ADDIS ABABA UNIVRSITY

FACULTY OF VETERINARY MEDICINE

A STUDY ON DAIRY CATTLE PRODUCTION AND ASSOCIATED CONSTRAINTS IN ADDIS ABABA, ETHIOPIA

BY

GEBREMICHAEL MELES

June, 2008

DEBREZEIT, ETHIOPIA

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A thesis submitted to the school of graduate studies of Addis Ababa University in partial fulfillment of the requirements for the Masters degree in tropical animal production and health.

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DEDICATION

This paper is dedicated to my beloved family: my wife, Sister Bisrat Meresa, my daughters: Selamawit Gebremichael, Sara Gebremichael, Samrawit Gebremichael and Senait Gebremichael as well as my brother Gebreyesus Meles.

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ACRYNOMS

AAAD	Addis Ababa Agriculture Department
AADPA	Addis Ababa Dairy Producers Association
AI	Artificial Insemination
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DDA	Dairy Development Agency
DDE	Dairy Development Enterprise
DDE	Dairy Development Enterprise
DFID	Department for International Development
DHIST	Dairy Herds in Secondary Towns
FAO	Food and Agriculture Organization
FAO	Food and Agriculture Organization
FMD	Foot and mouth disease
GLM	General linear model
Ha	Hectare
IFAS	Institute of Food and Agricultural Sciences
ILRI	International Livestock Research Institute
Kms	Kilo meters
L/d	Litres per day
MCCP	Mixed Crop-Livestock Production
MCLP	Mixed crop-livestock production
MoARD	Ministry of Agriculture and Rural Development
MSD	Market oriented specialized dairy production
NGOs	Non-Governmental Organizations
SCM	Sub-clinical Mastitis
SE	Standard error
Spp	Species
SPSS	Statistical packages for social study
UDF	Urban Dairy Farms
UDP	Urban dairy production
UNICEF	United Nations Children's Fund
UNRRA	United Nations Relief and Rehabilitation Administration
WFP	World Food Program
CSA	Central Statistics Agency
NSPC	Number of services per conception
AFC	Age at first calving
CI	Calving interval
NS	Not significant

ABSTRACT

A cross-sectional type of study was carried out to determine the status and major constraints of dairy cattle production in Addis Ababa. The study was undertaken from October 2007 to April 2008. 252 small, medium and large scale dairy owners of equal sample size and 18 participatory appraisal groups were included in the study from six of the ten sub-cities of Addis Ababa. The overall mean age of the respondents was 49.52 (SE=0.756) years with a range of 22 to 95 years. The value for small, medium and large scale producers was 47.74 (SE=1.395), 49.29 (SE=1.069) and 51.79 (SE=1.414), respectively. Both male and female having different occupational and educational status was engaged in dairy cattle keeping and 33.2% of the dairy farms were headed by women. The average household family size was 4.72 persons with a range of 1 to 13. The proportion of males was 52.5% and that of females was 47.5%. 33.8 % of the respondents use only family labor (65.8%, 29.3% and 9.9% for small, medium and large scale households). The overall mean landholding of the households was 0.45ha with a range of 0.01ha to 37ha. On the other hand, the mean landholding for small, medium and large scale households was 0.08ha (SE=139.8), 0.16ha (SE=416.7) and 1.10ha (SE=4938), respectively. About 81.2% of the respondents had their own plot of land and 23.6% respondents were involved in agricultural activities producing different types of vegetables, fruits and cereals. 81.6% of the respondents indicated that they started dairying with purchased stock, 15.2% secured stock from their family and the rest 3.3% of the respondents started with cattle acquired as gift. The over all mean of cattle holding (herd size) was 12.69 heads (SE=1.09). The minimum and maximum herd was 1 and 167 heads, respectively. The mean cattle herd size for small, medium and large scale households was 4.69 (SE=0.17), 8.82 (SE=0.22) and 24.78 (SE=2.75). In all the three production scales, cows dominate (overall mean of 5.26 milking and 2.74 dry and pregnant cows) the cattle herd size. The mean proportion of farm income to the total income of each household was 54.09 %. A range of decision-makers were involved in initiating and managing dairying activities in the city. Husband, wife, children and a combination of these were involved in making decisions on husbandry practices, animal sell/buy and cash utilization. All decisions in 32.1% households were made by the consensus or some form of approval of both partners (husband and wife). Majority of the dairy farms (82.2%) used indoor (Zero grazing) rearing system with varying housing standards depending on the wealth of the owners. Dairy farmers in Addis Ababa follow different waste disposing practices. However, majority of them use the same practice of preparing dung cakes regardless of the scale of production during dry season for sell and/or for house use as fuel. Different types of feed stuffs (conventional and non-conventional) were used to feed the animals. AI was the widely used mating method (86.1%). The mean number of services per conception was 1.72 (SE=0.10) and was significantly different among the breeds, the parity status ($P< 0.05$) and mating method ($p< 0.001$). However, there was no significant difference between the production scales ($p>0.05$). The overall means for age at first calving and calving interval were 34.79

months (SE=0.63) and 457.22 days (13.31), respectively. Age at first calving and calving interval for local breed were significantly longer by about 14 months and 93 days, respectively. The overall means of daily milk yield at early, middle and late lactation were 10.29 liters (SE=0.47), 6.82 liters (SE=0.38) and 3.76 liters (SE=0.22), respectively. There was significant difference ($p<0.001$) between the three scales of production, breeds and parities in milk yield ($p<0.001$) at all stages of lactation. Mastitis was the most important disease mentioned by over 60% of the households. About 27.13% of the respondents convert milk into butter, ayib and/or yoghurt mainly when milk was surplus and most of the households use these products for home consumption. Feed problem, poor animal health services and shortage of drugs, poor genetic material, unreliability of AI and shortage of space were the most important constraints mentioned with the highest rank in all the farm scale with out significant difference. It can be concluded that dairying in Addis Ababa is an important sector of urban agriculture in that it provides fresh milk to the community and is the only means of livelihood for some households. However, the sector is constrained by a number of factors which need to be addressed by government and non-governmental development institutions.

Key words: constraint, dairy, Ethiopia, production, urban

1. INTRODUCTION

One of the biggest challenges of the next decade facing mankind is the growing population and increasing urbanization (Jacobi *et al*., 2000). Sub-Saharan Africa as a whole experiences fairly high rates of urbanization. Currently, 30% of the population lives in urban areas, a figure that may reach over 50% by the year 2025 (Smith and Olaloku, 1998). In 2000, near 1.9 billion people lived in cities of the developing world and in 2030 the number will swell to nearly 3.9 billion (DFID, 2002). The creation of "sustainable cities" and the identification of ways to provide food, shelter and basic services to the city residents is a challenge to many city authorities around the world (Jacobi *et al*., 2000). Cities in the Horn of Africa are growing rapidly; for example, Addis Ababa, Kampala and Khartoum cities are growing at about 4%, 4.76% and 4.04% per annum. It is estimated that their populations could double over the next seventeen years (FAO-World Bank, 2002).

It has been found that a high proportion of urban households are engaged in food production as a means of living presenting its own specific problems and opportunities. There is a consensus that the observed rapid growth and expansion of urban farming in Africa is a response to market demands arising from rapid urbanization (FAO, 2001). According to Bee *et al*. (2006), urban smallholder dairying in Tanzania is regarded as one of the best means of providing resource poor farmers with regular income to pay for children's education and other family's daily necessities. Urban livestock keeping fits different livelihood strategies and contributes to food security, income, employment generation, saving and insurance.

In Ethiopia, where the highest livestock population in Africa is residing, livestock have multipurpose uses and serve as source of meat, milk, skins, fiber, fertilizer, fuel and cash for smallholder farmers. The contribution of livestock to the agricultural economy is significant accounting for 40% and could be even higher, if the non-monetary contributions are taken into account (Tegegne, 2003). Ethiopia also holds large potential for dairy development due to its large livestock population, the favorable climate for improved high-yielding animals and the relatively low disease challenge areas for livestock. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country (Ahmed *et al*., 2004). However, compared to other countries in Africa, Ethiopians consume less dairy products. FOA estimated annual total milk production for year 2000 at 1.2 million metric tones out of which 81% or 960,620 tones

is cow milk. Based on this, annual per capita consumption of milk is in the range of 16.4 to 18.8 liters which is below the average for Africa (37.2 liters) and very much lower than the values for Kenya (78.5 liters) and Sudan (161.4 liters) (Eshetu, 2001). In Ethiopia, if demand for fluid milk alone is to be met, production should grow by 4% annually until the year 2025 (Mekonnen *et al*., 2005).

Over the last decade following the political changes in 1993, the dairy sector in Ethiopia has shown considerable progress. Total milk production grew at an estimated rate of 3 percent as compared to 1.8 percent during the period of 1975-1992, thus, ending the long-time trend of declining per capita milk production in the country. The progress achieved is mainly due to technological intervention, policy reforms and population growth. However, per capita milk production stagnated during this period and grew at a positive but insignificant rate after the policy reform. In addition, the contribution of imports of milk to total consumption of milk declined from 24 percent in 1985 to less than 1 percent in the year 2000. At the same time, the share of government-owned enterprises in total milk production decreased markedly whiles the share of smallholder production increased by 30 percent. The dairy sector of Ethiopia is expected to continue growing over the next one to two decades given the large potential for dairy development in the country, the expected growth in income, increased urbanization, and improved policy environment (Ahmed *et al*., 2004).

In Ethiopia the livestock numbers in urban and peri-urban areas in 2001 were estimated at 169,200 cattle, 64,700 sheep, 22,600 goats, 15, 900 donkeys and 415,600 chickens (DFID, 2002) from which Addis Ababa takes the major part. Dairy husbandry is mostly carried out on an individual basis in Addis Ababa, which appears to provide practical solutions to some of the major problems of shortage of income, poverty, unemployment, and food insecurity faced by the urban low income population (Axumite *et al*., 1994).

In spite of the important contribution urban dairy farming makes to the livelihood security of the city's population, animals in urban areas can create problems such as smell, risk of disease, pollution of waterways and conflicts between neighbors when they invade and damage gardens. Such problems coupled with the redevelopment of the city, critically challenged dairying in the city (Tegegne, *et al.,* 2000; Lupal, 2002; Anderson 2006). Except few fragmented and highly focused studies, little has been done to investigate the status and different challenges of dairying in Addis Ababa at a wider scale.

Thus the objectives of the study were:

- To assess the status of dairy production in Addis Ababa
- To assess the challenges facing the dairy industry in Addis Ababa

2. LITRATURE REVIEW

2.1. Dairy production systems

Urban and peri-urban dairy production systems are among the many forms of dairy production systems in the tropics and sub-tropics. The systems involve the production, processing and marketing of milk and milk products that are channeled to consumers in urban centers. The development and sustainability of urban and peri-urban dairy production systems require a relatively large initial investment and long-term commitment. In addition, the major technical and non-technical constraints associated with these dairy production systems such as availability and cost of genetic materials, breeding systems, feed resources, feeding systems, animal health, processing, marketing, public health, waste handling, cattle management and handling, and policy issues need to be addressed (Tegegne *et al*., 2000).

Based on the study carried out by Tegegne *et al*. (2000) on market-oriented urban and peri-urban dairy production systems in the Addis Ababa milk shed, seven market-oriented, dairy production sub-systems were characterized. These are traditional crop/livestock farms in rural areas (between 25 and 130 km from Addis Ababa and are small farms with an average of four dairy cows and provide very little or no specialized inputs); intensified dairy/crop livestock farms (smallholder farms located around Addis Ababa and exercise some form of intensive dairy production system); Crop/livestock farms with intensive cropping (farms located relatively closer to Addis Ababa and the farms and herds are 25% larger than the traditional crop/livestock farmers), specialized dairy farms (located between 15 to 60 km from Addis Ababa with an average holding of 8.9ha and 17 cows and widely use specialized inputs), peri-urban farms in secondary towns (within 25 to 50 km from Addis Ababa), urban dairy in secondary towns (specialized dairy farms found in most secondary towns within the milk shed using high exotic blood, but herd size is the smallest of all types with an average of two cows per farm), and intra-urban dairy farms in Addis Ababa (these farms are specialized and intensive production units based on zero grazing of crossbred and high grade cows).

2.2. Land and labor

According to Smith and Olalku (1998), the main characteristic of urban dairy production units, both large and small-scale producers in Addis Ababa, are described as backyard producers because they have no land holdings and all operations are carried out within family compounds. The same study shows that all operations are carried out within family compounds measuring 275m^2 and 39m^2 for the large and small operators, respectively. The animals feed on road side grazing supplemented with purchased fodder and concentrates.

In Tanzania, dairy keeping is becoming popular among the smallholder dairy cattle farmers in urban and peri-urban areas. The smallholder dairy sector is composed of individuals owing a few numbers of dairy cows, mostly between one and five heads. This sector is characterized by having more intensive production systems because land is a limiting factor for expansion of arable crop farming (Bee *et al*., 2006). Dairying in Bangladesh contributed more to family income (63 to 74%) and utilized a smaller portion of land than did crops (Shamsudin *et al*., 2007).

According to the report of Kelay (2002), the family size of dairy farm households in Addis Ababa was 5.58 persons and ranged from 1 to 13. Most of the management activities in the medium and large scale farms were run by sons of the household and this could be probably due to the fact that 60.5% of the dairy cattle owners had a side line occupation and could not fully handle the responsibility of dairy cattle management. In addition, hired labor was also being used in large and medium scale farms since the owners can afford labor wages. The proportion of cows with 75% or more exotic blood increased with farm size and households without sideline occupation (specialized in dairy) kept significantly larger herd size and larger number of crossbred cows with 75% or more exotic blood than those with sideline occupations. Another report by Alderson (2006) revealed that women are mainly responsible for the dairy cattle husbandry including feeding, cleaning and manure disposal and milking the cows. They are also responsible for processing and marketing of the milk products. This could be due to the fact that roughly 43% of the dairy cattle owners included in the study were women. Younger children, especially girls aged between 7 and 15 tend the calves and other small animal in the farm (Alderson, 2006).

2.3. Dairy cattle feeding

The main feed resources in Addis Ababa city administration are grazing, hay, crop residues, crop aftermath (in surrounding areas), industrial by products (wheat bran, wheat middling, oil seed cakes, breweries of modern and local origin, abattoir byproducts), balanced rations, vegetable and fruit waste and improved forages (Tegegne, *et al.*, 2000; Alderson, 2006). According to Kelay (2002), wheat bran supplementation was significantly and positively affected by farm size and supplementation with concentrates resulted in better milk yield.

A study conducted to evaluate the potential of feed resources in smallholder dairy farming in peri-urban areas of eastern zone of Tanzania revealed that pasture and forage plants available could support milk production at a level of 5 to 6 litres/cow/day. The study envisaged that sustainability of smallholder dairy farming in peri-urban areas is in jeopardy as farmers rely on natural pasture without full control of the sources and recommended that there is a need to develop supplementary feeding strategies to boost milk production (Kavana and Msangi, 2005). Horticultural residues proved to be feed resource of high biological value in terms of feed conversion to animal products if harnessed judiciously especially for the peri-urban dairy sub sector (Akinbamijo *et al*., 2003)

2.4. Dairy cattle breeding

The study by Kelay (2002) showed that high daily milk yield was the most important preferred performance trait by individual farmers, which indicates the importance of milk as a source of income in market oriented dairy production system in the urban and peri-urban and rural highland areas. In addition, age at first calving was also one of the preferred performance trait mentioned by farmers in Addis Ababa and surrounding areas. Dairy cattle's breeding in Addis Ababa is predominantly dependent on artificial insemination (AI) although some farmers keep a bull mainly for emergency purposes. However, AI service offered by the Agriculture Department of the City Council is inadequate. Each sub-city has one AI technician with one motorbike, but he cannot possibly cover all the farms (cows) in his area and during breakage of motorbikes no AI service is available. According to Kelay (2002), in Addis Ababa, nearly half of the farmers using AI (46.7%) said that they had problem with AI. More than 93% of these farmers said the AI service was not reliable in that the inseminators were not punctual.

2.5. Dairy cattle housing

Cows are kept in tie barns and usually all types of cattle are housed together even sometimes with other species such as sheep, dogs and cats. The waste disposal methods employed by the farmers are drying and selling as dung cakes (during dry season); storing in slurry pits near the cow sheds; throwing into the near by river, which runs through the town cesspit and using for biogas (Tegegne, 2000).

2.6. Dairy cattle performance

Reproductive efficiency is determined by factors like age at first calving, calving interval and number of services per conception. Mugrewa (1989) indicated that calving interval in Zebu cattle ranged from 12.2 to 26.6 months. A study conducted to examine the fertility status of crossbred dairy cows in mixed crop-livestock production (MCLP), market oriented specialized dairy production (MSDP) and urban dairy production (UDP) systems in the central highland of Ethiopia revealed that age at first service and age at first calving were 29.58 months and 40.6 months, respectively. Cows managed under UDP were younger at first service and at first calving. The mean calving interval for cows was 551.82 days. First service conception rate (43.42%), number of services per conception (1.75) and pregnancy rate (79.29%) did not differ significantly between production systems (Shiferaw, *et al*., 2003)

According to Getachew (2003), at a national level, the range of milk yield per cow per lactation was 208-210kg from indigenous cow from 120-150 days, 1500-1625kg for crossbred cow and 3,725-5000kg for grade and pure dairy cow. According to Ike *et al*. (2004), the lactation yield in the urban area of Awassa was 1489.6 liter per local cow and 3949.6 l 1iters per crossbred cow, while in peri-urban area, the lactation yield were 444.4 liters and 2596.2 liters, respectively. According to a study conducted by Mekasha *et al*. (2003) on crossbred cows in urban and peri-urban dairy production systems in the Addis Ababa milk shed, daily milk production, milk yield in a 305-day lactation and fat corrected milk production varied ($p<0.001$) among sub production systems. Dairy cows in secondary town farms had 13.4, 26.3, and 20.2% greater mean daily, 305-day and lactation milk yield compared with intra and peri-urban farms, respectively.

Milk yield, age at first calving and calving interval of smallholder dairy farmers in three regions of Tunisia was reported by Rekhis *et al*. (2007). The values for milk yield ranged

from 12.3-19.7 liters/cow/day, age at first calving ranged from 27-33 months and calving interval from 13.4 to 14.7 months.

2.7. Dairy products processing and marketing

Dairy processing started with the objective of converting perishable milk into concentrated and long shelf life dairy products like butter, cheese, ghee and so on. Thus, the products could be easily transported to a market center and also fetch a better price or return (Thapa, 2000). As is common in other African countries (e.g., Kenya and Uganda), dairy products in Ethiopia are channeled to consumers through both formal and informal dairy marketing systems. Until 1991, the formal market of cold chain, pasteurized milk was exclusively dominated by the Dairy Development Enterprise (DDE) which supplied 12 percent of the total fresh milk in the Addis Ababa area (Ahmed *et al*., 2004). Data from ten years performance (1991 to 2002) indicated an annual processing average of 4,703.8 tons (Getachew, 2003). Recently, however, private business has begun collecting, processing, packing and distributing milk and other dairy products. Still, the proportion of total production being marketed through formal markets remains small (Ahmed *et al*., 2004). Getachew (2003) indicated that in Addis Ababa, there are 74 small scale and 9 medium scale milk processors.

The main suppliers of milk to Addis Ababa are dairy farms in the city, producers and dealers from Oromiya and Amhara regions and milk products from abroad. The estimated amount of milk produced in Addis Ababa is about 54,510 tons. Out of the total milk produced 73% is sold, 10% is used for home consumption, 9.5% is consumed by calves and 7.5% is processed into different milk products (Tegegne, *et al.*, 2000; AAAD, 2006).

The annual average per capita milk consumption of the city is about 20 liters which is a little bit more than the national average. When compared to the standard of 100 liters biological requirement per year per individual as established by FAO, only 20% of the need is met.

2.8. Constraints of urban dairy production

2.8.1. Institutional constraints

A week infrastructure base and poor support services have been repeatedly shown to adversely affect output and economic returns of urban dairy units. Inadequate infrastructure

such as feeder roads, unreliable power supply, inefficient cooling and processing capacity can discourage production or result in economic losses (Smith and Okaloku 1998). Institutional support services in terms of credit facilities, health delivery, input supply and distribution and technical advisory services are of crucial importance to the successful management of livestock products such as dairy, but are often not adequately provided, which is true for the situation in Addis Ababa.

2.8.2. Technical constraints

Diseases

According to Lema *et al*. (2004), the major health problems of crossbred dairy herds in urban and peri-urban production systems in the high lands of Ethiopia were categorized into 8 groups, and the mean annual incidence for all diseases being 44.7 %. Reproductive diseases and clinical mastitis were most frequently observed, where as gastrointestinal disorders, respiratory tract diseases, locomotion's disorders and metabolic diseases each occur in less than 5% of the cattle. Specific infectious and miscellaneous disease conditions each had annual incidence of about 6%. Cow and young stock were most affected and diseases were more frequent in urban stock than peri-urban situations. Herd size and season significantly influenced the incidence of disease but study year did not. The crude mortality rate was 4.2%.

Mastitis was the most frequently encountered disease condition and a big problem in Addis Ababa (Ethiopia) and it's surrounding (Alderson, 2006; Mekonen *et al*. 2005). According to Mungube *et al*. (2005), a quarter with sub-clinical mastitis lost an average of 17.2% of its milk production.

According to the study carried out by city agriculture department (2006), on 56 dairy farms to determine the situation of bovine tuberculosis, 30 (53.6%) of the farms were found positive for the disease.

Feeding and housing

The major dairy cattle feeding constraints are lack of farmers' awareness of appropriate dairy cattle feeding practices/nutritional requirements, high cost, poor quality and shortage of forage /supplement feeds, and lack of investigation into alternative forage/supplement feeds (Alderson, 2006). Regarding housing space is very limited and overcrowding is the

norm, cows sheds are often very poorly ventilated and dirty with inadequate drainage. Manure from inner city dairy farms poses a severe environmental pollution problem and causes the farmers considerable disposal problems. The existing evidence of negative impacts caused by inappropriate livestock waste management on water resources and public health calls for more detailed analysis of the problem (DFID, 2002)

2.8.3. Policy issues

In spite of the important contribution urban dairy farming makes to the livelihood security of the city's population, the urban livestock sector has not featured in the Addis Ababa development strategy and land available for agricultural purposes within the city is rapidly diminishing due to requirement for construction purposes. Also in the peri urban areas of the city, livestock production systems are rapidly being replaced by crop/livestock systems and floriculture farms. As a result, urban livestock keepers are accorded low priority and have received little attention or support in terms of policy and institutional and technical support (Alderson, 2006).

Under the current city redevelopment strategy, urban dairy farmers are being subjected to compulsory purchasing orders and eviction where their land is required for construction purposes. Urban livestock keepers and their dependents are re-housed in condominiums and are thus forced to get rid of their cattle. This results in a reduction in the urban milk supply, an increase in unemployment, and a reduction in income generation causing a severe social dilemma for the city in the future. For example, in 2005, large numbers of urban dairy farmers in the inner sub cities of Arada, Lideta and Addis Ketema were forced to leave their farms and sell their crossbred cows to make way for city redevelopment construction in the near future (Alderson, 2006).

2. 9. Opportunities for urban dairy production

The large demand for milk on the one hand and the small supply of milk and milk products for the major urban centers in Ethiopia on the other hand shows the untapped potential for development of urban and peri urban dairy farms. Market-oriented smallholder peri urban dairy production systems have tremendous potential for development and could play a significant role in minimizing the acute shortage of dairy products in urban centers. Current increase in economic pressure, competition for limited resources and market forces have led to an increase in the level of intensification in these production systems (Tegegne *et al.*,

2000). On top of these, the attention being given by international and national NGO's to urban livestock production, the efforts being under taken by these organizations to create awareness to city administrators on urban livestock production, the availability of specialized services such as artificial insemination, veterinary and feed processing industries in the proximity and also the short distance between producers and consumers for commodities such as "fresh" milk and the advancement of technologies to avoid hazards and inconveniencies in urban livestock production in one hand and to increase and boost productivity on the other hand are potential opportunities to dairy promotion in Addis Ababa.

3. MATERIALS AND METHODS

3.1. The study area

Addis Ababa, the capital of Ethiopia, lies between 8^0 55' and 9^0 07' north and 38^0 40' and 38^0 50'east situated in the central highlands of Ethiopia in the center of a well drained plateau and surrounded by hills and mountains, between 2300meters and 3000 meters above sea level. The city has a total area of 54,000 hectares. The rainy season extends from mid-June to late-September with an annual average rainfall of 1000mm. The average annual daily temperature is 16^0c with a minimum of 9^0c and maximum of $24.24.6^0$c. The population is about 3.15 million with an average annual growth rate of 4%. The annual milk production is estimated at 54,510 tons (CSA, 2007; Kelay, 2002; AAAD, 2007).

According to the information obtained from Agriculture Department of Trade and Industry Bureau of the City, the annual per capita income and consumption is almost the same and is estimated at Birr 2,943. Addis Ababa has a 40% unemployment rate and great majority of the unemployed are youth (Yilma, 2003).

The livestock population in Addis Ababa is 68,766 cattle, 29,862 Sheep, 18,811 goats, 360,777 poultry, 7,774 equines and 1,546 beehives (CSA, 203; AAAD, 2006). Out of the total cattle population found in the city 53.5% are indigenous and the rest 46.5% are exotic mainly of Holstein crosses and upgraded pure Holstein. There are over 5000 dairy farms in Addis Ababa. When categorized by herd size, 93.4% of the farms own 1-5 dairy cows, 3.9% own 6-10 dairy cows and 2.7% have a herd size of more than 10 cows. Each category supplies milk to the city, on the proportion of 66%, 12% and 22%, respectively (Getachew, F. 2003).

3.2. Study population

Small, medium and large-scale dairy farms in Addis Ababa City and their dairy cattle represented the study population.

3.3. Study design

Retrospective and cross-sectional types of studies were carried out to determine the status and major constraints of dairy cattle production in Addis Ababa from October 2007-April 2008.

3.3.1. Sampling procedure and sample size determination

The sample size is determined by the formula recommended for survey studies by Arsham (2007).

$$N = 0.25/SE^2$$

With an assumption of 3% standard error, the required sample size was 278 farms. As to the sampling procedure, six of the ten sub-cities of Addis Ababa (Bole, Yeka, Gulele, Kolfe-Keranyo, Nefas-silk-Lafto and Akaki-Kaliti) were purposively selected based on the availability of dairy farms. The farms in the sub-cities were stratified into small scale (1-5 cows), medium scale (6-10 cows) and large scale production (more than 10 cows). The lists of all dairy cattle producers in each sub-city were used as sampling frames to select randomly 14 to 16 farms from each level of production.

3.3.2. Data collection

Questionnaire survey

Structured questionnaire was prepared and one visit interview was carried out to collect data on socio-economics characteristics; production system characteristics (feeds and feeding, housing, breeding, health care, waste management); cattle herd size and composition; milk yield and reproductive performance; dairy processing and marketing; access to inputs and extension services; policy issues and constraints associated with dairy production (inputs and services), processing and marketing. When available, farm records were also be used as a source of primary data for performance variables (Annex 1). On top of this, relevant records and documents were used as a source of information.

Ranking methods such as good (meet that specific standard or norm), fair (deviating from the norm or below the standard), poor (does not meet) were used to describe dairy housing characteristics. Data on milk yield was collected on three lactation stages including early lactation (average yield of the first 2 months), mid lactation (average yield during 2-7 months of lactation), and late lactation (average yield during the last weeks of lactation.

Ranking of housing

Poor: Housing infrastructures with non-concrete floor structure, poor ventilation and light, poor slope for drainage and with out appropriate sewerage system, lacking enough working area and feeding and drinking troughs , over crowding of animals, un clean environment, and exposure of animals to hazards (rain, temp. etc)

Fair: Housing infrastructures with at least paved floor structure, having access to ventilation, light and drainage, has working space, feeding and drinking trough, keep the animals safe etc.

Good :Standard dairy houses fulfilling necessary dairy housing infrastructure (well concreted floor, ample ventilation, proper drainage and sewerage system, proper feeding and drinking troughs, working space, enough space for different groups of animals, loafing area and clean dairy housing environment, safeguard against injury and distress to cattle, with some isolation pens (for delivery and sick animals)

Ranking working space

Poor: Houses with difficulty to feeding, milking cleaning and with overcrowding of animals due to lack of space and poor housing design.

Fair: Houses with limited space for the movement of the herder (feeding, milking, cleaning etc) and for the animal

Good: Houses with enough space for work movement between the tying stalls (at least one meter width) and ample space between the cows (about 3 m^2 per mature exotic cow)

Ranking of sewerage system

Poor: Houses with out slope for proper drainage and have no any permanent sewerage connection system to septic tanks, rivers etc, and which can be causes to sewerage problems and health hazards. Usually labor is used to dispose wastes.

Fair: Houses with moderate slope and drainage facility and having sewerage system (open cannels) that lead to non permanent sewerage connection system.

Good: houses with well established drainage and sewerage system (waste disposal connection through pipes to septic tanks, rivers etc)

Participatory method of study

A total of 18 groups three from each of the selected sub-cities were organized. Each group was composed of 5 farm owners from each level of production. The points of discussion include the major constraints of dairy production and required services and supports in the respective sub-cities. Participants were given the chance to identify and rank the major constraints of dairy production by pair wise ranking method. Each constraint identified by the farmers group was compared with all other constraints regarding its relative importance and the constraints were ranked based on the number of times each constraint was ranked as more important in the pair wise comparison. The constraint with the highest relative importance rate will take the first rank. The same was done for possible solutions to the constraints as suggested by the respondents.

3.3.3. Statistical analyses

The collected data were entered in Microsoft Excel date sheet. Descriptive statistics was calculated using SPSS (release 11.5, 2002). The GLM of SPSS was used to compare the performance of dairy cattle (milk yield, age at first calving, calving interval and number of services per conception) in the three farm scales and between the different breeds and parity groups of cows. Kruskal Wallis-H was the statistical method used to compare ranks of constraints and possible solutions in the three scales of dairy production.

4. RESULTS

4.1. Demographic characteristics of sampled households

The overall mean age of the respondents was 49.52 (SE=0.756) years with a range of 22 to 95 years. The mean values for small, medium and large scale farmers were 47.74 (SE=1.40), 49.29 (SE=1.07) and 51.79 (SE=1.41) years, respectively. Both male and female are engaged in dairy cattle keeping. One third of the dairy farms (33.2%, n=83) were headed by women while the reaming two-third (66.8) were headed by men. The same trend of sex was observed in the three scales. The distribution of the level of education of the respondents was 8.8% (n=21) illiterate, 31% (n=74) attended elementary or basic education, 43.1% (n=103) attended high school and the rest 17.2% (n=41) attended higher education. The highest illiteracy level was found in medium scale farms while the proportion of respondents attending elementary and secondary education was comparable in the three farm scales. The proportion of farmers who attended higher education increased with the scale of production.

A considerable proportion of respondents (35.7%, n=89) were engaged only in dairying. In addition, there were also civil servants (12.9%, n=32), pensioners (11.2%, n=28), traders (17.8, n=44), house wives (13.3%, n=33), daily laborers (2.9%, n=7) and others activities (5.8%, n=14). There was no major difference between the farm scales on the distribution of occupation of the dairy farm owners (table 1).

The survey result indicated that the average household family size was 4.72 persons with a range of 1 to 13. Males and females consisted of 52.5% and 47.5% of the family size. An average of 1.14 females and 1.14 males were under the age of 15 years old, which normally could not be considered as a work force in the dairying activity. However, this may not always hold true and sons and daughters under the age of 15 were directly or indirectly involved in different farm activities.

Table 1. Demographic characteristics of respondents in the small, medium and large scale farms

Variable	Mean (SE)			
	Small scale N=84	Medium scale N=83	Large scale N=83	Total N=250
Age	47.74 (1.4)	49.29 (1.4)	51.79 (1.14)	49.58(0.76)
Family size	4.35 (0.2)	5.16 (0.28)	4.68(0.30)	4.72(0.16)
Own land (m^2)	873.3(177.2)	1714.87(479.4)	7072.8(2162.5)	3432.6(828)
Family land (m^2)	872.2 (385.3)	675(137.7)	516.7(137.2)	739.5(212.7)
Government land (m^2)	401.7 (148.7) (n=12)	400.1(95.7), n=7	370000(n=1)	18881(18480)

	Small scale (%) N=84	Medium scale (%) N=83	Large scale (%) N=83	Total N=250
Sex				
Female	34.5	33.3	31.7	33.2
Male	65.5	66.7	68.3	66.8
Educational. level				
Illiterate	8.5	13.8	3.9	8.8
Primary	35.4	27.5	29.9	31.0
Secondary	48.8	42.5	42.5	43.1
Higher education	7.3	16.3	28.6	17.2
Occupation				
Dairying	32.9	32.0	41.9	35.7
Civil servant	13.6	16.6	8.6	12.9
Pensioner	11.0	11.5	11.1	11.2
Trader	15.9	15.4	22.2	17.8
Daily laborer	6.0	2.6	0.0	2.9
House wife	14.6	15.4	9.9	13.3
Others	6.0	6.4	6.3	5.8

Others=wavers, tailors, non permanent activities

Out of the 240 respondents, 81.2% (195) run their dairy farm on own land, 9.2% (n=22) on family land, 1.25% (n=3) on rented land from individuals and 8.33% (n=20) on government rented land. On the other hand, the overall mean land holding was 4468m^2 and the mean for small, medium and large scale producers was 805m^2 (SE=140), 1550m^2 (SE=416.7) and 10948m^2 (SE=4938) respectively. This holding includes land used for residences and for other agricultural activities. The largest average own land was found for large scale farms (7072.8m^2) while the least (873.3m^2) was that of small scale farms. On the other hand, small scale farms had the largest family land (872.2 m^2) and the least was that of large scale farms (516.7m^2). About 23.6 % (n=59) of the respondents were involved in agricultural activities producing different types of vegetables, cereals and fruits.

4.2. Access to supplies and credit

Water supply was available to 81.3% (n=205) of the sampled households. On the other hand, 94.4% (n=238) of the households had electric power supply. The remaining 5.6% (n=14) were without electric power supply and were located in the periphery areas of the city and 57.1% (n=8) of them were medium scale producers. Regarding fixed telephone service, only 13.5% (n=34) did not have the service. Most of the households (79.4%, n=27) without telephone service were located in the periphery of the city.

Regarding access to credit, out of 241 respondents only 14.5% (n=35) approved that they had access to credit either from micro-finances or commercial banks, 50% of which were large scale farmers. Fifty six and a half percent (n=135) reported that they had no access to credit and the rest 29% (n=70) said that they had never asked for credit.

4.3. Livestock and cattle herd size and composition

Livestock and cattle herd composition in the different production scales are shown in Tables 2 and 3, respectively. The overall mean of cattle holding (herd size) was 12.69 heads (SE=1.09). The minimum and maximum cattle herd sizes were 1 and 167 heads, respectively. Eighty dairy farmers kept an average of 12.25 (SE=6.21) heads of sheep. Four farmers kept pig in line with dairying. One large dairy farm kept a herd of 1200 pigs. The mean number of asses per household increases as the scale of production increases. On the other hand smallholders keep more number of chickens (20.12) as compared to medium and large scale farms (8.09 and 8.89, respectively). The mean number of sheep ranged from 4.32 in small scale to 26.57 in large scale farms. Goat keeping was not practiced by small scale farms while the mean number was 5 in medium scale and 4.17 in large scale farms. There were also 8 beehives in one large farm and an average of 411 pigs in three large scale farms.

Table 2 Mean and standard error of livestock herd size and composition

Livestock species	Small scale(n=84)			Medium scale(N=84)			Large scale (N=83)			Overall
	n	Mean	SE	N	Mean	SE	N	Mean	SE	Mean (SE)
Cattle	84	4.69	0.17	84	8.82	0.22	83	24.78	2.75	12.69 (1.059)
Sheep	22	4.32	1.73	30	4.70	0.56	28	26.57	17.57	12.25 (6.213)
Goats	0	0.00	0.00	9	5	1.69	12	4.17	1.10	4.52 (0.938)
Ass	7	2.00	0.22	15	1.80	0.18	26	2.96	0.501	2.46 (0.287)
Poultry	17	20.12	14.38	22	8.09	2.16	18	8.89	1.510	11.93 ((4.36)
Pig	1	2.00	-	0	0	0	3	411.3	394.34	309 (297)
Beehive	0	0.00	0	0	0	0	1	8	-	8

N=number of observations

The average cattle herd size in small, medium and large scale farms was 4.69, 8.82 and 25.06 heads of cattle. The majority of the cattle herds (except bulls and oxen) in the small (28.53%), (n=83) medium (32.86%) (n=84) and large scale farms (40.22%) (n= 84) were made by milking cows. The highest proportion of dry and pregnant cows was found in middle scale farms (20.77%) (n=45) followed by small scale (17.01%) (n=65) and large scale farms (16.36%) (n=74). The proportion of female calves was highest in small scale farms (17.14%) (n=51) followed by medium (11.43%) (n=66) and large scale (5.65%) (n=75) farms. Although the difference is small, the same trend was observed for male calves (18.52 (n=8), 16.90 (n=19) and 15.52% (n=28) in small, medium and large scale farms). There was only 1 farm keeping one breeding and another 1 farm keeping 1 growing bull in the small scale farms and 2 farms each owning 1 breeding and another 2 farms each owning 1growing bull in the medium scale farms. In the large scale farm there were 17, 21 and 12 farms owning growing bulls, breeding bulls and oxen with an average number of 1.24 (SE=0.14), 1.17 (SE=0.11) and 5.83 (SE=2.63). Only (21.82%) of the respondents (n=55) were keeping male calves and (72.7%) of these were keeping only one male calf. The main reason was that male calves are sold with in few days after calving.

Table 3 Mean and standard error of cattle herd composition and size

Type of cattle	Snall scale (N=83)			Medium scale (N=84)			Large scale (N=83)			Overall
	n	Mean	SE	n	Mean	SE	n	Mean	SE	Mean (SE)
Male calves	8	1.25	0.25	19	1.21	0.10	28	1.43	0.12	1.33 (0.10)
Female calves	51	1.35	0.07	66	1.79	0.11	75	3.93	0.43	2.51 (0.19)
Heifer	63	1.37	0.08	76	1.91	0.11	83	5.63	0.77	3.14 (0.32)
Milking cow	83	2.08	0.10	84	3.48	0.13	74	10.18	1.38	5.26 (0.52)
DP cow	45	1.24	0.07	65	2.2	.137	83	4.14	0.39	2.74 (0.17)

N=number of observations, DP= dry pregnant

4.4. Dairying objective, experience and sources of foundation stock

In general, about 32.3% of the respondents started dairy cattle keeping activities as the only way of coping and sustaining their urban life (means of livelihood). That is, they consider dairy keeping as a way of being employed, where they have no chance of employment. About 36.8% of the respondents, which comprised civil servants, private employees, daily laborers, traders (mainly small scale business) and retired or retrenched persons run dairy farming activities in order to supplement their household incomes and reduce unemployment in the family. Some farmers (14.6%) started keeping dairy cattle in order to improve nutritional supplies particularly milk for their children. There were also 11.4% of respondents who started dairying for profit making or commercial purpose. The distribution of the different spectrum of dairying objectives in the three scales was very close to each other. However, there were more proportions of households who kept dairy cattle for commercial purposes in the large scale farms (29%) than the others (1.3% for small scale and 2.4 for medium scale). In addition, there was less proportion of farmers putting "meeting nutritional requirement" as objective in large scale farms (6%) than the other scales (20.3% in small scale and 16.7% in medium scale farms) (Table 4).

Table 4 Objectives of dairying in small, medium and large scale farms

Objective	Small scale (%) N= 79	Medium scale (%) N= 84	Large scale (%) N= 83	Total (%) N=246
Means of livelihood	36.7	31.0	30	32.3
Supplementing household income	39.2	41.4	30.2	36.8
Meet nutritional requirements	20.3	16.7	6	14.6
Commercial purpose	1.3	2.4	29	11.4
Multiple objectives	2.5	8.5	4.8	4.9

Multiple objective= supplementing income, nutrition requirements, interest and hobby etc

Regarding the source of foundation stock of the dairy farmers, out of the 244 respondents 81.6% (n=199) indicated that they started dairying with purchased stock, 15.2% (n=37) secured stock from their family and the rest 3.3% (n=8) of the respondents started with gift. The mean number of foundation stock for small, medium and large scale farms was 1.7, 2.3 and 6 cows or heifers, respectively.

4.5. Dairy products and functions

The products of the dairy farms were milk, Ayib (cottage cheese), butter, yoghurt, calf crop, fuel cakes/manure, cream, cheese of different kinds and biogas. All the dairy farms produce milk, calf crop and fuel cakes. About 27.13 (n=67) of the respondents were involved in Ayib, butter and yoghurt production either for only home consumption or for both home consumption and sale. Three large scale dairy farms (3.61%) engaged in milk processing activities producing different kinds of dairy products including pasteurized milk, butter, cream, different types of cheeses. Six large scale (7.23%) and one medium scale (1.20%) dairy farms produce biogas aiming at managing waste and fuel for home and farm consumption. Large scale producers involved more in butter making 38.1% (n=32) as compared to medium (34.5% (n=29) and small 31% (26) scale producers. Yoghurt making was very rare in all the three production scales 2.4% (n=2), 4.8% (n=4) and 4.8% (4) for small, medium and large scale producers respectively. On the other hand, smallholders involved more, 60.7% (n=51) in dung cake/manure production as compared to medium 55.4% (n=46) and large 48.8% (n=41) scale producers.

Majority 79.5% (n=184) of the respondents had different sources of income including salary, pension allowance, income from business, family assistance, other agriculture activities, safety-net programs, house rent, daily labor, milk retailing, and income from other activities such as handcrafting (waving and tailoring). On the other hand the farm income (net income) of respondents due to dairy cattle ranged from 0 to 100% of the household's total income. About 3.7% of the respondents said that currently they are subsidizing their cattle's expenses from other sources of income only not to loose their cows, because farm expenses mainly feed were extremely high and prices of milk were low. The over all mean proportion of farm income to the total income of the household was 54.09 %; about 22.7% of the households earn less than 25% of their total income from dairying, 31.2% earn 26 to 50%, 13.4% households earn 51 to 75 %, and the rest 24.6% households earn more than 75% of their income from their dairy farms and from this category 20.5% consisted of similar proportion between the production scales were completely dependent on their dairy farms. The mean dairy farm income proportion for small, medium and large scale farms was 49.80% (n=75), 56.14 % (n=79) and 56.7% (n=61) respectively.

Similarly, 238 respondents gave their views on the contributions of their dairy products to the family's food security. Accordingly, 4.6%, 18.9%, 43.7%, 21%, and 11.8% of the households responded that the dairy products contribute very small, small, moderate, high and very high, respectively, to the family food security. 64.4% of the smallholder, 83.8% of the medium holder and 81.2% of the large scale dairy farmers said that dairying contribute moderate or above moderate to the household food security.

4.6. Dairy cattle husbandry practices

4.6.1. Decision making

A range of decision-makers were involved in initiating and managing dairying activities in the city. Husband (men), wife (women), children and a combination of these were involved in making decisions on husbandry practices, animal sell/buy and cash utilization. Out of the 252 households studied, in 19.2% (n=48) of the households all the decisions of the dairy farms were made by wife. On the other hand, in 25.4% (n=64) of the farms, all decisions were made by husband. On the other hand, in 32.1% (n=81) of the households all decisions of were made by consensus or some form of approval of both partners (husband and wife).

About 17.9% (n=45) of the households involved their children in making decisions on the dairy farms. Children were also involved in deciding in all matters of the dairy farm, in conditions where parents were very old, in 2.4% (n=6) of the farms from which 83.3% (n=5) were large scale farmers and 16.7% (n=1) was a small scale farm. The rest 2.4% (n=6) of the farms had managers for decision making (83.3% large scale and 16.7% medium scale farms).

4.6.2. Housing and waste management

Majority of the dairy farms (82.2%) used indoor (zero-grazing) rearing system. About 17.8% (n=44) of the respondents allow their animals to graze for a period of 2 to 8 hours. Among these farms, 3.6% (n=9), 6.4% (n=16) and 7.8% (n=19) were small, medium and large scale farms, respectively.

Most of the farms in all scales of production (72.6-77.4%) kept their animals in closed type houses. The remaining used sheds (21.4-26.2%) and open barns (0-1.2%). Regarding the floor structure, the majority of the medium and large scale farms had concrete floor (63.4% in medium scale and 79.5% in large scale farms). In the small scale farms, there were equal proportions of farms with concrete and non-concrete floor (43.4%) (Table 5).

The majority of the farms in the large scale farms had good ventilation (84.4%). In the medium scale farms, slightly more than half of the farms had good ventilation (53.8%). The proportion of dairy farms with good and fair ventilation was comparable (42.2-43.4%). Most of the farms in the large scale group provided good working space and loafing area for animals than medium and large scale farms. Good sewerage system was found in 68.7, 35 and 25.3% of the large, medium and small scale farms. In 30.1, 36.3 and 19.3% of the small, medium and large scale farms the sewerage system was poor (Table 5).

The most important waste disposal methods in small scale farms were use of septic thank and preparation of dung cake (39.8%) and transporting waste to disposal areas (27.7%). In the medium scale farms, the above mentioned two methods were used mainly in addition to directing the waste to flow to rivers and dung cake preparation (19.5%) and accumulation of dung for use as fuel and manure (13.4%). The same trend was observed in large scale farms (Table 6).

Table 5 Housing characteristics in small, medium and large scale farms

Dairy house Characteristics	Category	Small scale (%) N=84	Medium scale (%) N=83	Large scale (%) N=83	Total (%) N=250
Type	Shed	26.2	21.4	25	24.2
	Closed house	72.6	77.4.	73.8	74.6
	Open barn	1.2	0.4	0	1.2
Floor	Concrete	43.4	63.4	79.5	65.9
	Non-concrete	43.4	32.9	4.8	26.9
	Stone paved	13.4	3.9	4.7	7.2
Ventilation	Good	43.4	53.8	84.4	60.6
	Fair	42.2	36.6	12.0	30.1
	Poor	14.5	9.6	3.6	9.2
Working space	Good	36.5	50.9	72.8	54
	Fair	48.2	30.1	22.9	33.7
	Poor	14.5	17.5	4.8	12.2
Loafing area	Available	42.9	51.9	76.3	57
	Not available	57.1	48.1	23.7	43
Sewerage system	Good	25.3	35	68.7	43.1
	Poor	30.1	36.3	19.3	28.5
	No system	44.6	28.8	12	28.5

N=number of observations

Table 6 Waste disposal practices by small, medium and large scale farms

Waste disposal practices	Small scale (%) N= 83	Medium scale (%) N= 82	Large scale (%) N= 84	Total (%) N=249
Use septic tank or pit + making dung cake	39.8	29.3	27.4	32.2
Direct it to river + making dung cake	7.2	19.5	22.5	16.8
Accumulation and use for manure or fuel	9.6	13.4	21.4	14.9
Mixing the feces and liquid, cracking and drying it out (used for fuel or manure)	8.4	2.4	2.4	4.4
Transport to disposing areas	27.7	26.8	16.7	23.7
Burning after drying the waste	2.4	4.9	2.4	3.2
Use for producing biogas	-	1.2	6	2.4
Liquid ignoring to sink in by itself or pouring evenly on the barn + making dung cake	3.6	2.4	1.2	2.4

According to the information found from the respondents, on an average barns were cleaned 3 times in a day and animals were washed every week (42%, n=100), every two weeks (19.7%, n=47) and every month (21.4%, n=51). Only 4.2% (n=10) of the respondents washed their cows and barns every day or every other day. Some farmers did not wash but brush their animals (10%, n=24) while 2.5% (n=6) responded that keeping cleanliness of their animals and barns depends on the availability of water.

4.6.3. Feeding

The types of dairy feed staffs used by the dairy farms were hay, industrial byproducts such as wheat bran, wheat middling, oil cakes, brewery byproducts, local beverage by product (atela), pulse bran (lentil bran, pea and beans bran), cotton seed hulls, straws, vegetable residues, formulated ration, urea and molasses. Salt was the only mineral supplementation provided to the animals, except those that use concentrate from feed processing plants. Green feeds are also supplied during or for a short period of time after the rainy season (mainly long rainy season).

Sources of hay for the farmers was mainly purchase of baled hay directly from retailers (82.5%, n=205). The remaining proportion bought grasses grown in the compounds of schools, offices and etc. Farmers acquired the other feed resources from wheat flour factories (mainly wheat bran), oil factories (oil cake), feed processing plants (balanced ration), small scale pulse crop grinders, retailers, and dairy associations.

Stall feeding was the widely used feeding practice. Out of the total 246 respondents, only 17.8% (n=44) had access to grazing either on their plot of land or on any open space. The greater share of this (43.2%) goes to the large scale producers, followed by medium (36.4%) and small scale farms (20.4%). The average grazing time was 4 hours ranging from 2 to 8 hours.

The quantities of hay and concentrates supplied to different types of dairy cattle are presented in Table 7. The quantity of hay provided to the different types of cattle was comparable in small, medium and large scale farms. In addition, there was little difference between the farm scales regarding the quantity of concentrates supplied to weaned calves and heifers. With regard to milking cows smallholder farmers supplied 79.9 and 91.8% of the concentrate supplied by large and medium scale farms. In the case of dry pregnant cows, small scale farmers supplied 76.8 and 87.5% of the concentrate supplied by large scale and medium scale farms.

Table 7 Quantity of hay and concentrate provided to different groups of cattle in the scales of production (kg/head/day)

Cattle category	Feed	Small scale N=57 Mean (SE)	Medium scale N= 51 Mean (SE)	Large scale N=53 Mean (SE)	Total N=161 Mean (SE)
Milking cow	Hay	5.67 (0.37)	5.13 (0.03)	5.67 (0.24)	5.49 (0.18)
	Concentrate	6.85 (0.32)	7.46 (0.38)	8.57 (0.44)	7.6 (0.41)
DP Cow	Hay	4.34 (0.36)	4.56 (0.30)	4.72 (0.19)	4.55 (0.16)
	Concentrate	4.68 (0.29)	5.35 (0.29)	6.09 (0.36)	5.38 (0.19)
Weaned Calves	Hay	1.36 (0.12)	1.24 (0.09)	1.35 (0.09)	1.31 (0.06)
	Concentrate	1.43 (0.10)	1.58 (0.09)	1.55 (0.07)	1.52 (0.05)
Heifer	Hay	2.94 (0.07)	2.82 (0.19)	3.28 (0.15)	3.01 (0.11)
	Concentrate	3.14 (0.36)	3.15 (0.17)	3.97 (0.11)	3.42 (0.13)

DP =Dry pregnant

Prices of feed had tremendously increased from time to time and are becoming the most prominent constraints for dairying. For instance when comparing the current price of wheat bran with that of the last 5 and 2 years, it has increased by about 3.4 folds and 1.7 folds, respectively.

About one third of the respondents (33.8 %) (65.8%, 29.3% and 9.9% for small, medium and large scale households) used only family labor for all feed supply and feeding activities from which wives account for 31.6%, husbands 34.2%, sons for 17.4%, daughters for 8.4% and relatives for 8.4%. . Similar labor distribution was observed in the other husbandry practices except that women involved more in milking and sanitary activities and men involved more in breeding and health care follow up.

Respondents were asked whether they get advice on feed preparation and feeding and only 17.6% (n=40) of the respondents said that they get advice from the agriculture department of the city, NGO's and feed processing plants. Most of the farmers (82.4%) didn't get any sort of advice regarding feeds and feeding dairy cows.

4.6.4. Breeding

Most of the dairy farmers interviewed (86 %, N=209) used on-farm born stock (females) for replacement and the rest (13.9 %, n=34) used both on-farm born and purchased replacement stock for breeding purpose. Regarding to preference of respondents to the dairy cow traits, about 90% indicated that good milk yield as their first priority. The second preferred trait

was reproductive efficiency such as early age of first calving, short calving interval and less number of services per conception (Table 8).

Table 8 Dairy cow traits preference as prioritized by the respondents in small, medium and large scale farms

Traits	Preference priority, N=235				
	1st	2nd	3rd	4th	Total
Milk yield	90.2	6.8	1.3	1.7	100
Reproductive traits	2.8	48.6	25.9	22.7	100
Disease resistance	6.5	21.2	49.3	21.2	100
Others	2.3	0.5	0.5	96.3	100

Others=includes behavior, size, feed consumption (less consumer), draught power etc.

The mating method employed by dairy farmers was artificial insemination 52 %(n=129), bull service 13.7% (n=34) or both 33.5% (n=83) as appropriate. Those farms that use bull service either kept their own bull (mostly large scale farms) 70.58% (n=24), consisted of 2.9% (n-1) smallholder, 5.8% (n=2) medium and 61.76% (n=21) large producers or rent bull from the nearest bull service providers 29.42% (n=10). The major reason for not using AI service was unreliability of the service. About 53.4% of the respondents, having almost equal proportion between the farm scales (51.4% (n=38), 51.3% (n=39) and 58% (n=40) for smallholder, medium holder and large scale respectively), reported that AI is unreliable especially during weekends and holydays. More than half of the respondents (61.5%) used only government employed inseminators, 31.7% used both private and government employed inseminator and the rest 6.9 % used private inseminators.

Most of the farmers (97.6%) follow their cows for the manifestation of heat symptoms with varying frequencies: 56.4 % through out the day, 21.2% twice in day and 20% three times in a day. The rest 2.4% don't have regular heat detection follow up. Concerning heat symptoms, bellowing and mucous discharge from vulva were the most recognized symptoms (mentioned by over 90% respondents) followed by mounting on other cows (70%), restlessness (48%), swelling and redness of the vulva (35%), milk yield reduction (both 35%) and reduced appetite (17%).

As to the practices of farmers on the time of insemination, 74% of the respondents used to inseminate their cows showing heat in the morning and the afternoon the same day in the afternoon and next day in the morning, respectively. About 15.8% used to inseminate their cows immediately after they see the heat signs (in the same morning and the same

afternoon). The rest 10.2% responded that the time of insemination was governed by the arrival of the inseminator.

Among the respondents that used bull service 75% did not know the reproductive heath status of the bull they used to breed their cow. The only observation they did was external symptoms of illness and its physical fitness. The rest either tried to have information from the owner or consult veterinarians if they had their own bulls. As to the bulls' genetic merit, 69% of the bull service users did not have any information while the rest checked for the performance of calves born from the bull, trusted the information from the owner about the bull's genetic merit, correlated the conformation of the bull with performance and used pedigree information.

Respondents were asked to give their views on problems of inbreeding. About 50.2% of the respondents did not consider inbreeding as having any problem and the rest mentioned problems such as stunted growth, poor milk yield, fertility problem, genetic abnormality (birth of defective calves) and death of the new born.

Animal culling (particularly culling unproductive animals) was one of the important dairy management practices. The causes of culling of female cattle for small scale farmers were old age (43.3%), financial problem (32.2%), and shortage of space (25.4%), lack of feed supply (22.8%), poor productive performance (22.6%), diseases (21.7%) and poor reproductive performance (20.6%). In the medium scale farms, old age (71.8%) and poor reproductive performance (34.8%) were the most important causes of culling. In large scale farms, old age (84.6%), poor reproductive performance (56.2%), poor productive performance 48.6% and disease 35.6% were the major causes of culling dairy cattle (Table 9). On the other hand, respondents were asked whether they sell productive and healthy cows/heifers and 50.3% (n=91) of the respondents said that they sell productive and healthy cows/heifers. The main reasons were space 6.1% (n=5), feed 18.3% (n=15) and financial 22% (18) problems, to substitute by another butter animal 4.9% (n=4), space and feed 8.5% (n=7), feed and financial 35.4% (n=29) and space, feed and financial 4.9% (n=4) problems. 4 out of the 5 respondents that sell their animals due to shortage of space were small scale farmers and 1 was medium scale farmer. The proportion of large scale farmers that sells their cows due to financial problems was only 16.67% (n=3).

Table 9 Criteria for culling dairy cattle by scale of production

Reasons for culling	Frequency (percentage)			
	Small scale	Medium scale	Large scale	Total
Age	29(43.3)	51(71.8)	66(84.6)	146(67.6)
Poor production performance	14(22.6)	16(24.6)	35(48.6)	65(32.7)
Poor reproduction performance	13(20.6)	23(34.8)	41(56.2)	77(38.1)
Disease problem	13(21.7)	12 (19)	26(35.6)	51(26)
Shortage of space	15(25.4)	12(19)	9(12.3)	36(18.5)
Financial problem	19(32.2)	19(29.7)	12(16.2)	50(25.4)
Problem of feed supply	13 (22.8)	9 (14.5)	13(17.8)	35(18.2)
Unwanted (males)	58(87.9)	62(89.9)	73(93.6)	193(90.6)

4.6.5. Health management

Dairy farmers get animal health services from government animal health clinics (34.3%) (n=84), private animal heath services (41.2%) (n=101) and others use both (22.9%) (n=56). Very few dairy cattle farmers hired animal health professionals (1.2%) (n=3). The following diseases that were put in the order of importance (prevalence) were reported by the respondents. Mastitis (44.9-68.8%) was the first most important disease mentioned by small (44.9%) (n=31), medium (66.2%) (n=47) and large scale (68.8%) (n=53) farms. Mastitis incidence increases as scale of production increases. Black leg, FMD and anthrax were also mentioned by significant proportion of farmers in the three scales of production (Table 10).

Table 10 Major health problems mentioned by respondents in the three scales of production

Disease reported	Small scale (%) N=70	Medium scale (%) N=74	Large scale (%) N=72	Total (%) N=216
Mastitis	44.9	66.2	68.8	60.4
Blackleg	18.2	32.9	20.3	23.9
FMD	18.5	17.8	24.7	20.5
Anthrax	10.6	21.9	9.3	14
Bloating	4.4	16.7	18.4	13.4
Pneumonia	7.4	11	15.6	11.5
Retained fetal membrane	10.3	5.5	17.3	11.1
Reproductive diseases	1.5	4.1	17.3	11.1
Calcium deficiency	3	7	14.7	8.5
Lameness	10.3	4.2	9.3	7.9
Internal parasites	5.9	9.6	5.3	6.9
Reduced appetite	4.3	5.6	4.1	4.7
Lump skin disease	3	5.6	4	4.2
Diarrhea in calves	0	4.2	5.3	3.3
Dystocia	1.5	1.4	4.1	2.3
Tuberculosis	0	0	0.9	0.9

Farmers were interviewed about cattle death incidences for the last one year before the study and 34.56% (n=75) reported death of cows with an average of 2.16 cows per household ranging from 1 (42 households) to 18 (1 large farm), 17.05% (n=37) reported death of heifers with an average of 2.15 and a range of 1 to 7 heifers per household and 9.21% (n=20) reported death of calves with an average of 2.16 and a range of 1 to 20 (1 large farm). The major reason for the death of the animals was disease (78.4 %) and other reasons such as injury, feed toxicity and delivery problems were also mentioned. Regarding incidences of abortions during one year before the study, only 22.2% (n=55) reported incidence of abortion (1 to 3 cows per household with an average of 1.4 cows).

Animal disease prevention practices such as vaccination against the most important communicable diseases (FMD, blackleg, anthrax and bovine pasteurollosis) once a year; spray against external parasites (1 to 3 times a year) and deworming against internal parasites (1 to 4 times a year) were carried out by respondents. Vaccination of cattle was carried out in 91.7 % of the farms, deworming was done in 82% of the households and spraying was carried out in 24.7% of the farms.

Farmers fed colostrums to new born calves for an average of 6 days (ranging from 3 to 10 days) and bucket feeding was commonly used (92.5%, N=245). The average age of weaning was 105 days with a range of 60 to 240 days. The criteria used by respondents for weaning

female calves were body condition (30.6%), status of solid feed intake (53%) or both (16.4%). Calves were housed separately in 47% of the farms while the rest were kept with the herd tied at one corner. Male calves are sold at an overall mean age of 13 (00.71) days with minimum of 2 days and a maximum of 120 days (only one respondent), at an overall mean price of Birr 129.60(3.32). The mean selling age and price for small, medium and large scale farms were 11.82(0.64) and 123.75(4.65), 11.64(0.56) and 125.34(4.03), and 15.28(1.92) and 139.51(7.71) respectively.

4.6.6. Record keeping

It seems that the most neglected activity of dairying in the sampled farms was record keeping. More than half of the households (66.8%) do not have enough awareness of the advantages of record keeping. About 50% of the respondents that are aware of the advantages of recording were large scale producers. Thus, about 78.5% and 79.5% of the small and medium scale producers, respectively, did not keep any record, while about 46.3% of the large scale farmers keep at least one type of record. The responses of the respondents regarding the types of records they keep are summarized in Table 11. The most important record kept by small scale farms was breeding record (17.7%). In the case of medium scale farms, breeding (14.8%) and financial records (11%) were given better emphasis. The type of records given emphasis in the large scale farms included breeding record (40%), production records (31.6%), financial record (15.2%) and health records (13.9%).

Table 11 Types of records kept by the three dairy production scales

Types of records		Small scale	Medium scale	Large scale	Total
Breeding record	N	14	12	32	58
	%	17.7	14.8	40	24.2
Production	N	6	4	25	35
	%	7.7	5	31.6	6.3
Health record	N	2	2	11	15
	%	2.6	2.6	13.9	6.3
Feeding record	N	1	1	7	9
	%	1.3	1.3	8.9	3.8
Income and expense	N	6	9	12	27
	%	7.7	11	15.2	11.3
No Record	N	62	66	44	172
	%	78.5	79.5	53.7	70.5

4.7. Production and reproduction performance

The results of analysis of variance for reproductive performance parameters are presented in Table 12. Age at first calving was significantly influenced by breed of cows ($p<0.001$). It was shortest in Jersey cattle (30.56 months) and longest in local animals (45.82 months). Number of services per conception was significantly affected by breed of cows ($p<0.01$) and mating method ($p<0.05$). It was lower in Friesian (1.58) than their crosses (1.88) and cows served by bulls (1.48) than AI (1.97). Calving interval was affected significantly by breed of cows ($p<0.05$) and parity of cows ($p<0.01$). The shortest calving interval was observed in Jersey (406.70 days) while the longest was found in local cows (540.80 days). In addition, calving interval decreased with the increment of parity number.

Table 12 Least square means and standard errors of age at first calving (AFC), calving interval (CI) and number of services per conception (NSPC) of diary cattle in the study areas

Factors	N	Least Squares Means (SE)	N	Least Squares Means (SE)	N	Least Squares Means (SE
		NSPC		AFC		CI
Overall	501	1.72 (0.10)	449	34.79 (0.63)	435	457.22(13.31)
Scale		NS		NS		NS
Small	110	1,56 (0.14)	127	35.15 (0.51)	104	472.63 (16.08)
Medium	174	1.77 (0.12)	131	34.79 (0.73)	138	453.34(14.17)
Large	217	1.85 (0.12)	191	34.42 (0.72)	193	445.71(14.54)
Breed	501	*		***		*
Friesian	412	1.56 (0.90)	313	31.17 (0.30)	328	434.20 (6.26)
Friesian crosses	89	1.88 (0.15)	112	31.67 (0.55)	92	447.19(10. 51)
Local	-	-	9	45.82 (1.74)	7	540.80(36.83)
Jersey	-	-	9	30.56 (1.74)	8	406.70(34.38)
Parity	-	-	-	-		**
2^{nd} parity	-	-	-	-	168	484.58(13.91)
3^{rd} parity	-	-	-	-	155	469.76 (14.44)
4^{th} parity	-	-	-	-	72	451.15(179.23)
5^{th} parity	-	-	-	-	40	401.48(19.26)
Mating method	501	**	-	-	-	-
Bull	68	1.48 (0.16)	-	-	-	-
AI	433	1.97 (0.09)	-	-	-	-

N=number of observations,

The daily milk yield at different stages and lactation length of cows in the study areas are presented in Table 13. Milk yield at all stages of lactation was significantly influenced by scale of production, breed and parity ($p<0.001$). Daily milk yield increased at all stages of lactation with scale of production and Friesian cows gave the highest milk yield at all stages of production followed by Friesian crosses, Jersey and locals. The highest milk yield was found in the third parity and decreased thereafter.

Lactation length was significantly affected by breed ($p<0.001$) and parity ($p<0.01$). Friesian and their crosses (317.38-317.62 days) were milked for a longer period than Jersey (274 days) and local cows (213.19 days). There was in general an increasing trend of lactation length with parity number. The overall mean and std. error of cow's lifespan (N=177) was found to be 11.06 (0.19) years with a range of 6years to18 years and the mean number of calves born per cow (N=177) were 6.98 (0.13) years and ranged from 3 to 12 calves per cow. Similar results were found between the production scales.

Table 13 Least squares means and standard errors of milk yield and lactation length in the study areas

Factors	N	Least Squares Means (SE)			
		Early lactation	Mid lactation	Late lactation	Lactation length
Overall	658	10.29(0.47)	6.82 (0.38)	3.76 (0.22)	280.97(8.28)
Scale	658	***	***	***	NS
Small	154	9.40(0.55)	6.03 (0.45)	3.22 (0.26)	284.13 (9.74)
Medium	209	10.31 (.51)	6.84 (0.42	3.86 (0.24)	281.68 (9.03)
Large	297	11.14 (0.51)	7.60 (0.41)	4.18 (0.24)	277.10 (8.97)
Breed	657	***	***	***	***
Friesian	467	15.47 (0.23)	10.76 (0.19)	5.73 (0.11)	318.38 (4.11)
Friesian crosses	169	11.34 (0.33)	7.66 (0.27)	4.78 (0.16)	317.62 (5.89)
Local	10	3.16 (1.29)	1.48 (1.05)	0.66(0.62)	213.19 (22.81)
Jersey	11	11.17 (1.23)	7.41 (1.00)	4.19 (0.59)	274.68 (21.67)
Parity	658	***	***	***	**
1st parity	92	8.28 (0.60)	5.59 (0.48)	2.88 (0.28)	254.92 (10.50)
2nd parity	255	10.10 (0.49)	6.58 (0.40)	3.6 (0.23	282.02 (8.64)
3rd parity	203	11.95 (0.5235)	8.15 (0.42)	4.34 (0.25)	288.14 (9.12)
4th parity	69	10.85 (0.66)	7.22 (054)	4.26 (0.32)	287.92 (11.73)
5th parity	39	10.25 (0.77)	6.58 (0.62)	3.69 (.37)	291.85 (13.52)

N=number of observations,

4.8. Marketing of dairy products

About three fourth of the respondents (72.87%) (n=180) were not involved in any kind of milk processing activity while (27.13% (n=67) processed milk to butter, ayib (cottage cheese) and/or yoghurt and 1.2% (all large scale producers) were engaged in milk processing producing pasteurized milk, butter, cream, different kinds of cheese.

Majority of the respondents (89.6%) sold their dairy products through informal market routes. Table 14 shows the main routes of dairy products (mainly milk) marketing. Even out of the 10.4% that sold their product through formal market, 3.2% sold their milk to dairy associations which are not strong and resell the product through informal market. Whenever there is market problems during fasting, farmers try to deliver their raw milk to milk processing plants although the dairy processing plants are not willingly to accept. The over all mean for the price of raw milk was Birr 4.03 (SE=0.54) and mean for small, medium and large scale dairy farms was Birr 3.86, 3.91 and 4.26, respectively. Prices paid to raw milk by formal markets were lower (below the mean price i.e Birr 3.40)

Table 14 Milk and milk products marketing routes in the three scales of production

Market routes	Small scale (%), N=83	Medium scale (%) N=84	Large scale (%) N=84	Total (%) N=251	Route
Neighbors (consumers)	18.3	16.8	17.4	52.6	Informal
Dairy association	1.28	1.92	-	3.2	Formal
Dairy processing plants	2.2	1.6	3.4	7.2	Formal
Cafeterias, hotels	6.4	9.1	14	29.5	Informal
Retailers (vendors)	1.5	3.8	2.2	7.5	Informal

4. 9. Constraints of dairy cattle production

The constraints of dairy production and the possible solutions as suggested by the respondents are presented in Tables 15 and 16, respectively. Feed problem, poor animal health services and shortage of drugs, poor genetic material, unreliability of AI, shortage of space market problems to dairy products were the most important constraints mentioned with the highest rank in all the farm scale with out significant difference.

The solutions for the constraints as proposed by the respondents were the reflection of the constraints themselves. Those solutions with top ranks were solving feed problems, strengthening animal health service, promoting dairy marketing cooperatives, introducing superior genetic material and improving the reliability of AI and creating dairy zone 4.

Table 15 Mean ranks and standard errors of constraints of dairying in the three farm scales

Constraints	Scale	Mean rank (SE)	Chi-square	P-value
Feed problem	Small	1.67 (0.33)	0.45	0.80
	Medium	1.33 (0.21)		
	Large	1.83 (0.54)		
	Overall	1.61 (0.92)		
Poor animal health services and shortage of drugs	Small	2.5 (0.560	1.60	0.45
	Medium	2.67 (0.33)		
	Large	3.33 (0.62)		
	Overall	2.83 (0.29)		
Dissemination of poor genetic material	Small	3.33(0.33)	4.43	0.11
	Medium	5.00 (0.00)		
	Large	3.00 (0.58)		
	Overall	3.63 (0.38)		
Poor government attention to urban dairying	Small	3.00 (2.00)	0.72	0.70
	Medium	5.00 (1.58)		
	Large	5.50 (1.50)		
	Overall	4.63 (0.94)		
Unreliable AI service	Small	4.67 (0.56)	0.64	0.73
	Medium	5.00 (0.55)		
	Large	4.50 (0.92)		
	Overall	4.71 (0.39)		
Shortage of space	Small	5.17 (0.95)	5.12	0.08
	Medium	3.00 (0.71)		
	Large	6.00 (0.82)		
	Overall	4.82 (0.55)		
Market problems for dairy products	Small	4.33 (1.67)	1.93	0.37
	Medium	6.33 (0.33)		
	Large	5.2 (0.58)		
	Overall	5.27 (0.52)		
Lack/poor extension service & training	Small	4.00(0.58)	4.01	0.13
	Medium	6.75 (0.48)		
	Large	6.00 (2.00)		
	Overall	5.60 (0.60)		
Water shortage				
	Small	6.00 (4.00)	0.60	0.74
	Large scale	6.50 (2.50)		
	Overall	5.67(1.63)		
Financial problem (absence of credit)	Small	7.00		
	Medium	5.50 (1.50)		
	Overall	6.00 (1.00)		
Waste disposal	Medium	4 (0.58	1.00	0.32
	large	9		
	overall	6.5		
Lack of recording system (poor information flow)	Small	6.50(2.50)	0.36	0.84
	Medium	9.00		
	large	6.00(3.10)		
	overall	6.67(1.59)		

Table 16 Mean ranks and standard errors of solutions proposed by respondents in the three scales of production

Proposed solutions	Scale	Mean Rank (SE)	Chi-square	P-value
Work to reduce feed problems	Small	1.50 (0.22)	1.42	0.49
	Medium	1.33 ((0.21)		
	Large	1.17 (0.17)		
	Overall	1.33 (0.11)		
Strength animal health services	Small	2.50 (0.43)	1.26	0.53
	Medium	3.67 (0.92)		
	Large	3.83 (0.95)		
	Overall	3.33 (0.46)		
Promote dairy marketing cooperatives	Small	7.00	2.00	0.37
	Medium	2.00		
	Large	2.00		
	Overall	3.57 (1.67)		
Introducing superior genetic material (GM)	Small	3.60 (0.60)	0.27	0.88
	Medium	4.00		
	Large	4.00 (0.00)		
	Overall	3.78 (0.32)		
Giving attention to dairying by government	Small	2.67 (0.88)	3.94	0.14
	Medium	3.50 (2.50)		
	Large	7.00 (0.00)		
	Overall	4.14 (0.97)		
Creating dairy zones around the city	Small	5.2(1.07)	1.13	0.57
	Medium	3.75(1.25)		
	Large	4.17(1.28)		
	Overall	4.40(0.68)		
Making AI service reliable	Small	4.50 (0.43)	0.78	0.68
	Medium	5.25 (0.85)		
	Large	4.60 (0.80)		
	Overall	4.73 (0.33)		
Improving water availability	Small	4.50(1.04)	3.28	0.19
	Medium	4.50(0.62)		
	Large	6.00(0.32)		
	Overall	5.00(0.40)		
Strengthening of extension and training services	Small	5.67 (1.20)	0.22	0.89
	Medium	5.67 (0.33)		
	Large	6.00 (1.58)		
	Overall	5.80 (0.66)		
Improved credit access	Small	5.00	1.00	0.32
	Medium	8		
	Overall	6.5(1.5)		
Supporting technologies such as biogas	Small	9.00	2.00	0.37
	Medium	4.00		
	Large	9.00		
	Overall	7.33 (1.67)		
Promote dairy recording	Small	8.00	1.00	0.32
	Medium	10.00		
	Overall	9.00 (1.00)		

5. Discussion

Socio-economic characteristics

The mean value for the age of the dairy farmers was 49.52 years and 62.6% of the respondents were above 45 years old. This is in agreement with the mean age of livestock keepers in Dar es Salaam, Tanzania, reported by Lupala (2002) (51 % of respondents were more than 50 years old)and lower than reorted by Tegegne (2004) (55 for women and 57 for men). From these results, one can interpret that dairy keeping requires long experience and long time for capital accumulation.

The result of this study indicated that 33.2% of the households were headed by women which is greater than that reported by Mekasha *et al*. (2003) (24.4%) and very much agee with that reported by Tegegne (2004) (33%) for Addis Ababa milk shed area and is lower than that reported by Lupala (2002) (48% in Dar es Salaam). On the other hand, the proportion of illiterate dairy farmers (8.8%) revealed by this study was much lower than reported by Mekasha *et al*. (2003) (22%) and Tegegne *et al*. (2000) (50% in intra-urban, 37.5% in secondary town and 12.5% in peri-urban). The mean values for family size (4.72 persons) were closer to those reported by Kelay (2002) (5.58 persons per household at Addis Ababa).

The dairy producing households run their activities on own plot of land (81.2%), family land (9.16%), rented land from private landholding (1.2%) and rented public land (8.33%). The overall mean of landholding was 0.44 hectares. The mean values for small, medium and large scale producers were 0.08ha, 0.16ha and 1.09ha, respectively. Our findings for all scales of production are higher than that of Smith and Olalku (1998), (0.0039 h and 0.0275 ha) while it is less than that reported by Swai *et al*. (2005) in Tanga, Tanzania (2.7 ha for urban areas) and those values reported by Tegegne *et al*. (2003) (8ha for specialized dairy farms in the Addis Ababa milk shed area). Plot (land) size is mostly a limiting factor in any urban dairy production system. Many dairy farmers might be forced to leave their plot of land as a result of the expansion and development of the cities.

The mean proportion of income from dairying to the total income of the households was 54.09%. This is lower than that reported by Shamsudin *et al*. (2007) (63 to 74% in Bangladesh). About 50% of the respondents said that the contribution of dairying to the households' food security was moderate and this is also lower than Lupala's report in 2002

(78% in Dar es Salaam). Relatively few numbers of respondents reported problem of access to water and electricity as compared to those reported in Dar es Salaam by Lupala, 2002 (37%).

In our study, the respondents kept dairy cattle for various reasons. For the poor smallholders, it is the only means of their livelihood. For some groups of households it is a source of supplementary income and nutritional requirements to sustain their family. For some others, particularly the large scale producers, it is the area of investment to make profit. Majority of the dairy producers in the city sell raw milk and don't convert it to other dairy products. The reason was that small scale traditionally converting milk to butter, ayib (cottage cheese) and yoghurt is not profitable and adds additional labor and facilities to run the activity. It is mostly practiced when milk is surplus during the fasting periods.

The mean cattle herd size in this study was ranged from 4.69 to 25.06 heads of cattle. The findings of Mekasha *et al*. (2003) and Tegegne *et al. (2000)* are within this range (9.1 and 9.2 for secondary towns and intra-urban, and 17 for specialized dairy farms in Addis Ababa milk shed, respectively). Milking cows contributed 43.4% of the total herd and 72.3% of the cows. This was in agreement with the findings of Mekasha *et al*. (2003) (35.8% of the total herd and 72.2% of the total cows in Addis Ababa milk shed)

Dairy cattle management/husbandry practices

Decisions on all aspects of dairying are made by husbands, wives, children and a combination of these. Decisions in 32.1% (n=252) and 17.9% of the farms were made by the consensus of husband and wife and by the involvement of household members especially children, respectively. Both these, participatory approaches of decision making was important to create better understanding, concern and involvement among the family members in the activity and to achieve better results. On the other hand, decisions in 25.4%, and 19.2% of the farms, were made by husband and wife, respectively. The involvement of women in decision making in dairy farming is lower than the report of Lupala (2002) (48%).

A variety of feed staffs (conventional and non conventional) were used by dairy farmers to feed their dairy cows. Hay is very important feed staff used by all farmers to feed their dairy animals. Horticultural wastes (vegetable residues) were also among the feed resources used by farmers in this study. In line with this, Akinbamjo *et al*. (2003) proved horticultural

wastes to be feed resource of high biological value in terms of feed conversion to animal products especially for the peri-urban dairy sub-sector.

Generally, grazing had no significant contribution in the feeding practice in the current study. As far as concentrate feed is concerned wheat bran was the commonest supplemental feed used by all dairy farms. Concentrate supplementation increased as the herd size (level of scale of production) increases. This finding was in agreement with that reported by Kelay (2002) in Addis Ababa. Probably, this was a good indication of the buying power of farmers at different levels of production scales under the extremely inflated feed prices. Generally, about one third of the households use only family labor. Majority of the smallholder households use only family labor and on the contrary, only few large scale households use only family labor. The use of only family labor by medium scale dairy farmers was also lower as compared to the smallholders.

Artificial insemination was the widely used mating method in the present study. Both government and private AI service were available in the study areas. Over 50% of the farmers approved that AI service was unreliable. Similarly, Rekhis (2007) reported that small scale dairy farmers' dissatisfaction on AI service in different regions of Tunisia and Kelay (2002) indicated that nearly half of the respondents in Addis Ababa that used AI had problem with AI service (unreliable). Almost all of the farmers that use rented bull service did not know the health status and genetic merit of the bulls they use on their cows. This would expose the dairy herds for reproductive diseases and for unplanned mixing of genetic material and hence to genetic erosion.

High daily milk yield was the most preferred trait by farmers. Milk yield was the first priority for over 90% of the respondents. This was in agreement with Kelay's report in 2002 (92.5%). Mastitis was the most important disease reported by over 60% of the respondents. Similar results were reported by Mekonnen *et al*. (2005) in Debre Zeit area.

Dairy cattle performance

Breed, parity status, and farm scale significantly affected milk yield. This is partly in agreement with the finding of Kelay (2002) (who reported significant effects of scale of production and breed on daily milk yield). Milk yield increases as the herd size (scale of production) increases. This could be due to the fact that smallholders are not able to properly

feed their animal as a result of feed cost inflation. Milk production also increased with parity status but up to the 3rd parity.

The pick daily milk yield found in this study (10.29 liters) is very close to the finding by Mekonnen *et al*. (2005) (9.96). Our findings for milk yield were lower than the reports by Rekhis (2007) in three regions of Tunisia (12.3-19.7 liters). The overall age at first calving (34.79 months) in our study is longer than the reports of the same author (27-33 months). Our finding on calving interval (15.26 months) is slightly longer than the report of the same author (13.4-14.7 months). On the other hand, the mean for age at first calving (34.79 months) was much lower than the one reported by Shiferaw *et al*. (2003) (40.6 months) in the highlands of Ethiopia. Significantly longer calving interval (mean 540.86 days) was recorded on indigenous cows in this study which was in agreement with that indicated by Shiferaw *et al.* (2003) (551.82 days in the highlands of Ethiopia) and Mugrewa (1989) (calving interval in zebu cattle ranged from 12.2 to 26.6 months). The mean number of services per conception (1.72) in this study was in agreement with the report of Shiferaw *et al*. (2003) (1.75).

Marketing of dairy products

Informal marketing was the major way of selling dairy products. About 90% of the farmers usually used this type of market route. This was greater than the report of Alderson (2006) (70% in Addis Ababa). Informal markets pay better prices to the dairy farmers as compared to the formal markets mainly the dairy processing plants.

6. Conclusion and recommendation

The people involved in dairying in this study were of different age and sex category and most of them were literate. The involvement of women in dairy business was substantial. Dairying was the only means of livelihood for some farmers but most of the farmers had side line businesses yet the contribution of dairy to their income was enormous. Large land size was owned by large scale farms and the land size decreased with farm scale. The cattle herd in all scales was dominated by milking cows. The major feed resources in all the scales were hay and industrial byproducts. The most common method of housing in all the scales was enclosed barns with varying level of ventilation, floor and roof structure and sewerage system. The most common methods of west disposal were dung cake making, usage of septic tank, slurry pits and diversion to nearby rivers. Space was one of the limiting factors of dairying animals were overcrowded in considerable number of households. The major dairy products and byproducts in the study farms included milk, ayib (local cheese), butter, yoghurt (sour milk), calf, Dung cake/manure, cream, cheese of different kinds and biogas. The milk yield performance of the studied animals was poor and age at first calving and calving interval were lower than the recommended values for tropical conditions. There is in general high demand for milk and milk products which lowers during the fasting season. However, the current price for milk especially that of the formal market (prices of the milk processing plants) is not fair as compared to the feed and other management costs. Recording and record keeping was one of the neglected dairying activities by the households due to lack of awareness or negligence. The major constraints in the studied farms were feed problem, poor animal health services and shortage of drugs, market problems for dairy products, unreliable AI service, poor genetic material, shortage of space, lack/poor extension service and training, water shortage, waste disposal problem, and poor government attention to urban dairying.

Based on this conclusion, the following are recommended:

- Efforts should be made by government and non-governmental development agents, research and teaching institutions and all other relevant stakeholders including the beneficiaries to urgently alleviate the feed problems in Addis Ababa;
- The animal health, AI and other extension services (providing advices and training regularly on proper dairy husbandry practices) should be strengthen and reliable input supply and services should be provided to the dairy sector in Addis Ababa;

- The existing dairy cooperatives should be strengthened and the establishment of new ones should be encouraged by government and non-governmental development institutions, so that they can assist in delivery of services and involve in promoting output through milk collection, transportation, processing and distribution.
- The dairy sector should be given appropriate attention by the City and Federal government and policies regulating the production process and waste disposal system should be prepared and implemented;
- Dairy farmers should be encouraged through availing credit schemes and providing separate land for the business especially for those living in highly congested areas of the city and urban development planning and management should innovatively integrate dairy keeping.

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8. ANNEXES

Annex 1 Questionnaire

Part1. Household questionnaire survey

1. Socio-economic characteristics

1.1. Farmer's full name ---------- Code of the farm household----------

1.2. Address

Kifle Ketema ----------

Kebele/PA ----------

1.3. Religion ----------

1.4. Level of education of the farmer----------

1.5. Age of the farmer----------

1.6. Sex of the farmer ----------

1.7. Scale of production----------

1.8. Occupation of the farmer----------

1.9. Family status of the farmer: a/ Married b/ Single c/ Divorced d/widow

1.10. Family composition

Age group	Sons	Daughters	Others
<5 years			
6-10 years			
11-15years			
16-20 years			
21-30 years			
>30 Years			

1.11. Land ownership (size): a/ Own land (------m^2) b/ Short term rent (-------m^2) c/ Family land (------m^2) d/ government (---------- m^2)

1.12. Do you produce vegetables and/or crops? If yes what types of produces ----------

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1.13. Do you get reliable supplies such as water, electricity, telephone etc.? If not why?

1.14. Do have access to credit? If yes how?

2. History and objectives of dairy farming

2.1. When did you involve in dairy cattle production?

2.2. What was the source of your initial stock?

2.3. Which group and breed of cattle compose your initial stock (cows or heifers, indigenous, crossbred or exotic?)

2.4. What is the primary objective of keeping dairy cattle?

2.5. What is/are the most important product (s) of the farm?

2.6. Who decides on a/ husbandry activities----------

b/ sells of animals----------

c/ income ----------

2.7. What are the sources of income other than dairying?

2.8. what percent is the income from dairying from your total income

2.9. the role the dairy production plays in your food security (minimal, medium, high, very high)

2.10. Do you have any linkage with farmers around Addis Ababa? Give details

3. Dairy cattle management practices

3.1. Labor distribution in dairy production

Actors	Dairy Production Activities						Others
	Feeding	Milking	Breeding	Herding	Health	Housing	
Husband							
Wife							
Sons							
Daughters							
Relatives							
Hired labor							

3.1.1 If hired labor is used, number of laborers hired----------, wage/month (average) ------

3.1.2 Have you got training on dairying? If yes how many times?----------

3.2. Dairy cattle housing

3.2.1. Type of dairy cattle housing ---------- ---------- ----------

3.2.2. Location of dairy house in relation to the residence of the owner ----------

3.2.3. Floor structure of the dairy house ----------

3.2.4. Ventilation situation of the dairy house ----------

3.2.5. Availability of area for exercise ----------

3.2.6. Frequency of cleaning the dairy cattle house ----------

3.2.7. Space available per TLU ----------

3.2.8. Availability of drainage system (observation), if available how does it function?

3.2.9. Overall assessment of the house (good/fair/bad) ----------

3.2.10. What are your major problems in relation to housing? Put in order of priority.

3.2.11. How often do you wash the animals? Do you use detergents?

3.2.12. have you quarreled with your neighbors particularly in relation to dairying?

3.2.12. How do you dispose the wastes of your animal?

3.2.13. What problems have you faced so far in relation to the waste disposal?

3.3. Dairy cattle feeding

3.3.1. What are the types of feed staffs you provide to your animals?

3.3.2. How do you get the feed stuff you mentioned above? Do you have feed supplier ?

3.3.3. What is the amount of the different feed stuffs provided to different classes of dairy cattle per day?

Cattle class	Grazing (hrs)	Hay (kg)	Crop residue (kg)	Concentrates (kg)	Others
Weaned calves					
Heifers					
Lactating cows					
Dry cows					
Pregnant cows					
Non-pregnant cows					
Oxen					
Bulls					

3.3.4. How do you feed your cattle?

Cattle class	Feeding type (individual, group or others)
Weaned calves	
Heifers	
Lactating cows	
Dry cows	
Pregnant cows	
Non-pregnant cows	
Oxen	
Bulls	

3.3.5. While you are feeding, is the level of feeding influenced by factors such as milk yield and stage of lactation? If yes, how is it influenced?

3.3.6. Do you provide your animals with green feed other than grazing? If so, how and when?

3.3.7. Price of feed stuffs

Feed staff	Unit	Previous and Current price (Birr)		
		Before 5 years	Before two years	Currently
Hay	Bale			
Balanced ration	Kg			
Wheat bran	"			
Wheat mead ling	"			
Crop residue	Bale			
Beverage byproducts	Kg			

3.3.8. Do you get advice on proper feed preparation and feeding? a/ yes b/ no

3.3.9. If yes, which organizations provides you the advice ----------

3.3.10. What are the major problems associated with feeding of your dairy herd?

3.4. Dairy cattle breeding and mating practices

3.4.1. What is your source of replacement stock?

3.4.2. Which traits of dairy production is your primary concern? Why?

3.4.3. What is your source of information about the performance of animals on the trait of your interest?

3.4.4. Which method of mating are you using? Why?

3.4.5. Is AI easily available in your area? If not, why?

3.4.5. If AI is available in your area, is it reliable? If not, why?

3.4.6. How do you know when your cows are in heat? List the indicators in order of importance.

3.4.7. If you see your cow in heat in the morning, when do you take her for service?

3.4.8. If you see your cow in heat in the afternoon, when do you take her for service?

3.4.9. If you are using AI or bull service, how long would it take you to let your cow served after the observation of the heat sign?

3.4.10. If you are using AI, how do you communicate the service center

3.4.11. If you are using bull service, do you know the health status of the bull?

3.4.12. If you are using bull service, do you know the potential of the bull for the Performance traits? If yes, how?

3.4.13. Are you aware of the problems associated with breeding of animals with their

close relatives?

3.4.14. If you are aware, what are the problems and how do you avoid it?

3.4.15. How much do you pay for AI service per conception?

3.4.16. How much do you pay for bull service per conception?

3.4.17. Do you practice culling?

3.4.18. If yes, what are the most important reasons for culling?

3.4.19. How do you dispose culled animals?

3.4.20. What are the major constraints associated with breeding and mating practices?

3.5. Dairy cattle health management

3.5.1. What are the most important diseases affecting your dairy herd? List in order of priority

3.5.2. What measures do you take, when you encounter health problems in your herd?

3.5.3. Have you encountered deaths in your farm last year, if yes, which group of cattle was affected, how many?

3.5.4. What was the suspected cause of the deaths?

3.5.5. From where (public or private sector) do you get animal health services? and why?

3.5.6. Are you satisfied with the service? If not, why?

3.5.7. Is it possible for you to estimate your costs associated with animal health services during the past year? If yes, how much was it?

3.5.8. Do you practice vaccination of your animals, If yes, against which diseases?

3.5.9. Do you practice deworming of your animals? If yes, which type of antihelmethic do you use?

3.5.10. Have you ever encountered abortion in your farm last year? If yes, at which month of pregnancy did it occur and how many cases have you seen?

3.6. Dairy calf management

3.6.1. How long (in days) do you feed colostrum to newly born calves?

3.6.2. How do you feed colostrum to calves (hand feeding or suckling)?

3.6.3. When do you start to feed your calves with non-milk feedstuff?

3.6.4. When do you wean your calves? What is your basis to determine the weaning age?

3.6.5. Do you have a separate house for calves? What type of housing is provided?

3.6.6. How do you feed milk to calves? (suckling or bucket feeding) If they are fed by bucket, what is the amount?

3.6.7 Do you feed equal amount of milk to both sexes? If no describe why?

3.7. Dairy herd record keeping

3.7.1. Do you know the importance of record keeping? If yes, what are the important ones?

3.7.2. Do you keep records of your farm, If yes, what are the records you keep?

3.7.3. Do you keep financial records? If yes, do you account, expenses and profits?

3.7.4. What are the most important expenses of the farm in the order of importance?

3.7.5. How much is the proportion of income you get from the dairy farm from the total?

4. Livestock and cattle herd size and composition

4.1. Livestock herd size and composition

Livestock species	Number
Cattle: Local	
Cross/exotic	
Sheep	
Goat	
Donkey	
Horse	
Mule	
Poultry	
Others	

4.2. Cattle herd size and composition

Type	Local breed	Crossbred*	Exotic	Total
Male calves				
Female calves				
Heifers				
Growing Bulls				
Breeding bulls				
Oxen				
Dry cow				
Lactating cow				
Pregnant cow				
Non-pregnant cow				

* please specify the exotic breed used in crossing

4.3. Cattle herd dynamics during last year

Types	Added to the herd	Reasons for additions	Removals from the herd	Reasons for removals
Male calves				
Female calves				
Heifers				
Bulls				
Oxen				
Dry cow				
Lactating cow				
Pregnant cow				
Non-pregnant cow				

4.4. Is the size of your cattle herd decreasing or increasing?

4.5. What was the reason for the decrease or increase?

4.6. How long would you use a cow for milk production purpose (average)?

4.7. Are you a member of any association/cooperative related to livestock/dairy production?

4.8. If yes, name(s) of the association(s) and the respective advantages of being member of each association (s)?

5. Performance of the dairy herd

5.1. What is the average daily milk yield of your dairy cattle herd?

Cow ID	Breed (L, C, E)	Daily Milk Yield at Three Stages of Lactation			Lactation length (days)
		Beginning	Middle	End	

L= local breed, C= crossbred, E= Exotic

5.2. What is the number of calves you have got from each cow in the herd?

Cow ID	Breed	Age	Calf crop

5.3. At which age did your cows gave birth for the first time?

Cow ID	Breed	Age at first calving

5.4 When did your cows gave their recent birth? When did your cows give birth immediately before the recent birth?

Cow ID	Previous birth	Recent birth

6. Product processing and marketing.

6.1. Are you producing dairy products other than liquid milk? If yes, mention them

6.2. What is the amount of dairy product you can get from a litter of milk?

6.3. How much of the milk you produce would be used for household consumption?

6.4. How much of the other dairy products would be used for household consumption?

6.5. If you are selling the products, what is the price of a unit of each product?

6.6. To whom do you sell your dairy products?

6.7. Do you face market problem for your products? If yes, how do you solve the Problem

6.8. Do you have any sort of storage facility? If yes, specify.

6.9. What do you do with your male calves?

6.10. If you sale, a male calf, how much would be the price?

6.11. Do you sale a healthy and productive heifer or cow (not culled due to problem)? If yes, how much is the price?

6.12. What are the reasons for selling healthy and productive heifers and cows?

6.13. Do you have any problems associated with the marketing of the dairy products? If yes, specify with the order of importance.

7. Policy issues

7.1. Have you ever experienced any sort of legal issue associated with your farm so far? If yes, specify the reason.

7.2. Is there any legal body controlling the quality of your milk and milk products? If yes, specify the legal body

7.3. Is there any legal body controlling the price of your milk and milk products? If yes, specify the legal body

7.4. Do you get support services from government organizations and NGO's? If yes, which organizations provide the support and what are the supports?

7.5. Taking into account the city's redevelopment and expansion; what measures should be taken by government to solve the problem of dairying in the city?

Part 2. Check-list for points of discussion for participatory approach

Major constraints affecting the dairy sector in the respective sub-cities

Supports provided by government and NGO's and their impacts

Additional supports required from government and NGO's

Possible solutions against the major constraints with ranking

Annex 2 Curriculum vitae

1. Personal data

Name: Gebremichael Meles Abreha

Age: 50

Marital status: married

Place of Birth: Tigray National Regional State, Eastern Zone, Ethiopia.

Language (speaking and writing): Tigrigna, Amharic and English.

2. Educational background

1967-1972: Meserte primary school, Mekelle, Tigray

1973-1978: Atse Yohanse junior and Comprehensive secondary school

1979-1982: Higher education, Haremaya University, the X Alemaya Agricultural College.

3. Work experience

1983-1985: Ministry of Agriculture, Tigray agricultural office, junior animal products processing and marketing.

1986-1987: Ministry of Agriculture, Tigray agricultural office, head Awraja agricultural office.

1988-1997: Ministry of Agriculture, National Artificial Insemination Center (NAIC), Artificial insemination field service expert/s.expert.

1997/98-2003: Ministry of agriculture, NAIC, head, Semen and Liquid Nitrogen production and distribution department.

2003-2005: Ministry of Agriculture, NAIC, head, AI field service coordination, extension and training department.

2005-2007 Ministry of Agriculture and Rural Development, civil service reform Office, Human Resource Development Team Leader.

4. Study papers produced

Artificial Insemination Results in Selale and Tegulet-Bulga Awrajas. A paper presented to the third National Livestock Improvement Conference (NLIC), Proceedings 24-26 of May 1989, Addis Ababa.

The Impact of Artificial Insemination on cattle breeding collection centers, a case study of Northern Shewa Administration, 1991, Addis Ababa.

5. Special skills

Computer proficiency.

6. Reference

Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia. Tel. 0115518040

Emiru Zewde Dr. Land O’ lakes, USAID, Addis Ababa, Ethiopia. Tel. 0911442671,.

Annex 3. Detail description of the constraints in the study area as forwarded by the participants

Feed problem

- Un affordable prices
- Shortage of feed stuffs
- Poor quality of feed stuffs

Poor animal health services and shortage of drugs

- Unreliable animal health service (inadequate facilities such as transport and number of professionals)
- Ineffective (mainly due to shortage of drugs and hormones)

Market problems for dairy products.

- Low demand during fasting
- Low prices as compared to expenses

-poor market outlet (formal market) and market information

Unreliable AI service

- Total breakage of service and interruption during week ends and holidays (cows missing heat)
- unreliable (shortage of inseminators and work facility)
- Repeat breeding

Dissemination of poor genetic material

-Deterioration of productivity of cows born from AI

-Birth of weak and stunted calves

Shortage of space

- Shortage of space to shelter the cows
- Shortage of space to manage wastes
- Shortage of space to store feed

Lack/poor extension service & training

- Lack of regular advices and training to farmers on urban husbandry practices including recording and record keeping , waste management and product processing handling and marketing

Waste disposal problem.

- Problem of sewerage systems
- Space shortage to manage wastes

-disputes with neighbor due sewerage and smell

Lack of recording and record keeping

- Poor/lack of attention to recording by dairy farmers and developmental organization
- Poor dairy management and decision making due to lack of records
-No information for any improvement measures at farm level or national level

Water shortage

. Interruption of water supply

. Lack of water supply (no water line)

Financial pro. (Credit)

. Shortage of finance to upgrade the cow sheds, properly manage waste (such as constructing biogas) and in general to sustain and expand their farms.

. Not easy access to credit (problem of collateral)

Poor attention to urban dairying

- Lack of supports from government,
- Lack/poor effort to solve problems related to dairying

. Lack of urban dairying guidance and regulation

. Absence of breeding policy that helps genetic improvement

Annex 4 Detail descriptions of the proposed solutions to alleviate the constraints in the study area.

Work to reduce feed problems

-Maintain and develop the feed resource areas

-encourage investment on production and distribution of feed

- proper distribution of industrial by-products

Strength animal health services

- Increase Staff and Fulfill transport facilities

- Improve drug and hormone availability

- encourage private animal health service

Promote dairy marketing cooperatives (DMC).

-Initiating and encouraging farmers to form DMC

-Give support to strengthen and promote the DMC to play major in solving problems and giving services

Creating dairy zones around the city

- Moving dairy Farms in the congested intra-urban areas to the periphery areas (studied areas).

Making AI service reliable

-increase number of insemintors and fulfilling facilities

- encourage private AI service

-Proper monitoring

Introducing superior genetic material (SGM)

-Importation of superior genetic material (AI Bull or/and, Semen etc)

-Strong selection and sire evaluation program locally

Strengthening extension & training services

-Regular advisory services in all aspects of urban dairying.

-sufficient training to dairy farmers

Introducing & supporting technologies such as biogas

- solve waste disposal problems by promoting biogas

- promoting other systems of waste disposing.

- strength sanitary regulatory services

Giving attention to dairying by government

- Developing Clear policy, breeding program and regulation of urban dairying

-Create forum with farmers and discuss the problem

-Encourage and support dairying

-giving more recognition to urban dairying (as an area of potential investment)

Promote dairy recording

- Establish dairy recording schemes.

- Encourage dairy farmers to keep and utilize records as one of the important step for genetic improve

Water shortage

- Improve supply of water for the farms. The issue was strongly raised especially in Gulele sub-city.

Financial pro. (Credit)

- Improve accessibility to credit (solving problem of co-lateral)

Annex 5 Signed declaration sheet

I the under signed, declare that the thesis is my original work and has not been presented for a degree in any university.

Name: Gebremichael Meles
Date of submission: June 23, 2008

This thesis has been submitted for examination with my approval as university advisor.

Dr. Kelay Belihu (PhD) _____