with gel formation
3	Strong positive	Viscosity greatly increased strong gel i.e. cohesive with a convex surface

Annex 3. Questionnaires

Region_____ Zone_____Distric _____PA ____Village _____Date_____

1 Owners' profile

1.1. Owner Name: _____

1.2. Sex_____Age: _____years

1.3. Family size _____ female: _____ male: _____

1.4. Age category: a) < 6 years ☐ b) 6 - 15 years ☐ c) 16 - 60 years ☐ d) > 60 years ☐

1.5. Level of education (encircle) a). Illiterate ☐ b) Read only ☐ c). Elementary ☐

d) Secondary ☐ e). Above secondary ☐

1.6. Marital status

1. Married ☐
2. Single ☐
3. Divorced ☐
4. Widowed ☐
5. Others (Specify) _____

1.7. Main occupation

1. Crop farming (only)☐
2. Mixed farming ☐
3. Agro pastoralist ☐
4. Dairy production ☐
5. Private /governmental work☐
6. Others (Specify) _____

1.8. Milk production is a) Used as additional income☐ b) Main source of income ☐ c) other (specify) _____

1.9. When did you start dairy farming? _____

2. Livestock herd size and composition: Completed after observation

Type	Number
Local cows	
Crossbred cows	
Local oxen	
Crossbred oxen	
Local heifers	
Crossbred heifers	
Local bulls	
Crossbred bulls	
Local calves	
Crossbred calves	
Sheep	

3. Indicate members of household responsible for livestock management in this year

Rank the responsibility of the household for the following activities

Dairy activities	Husband	wife	Sons	Daughter	Hired labour
Herding					
Cleaning sheds					
Caring for suckling calves					
Feeding and watering					
Milking					
Milk processing					
Selling milk products					
Breeding Decisions					
Purchasing cattle					
Selling cattle					
Others (specify)					

4. Land holding and use pattern (ha):

1. Used for grazing_____
2. for crop production_____
3. Cultivated forage production_____
4. For other (specify) _____
5. Total land (ha) _____

5. Breeding practices:

5.1 .What is the means you use for cattle reproduction?

a) AI ☐ b) breeding bulls (cross) ☐ c) Local bull ☐ d) All ☐

E) A and B ☐ F) A and C ☐ G) B and C ☐

5.2 Sources of bull: a) Own ☐ b) Neighbours ☐ c) open mating ☐ d) others (specify)

5.3 Types of natural breeding: a) Select bull ☐ b) No selection ☐

5.4. Replacement animals are: a) Reared on the farm itself ☐ b) Purchased from outside ☐

5.5. For what purpose do you use crossbred (purebred exotic) male calves?

a) Breeding ☐ b) Selling at early age ☐ c) Slaughtered at early age ☐ d) for traction ☐

5.6. Way of disposing older animals

a) Fattened and sold at market ☐ b) Sold without finishing at market ☐ c) Slaughtered at home without finishing ☐ d) Slaughtered at home after fattening ☐

5.7. Where did you get dairy cows initially?

a) Bought from market ☐ b) bought from dairy farm ☐ c) Obtained from the respective agricultural offices ☐ d) bred at home from AI service ☐ e) Other (specify) _____

5.8. For what purpose do you use female calves use on the farm?

a) For replacement purpose ☐ b) sold at early age for the market ☐ c) other specify _____

5.9 Was there a practice of introducing new animal to your herd? a) Yes ☐ b) No ☐

5.10. If yes; Source of animal: a) purchase from market ☐ b) Dairy farm ☐

5.11. Examinations made before mixing the new animal: a) Clinical exam ☐

b) Lab examination for Brucellosis ☐ C) Other lab exam (Specify) _____

5.12. Do you have an experience of selecting the best cattle type for breeding purpose?

a). Yes ☐ b). No ☐

5.13. If yes, what are your parameters used to select the best cattle for breeding purpose?

a). Colour coat ☐ b). Behaviour of the animals ☐ c). Body conformation ☐ d). Milk production potential ☐ e). Drought power potential f). Others_____

5.14. What are the major problems in managing crossbred dairy cows?

a) Feed problem ☐ b) Disease problem ☐ c) Lack of labour ☐ d) Lack of water ☐

e) Lack of money ☐ f) other (specify) _____

Rank: 1 _____ 2 _____ 3_____ 4 _____

6. Feeding management of animals

6.1. Feeding System: a) Grazing ☐ b) Stall feeding ☐ c) Both ☐

6.2. What are the sources of feed?

a) Natural grazing land ☐ b) Crop residue ☐ c) Concentrate ☐ d) Brewery product (atela) ☐

e) Hay ☐ f) Roughage ☐ g) others (specify) _____

Rank them: 1._____2. _____3. _____ 4. _____ 5. _____ 6. _____

6.3 Roughage: a) Farm produced ☐ b) Purchased ☐ c) Both ☐

6.4. Concentrate: a) Farm produced ☐ b) Purchased ☐ c) Both ☐

6.5. Crop residues: a) Farm produced ☐ b) Purchased ☐ c) Both ☐

6.6 Molasses: a) purchase from market ☐ b) purchase from the factory ☐ c) Both ☐

6.7 Brewery product (atela (areki/tella)):

a) From home ☐ b) purchased from neighbours ☐ c) both ☐

6.8 What are the crop residue sources? a) Teff ☐ b) Millet ☐ c) Sorghum ☐

f) Maize ☐ g) wheat ☐ h) others (specify) _____

Rank them: 1. _____ 2. _____3. _____4. _____ 5. _____ 6. _____

6.9. Do you practice crop residue treatment before feeding? a) Yes ☐ b) No ☐

6.10. If yes, indicate the treatments done to crop residues? _____

(specify)_____

6.11. At which season do you face feed shortages?

a) Wet season ☐ b) dry season ☐ c) other (specify) _____

g) Others (specify) _____

6.12. Do you plant improved forage crops? a). Yes ☐ b). No ☐

6.13. If yes, which forage crops? _____

6.14. Do you feed hay to your animals? a) Yes ☐ b) No ☐

6.15. If yes where does the source of hay? a) Home grown ☐ b) purchased from the market ☐

6.16. Calf feeding system: a) Hand feeding/bucket feeding ☐ b) Suckling ☐ c) Mixed ☐

6.17. Hand feeding/bucket feeding a) cross breeds calf☐ b) local calf ☐ c) for both ☐

6.18. Suckling a) cross breed calf☐ b) local calf ☐ c) for both☐

6.19. How much milk is given for your calf _____liter/day?

6.20. What type of feed is given to the calf immediately after weaning?

a) Concentrate ☐ b) hay☐ c) grazing ☐ d) crop residue☐ e) other (specify)_____

6.21. Is there animal feed shortage? a) Yes ☐ b) No☐

6.22. If yes when feed shortage is faced? _____

6.23. What measures do you take to alleviate problems of feed shortage?_____

7. Watering Management

7.1. What are the sources of water to your animals?

a) River☐ b) Pond☐ c) Well☐ d) Pipe water ☐e) Other (specify) _____

7.2. What is the average distance travelled by livestock to the water point?

a) Watered at home☐ b) < 1km☐ c) 1-5km ☐ d) 6-10km e) >10km ☐

7.3. How frequently cattle are watered during dry season?

a) Once a day ☐ b) Twice a day ☐ c) Ad libitum☐ d) Once two days ☐

e) Once three days ☐ f) other (specify) _____

7.4. How frequently cattle are watered during wet season?

a) Once in a day☐ b) Twice in a day ☐ c) Ad libitum☐ d) Once in two days ☐

e) Once in three days☐ f) other (specify) _____

7.5. Is there Water scarcity? a) Yes ☐ b) No☐

7.6. If yes, when water sacristy is faced? _____

8. Housing system

8.1. Do you have an experience of housing your dairy animals? a). Yes ☐b). No ☐

8. 2. If yes, what type of housing system?

a). Communal with the people ☐ b). Isolated ☐ c) Simple fenced area (beret) ☐

8.3. Is there a separate calf pen a). Yes☐ b). No ☐

8.4. Barn cleaning frequency

a). One times a day ☐ b) Two times a day ☐ c). Three times a day ☐d). Other specify_____

9. Milking practices

9.1. Types of milking? a) Hand milking ☐ b) machine milking ☐

9.2. Milking frequency per day a). Once per day ☐ b). twice per day ☐c). thrice per day☐

9.3. What kind of hygienic practices do you perform before milking?

a) Wash milking equipments ☐ b) Let calf suckle and milk. ☐ c) Wash hands☐ d) all☐

9.4. Are hands washed between cows? a). Yes☐ b). No ☐

9.5.Wash the teats a). Yes ☐ b). No ☐

9.6 Udder or teat cleaning material

a). Cold tap water☐ b). Warm water ☐c). Detergent ☐ d). Disinfectant☐

e). A combination of the listed options ☐ f). Other (specify) _____

9.7. Milking utensils washing materials _____

9.8. What kind of equipment do you use for milking? _____

9.9.Do you use Hand drying after wash? a) Yes ☐ b) No ☐

9.10. Do you dry teats after washing? a) Yes☐ b) No ☐

9.11. Type of storage container used to transport milk to the processing plant

a) Aluminium cans ☐ b) Plastic bags ☐ c) Tanks ☐d) Others (specify) _____

9.12. What kind of equipment do you use for storage/ fermentation? _____

9.13Do you practice smoking milking equipment a) Yes ☐ b) No ☐

9.14. If yes herbs/ plants/ used for smoking? _____

9.15. Why do you use these plants?

a) Give good flavour and aroma, ☐ b) Increase the shelf life of the milk ☐

c) Facilitate fermentation ☐ d) It just a tradition ☐ e) Other (Specify) _____

9.16. Is there milk test on the farm? a) Yes ☐ b) No ☐

If yes with what method

a) CMT test ☐ b) Alcohol test ☐c) visual checking of mastitis ☐d) other specify☐

9.17. Mastitic cows are milked a). At first☐ b) At last ☐ c) any position ☐

9.18. Do you practice milk selling? A). Yes ☐ b). No ☐

9.19. Where does the milk go after milking?

a) to household consumption ☐ b) to processing plants ☐ c) Milk collection centre ☐

d) Given to a calf☐ d) a and b☐ e) a and c ☐ f) c and d ☐

9. 20. If yes where do you sell milk? ☐ a). To local market ☐ b). To milk collection center ☐

c) Renting to individuals ☐ d) others (specify) _____

9.21. What is the price per litre/kg of whole milk during dry season_____birr/litter?

Wet season _____birr/litter?

9.22. How far do you travel to reach market/milk collection center? _____km

9.23. Do you process milk at farm? a). Yes ☐ b). No ☐

9.24. If yes to which products?

a) Butter ☐ b) Cheese ☐ c) Yogurt ☐ d) others (specify) _____

9.25. What is the price per kg of butter during?

Dry season_____birr/Lit, wet season_____birr/Lit?

9.26. What is the price per kg of cheese during?

Dry season_____birr/Lit, Wet season _____birr/Lit?

9.27. Do you keep any milk record at farm a) Yes ☐ b) No ☐

9.28. If yes, specify the type of records kept? _____

10. Health condition

10.1. Disease occurrence on the farm: a) Yes b) No

10.2. What are the major animal health problems in your farm? Please rank in order of importance (number 1 being the most important).

1. _____
2. _____
3. _____

10.3. Health service provided by: a) Public vet. Clinic☐ b) private vet serv. provider ☐

c) Owner ☐ e) other (please specify) _____

How often: a) when animal is sick ☐ b) periodically☐ c) other (specify) _____

10.4. Do you practice culling in your farm? a). Yes ☐ b). No ☐

105. If yes, specify culling reasons in order of importance (reason one being the most common reason of culling

1. _____
2. _____
3. _____

11. Dairy cattle Production and Reproduction

No	Reproductive and productive performance	cow breed
1	Age at first mating (months)	
2	Age at first calving(months)	
3	Average lactation length (months)	
4	Average lactation yield(litters)	
5	Daily milk production per animal, peak period (Liter	
6	Daily milk production per animal, lean period (Liters)	
7	Daily milk production per animal, mid period (Liter)	
8	Weaning age (months)	
9	Number of offspring given through out their life (number)	
10	Calving interval (months/year)	
11	For how long does your crossbred cow survive(years)	
12	For how long keep on male calves in your farm(month/year)	

11.1. Manure utilization a) Fertilizers ☐ b) Fuels ☐ c) Others use ☐ d) No values ☐

11.2. What are the major opportunities for milk production in the study area? Rank them with the

Priority given:

1. _____

2. _____

11.3. What are the major problems existed in milk production? Rank them with the priority given:

1. _____

2. _____

Annex 4 Formats of individual cow history and CMT Test result

Milk sample collection format

Owners Name: _____district _____

Date of sample Collection_____

1. Cow History:

1. Cow ID no_____

☐

2. Breed type a) Cross breed ☐ b) Local c) Pure exotic ☐

3. Age_____

4. parity_____lactation stage_____ body condition score_____

5. How much Daily milk yield obtain from the cow _____litre/day

6. Previous history of mastitis: a) absent ☐ b) present ☐

7. Tick infestation: A. present ☐ B. absent ☐

8. Teat Lesion: a) present ☐ b) absent ☐

9. Swelling of the udder: a) present ☐ b) Absent ☐

10. Anatomical malformations: a) present ☐ b) Absent ☐

11. Abnormal colour of milk: a) Yes ☐ b) No ☐

12. Abnormal odour of milk: a) Yes ☐ b) No ☐

13. Clinical mastitis test: a) Yes ☐ b) No ☐

Observed sign: a) Present ☐ b) absent ☐

14. Sub clinical mastitis test a) Yes ☐ b) No ☐

15. Sample collected from: (Yes/No, if no why)

A. Right front (RF) Quarter (A) ☐

B. Right back (RR) Quarter (B) ☐

C. Left front (LF) Quarter (C) ☐

D. Left back (LR) Quarter (D) ☐

16. CMT score:

Right front (RF) Quarter (A)

a) Visible reaction_____

b) Interpretation_____

c) Score_____

Right back (RB) Quarter (B)

a) Visible reaction_____

b) Interpretation_____

c) Score_____

Left front (LF) Quarter (C)

a) Visible reaction_____

b) Interpretation_____

c) Score_____

Left back (LB) Quarter (D)

a) Visible reaction_____

b) Interpretation_____

c) Score_____

Clinical mastitis test result: A. positive ☐ B. negative ☐

Sub clinical mastitis test result: A. positive ☐ B. negative ☐

Annex 5. Check list for observation or Farm visit of each study farms

Farm owner's name_____ Sex_____ District _____

1. Housing condition

1.1. Housing type a) close☐ b) semi open ☐ c) simple enclosure☐

Floor: a) concrete cement ☐ b) stone layer ☐ c) earthen yard ☐

Roof: a) corrugated iron sheet ☐ b) grass (straw) ☐ c) other materials_____

Wall: a) concrete ☐ b) mud ☐ c) open type ☐ d) other material _____

1.3. Ventilation: a) good ☐ b) poor ☐

1.4. Cleanness of the barn: a) good ☐ b) poor ☐ c) medium ☐

1.5. Drainage system of the barn: a) good ☐ b) poor ☐

2. Feeding and watering troughs:

2.1. Housing facilities: a) watering trough ☐ b) feeding trough ☐ c) a and b ☐

d) No facilities ☐

3. Animal examination

3.1. General body condition (body condition score)

Cow 1: Lactation stage _____ body condition score _____

Cow 2: lactation stage _____ body condition score _____

Cow 3: lactation stage _____ body condition score _____

3.2. General health condition:

Dehorning practices: a) yes ☐ b) No ☐ if yes c) on _____animals

Hoof trimming: a) Yes ☐ b) No ☐ c) if yes on _____animals

Skin injury: a) present ☐ b) absent ☐ if present c) on _____animals

Lameness: a) present ☐ b) absent ☐ if present c) on _____animals

External parasites: a) present ☐ b) absent ☐

Cleanness of the animal body: a) good ☐ b) poor ☐

3.3. Udder/teat health

Tick infestation (invasion): a) present ☐ b) absent ☐ if present c) on _____cows

Swelling of udder: a) present ☐ b) absent ☐ if present c) on_____cows

Teat lesion (injury): a) present ☐ b) absent ☐ if present c) on_____cows

Anatomical malformations a) present☐ b) absent ☐ if present c) _____cows

4. Milking equipment inspection

4.1. Hand washing before milking a) yes ☐ b) No☐

4.2. Udder washing before milking a) yes ☐ b) No ☐

4.3. Cleanness of the milking equipment a) good ☐ b) poor☐

5. Feed storing conditions

5.1. Storage condition a) good ☐ b) poor ☐

6. Manure disposal system

6.1. Space for disposal: a) adequate ☐ b) not adequate ☐

9. DECLARATION

I the undersigned, declare that the thesis is my original work and has not been presented for a degree in any University and that all source of material used for the thesis have been duly acknowledged.

Name: Etagegnehu Misaw

Signature: _____

Place: Addis Ababa University, Debre Zeit, Ethiopia.

Date of Submission: July 2012

This has been submitted for examination with our approval as University advisers

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Dr. Mekonen H/ mariam _____