ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

STUDY ON CATTLE PRODUCTION SYSTEMS IN SELECTED SITES IN GAMBELLA REGION WITH EMPHASIS ON BREEDING PRACTICES

BY
OJUNI ODIER

JUNE 2009
DEBRE ZEIT, ETHIOPIA

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A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirement for the degree Master of Science in Tropical Animal Health and Production

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Board of Examiners	**Signatures**
1.	_____
2.	_____
3.	_____

Academic Advisors	**Signature**
Dr. Kelay Belihu	_____
Prof. Harpal Singh	_____

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LISTS OF ABBREVIATIONS

AFC	Age at first calving
AI	Artificial Insemination
CI	Calving interval
CSA	Central Statistics Authority
CSG	Conservation Strategy of Gambella
EARO	Ethiopian Agricultural Research Organization
ESAP	Ethiopian Society of Animal Production
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization of the United Nations
GBOA	Gambella Bureau of Agriculture
GDP	Gross Domestic Product
ha	Hectares
HH	House holds
IAR	Institute of Agricultural Researches
IBC	Institute of Biodiversity Conservation
ICAR	International Committee for Animal Recording
IIRR	International Institute of Rural Reconstruction
ILCA	International Livestock Center for Africa
ILRI	International Livestock Research Institute
IPS	International Project Service
MOA	Ministry of Agriculture
N	Sample respondents
NAIC	National Artificial Insemination Centre
NSPC	Number of service per conception
PA	Peasant Association
PRA	Participatory Rural Appraisals
SD	Standard Deviation
SDDP	Smallholder Dairy Development Project
SE	Standard Error
SNNPRS	Southern Nations Nationalities and Peoples Regional State
USD	United State Dollar

ABSTRACT

The study was conducted between September 2008 and April 2009 in Gog district and Gambella town areas in Gambella region, west Ethiopia. Two hundred eighty eight dairy producers, both rural and urban producers representing the two major studied areas, were selected using a multi-stage sampling technique, with the objective of characterizing dairy production system and describe dairy breeding practices in the areas. To characterize dairy production systems and breeding practices in the study area, dairy producers were interviewed using a pre-tested and structured formal questionnaire. Participatory Rural Appraisals (PRA) was also employed. Two major dairy production systems, namely the urban and mixed crop–livestock systems were identified, and again mixed crop–livestock systems classified into cereal crop producing based on the major crops grown. The average family size of urban and rural dairy producers was 6.33 and 7.22 persons, respectively. The average (Means ± SE) land holding for crop production in urban and mixed crop-livestock were 1.86 ± 0.09 and 2.16 ± 0.14 ha respectively. The average (Means ± SE) of landholding for pasture lands were higher in mixed crop-livestock 4.74 ± 0.24 ha, while in urban production system 2.66 ± 0.17 ha. Average Cattle herd size per household in the urban production systems (9.23 ± 0.41) was higher than in the mixed crop-livestock production system (6.81 ± 0.45). Husbandry practices like feeding, watering, housing, breeding, milking, calf rearing and record keeping were also different between the two productions systems. The majority of producers (39.8%) in the mixed crop–livestock system produced milk for home consumption, while the majority of urban producers (64.4%) produced milk for sale. Reproductive performances of dairy cows were also different in two production systems. Mating of cow was uncontrolled and only local animals were founding in both production systems. Individuals and dam performances 52.22% and 45% respectively were the major sources of information for acquiring dairy cow in mixed and urban production systems. In both urban and mixed crop-livestock high milk yields were the major preferred traits 70 and 64.8% respectively and also farmers used different selection criteria for both dairy cows and breeding bull in two production systems. The major disease identified in studied areas was trypanosomosis. Constraints for dairy development in the area included: diseases, thieves, veterinary services, lack of credit, feed and feeding, poor extension and lack of veterinary clinic. The rapid urbanization, subsequent increase in human population and standard of living of the urban dwellers especially the regional town Gambella as well as Pignudo towns can be considered as a good prospect for

the development of dairy in the area. Dairying in the studied areas can be improved by solving major problems of smallholder dairy producers through services related to feed supply, access to veterinary clinic, good marketing systems, controlling thieves and through provisions of veterinary services, improve breeding practices, credit, extension, and training services at reasonable time and cost.

Key words: Breeding practices, dairy cattle, Gambella, production systems

1. INTRODUCTION

Ethiopia has the largest livestock population in Africa estimated to be 47.57 million cattle, 26.1 million sheep, 21.7 million goats, 1.78 million horses, 5.57 million donkeys, 380 thousand mules, 1 million camels, 39.6 million chicken and 4.7 million beehives (CSA, 2008**)**. The livestock sub sector plays a vital role as source of food, income, services and foreign exchange to the Ethiopian economy, and contributes to 12 and 33% of the total and agricultural GDP, respectively, and accounts for 12–15% of the total export earnings, second in order of importance (Ayele *et al*., 2003). Livestock contribute to the livelihoods of 60-70% of the population (Ayele *et al*., 2003; Ejigu, 2003). Milk contributes about 20-25% to the agricultural sector. In general, more than 75% of the produce is absorbed locally for consumption. The contribution of milk and milk products to the gross value of livestock production is not known.

Out of the total cattle population, the female cattle constitute about 55.64%. The majority (99.25%) of the cattle population are local breeds, which are found in rural areas under subsistence type of farming system and the remaining are hybrid and exotic breeds that accounted for about 0.65 percent and 0.09 percent, respectively (CSA, 2008**)**. However, performance in the production of the major food commodities of livestock origin has been poor compared with other African countries (Befekadu and Birhanu, 2000). As in many countries, livestock, particularly cattle play multiple roles in Ethiopia being a source of milk, meat, hide, draft power and etc **(**Feleke and Geda, 2001**)**. But the country's per capita milk consumption is estimated to be about 19.2kg per year, which is far below the average per capita consumption of Africa, 37.2kg per year (FAO, 2000).

Livestock production system in Ethiopia is mainly smallholder subsistence farming with animals having multi-purpose use, and as such no specialized and systematic breeding is practiced. It includes pastoral dairy production systems, rural subsistence smallholder system, rural market oriented smallholder system, urban and pre-urban (market oriented small and medium scale dairy farms) and large scale commercial dairy production system (Feleke and Geda, 2001; Reda, 2001). But reliable figures on the relative importance of these systems in terms of number of farms/herds, dairy population and share of milk produced are not available. However, a rough estimate indicate that currently, out of about 1430 million liters

of milk produced annually, 900 million liters (63.3%) is produced by rural small-scale mixed farms in the highlands, 205 million liters (14.3%) by small urban/peri-urban farms in the highlands, 320 million liters (22.4%) by pastoral/agro-pastoral producers in the lowlands, and 5 million liters (less than 0.03%) by large private and state farms (Ahmed *et al*., 2003).

Breeding strategies generally evolve in response to changes in production system, farmers` preferences and production objectives and farmers` knowledge about breed characteristics and market opportunities (Jabber, *et al*., 1999). Despite the importance of the subsistence systems, no breeding objective suitable to the systems is currently available (Rege *et al*., 2001) and genetic improvements have been made mainly to improve the local cattle through cross breeding with less emphasis to selection. However, natural selection has resulted in animals that are tolerant to prevalent diseases and parasites, feed and water shortage and harsh climate (IPS, 2000). In addition, genetic improvement for productive traits in livestock, particularly in cattle, has been very slow and insignificant in the country. One of the main reasons for this is lack of well-organized and usable recorded information on the performance of both the indigenous and crossbreeds with exotic genotype to undertake structured selection and breeding programs (Azage, 2000). Similarly, Zegeye (2003) reported that poor genetic potential for productive traits in combination with the sub-standard feeding, health care and management practices that animals are exposed to contribute to the low productivity.

One of the pre-requisites in deigning a breeding strategy for a country or a region is investigation and characterization of the production systems and the traditional management practices prevailing in the area. There have been a number of such types of researches in the country, which are limited to the highland and mixed crop-livestock farming systems. Little has been done in the lowland areas like Gambella, which are characterized by low rainfall, high temperature, prevalence of important diseases and low forage production. There is a need, therefore, to identify and characterize the different types of cattle production systems and breeding practices that exist in the Gambella area so that appropriate recommendations can be tailored to the specific needs of the farmers in each production system.

Therefore, the objectives of this study were:

- To characterize dairy production systems in selected districts in Gambella area;
- To describe the cattle breeding practices in selected districts in Gambella area.

LITERATURE REVIEW

2.1. Cattle production systems in sub-Saharan Africa

In many parts of the developed and developing world, cattle production systems have been intensified in this century. Average herd sizes have increased by process of amalgamation of small units and an increase in purchased feed use. The future will bring greater control of cattle production, preserving these systems that benefit society and outlawing those that have detrimental effects on the region in which they are practiced (Philips, 2001). According to (Ibrahim and Olaloku, 2000), the livestock production systems in Sub-Saharan Africa can be divided into two broad types: traditional production systems and improved production system.

2.1.1. Traditional production systems

These systems include the pastoral, agro-pastoral and subsistence mixed crop-livestock production systems. In the pastoral system, relatively large herds of cattle are grazed on communal and public land. Due to seasonal scarcity of feed and water cattle trek over long distances. In this system, cattle owners acquire minimal land holdings at the home base. Pastoralists are unable to settle and take advantage of available production technology. It is estimated that up to 70-80% of Africa's cattle population is within this system (Ibrahim and Olaloku, 2000).

Agro-pastoralists own sizable pieces of land and practice integrated cop-livestock production. In this system, crop residues are utilized when feed is scarce but nutritional inadequacies remain. Transfer of technology is not easy and in spite of this in a few countries farmers in this system adapted improved technologies. For example, addition of urea to crop residues was adapted in West Africa. Productivity, nevertheless, is below potential because animals are fed below the optimum level. Agro-pastoralists and pastoralists' production systems produce about 70% of the milk and meat in sub-Saharan Africa. The agro-pastoral system is a considerable improvement over the pastoralists' production systems (Rass, 2006).

Subsistence mixed systems are defined by (Sere and Steinfeld, 1996) as those in which more than 10% of the dry matter fed to livestock comes from crop by-products and/or stubble or

more than 10% of the value of production comes from non-livestock farming activities. Globally, mixed farming systems produce the largest share of total meat (54%) and milk (90%) and mixed farming is the main system for smallholder farmers in many developing countries (Sere and Steinfeld, 1996). In Ethiopia, subsistence mixed crop-livestock system, livestock play an important role in the provision of food (milk and meat), draft power and dung which is used mainly as a source of fuel as well as for soil fertility enhancement (Feleke and Geda, 2001).

2.1.2. Improved production systems

Production systems in this category are characterized by high inputs. The production systems are market-oriented and farmers adopted improved technology to optimize productivity. These systems are increasingly popular in eastern and southern Africa. Producers usually own less than 10 cows and about 2-4 hectares of land with intensive crop-livestock production **(**Ibrahim and Olaloku, 2000**)**. There are also large-scale commercial livestock keeping in peri-urban areas targeted to respond to the demand of urban consumers and depends on high level of purchased feeds, including by-products from agro processing industries. In contrast, small-scale livestock keeping by poorer urban dwellers offers supplementary source of income, as well as source of animal protein, which the families could otherwise not afford to buy. Peri-urban and urban livestock-keeping systems have a potentially important role to play in disposing of organic waste, which other wise could endanger human health, and converting in into useful products (Ibrahim and Olaloku, 2000**)**. In this system due to High population densities and animal stocking rates, as well as easy access to markets, make it attractive to invest in market-oriented dairy production technologies in peri-urban areas in these regions (Tangka *et.al*, 2002).

2.2. Overview of dairy production systems and consumption patterns in Ethiopia

2.2.1. Dairy production systems

De Leeuw *et al*., (1996) defined dairy production as a biologically efficient system that converts large quantities of roughage, the most abundant feed in the tropics, to milk, the most nutritious food. Dairying is practiced almost all over Ethiopia involving a vast number of

small, medium or large-sized subsistence or market-oriented farms. Based on climate, land holdings and integration with crop production as criterion, the following dairy production systems are recognized in Ethiopia: the rural dairy system, which is part of the subsistence farming system and includes pastoralists, agro-pastoralists, and mixed crop–livestock producers and the peri-urban and urban dairy systems, which are market oriented (Ketema, 2000; Tsehay, 2001; Yoseph *et al*., 2003; Zegeye, 2003; Dereje *et al*., 2005). The rural dairy systems contribute up to 98%, while the peri-urban and urban dairy farms produce only 2% of the total milk production of in Ethiopia (Ketema, 2000) (Table 1). The rural system is not market oriented and most of the milk produced in this system is retained for home consumption (Ahmed *et al.,* 2003). The level of milk surplus is determined by the demand for milk by the household and its neighbors, the potential to produce milk in terms of herd size and production season, and access to a nearby market. The surplus is mainly processed using traditional technologies and the processed milk products such as butter, ghee, *ayib* and sour milk are usually marketed through the informal market after the households satisfy their needs (Tsehay, 2001). Pastoral milk production system is one of the major systems of milk production, practiced in the lowland region of Ethiopia where the livelihood of the semi-nomadic transhumance population is dependent on their stock. Pastoralists raise about 30% of the indigenous livestock population, which serve as the major milk production system for an estimated 10% of the country's human population living in the lowland areas. Milk production in this system is characterized by low yield and seasonal availability (Zegeye, 2003).

The highland mixed farming milk production is the predominant milk production system accounting for the major part of the 97% milk produced from indigenous stock. The highland livestock, as in the lowland, is dominated by cattle constituting 72.4% of the total TLU. From this only 28% are cows of which 40-45% is milked each year (Feleke and Geda, 2001). Oxen comprise 27% of the herd indicating the significance given for oxen as source of power in crop production. The highland smallholder milk production is found in the central part of Ethiopia, where dairying is nearly always part of the subsistence, smallholder mixed crop and livestock farming. Local animals raised in this system generally have low performance with average age at first calving of 53 months, average calving intervals of 25 months and average lactation yield of 524 liters (Zegeye, 2003).

Peri-urban milk production is developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities like Addis Ababa and other regional towns. It possesses animal types ranging from 50% crosses to high grade Friesian in small to large sized farms. This sector owns most of the country's improved dairy stock (Tsehay, 2001). The main source of feed is both home produced and purchased hay and the primary objective is to get additional cash income from milk sale. This production system is now expanding in the highlands among mixed crop–livestock farmers, such as those found in Selale and Holetta, and serves as the major milk supplier to the urban market (Gebre Wold *et al*., 2000).

Urban dairy farming is a system involving highly specialized, state or businessmen owned farms, which are mainly concentrated in major cities of the country. There are about 40,000 crossbred and pure exotic cows in urban and peri urban areas of the country. In Addis Ababa alone, there are about 5200 dairy farms with some 58,500 cattle (almost 50 percent crossbred). Total annual milk production is estimated at 44 million liters from which 83% is marketed, while the difference is used for household consumption (Azage, 2004). In terms of marketing, 71% of the producers sell milk directly to consumers (Tsehay, 2002). Moreover, price is high even when quality is low. No standardize quality control mechanisms or dairy policy exists to safeguard consumers (Tsehay, 2002). They have no access to grazing land. Currently, a number of smallholder and commercial dairy farms are emerging mainly in the urban and peri-urban areas of the capital (Felleke and Geda, 2001; Azage, 2003) and most regional towns and districts (Nigussie, 2006).

Table 1. Structure of demand for milk products in Ethiopia

	Households			
Milk products	Rural (%)	Peri-urban (%)	Urban (%)	Total (%)
Raw milk consumed by calves	32	13	9	32
Raw milk consumed by humans				
Farm households	15	8	10	15
Marketed	2	59	61	4
Butter and cheese	50	20	8	49
Pasteurized milk	1	0	12	1
Total milk equivalent } milk	100	100	100	100
Liters(x106)	1115	15	20	1135

Sources: Gebre Wold *et al*., (2000); Feleke and Geda, (2001); Tsehay, (2002)

2.2.2. Consumption patterns of milk and milk products

Milk and milk products form part of the diet of many Ethiopians and they consume dairy products either as fresh milk or in fermented or soured form. Feleke and Geda (2001) estimated that 68% of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese and yoghurt, while the rest is given to calves and wasted in the process. Butter produced from whole milk is estimated to have 65% fat and is the most widely consumed milk product in Ethiopia (Table 1). Of the total milk produced, around 40% is allocated for butter while only 9% is reserved for cheese. Traditional butter, which ferments slowly at room temperature, can be kept for a year or longer, offering rural consumers a readily storable and durable dairy product (Ahmed *et al.*, 2003).

The consumption of milk and milk products varies geographically between the highlands and the lowlands and the level of urbanization. In the lowlands, all segments of the population consume dairy products, while in the highlands major consumers primarily include children and some vulnerable groups of women. The limited statistical data available on potential milk demand suggest that demand for milk will increase at least in the urban centers and among the people with high purchasing power.

The demand for milk depends on many factors including consumers' preference and income, population size, price of the product, price of substitutes and other factors. Feleke and Geda (2001) indicated that the demand for milk is inelastic with respect to income and price. In general, increasing population growth, rising income and decreasing consumer prices are expected to expand the demand for milk and milk products. The population of Ethiopia is estimated to grow at 2.9% per year while the urban population increases at a rate of 4.4%. Therefore, growth in population and income are expected to increase fluid milk consumption.

Based on the 1994 national population census of the Central Statistics Authority of Ethiopia, urban dwellers account for 15% of the total population of 63.5 million in 2000. It is estimated that 40% of the urban population (those with average income above Ethiopian Birr (ETB) 350, or less than US$ 50) can afford to buy 20 liters of milk per month. A study by the Ministry of Agriculture in Addis Ababa indicated that effective demand for milk was about 36,240 tons in 1995 and projected to reach 55,440 tons in the year 2005 (MOA, 2000).

Similarly, the demand for butter was estimated to be 10,624 and 16,227 tons in the years 1995 and 2005, respectively. The rural population is estimated to be 85% of the total population and its milk consumption largely depends on livestock holding. In the mixed crop–livestock keeping highland region, it is estimated that 50% of households own cattle of which 56% are dairy cattle. Consequently, most households have access to milk. Similarly, more than 80% of the households in the lowlands own cattle, significant numbers of small ruminants and camels. In this area, it is likely that all households consume milk (Feleke and Geda, 2001).

2.3. The role of the dairy sector in the Ethiopian economy

The livestock sub sector plays a vital role as source of food, income, services and foreign exchange to the Ethiopian economy, and contributes to 12 and 33% of the total and agricultural GDP, respectively, and accounts for 12–15% of the total export earnings, second in order of importance (Ayele *et al*., 2003). Livestock contribute to the livelihoods of 60-70% of the population (Ayele *et al*., 2003; Ejigu, 2003). Milk contributes about 20-25% to the agricultural sector. In general, more than 75% of the produce is absorbed locally for consumption. The contribution of milk and milk products to the gross value of livestock production is not known.

Over the last 30 years, national and per capita production and consumption of livestock products declined (Ayele *et al*. 2003). During 1993-2001, per capita income remained at about USD 100. Livestock production increased by much less than the production increase for the agriculture sector as a whole, so relative share of livestock to agricultural GDP declined. Halderman (2004) reported that during this period, per capita livestock output fell by 5% while crop, food and agriculture grew at 14.7 and 6%, respectively. From 1966-2000, milk production in Ethiopia increased by 1.6% and per capita production decreased by 0.8% annually (Table 2). Per capita production grew slightly only after the introduction of structural adjustment and market liberalization policies in 1992. Due to declining per capita production over the long term and decreases in net imports in recent years, per capita consumption decreased from about 26 liters in the mid 1980s to about 16 liters in 2001 (Muriuki and Thorpe, 2003). According to (FAOSTAT, 2007), among the 20 major food and agricultural commodities ranked by value in 2005, whole fresh cow milk is ranked third. Milk production in the same year was estimated at 1.5 million tones, which is equivalent to USD 398.9 million

(FAOSTAT, 2007).

At household level, dairying is important in one way or another in all the farming systems of Ethiopia. In the mixed crop-livestock systems of the Ethiopian highlands, cattle are subordinate but economically complementary to crop production in providing draft power, the main agricultural activity (Feleke and Geda, 2001; Ahmed *et al*., 2003). Cattle also provide meat, milk, cash income and manure, and serve as a capital asset against risk (FAO, 2003**)**.

In the semi-arid low lands, cattle are the most important species because they supply milk for the subsistence of the pastoral families (Ketema and Tsehay, 2004). In the urban and peri-urban areas, dairy production is practiced mainly as a source of income (Azage, 2004). In addition, cattle also play significant socio-economic and socio-cultural roles.

In general, livestock products, especially dairy, can make unique contribution to human nutrition of the poor in developing countries by providing micronutrients in bio-available form such as vitamin A, in addition to carbohydrates, protein and calcium (Ahmed *et al*, 2003).

Table 2. Trends in total and per capita milk production in Ethiopia

Period	Total production		Per capita production	
	Annual average (tones)	Growth rate (%)	Average (kg)	Growth rate (%)
1961-1974a	698, 555	1.63	24.07	-0.87
1975-1992a	869,181	1.66	20.62	-0.91
993-2000	1,100,831	3.00	19.09	0.36
1961-2000	862,997	1.55	21.52	0.84

a. Includes figures for Eritrea, as separate figures were not available

Source: Ahmed *et al*. (2003)

2.4. The major constraints of dairy production system in Ethiopia

The livestock sub-sector in general and the dairy sub-sector in particular are constrained by both non-technical and technical constraints (Feleke and Geda, 2001).

2.4.1. Non-technical constraints

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

Human population

The demand for milk depends on many factors including consumer preference, consumers' income, population size, price of the product, price of substitutes and other factors. Felleke and Geda (2001) indicated that the demand for milk is inelastic with respect to income and price. In general, increasing population growth, rising real income and decreasing consumer prices are expected to expand the demand for milk and milk products. Population in Ethiopia is estimated to grow at 2.9 percent per year while the urban and rural population increases at a rate of 4.4 and 2.57 percent and this directly affect livestock development. Therefore, increase in population growth and consumer income in the future is expected to increase demand for dairy products especially in the urban areas, thus, production should increase well above the estimated current milk production rate (Mohamed *et al*., 2004).

Livestock Function

One of the serious constraints to the livestock development in Ethiopia rest on the importance attached to the economic functions of the livestock found in various agro-ecological zones. The functions of livestock in the Ethiopian context can generally be categorized in terms of food production, supplier of inputs and services for crop production, raw material for industry, cash income and export earning, saving and investment, social functions and generator of employment(Feleke and Geda, 2001; Gebre Wold *et al*., 2000).

In the highland production systems, the input function, mainly need for draught power, is the determinant factor for keeping cattle (Gebre Wold *et al*., 2000; Ahmed *et al*., 2003). Oxen provide virtually the only traction power for cultivation for the annually 6.4 million hectares of land used for production of 8 million tons of grain (Feleke and Geda, 2001). In the absence of alternative source of traction power, such as mechanization, the dependency on animal power will still be the only means to carry out cultivation. Unless the efficiency of oxen or the associated traditional farm implements used for cultivation are improved, the increased need for oxen power would demand the presence of higher livestock population. Therefore, to fulfill this demand more ploughing capacity requires for the presence of a higher cattle herd, which created pressure on grazing land and ultimately poor economies of peasant farm in highland (FAO, 1999). According to (Feleke and Geda, 2001), the other economic benefit of livestock, as a source of additional income consideration as assets and security are also important, and due to low productive indigenous stock these functions requires to maintain large herd and demand additional area of grazing land.

In the low lands, the pastoral nomads benefit from livestock through milk and meat. The predominant character of this system of production is the holdings of large herd and flock size to produce mainly food and sale some stock for cash income to substitute crop food and satisfy other requirement (Rass, 2006). Furthermore, in order to overcome low productivity of their livestock and recurring draught, large number of stock is maintained as security function as well (IPS, 2000).

Policy and institutional issues

The past poor performance of Ethiopia's dairy sector has been attributed also to socio-economic, infrastructure and policy problems (Gebrewold *et al*., 2000). The most common constraints noted are land tenure policies, and lack of animal services, marketing outlets, roads and transportation. Felleke and Geda (2001) argue that there is no livestock breeding and dairy development strategy in the country except for the draft policy incorporated in the general agricultural policy and the draft breeding policy of 1986, neither of which are yet finalized. Furthermore, past dairy development efforts were based on projects related to purpose- and area-specific dairy strategies, without any national policy aimed at setting out a comprehensive dairy development strategy or program (Zegeye, 2003). Besides, cross- breeds

may need specialized management and veterinary health care. These were also not addressed in these projects. The only development project that addressed these issues simultaneously, beside marketing and processing, agro-forestry and water development, was the Smallholder Dairy Development Project supported by the Finnish International Development Agency and implemented between 1995 and 1998 in 16 *woredas* in three regions.

2.4.2. Technical constraints

Animal health

Animal health care and improved health management is also one of the major constraints of dairy development in Ethiopia and sub-Saharan Africa in general, which caused poor performance across the production systems. Trypanosomosis is one of the major constraints to livestock productivity, with forty six million cattle at constant risk of infection (Kristjanson *et al*, 1999). In the tsetse infested areas of Ethiopia, mostly lowlands, 20-30% of cattle are affected by trypanosomosis and in some high tsetse challenge areas the prevalence of the diseases reaches up to 50% (Getachew, 2005). Many of the problems result from the interaction among the technical and non-technical constraints themselves. For example, poorly fed animals develop low disease resistance and fertility problems. When this is coupled with poor animal health care system, the situation worsens (Ibrahim and Olaloku, 2002). Contact of livestock brought from various localities through the use of communal pastures and watering as well as marketing places play an important role in the transmission of economically significant infectious and parasite diseases (Zinash, 2004). The annual mortality of livestock is estimated at 8-10 % cattle, 14-16 % sheep and 11-13% goats (Feleke and Geda, 2001).

Feed and Nutrition

Availability, quality and quantity of feed vary among various production systems. In Ethiopia, cattle largely depend on rangeland grazing or crop residues that are of poor nutritive value and Feleke and Geda (2001) reported that grazing and browsing account for nearly 84.8% of the total feed supply from permanent grazing lands, fallow lands and stubble following crop harvest. Feed is not uniformly supplied and the quality is poor (Ibrahim and Ololaku, 2000).

Natural pasture, browse and bushes accounts to the major food sources of livestock owned by pastoralists. Seasonal fluctuation in the availability and quality of feed has been a common phenomenon, inflecting serious changed in livestock production mostly in lowland (Ketema and Tsehay, 2004). The feed shortage mostly happens in dry season of the year (Ibrahim and Ololaku, 2000). In contrast, under normal circumstances, in lowlands when there is sufficient feed for cow, milk tends to be adequate for home consumption as well as for market (Beruk and Tafesse, 2000). In addition, feed constraints result in low milk and meat yields, high mortality of young stock, longer parturition intervals, and low animal weights (Ibrahim and Ololaku, 2002). Improved nutrition through the adoption of sown forage and better crop residue management can substantially raise livestock productivity. National and international research agencies, including the International Livestock Research Institute (ILRI), have developed several feed production and utilization technologies and strategies to address the problems of inadequate and poor quality of feeds (Mohamed *et al*., 2004).

Genetics

The livestock genetic resources of Ethiopia's have involved largely as a result of natural selection influenced by environmental factors (IPS, 2000). This has made the stock better conditioned to withstand feed and water shortages, diseases challenges and harsh climates. Genetic improvement for productive traits in livestock, particularly in cattle, has been very slow and insignificant in the country. One of the main reasons for this is lack of well-organized and usable recorded information on the performance of both the indigenous and crossbreeds with exotic genotype to undertake structured selection and breeding programs (Azage, 2000). The indigenous zebu breed produces about 400–680 kg of milk/cow per lactation compared to grade animals that have the potential to produce 1120–2500 liters over 279-day lactation. In most of the highlands of Ethiopia, milk production per head is low as compared to the highlands of Kenya due to the wide adoption of upgrading the indigenous breeds through cross breeding (Perera, 1999).

2.5. Cattle breeds and Genetic improvement in Ethiopia

2.5.1. Cattle breeds

Ethiopia is a country of diverse genetic resource. However, little has been done to identify this diversity other than recognizing breeds by morphology or by the name of ethnic group or by locality where these animals are usually found (Azage, 2000). Further evaluation at the genetic level to gain fuller understanding of the relationships among types, classes, breeds and populations is lacking and is required for efficient utilization of these species based on the genetic merit and potential to survive, reproduce and produce the desired output.

The country has several breeds/types of local cattle of unimproved zebu types distributed in the different parts of the country. Major indigenous cattle breeds of Ethiopia thus far identified are Sheko, Begayit, Boran, Abigar, Afar, Horro, Fogera, Arado, Jidu, Arsi and Red Bororo. In addition, very heterogeneous mixtures of Zebu sub-types (Black Zebu or Jem-Jem, Short horn zebu and small zebu) have been described under the name Abyssinian Zebu. Furthermore, report by FAO (1999) indicates the presence of zebu-sub-classes (Adwa, Ambo, Bale, Goffa, Gurage, Harar, Smada, Mursi and Hammer) at different parts of the country. The study conducted by the Tigray Regional Agriculture Development Bureau (1999), reported the presence of two breeds, namely, Medence and Abergelle in that part of the country. Although little is known on the productivity of all kinds of cattle the Barka, Fogera, Borana and Horro cattle show very considerable potential for milk production.

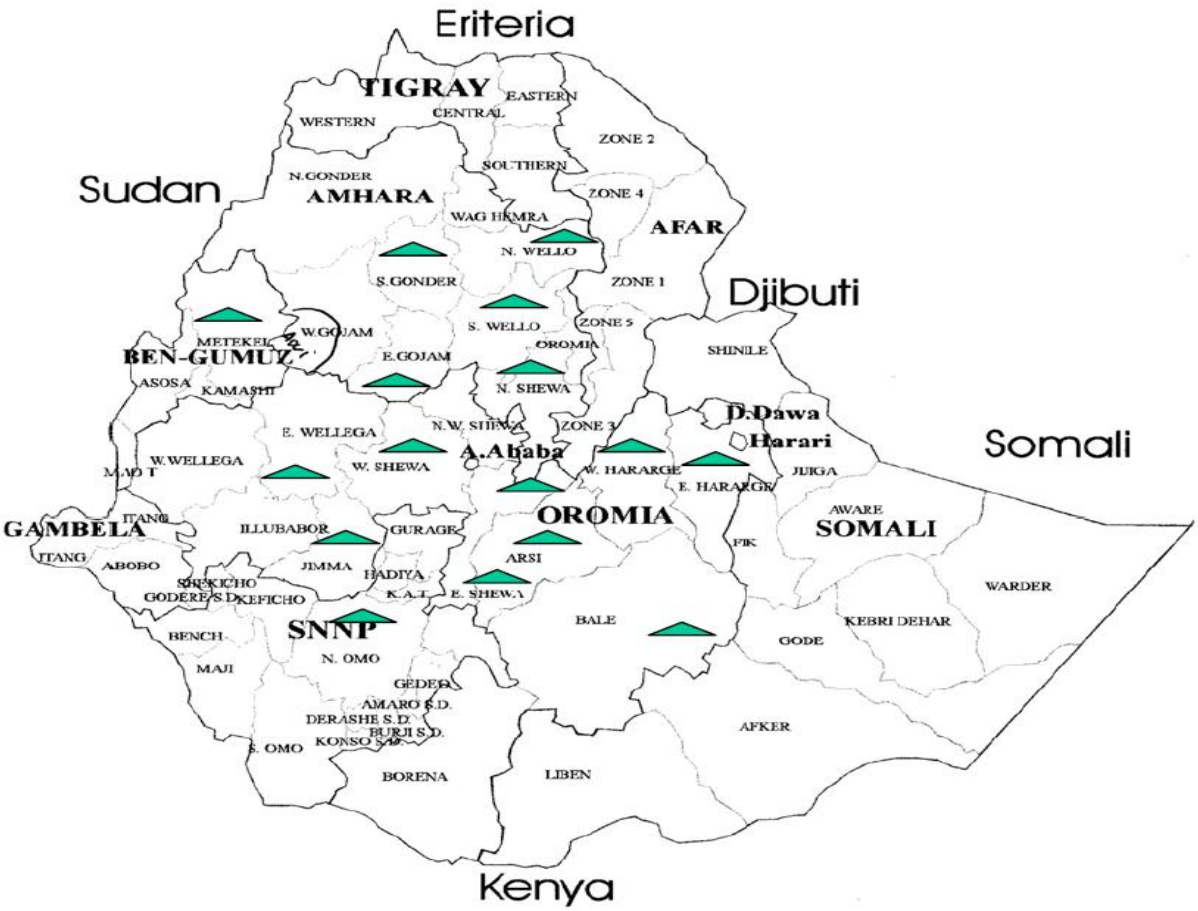
Many European breeds have also been imported for milk production and improvement program and the breeds so far imported are Holstein-Friesian, Jersey and Simmental of which Friesian and Jersey are considered the best adaptive breeds for both pure line and crossbreeding programs (IBC, 2004). The breeds are being used in medium input production system where Holstein-Friesians and their crosses occupy the lion's share. Crossbreeds used under medium input production system are those produced from crossings between exotic sire breeds and three indigenous dam breeds namely: Borena, Fogera and Arsi. The above crossbreds and others resulting from crossings between Borena with Simmental, Arsi with Jersey, Horro with Holstein Friesian, Horro with Jersey, Horro with Simmental are being used by research and/or teaching institutions (NAIC, 2001). There are about 40,000 crossbred and

pure exotic cows in urban and peri urban areas of the country (Azage, 2004).

2.5.2. Genetic improvement

The large cattle population of Ethiopia has relatively limited numbers of exotic dairy cattle and their crosses. Less than 1% of the 34.5 million cattle populations of Ethiopia are exotic or crossbred dairy cows (Muriuki and Thorpe, 2003). Although it was difficult to trace the ownership of improved dairy animals, it is estimated that state and private farms own a total of 128,745 grade and pure female dairy animals of which the smallholders sector owns 32,204 crosses and improved female dairy cattle (CSA, 2003). However, due to the dissolution of producer's co-operatives and the privatization of state farms, most of the crossbreed cows are currently privately-owned in peri-urban and urban areas of the country (Feleke and Geda, 2001).

Genetic improvement has been recognized in the design and implementation of the development projects in the country during the last four decades. With the exception of SDDP, the production and distribution of crossbreed heifers, the provision and distribution of dairy stocks, the provision and strengthening of AI services, and/or bull service were major components of the development projects implemented between 1967 and 1998. Through the effort of these projects, Ethiopia has built up a herd of 120 thousand exotic cattle. So far, only one government institution, the National Artificial Insemination Center (NAIC) provides AI services in the country. Out of a total of 9 million dairy cows in the country (including about 7 million milking cows), there are only about 300,000 (3.3% of total cows) cross-bred or grade cattle, most of them located around Addis Ababa (Ejigu, 2003). The exact exotic blood levels of these animals are not known. The service is available in urban, peri-urban and rural areas. All regions except Tigray, Somali and Gambella appear to have benefited from the distribution of crossbred heifers (Figure 1). However, most of these projects except two failed to address the genetic improvement and the feed shortage problem simultaneously.



Source: Mohamed *et al*, (2004)

N.B. Triangles represent distribution points.

Figure 1. Distribution of crossbred heifers in Ethiopia

2.6. Factors affecting dairy cattle productivity in Ethiopia

2.6.1. Milk yield and lactation length

Indigenous breed of cows are generally considered low milk producers. However, they are the major source of milk in Ethiopia that account for 97% of the total milk production in the country (CSA, 2008). Milk yield has remained extremely low with national average of 1.09 liter/day/cow (Dagenae and Adugna, 1999). Similarly, Lemma *et al.* (2005a) reported that the average milk yield of local Arsi cows was 1.0 liter/head/day. For Fogera cattle, the overall average estimate lactation yield was 506.78 liters, which is very low due to poor genetic make

up and shortage of feed and poor management conditions (Mulugeta, 2005). Kedija (2007) reported that the lactation length of local cow in Mieso district is 7.29 months. The overall lactation length of local cows in the Gambella region is estimated to be 7 months with average daily milk of 2.07 liters (CSA, 2008). The average milk yield of local cows found in Somalia region is less than two liters per day which could reach up to 488 liters over a 249 days lactation period in all pastoral areas elsewhere (IPS, 2000). Kelay (2002) reported that the lactation length of different crosses and exotic cow in Selale and Addis Ababa is 10.2 and 10.3 months, respectively. In Harar milk shed, mean lactation length for local cows was 212 days (Kurtu, 2003). Lemma *et al.* (2005a) however reported a longer lactation length of 9.5 months for local cows in the East Showa zone of Oromia. Elias, (2008) report average lactation length of 10.66 months for local Sheko cow in Bench-Maji zone of SNNPRS.

According to a report by Tawah *et al*. (1999), lactation performance of pure breed Arsi and crosses with Friesian kept at Assela station in the Arsi region of Ethiopia, was not affected by pre-partum supplementation with concentrate mixes, however, it was significantly and positively affected by postpartum concentrate supplementation. Similarly, a mean increment of milk yield by 35% was also recorded by Kurtu *et al.* (1999) after supplementation with noug cake (*Guizotia abyssinica*).

2.7. Reproductive performance

The reproductive performance of the breeding female is probably the single most important factor that is a prerequisite for sustainable dairy development and influencing herd/flock productivity. Perera (1999) and Zegeye (2003) reported that feed, genetics, diseases and a huge variety of management practices influence the reproductive performance. The reproductive efficiency of a breeding cow is determined by factors like age at first calving, calving interval and number of services per-conception.

2.7.1. Age at first calving (AFC)

First calving makes the beginning of a cow productive life and influences both the production and reproduction life of the female, directly through its effect on her life time calf crop and milk production and indirectly it influences also the cost invested for up-bringing (Perera,

1999). Heritability of age at first calving is generally low, indicating that this trait is highly influenced by environmental factors such as feed and health (Ibrahim and Ololaku, 2002). For instance, age at first calving of Borana cattle ranged between 45.5-51.1 months (Hailemariam and Kassamersha, 1994). But under better management in Kenya, the Borena breed calved remarkably at earlier age of 34-36 months. Age at first calving in pastoral and agro-pastoral areas with indigenous cattle is 4 years (IPS, 2000). In general, the ages at first calving for local cows in the same area were 52 months and for crossbreed were 31.06 months (Kurtu *et al.*, 1999). Workneh and Rowland (2004) reported that age at first calving for pastoral and agro pastoral production system of Oromia region in general is 51 and 48.4 months, respectively. The work of Elias (2008) indicated that the overall average age at first calving of cow in Bench-Maji zone of SNNPRS is 55.13 months. Kelay (2002) reported that the overall age at first calving of different cross blood level and exotics were 39.37 and 30.14 months in Selale and Addis Ababa, respectively.

2.7.2. Calving interval

Calving interval refers to the period between two consecutive calving and is a function of a days open and gestation length. Calving interval is probably the best indicator of a cow's reproductive efficiency. Calving interval has a very low heritability and can be improved through nutrition and early breeding (Ibrahim and Ololaku, 2002). In order to maintain optimum economic benefits under modern intensive dairy systems, it is generally accepted that the calving interval should be around one year. However, under many dairy systems in tropical countries a one-year calving interval is often difficult or impossible to achieve and, in some situation, even undesirable. In Ethiopia, the calving interval of zebu cattle raised under traditional management averaged 26 months (Perera, 1999). The overall calving interval of cows in Oromia region is 18.6 months. In pastoral and agro-pastoral areas shorter calving intervals of 15.5 months than 19 months, respectively, have been reported (Workneh and Rowland, 2004). The work of Elias (2008) indicated that the calving interval of Sheko cow in Bench-Maji zone of SNNPRS was about 463.67 days. The overall calving intervals of different cross and exotic cow were 24.84 and 13.75 months in Selale and Addis Ababa, respectively, as reported by Kelay (2002).

2.7.3. Number of services per-conception (NSPC)

Number of services per conception depends largely on the breeding system used. It is higher under uncontrolled natural breeding than hand mating and artificial insemination (Felee and Geda, 2001). The overall number of service preconception of different cross and exotic cow were 1.59 and 2.35 in Selale and Addis Ababa, respectively (Kelay, 2002). Heritability of NSPC is low and most of the variation is attributable to environmental factors. The work of Hailemariam and Mekonnen (1996) showed that breed and season of conception influence NSPC.

3. MATERIALS AND METHODS

3.1. Description of the study area

This study was conducted in Gambella Region, which is found at 777km distance from Addis Ababa in the Western part of Ethiopia. It extends between 7'N to 8.17'N latitude and 33'E to 35.02'E longitude (GIO, 2002). The area comprises of diversified topography features with altitude ranges between 300-2300 meters above sea level. The average annual rainfall and temperature range from 800-1200mm and 30.7-37^{o}C, respectively. The Region has wet season (May-October) and dry season (November-April) (GBOA, 1999). The region has an area of 34,063km^{2}and divided into three zones and eleven Woredas. The selected areas for study are Gambella town and Gog district. The population of the region is estimated to be 228,435 with annual growth rates of 2.23% for rural and 4.11% for urban areas and around 17%of the populations live in Gambella (CSG, 2000). The estimated livestock populations of the region are 212,591 cattle, 48,114 sheep, 54,638 goats, 336 horses, 173,844 poultry and 35,122 beehives (CSA, 2008).

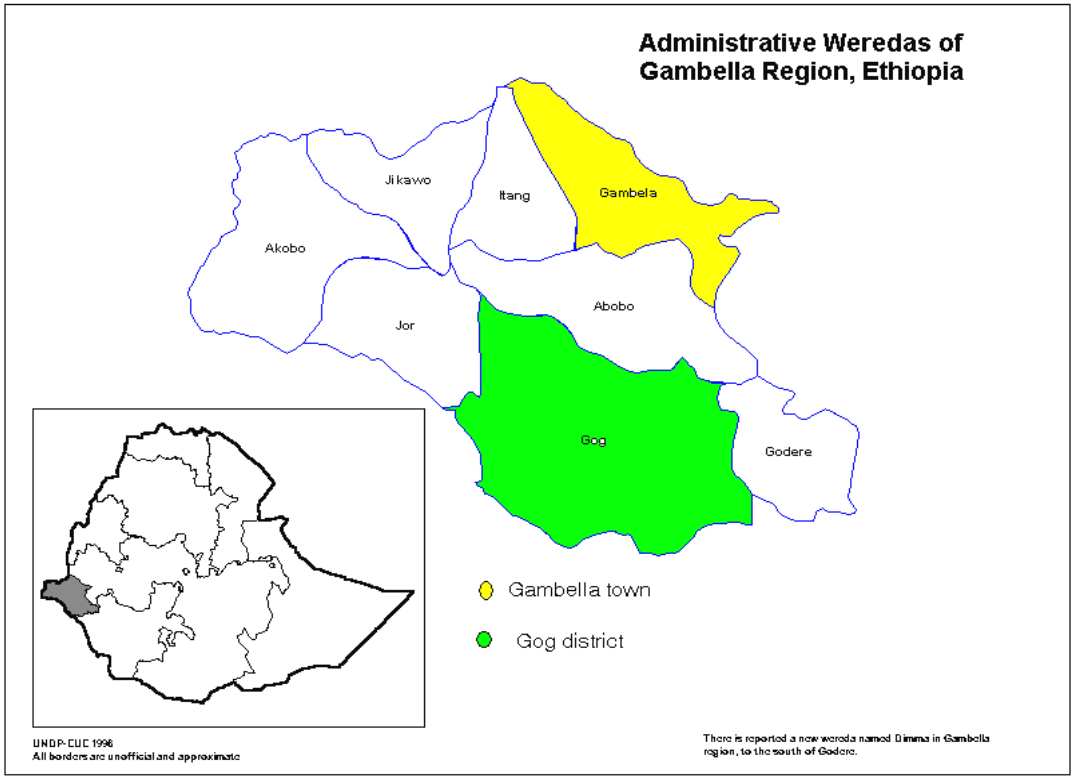


Figure 2 . Map of the study areas

Gambella town is the region's capital and is found 777 km west of the capital Addis Ababa. It has an altitude of 530 meters above sea level, and with an annual average rainfall of 800 mm with mean annual temperature of 33^{o}C (GBOA, 1999). Major crops grown in the area are maize, sorghum, and groundnut. Out of the total human population (228,435) found in the region, the town account for about 17% of the population (CSG, 2000).

Gog district is one of the districts in Anywaa zone, which is located 111km from Gambella town and 888km from the capital, Addis Ababa. It has an altitude of 340-500 meters above sea level, and an annual average rainfall of 850 mm with mean annual temperature of 30^{o}C (GBOA, 1999). The District has wet season (May-October) and dry season (November-April) (GBOA, 1999). The soil types of the District are sandy, red loam and black and the major crops grown is Maize, sorghum, Seasam and groundnut and monkey beans. The cattle population in the woreda is 30,410.

3.2. Study population and study design

Cattle producers and cattle kept by the farmers in Gambella town and Gog Wereda represented the study population. This research is basically a retrospective and cross-sectional survey focused on the selected area. Generally, data were gathered through survey methods and interview with key informants.

3.4. Sampling procedures and sample size determination

The sampling units were households keeping dairy cattle. The sample size required for the study was determined by the formula recommended by Arsham (2007) for survey studies:

$$N=0.25/SE^{2}$$

With the assumption of 3% standard error, a total of 278 households should be sampled. Thus, a total of 288 households were included.

A simple random sampling procedure was followed at three stages. The two districts (Gambella town with totally four urban kebeles and Gog district with three rural and one town

kebele) were selected purposely taking into account their cattle population and also accessibility. Then the four kebeles found in the selected districts were included in the study. Individual households having dairy cows of any breed and herd size were identified and listed in selected kebeles. Finally, 36 households owning cattle were randomly selected from each kebeles that made a total sample size of 288 households comprising 144 households from each district.

3.5. Data collection

3.5.1. Questionnaire survey

In order to characterize the dairy production systems and breeding practices in the area, farmers/producers were interviewed using a structured questionnaire which was pre-tested and amended as deemed necessary. The content of the questionnaire prepared to interview sample survey included socioeconomic characteristics, cattle herd size and composition, production system characteristics (production objective, housing, feeding, health care and constraints), performance of dairy cattle (milk yield, reproductive traits, disease resistance, and marketing value), breeding practice (breeding objectives, selection criteria for females and males, sources of information to select breeding animals and sources of establishment and replacement stock) and mating pattern (Annex-1). The questionnaire survey was supported by observation as much as possible.

3.5.2. Participatory methods

Group discussions were held with 2 farmer groups in each studied areas. In each group 8 representative households were organized and each group was given the chance to identify and rank the production system, merits and demerits of indigenous cattle, constraints of dairy cattle production and supports required for breeding activities. During the group discussions, farmers were also asked to indicate their objectives of cattle keeping and the cattle traits or attributes that they prefer in cattle breeding. The outcomes of this activity were listed horizontally and vertically and this make easier for farmers to undertake a pair wise ranking of items listed horizontally and vertically. For all the variables pair-wise ranking techniques was applied for the participatory approach (Ibrahim and Ololaku, 2000). For feed availability

seasonal calendar for each groups and the results of the pair wise ranking were summarized by counting the number of times one item is preferred against any other item in the list. The item with the highest count was ranked first and the ranking continued accordingly. Since the data collection is one way methods detail information were collected and ranked at once.

3.6. Statistical analysis and data entry

Data collected for the characterization of dairy production systems and breeding practices were entered into MS-excel and analyzed using SPSS (version 15.00, 2006). Survey results were reported using descriptive statistics like means, standard errors, and frequency distribution. Mean comparisons were made using one-way ANOVA.

4. RESULTS

4.1. Household characteristics

Out of the total interviewed dairy cattle producers (N = 288), 82.6% were male and the rest (17.4%) were female. The proportion of females was almost similar in urban (17.8%) and mixed crop livestock (16.7%) production system.

In mixed crop-livestock and urban dairy production system the average (Mean ± SE) of age were 41.97 ± 1.10 and 42.11 ± 0.76 years, respectively. The overall mean average age (Mean ± SE) of respondents in the studied households was 42.06 ± 0.63. The overall mean family size (Mean ± SE) in the studied household was 6.78 ± 0.18 persons. The highest mean value for family size was found in mixed crop-livestock with 7.22 persons and the lowest mean was found in urban with 6.33 persons. The average family size composition by age group indicates that the majority of household members (58.84%) were within productive age group categories in both urban and mixed crop–livestock production systems.

With respect to educational status of the household head, the overall proportion of illiterate farmers was 78.5%. About 13.9 and 7.6% have completed elementary school and secondary school, respectively.

The average (Means ± SE) land holding for crop production in urban and mixed crop-livestock were 1.86 ± 0.09 and 2.16 ± 0.14 ha, respectively. The average (Means ± SE) of landholding for pasture lands were higher in mixed crop-livestock system (4.74 ± 0.24 ha) than in urban production system (2.66 ± 0.17 ha).

4.2. Livestock and cattle herd composition

The livestock herd size and compositions at the different production systems are shown in Table 3. In the mixed crop-livestock production system, the livestock herd was dominated by poultry (38.9%) followed by goat (26.7%), cattle (26.4%), sheep (7.8%) and donkeys (0.2%). On the other hand, cattle (35.2%) dominated the livestock herd in the urban production

system followed by poultry (28.3%), goat (27.4%), sheep (7.2%) and donkeys (2%).

Table 3. Means and standard errors of livestock herd size and composition by production systems

Livestock spices	Mixed crop-livestock (N=108)		Urban (N=180)		Overall (N=288)	
	Mean(SE)	%	Mean(SE)	%	Mean(SE)	%
Cattle	6.81(0.45)	26.4	9.23(0.41)	35.2	8.32(0.31)	31.9
Sheep	2.01(0.28)	7.8	1.88(0.30)	7.2	1.93(0.22)	7.4
Goat	6.89(0.68)	26.7	7.18(0.58)	27.4	7.07(0.44)	27.1
Poultry	10.05(0.71)	38.9	7.43(0.59)	28.3	8.41(0.46)	32.3
Donkey	0.05(0.02)	0.2	0.53(0.09)	2.0	0.35(0.06)	1.3
Total	25.81(2.14)	100	26.25(0.97)	100	26.08(1.49)	100

N= Number of observations, SE= Standard Error

All the cattle owned by the sampled households were indigenous. The overall cattle herd size and composition in both mixed and urban dairy producers is dominated by cows (56.8%) followed by heifer (10.3%) and female calves (9.9%). In the mixed crop livestock system, cows contribute the higher proportion (61.5%) followed by heifer (10.1%), female calves (8.5%), bull (8.2%), male calves (8.1%) and steers (3.5%). In urban dairy producers, cows also contribute the higher proportion (54.6%) followed by female calves (10.5%), heifer (10.4%), male calves (9.4%), bull (7.8%), and steers (7.3%) (Table 4).

Table 4. Means and standard errors of cattle herd size and composition by production systems

Cattle types	Mixed crop-livestock (N=108)		Urban (N=180)		Overall (N=288)	
	Means (SD)	%	Means (SD)	%	Means (SD)	%
Cows	4.55(6.39)*	61.5*	5.10(7.72)*	54.6*	4.90(7.36)*	56.8*
Pregnant non lactating	1.21(1.25)	16.4	1.19(1.64)	12.7	1.20(1.56)	13.9
Lactating non pregnant	1.19(1.64)	16	1.01(1.60)	10.8	1.08(1.62)	12.5
Lactating pregnant	0.86(1.28)	11.6	1.11(1.44)	11.9	1.02(1.41)	11.8
Dry pregnant	0.70(1.21)	9.5	0.94(1.52)	10	0.85(1.41)	9.9
Dry non- pregnant	0.59(1.01)	7.8	0.85(1.52)	9.1	0.75(1.36)	8.7
Heifer	0.75(1.15)	10.1	0.97(1.33)	10.4	0.89(1.27)	10.3
Bull	0.61(0.90)	8.2	0.73(0.82)	7.8	0.68(0.85)	7.9
Males Calves	0.60(0.86)	8.1	0.88(1.25)	9.4	0.78(1.23)	9
Female Calves	0.63(1.04)	8.5	0.98(1.26)	10.5	0.85(1.19)	9.9
Steers	0.26(0.55)	3.5	0.68(1.45)	7.3	0.52(0.99)	6

N= Number of observations, SD=Standard Deviation

4. 3. Labor use pattern

The task of herding of animals depended on the sex and age of the household members. Accordingly, in 61.1% of the respondents, male members of the households were responsible only for herding of cattle and goats. As reported by (90%) of the respondents, cattle and goat herding is the task of children in the age group of less than 10 years.

According to the respondents in both systems, men are not involved in barn cleaning; it is done by women(42.6%), young boys (25.9%), young girls (15.7%) and hired laborers (15.7%) in mixed –crop livestock. In urban production system, barn cleaning was done more by hired laborers (32.2%), women (27.8%), young girls (25%) and boys (15%).

Feeding of cattle was the responsibility of women (41.7%) and young boys (29.6%) and girls (28.7%) in mixed crop-livestock production system. In contrary to this, mainly hired laborers (33.8%) were undertaking feeding of cattle in urban systems followed by women (22.8%) and young boys and girls (21.7 %).

In mixed crop livestock system, breeding was the task of husbands as reported by majority (65%) and the remaining (35%) respondents indicated that breeding is the task of young boys. Unlike the mixed crop-livestock system, breeding is more of the tasks of laborers (49.1%) in urban system followed by husbands (26.6%) and young boys (24.3%),

Young boys (58.3%), women (22.3%) and young girls (19.4%) were engaged in milking of cows in mixed crop-livestock production system. In urban production system labouer (57.2%) are more responsible for milking cow followed by boy (22.8%) and daughter (20%) respectively.

All (100%) respondents in mixed crop-livestock and urban production systems indicated that dairy cattle health care, purchasing and selling of animals were the responsibilities of husband.

4.4. Trends in dairy development in the study area

The majority of dairy farms were established about 15 years ago in both mixed and urban production systems. Most of the dairy farms in the mixed crop–livestock system of Gog district (34%) and urban areas of Gambella town (29.5%) flourished over the last 5 years. The overall trends in dairy development showed that the majority (50%) of the farms were showing a progressive trend, while 32.3% regressed, 13.2% remained stable and the remaining (4.5%) did not have any idea about the trend. In the mixed crop-livestock system, the majority of respondents (51.9%) showed regress trends, while 29.6% progressed, (13.9%) remained stable and (4.6%) have no idea about the situation. In urban production majority, 56.7% of farms showed progress, whereas 26.6% regressed, 12.8% remained stable and the rest did not have any idea about the trend (4.4%). The major reasons for regressing as reported by the respondents were diseases (59.7%), thieves (30.9%) and predators (9.4%) in both mixed crop-livestock and urban production systems.

4.5. Purposes of keeping cattle

In both systems, most of the farmers were keeping cattle for milk production (75% in mixed crop-livestock system and 84.9% in urban system). However, cattle keepers in urban and mixed crop–livestock production systems, milk had different functions. In the mixed crop-livestock system, the majority of households (39.8%) used milk for household consumption. Where as, in the urban system, most of the households (64.5%) produce milk for sale (Table 5).

Table 5. Primary purposes for keeping cattle by farmers by production systems

Purpose	Mixed crop–livestock (N = 108)	Urban (N = 180)	Overall (N=288)
Produce milk for sale	7.4	64.4	35.9
Produce milk for consumption	39.8	17.2	28.5
For milk and meat	27.8	3.3	15.6
For asset	19.4	8.3	13.9
Dowry	4.6	4.4	4.5
Income	0.9	2.2	1.6

N= number of observations

4.6. Cattle husbandry and management practices

4.6.1. Feeds and feeding systems

Feed resources commonly used by cattle keepers in the study areas were grazing land, succulent grass, cereal crop residues, maize and sorghum Stover, homemade concentrate feeds, plant weeds, and non-conventional feeds like ‘attalla’ (brewery by-product from locally produced beer, and other alcoholic drinks), fruit wastes and leaves of other palatable agro-forest plants. Maize Stover is the most commonly used roughage feed resource in all the production systems of the study areas.

In the mixed crop–livestock system, mostly cereal crop residues and grazing were the major

feed resources and all species of livestock were allowed to graze together. Almost all respondents in this system (96.5%) do not supplements their lactating cow with additional feeds, while only 3.5% used to supplement their dairy cows with additional feeds. Rotational grazing is practiced by farmers naturally due to seasonal change. With this regard, farmers used to keep their livestock for grazing in marginal land during wet season and waterlogged areas for grazing during dry season. Shortage of feeds occurs in January and April during the dry season. Aftermath grazing is another source of feed that is available as the dry season commences.

Figure 3. Cattle grazing at waterlogged areas during dry season around Lake Thata

Contrary to this, 85% of the respondents in the urban production system used to supplement their lactating cow with additional feeds (local brewery by-products, greens grasses and very few use homemade concentrate feeds). All the urban producers (100%) indicated that they do not have enough access to improved feeds and this make them to depend totally on grazing during day times and supplementation at night time. In the study area, supplementary feed was mainly given to lactating cows. For example, (71.1%) of the respondents indicated that they give priority to lactating dairy cows, while the rest did not give any special attention

Figure 4. Concentrate feeders prepared locally by wood

4.6.2. Water resources and watering practices

The studied farmers used different water resources for their cattle in the study areas. The main sources of water identified in the present study areas were rivers (74%), lakes (12.5%), ponds and holes (12.5%) and pipe water (1%). The majority (87.5%) of respondents in both production systems could get water throughout the year and the rest (12.5%) reported that during the dry seasons there is a scarcity of drinking water in area during which they used pond and holes as a water sources for their animals.

Frequency of watering to dairy animals varied from one production system to another, which is affected by different factors such as season of the year, accessibility, performance of the cow and type of predominant feed and feeding systems. The overall figure during wet season shows that the majority (55.6%) of the household give water to their cattle freely while the rest did it twice a day (24.1), once a day (16.7), and leave cattle to fetch water by themselves (3.6%). In the mixed crop–livestock system, the majority (78%) of farmers waters their cattle twice a day during dry season and all of them (100%) give water to their cattle freely during wet season. Since urban producers usually give water in the form of liquid feeds such as ‘atella’ mixed with water and concentrates, free water is not given by some of the households (8.4 and 4.2% for dry and wet seasons, respectively).

4.6.3. Housing systems

Most households (72.5%) in the mixed crop–livestock system kept their cattle within separately built barn, while considerable proportions (27%) used corrals or barns to keep all species of livestock together. The remaining few farmers (0.5%) had no houses for their animals. By contrast, in the urban systems, the majority (43.9%) used a separate shelter for their animals with few people sheltering cattle with the family (9.4%) and keeping cattle mixed with other species in the open (10.6%) and in corrals (18.9%). Calves were housed in well-protected enclosures and separately until they reach one month old.

4.6.4. Calf rearing practices

All cattle producers in the mixed crop–livestock system practiced partial suckling prior to milking, and colostrums are given freely. Traditionally, calves are allowed to suckle two teats at the left side while the women milk the other two for home consumption or sales. However, in the urban production system, 31.6% of households followed early weaning (4.8 months), while the rest (68.4%) practiced partial suckling prior to milking until weaning. The average weaning age of calves in the studied areas were 6.90 ± 1.54 months in mixed crop-livestock system and 6.59 ± 1.41 months in urban production system. Colostrums feeding for early weaning calves in the urban system lasted for 3 days in some cases (16.8%) and for more than 3 days in most of the cases (83.2%).

Out of the interviewed dairy producers in the mixed crop–livestock production system (60.2%) of households provided supplementary feed (on top of milk) to calves between 15 and 30 days after birth, while 36.8% provided supplementary feeding after one month of age. On the other hand, providing supplementary feed within seven days after calving is quite rare and was practiced by only 3% of the respondents. In case of urban producers, the majority (57.7%) started supplementation within 7 to15 days after birth, and relatively less proportion started between 15 to 30 days (30%), and after 30 days (12.3%).

4.6.5. Animal health problems

The major diseases of cattle identified in the studied areas were trypanosomosis (55.6%), pasteurellosis (18.8%), CBPP (11.8%), FMD (9.4%) and parasites (4.5%). Trypanosomosis was identified as the most important in both production systems. All the respondents in mixed crop-livestock and urban production system reported that calves are more susceptibility than cows and bulls.

Out of all respondents, the majority (53.5%) do not take their animals to modern veterinary services, 25% take their animals to veterinary service areas while 21.5% used traditional healer to treat their animals. The majority of the sampled farmers (77.4%) did not practice vaccination of animals and only 22.6% used vaccination for their animals. All the farmers reported that there is no veterinary service given by the government in the studied areas. In general, more than half of the farmers were not aware of zoonotic diseases (58%) and the rest 42% of respondents were aware of zoonotic diseases.

4.6.6 .Record keeping and culling

About 75.6 and 100% of the urban and mixed crop–livestock producers, respectively, did not have any record keeping schemes. Only 24.4% of the urban producers were found to have recording some production and reproduction parameters using informal sheets.

Culling of animals is practiced by majority of farmers (93.8%). The major reasons for culling of animals in mixed crop-livestock production system were old age (40.6 %), poor production and reproductive performance (28.4%), disease (25%) and behavioral problems (7%). In the urban setting, there were the same reasons for culling but with different order of importance (poor production and reproductive performance (50%), diseases (31.5%), old age (15%) and behavioral problems (3.5%)).

4.7. Milk yield and reproductive Performances

4.7.1. Age at first calving, calving interval and number of services per conception

The estimated overall mean (mean ± SE) age at first calving for cows was 46.76 ± 0.37 months (Table 6). As indicated in this table the age at first calving for cows in mixed crop-livestock is higher 48.38 ± 0.69 months than that of urban production system 45.78 ± 0.41 months. There was significant ($p < 0.05$) variation among the studied production systems in age at first calving of cows.

The overall mean calving interval of cows was 16.60 ± 0.14 months. The results of showed that the calving intervals of cows in the mixed crop livestock (17.03 ± 0.20 months) and urban systems (16.17 ± 0.18 months) were not significantly different ($p > 0.05$).

The overall means of NSPC was 1.78 ± 0.05 in studied production systems. The NSPC in mixed crop-livestock system was 1.94 ± 0.07 while that of urban production system was 1.68 ± 0.05. There was no statistically significant ($p > 0.05$) different among the studied production system in NSPC.

4.7.2. Lactation length and milk yield

The average lactation length for cows was 8.43 ± 0.11 months. The lactation length of cow in mixed crop-livestock was 8.24 ± 0.14 months which is shorter than that of urban dairy production system (8.55 ± 0.15 months). There was no statistically significant ($P > 0.05$) difference among the studied production systems in lactation length (Table 6).

The average amount of milk yield/head/day at the beginning, middle, and end lactation stages was 1.69 ± 0.07 liters, 2.89 ± 0.08 liters and 1.12 ± 0.06 liters, respectively. In mixed crop-livestock system, the means average milk yield/head/day at beginning, middle, and end lactation stages was 1.57 ± 0.12 liters, 2.63 ± 0.16 liters and 1.25 ± 0.14 liters, respectively. Unlike mixed crop-livestock, high milk yield head/day at beginning, middle, and end lactation stages was reported in urban production system 1.76 ± 0.09 liters, 3.05 ± 0.08 liters and 1.04 ± 0.05 liters, respectively. There were significant ($p < 0.05$) variations among production

system in daily milk yield/head at all stages of lactation (Table 6).

Table 6. Mean and standard errors of performance parameters of cows by production systems

Variable	Performance (Mean ± SE)			P-value
	Mixed crop-livestock (N=108)	Urban (N=108)	Overall (N= 288)	
Age at first calving (months)	48.38(0.69)	45.78 (0.41)	46.76 (0.37)	0.001
Calving interval (months)	17.03 (0.20)	16.17 (0.18)	16.6 (0.14)	0.092
Daily milk yield (beginning)	1.57(0.12)	1.76 (0.09)	1.69 (0.07)	0.000
Daily milk yield (middle)	2.63 (0.16)	3.05 (0.08)	2.89 (0.08)	0.000
Daily milk yield (end)	1.25 (0.14)	1.04 (0.05)	1.12 (0.06)	0.032
Lactation length (months)	8.24 (0.18)	8.55 (0.11)	8.43 (0.11)	0.156

N= Number of observations, SE= Standard Error

4.8. Breeding practices

4.8.1. Breed types and sources of establishment of herds

All dairy cattle animals (100%) in the study areas were indigenous zebu breeds in both mixed crop–livestock and urban production system and have not been characterized well. The local cattle types kept by farmers in Gog district are *Agnwa* and *Fellata*, while in Gambella town *Abigar*, *Felalta*, *Nuer* and *Agnwa* types/breeds were reported by farmers. The overall major sources of establishment of herd for household were market (68.1%), dowry (12.8%), gift (11.1%) and exchange with small ruminants (8%) (Figure 5). In both mixed crop-livestock and urban production system market as sources of establishment of herds dominated by 58.3 and 73.9%, respectively.

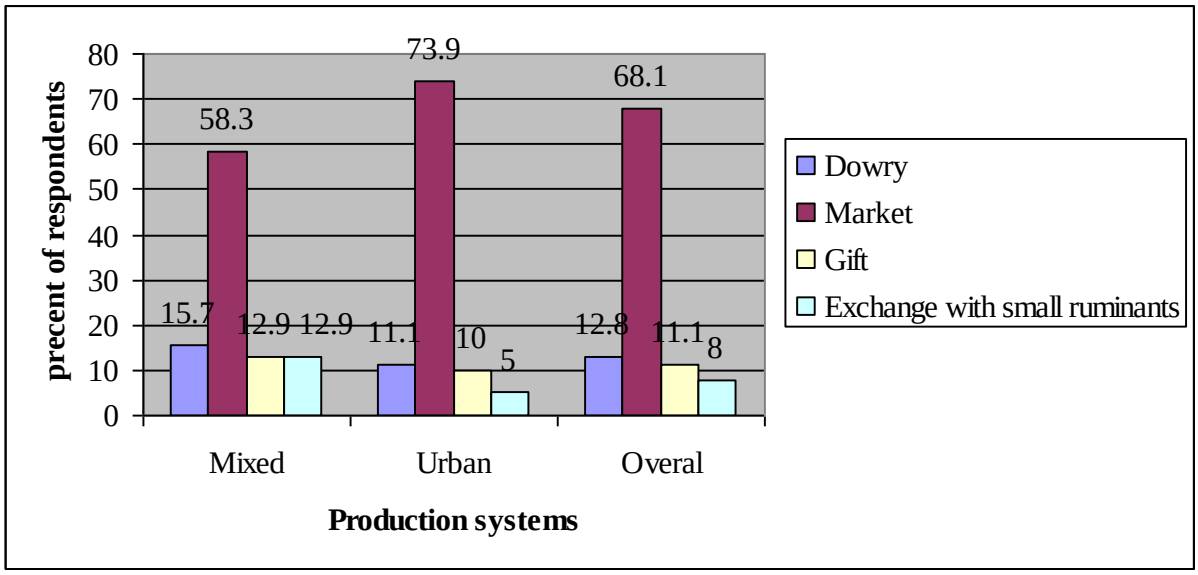


Figure 5. Sources of establishment of herd in different production systems

4.8.2. Preferred performance traits and selection criteria for dairy cows

The most important preferred trait mentioned by farmers in both mixed crop-livestock and urban production system was high daily milk yield. Thus was followed by shorter age at first calving in the mixed crop-livestock system and calving interval in the urban system (Figure 6).

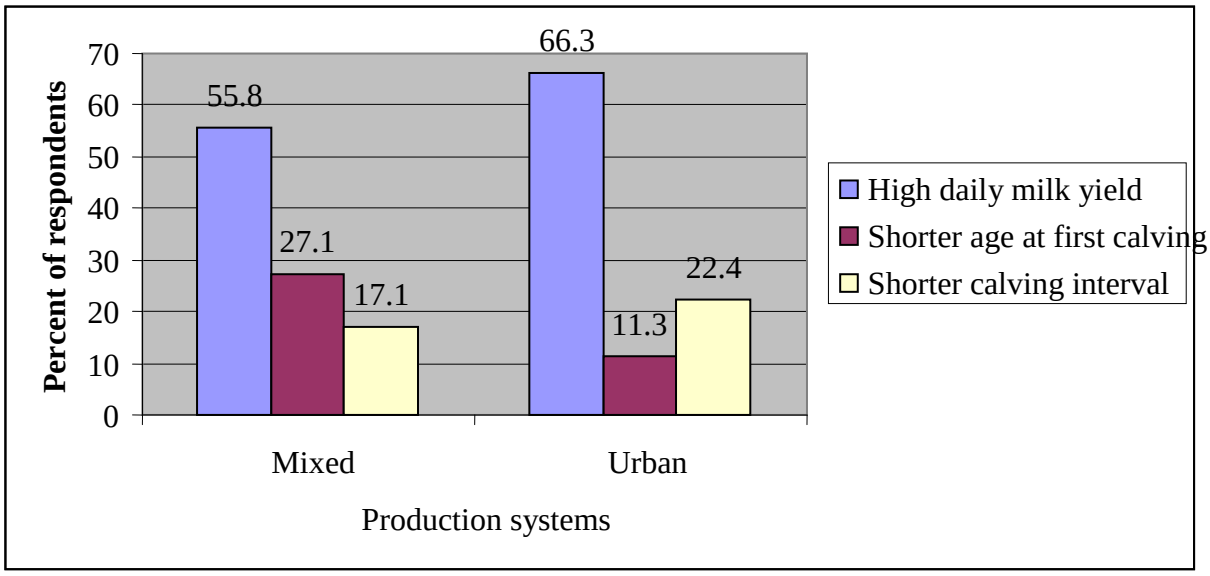


Figure 6. Preferred traits of dairy cows in both mixed crop-livestock and urban production system

The most important selection criteria for dairy cows as mentioned by the respondents in the order of their importance were long thin tail which has curled hair at the tip (52.8 %), large udder and teat (13.9%), teats of equal size (9%) and curved neck (6.9%). Other selection criteria mentioned by the respondents in both systems include thin body, large body size, concave fore head and long face and large ear (Table 7).

Majority of respondents (68.1 %) are aware of heat detection in cows while (31.9%) don't detect heat in cows. The major signs of heat reported by farmers stand to mount (26.8%) were the most followed by clear mucus discharge (25.2%), blowing (8.1%), mounting others (5.1%) and the rest 4.8 % frequent urination in urban production systems. But in mixed crop-livestock farmers indicated that clear mucus discharge (34%) were the major signs followed by stand to mount (25.1%), mounting others (20.8%), frequent urination (14%)and the rest (6.1 %) for blowing.

Table 7. Selection criteria for dairy cow by production systems

Selection criteria	Mixed crop-livestock (N=108)	Urban (N=180)	Overall (N=288)
Long thin tail circular at the tip	48.1	55.6	52.8
Equal teat	9.2	8.9	9
Long and curved neck	6.5	7.2	6.9
Large body size	3.7	5	4.5
Concave fore head and long face	5.6	2.8	3.8
Large ear	4.6	2.8	3.5
Thin body	5.6	5.6	5.6
Large udder and teat	16.7	12.2	13.9
Total	100	100	100

N= Number of observations

The results of PRA for selection of dairy cows were comparable with the results of questionnaires survey in both districts (table 8).

Table 8. Pair wish ranking for selection of dairy cows in Gambella town and Gog district

No	Selection criteria	Rank	
		Gambella	Gog
1	Long tail that is thin and circular at the tip	1	1
2	Equal teat	3	3
3	Long and curved neck	7	4
4	Concave fore head and long face	8	5
5	Large ear	5	8
6	Thin body	6	6
7	Large udder and teat	2	2
8	Large body size	4	7

4.8.3. Bulls selection and mating

In the mixed crop–livestock and urban production system, all of the households (100%) used local bulls for mating and used of AI still yet to be introduce in the region. The majority of farmers reported that the use of bulls were for breeding (95.2%) and the rest 4.8 % of respondents indicated that bull were use for income. Bulls are commonly run with cows all year round and breeding is thus uncontrolled and because of this inbreeding were reported by all respondents in mixed crop-livestock and urban dairy production systems. The average age of breeding bulls was 5.42 and 5.91 years, respectively in the mixed crop–livestock and urban production system. However, all farmers in both mixed and urban dairy production used different criteria to select their own bulls (Table 9).

Figure 7. Show preferred bull that were selected by households based on selection criterias

As indicated in Table 9, majority of farmers used to select their bulls by large body size (60.1 %), large tail (8.7%), equal sized testicles (5.9 %), large neck (9.7 %), strong and long legs (10.8%), and long tail (4.9%). In both urban and mixed crop-livestock selection of breeding bulls were dominated by large body size 66.7 and 49.1%, respectively.

Table 9. Selection criteria for breeding bulls by production system

Selection criteria	Mixed crop-livestock (N=108)	Urban (N=180)	Overall (N=288)
Large body size	49.1	66. 7	60.1
Large tail	14.8	5	8.7
Equal sized testicle	6.5	5. 6	5.9
Large neck	13.9	7.2	9.7
Long tail	3.7	5. 6	4.9
Strong and long legs	12.0	10	10.8
Total	100	100	100

N= Number of observations

The results of PRA for selection of breeding bull were almost similar with the results of questionnaires survey (table 10).

Table 10. Pair wish ranking for selection of breeding bull in Gambella town and Gog district

No	Selection criteria	Rank	
		Gambella	Gog
1	Large body size	1	1
2	Equal sized testicle	4	5
3	Large neck	3	3
4	Long tail	5	6
5	Strong and long legs	2	4
6	Large tail	6	2

Farmers in the mixed crop-livestock system also used information about the individual animals own performance (52.2%), dams performance (27%) and performances of the progeny (20%) to select cows for milk production. In contrary to this, dam performance (45%) was the most frequently used source of information in urban production followed by

individual performances (32.3%) and progeny performance (22.7%) (Figure 7). In case of selection of breeding bull, dam performances and progeny performances were the most important source of information for acquiring breeding bull (68%) and (87%), respectively in urban and mixed crop-livestock production system.

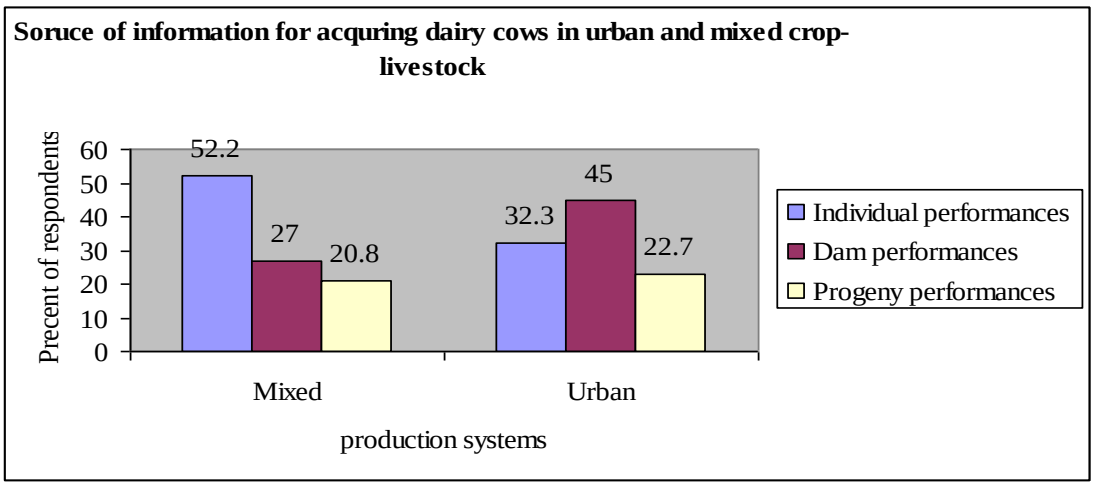


Figure 8. Sources of information for acquiring dairy cows in urban and mixed production system

Almost all the respondents in mixed and urban dairy production systems preferred their cows to breed and delivery during wet season instead of dry season. Farmer expressed that it would be much preferred if cow calve in between July and October when there is availability of plenty of green feed.

4. 9. Constraints and Opportunities for dairy developments

The major constraints identified by respondents in both mixed crop-livestock and urban production system diseases contribute 51.9 and 30.6%, respectively. Next to diseases Thieves 28 and 30 % for Veterinary services respectively in mixed crop-livestock and urban production system (Table 11). A chi-square statistic shows that there were highly significant ($p< 0.001$) among the production systems.

Table 11. The major production constraints in urban and mixed crop-livestock production

systems

Production constraints	Production systems					
	Mixed crop livestock (N= 108)		Urban (N= 180)		Total (N= 288)	
	Frequency	%	Frequency	%	Frequency	%
Diseases	56	51.9	55	30.6	111	38.5
Veterinary services	8	7.4	54	30	62	21.5
Lack of credit	2	1.9	11	6.1	13	4.5
Lack veterinary clinics	3	2.8	12	6.7	15	5.2
Feed and feeding	4	3.7	5	2.8	9	3.1
Thieves	28	25.9	33	18.3	61	21.2
Human power	3	2.8	4	2.2	7	2.4
Extension services	4	3.7	6	3.3	10	3.8
Total	108	100	180	100	288	100

N= Number of observations

The results of this study indicated that the majority of dairy producers of both the mixed crop–livestock (63.7%) and urban (91.2%) production systems were willing to continue, expand and/or involve in dairying in the future. The rest of the producers were not willing to expand dairying in the future for various reasons. About 25 and 9.3% of the respondents in the mixed crop–livestock system and 7 and 1.8% in the urban system, respectively, indicated that they will maintain their stock or stop dairying, respectively. About 85 and 98% of respondent, respectively in mixed crop-livestock and urban production system willing to improve their dairy herds and breeding practices and rest 15 and 2%, respectively of respondents in both production systems are not willing.

5. DISCUSSIONS

The result of present study show that, the total interviewed dairy cattle producers, 82.6% were male and the rest (17.4%) were female of different age and educational status. The proportion of females was almost similar in urban (17.8%) and mixed crop livestock (16.7%) production system. This is not similar with the finding of (Azage, 2004) stated that 33% of the livestock keeper households in Addis Ababa are headed by women. In mixed crop-livestock and urban dairy production system the average (Mean ± SE) of age were 41.97 ± 1.10 and 42.11 ± 0.76 years, respectively. The overall mean average age (Mean ± SE) of respondents in the studied households was 42.06 ± 0.63. The overall mean family size (Mean ± SE) in the studied household was 6.78 ± 0.18 persons. The highest mean value for family size was found in mixed crop-livestock with 7.22 persons and the lowest mean was found in urban with 6.33 persons. The average family size composition by age group indicates that the majority of household members (58.84%) were within productive age group categories in both urban and mixed crop–livestock production systems.

With respect to educational status of the household head, the overall proportion of illiterate farmers was 78.5%. About 13.9 and 7.6% have completed elementary school and secondary school, respectively. The results in general indicated that those dairy cattle owners in the study areas are mainly illiterate; suggesting that with good extension and training program they can not improve their dairy production and breeding practices easily. The average (Means ± SE) land holding for crop production in urban and mixed crop-livestock were 1.86 ± 0.09 and 2.16 ± 0.14 ha, respectively. The average (Means ± SE) of landholding for pasture lands were higher in mixed crop-livestock system (4.74 ± 0.24 ha) than in urban production system (2.66 ± 0.17 ha). This is due to the fact that due to high population pressure and urbanization in urban land are scares for both crop and pasture.

In the mixed crop-livestock production system, the livestock herd was dominated by poultry (38.9%) followed by goat (26.7%), cattle (26.4%), sheep (7.8%) and donkeys (0.2%). On the other hand, cattle (35.2%) dominated the livestock herd in the urban production system followed by poultry (28.3%), goat (27.4%), sheep (7.2%) and donkeys (2%). Farmers indicated that the reasons for domination of Poultry and Goats in mixed crop-livestock due to the fact that farmers use to kept them instead of cattle because of high prevalence of

trypanosomosis. The number of Goats was however observed to be higher in the stock than sheep, possibly due to the weather condition, management and the practices of herding them along with cattle. The overall livestock herd was dominated by poultry (32.3%), cattle (31.9%) and Goat (27.1%) per households. Next to poultry, cattle and Goat Sheep comprised a significant proportion of the livestock herd in both mixed crop livestock and urban areas. The livestock herd composition Donkey comprised only a very small proportion of the herd. However, contrary to the present result, in Somali region that distribution of livestock species owned by a household consists of large number of cattle 58.1 %, 53.2 % goats, 45.3 % sheep, and 33.1 % camels (IPS, 2000) and this true for urban production system. These results agree with the results of (Daodu *et al*, 2009) showed that cattle constituted 36% of the herd, poultry 26%, goats 17% and sheep 21% in Oyo area of Southwest Nigeria.

The cattle herd size and composition found in both mixed and urban dairy producers is dominated by cows (56.8%) followed by heifer and female calves, (10.3%) and (9.9%) respectively. Male calves and bulls have significant in cattle herd size and composition and steer share small portion of the herd. The current study results were inline with the finding of (Kidija, 2007) indicate that cows are dominated cattle herd composition at Mieso district. In Mixed crop livestock cows contribute the higher proportion (61.5%) followed by heifer (10.1%), female calves (8.5%), bull (8.2%), male calves (8.1%) and steers (3.5%) ,respectively and in Urban dairy producer cows also contribute the higher proportion (54.6%) followed by female calves (10.5%), heifer (10.4%), male calves (9.4%) ,bull (7.8%), and steers (7.3%) respectively. The numbers of heifer were dominated in mixed crop-livestock system than urban production system. This result may be due to the large pasture land holding of the production system that might had effect on keeping large replacement stock.

Like most smallholder dairy production systems of Ethiopia, family members are the major source of labour for any dairy activities in the studied areas, such as indicated for Addis Ababa milk shed (Yoseph *et al*., 2003). Results of the interviewees indicate that cattle purchasing, selling and breeding activities were mainly operated by adult males. Of the interviewed producers in the mixed crop–livestock and urban system households, 100% and 100% of adult males including husband were involved in purchasing, 100% and 100% in selling of cattle and 65 and 26.6% in breeding activities, respectively. Cattle herding, if grazing is allowed especially in the mixed crop-livestock production, was found to be

operated by either male family 60.1% or hired children 90%. But other family members were also found to be involved in this activity on a shift basis especially daughters. Routine dairy activities like feeding, milking, barn cleaning and nursing of sick animals were operated by family members and hired labourers. Feeding and cleaning were the task of women 41.7% and 42.6% in mixed crop-livestock and in urban the tasks of labourer by 49.1% and 32.2% for feeding and cleaning respectively and milking also the task of labourere 57.2%. In the case of urban producers, the overall role of hired labour in the Pignudo and Gambella towns ranged from 10 to 57.2%. This figure is lower as compared to the urban dairying of Mekele town, where the involvement of hired labour goes as high as 75.7% in large and medium scale farms (Nigussie, 2006).

Most of the dairy farms in the mixed crop–livestock system of Gog district (34%) and urban areas of Gambella town (29.5%) flourished over the last 5 years. This result shows that farmers in both mixed crop–livestock and urban systems have been encouraged to engage in dairying activities quite recently and improved dairy farming is fairly a recent development in these areas. The overall trends in dairy development showed that the majority (50%) of the farms were showing a progressive trend, while (32.3%) regressed, (13.2%) remained stable and the remaining (4.5%) was unknown. The major reasons for regressing reporting by respondents are diseases (59.7%), thieves (30.9%) and predators account for (9.4%) in both mixed and urban production system.

Dairy producers in urban and mixed crop–livestock production systems had also different purposes for keeping cows. There is a big difference between the mixed crop-livestock and urban production system, where the majority proportion of households (64.4%) in the urban system produced milk primarily for sale, while the majority of households (39.8%) in the mixed crop-livestock system used milk for household consumption. These characteristics were also noted by other authors for different crop–livestock production systems in the country, such as Wollega (Alganesh *et al*., 2004); Oromia Regional State (van Dorland *et al*., 2004); and Wollo in Amhara Regional State (Dereje *et al*., 2005).

The mixed crop–livestock system, which is mainly found in the rural areas of Gog district, is similar in feed resource use with most mixed crop–livestock production systems of Ethiopia (Tessema *et al*., 2003; Dereje *et al*., 2005). Natural pasture and Crop residues are also the

major source of feeds for most dairy cows in the studied areas. The livestock herders are dependent on natural pasture and grazing area and to some extent on grazing crop residues in crop production systems after harvest (Ahmed *et al*., 2003). In this systems, an annual food crop particularly cereals crops are dominant and crop farming is highly integrated with livestock production, particularly with cattle rearing. In the current study, the majority of respondents (96.5%) do not supplements their lactating cow with additional feeds, while only (3.5%) used to supplement their dairy cows with additional feeds rather than grazing. The majority (55.7%) of the households use animal feeds from natural pasture grazing, while (23.7%) use a combination of own farm and natural pasture grazing and (15.8%) use own farm and purchased feed and about (5%) use other sources.

According to (85%) of dairy producers in the urban production system uses to supplement their dairy cow with additional feeds (local brewery by-products, salts, green grasses and very few use unbalanced home made concentrate feeds). According to (Yoseph *et al*., 2000), hay stacking is also the most common feed resource in intra-urban and peri-urban dairy farmers around the Addis Ababa milk shed but this was not the case in urban dairy production in Gambella region. Respondents also believed that salt licking improve milk production. This type of feeding of salt was also reported by (Ahmed, 2002) in the Somali region that herders travel to their potential salt rich areas when the dry season approaches or pastoralists transport salt to their dwelling sites. This report is also in line with the report of (Abule *et al*, 2004) who indicated that in middle Awash valley that mineral salt feeding to cow were perceived to increase milk production. The all urban producers (100%) indicated that they do not have enough access to improved feeds and conservation of feeds was practiced in the region and this make us to depend totally on grazing during day times and supplementation at night time. Milk production and market access were better in this system. Unlike, others urban production in Ethiopia there was no exotic and cross breeds and only local breeds of cows were found. Cattle were largely depending on rangeland grazing or crop residues that are of poor nutritive value. Feed resources identified in the present study are similar to the commonly used feeds in other urban dairy farming systems in the country (Yoseph *et al*., 2003; Nigussie, 2006) except for concentrates feeding. In the study area, supplementary feed was mainly given to lactating cows. For example, (71.1%) of the respondents indicated that they give priority to lactating dairy cows, while the rest did not give any special attention.

The main sources of water identified in the present study areas were rivers (74%), lakes (12.5%), ponds and holes (12.5%) and pipe water (1%). This result inline with work of (Kidija, 2007) which indicated that rivers (78 %) is the major water sources at Mieso district followed by springs (65%), ponds (36%), wells (18%), lake (7.5%), and pipe water (5%) respectively. In contrary to this, Belete (2006) reported that Out of the total respondents included in the study 48.75% use water for their cattle from ground wells, 47.2 % from rivers, 3 % from Lake Tana, 2.29 % from the ponds and 0.2 % from tap water at Fogera Woreda. The majority (87.5%)of respondents in both production system the water is available through out the year and the rest(12.5%) reported that during the dry seasons there was a scarcity of drinking water in area that were using pond and holes as a water sources for their animals. Frequency of watering to dairy animals varies from one production system to another, which is affected by different factors, among which season of the year, accessibility, performance of the cow, and type of predominant feed and feeding systems are some to be mentioned. The development of livestock rearing could not be considered without water supply but water is not a problem in Gambella region because of resettlement of people are near the rivers.

The results of this study show that most households (72.5%) in the mixed crop–livestock system kept their cattle within separately in barn, while considerable proportions (27%) used mixed open barn/shed and rest 0.5% have no houses for their animals. By contrast, in the urban systems sheltering cattle with the family was uncommon and was only practiced by 9.4% of the households. Similarly, urban dwellers seldom used open mixed barn (10.6%) and Mixed in corral (18.9%) as a night shelter for cattle and the majority (43.9%) used a separate shelter for their animals. Cattle calves were housed in well-protected enclosures and separate until they reach one month old. Sheltering cattle, not only protects animals from extreme environmental hazards and predators, but also ease some other husbandry practices. Therefore, cow sheds must be designed in such a way that routine activities like feeding, watering, milking, cleaning and other activities can be easily and effectively handled. This result is agreed with the finding of (Sintayehu *et al*, 2008) at Shashemene- Dilla areas.

All dairy cattle producers in mixed crop–livestock and (68.4%) urban system practiced partial suckling prior to milking, and colostrums are given freely. Traditionally, calves are allowed to suckle two teats at the left side while the child milks the other two for home consumption or sales. Since local cows are believed not to give milk without partial suckling, local calves

from such cows are not weaned early. The average weaning age of cows in the studied areas is 6.70 ± 0.09 months. The high average mean of weaning age for cows were found in mixed crop-livestock 6.90 ± 1.54 months, while the lowest found in urban production system 6.59 ± 1.41 months. This due to the calves is force to stop suckling in order to get high milk for selling by urban dairy producers. The current study result show that provision of supplementary feed (on top of milk) to calves after birth were practiced by households in both urban and mixed crop–livestock production systems.

Diseases pose a major threat to cattle production in urban and mixed crop-livestock production system in Gambella region. The extent of losses due to diseases was expected to be very high as compared to losses due to other causes. According to the respondents and personal observation in the study area, there is a shortage of veterinary experts. Generally, shortage of experts, accessibility of veterinary service in the area and lack of adequate transport facility are the major problems. Those things aggravate the loss of animals due to diseases. Tafesse, (2001) reported that the poor performance of veterinary service in the lowlands is the outcome of the government monopolized service. Livestock keepers therefore tend to divert to traditional ethno-veterinary practices in the villages and make use of various herbs and/or illegal drugs to treat their animals. Poor animal health service and lack of improved management are the major constraints for dairy development in Ethiopia, which caused poor performance across the production systems (Ibrahim and Olaloku, 2002). The major diseases of cattle identified in the studied areas Trypanosomosis 55.6% contribute the higher proportion followed by Pastuerlosis 18.8%, CBPP 11.8%, FMD 9.4% and the rest 4.5% contribute by internal and external parasites. In Gambella trypanosomiases is a disease of considerable economic importance. The current study result was similar with the work of (Belete, 2006) in Fogera district. The disease has a serious impact on livestock production and agricultural development over most land of the region especially forest areas. Much of this land is potentially highly productive but its full economic development is being denied because of the danger of trypanosomosis. The local name for this disease in animal is called “Taw Mingngo” and since no effective treatment, farmers control the fly only by smoking the herds frequently by cow dung. The farmers reported that vaccinations are given against three important diseases, such as that Pasturolosis, CBPP and FMD in the studied areas. Mastitis is also one of the major diseases in the studied areas high incidence of clinical mastitis in milking cows was observed during the course of the study. However, there may be high

incidence of sub-clinical cases. This disease has received a little attention and the name not found in the list because they thought that cannot causes death of animals. This disease is an economically important disease in milking cows as it causes financial loss as a result of decreased milk yield (Azage, 2004).

About 75.6 and 100% of the urban and mixed crop–livestock producers, respectively, did not have any record keeping schemes. Only 24.4% of the urban producers were found to have recording some production and reproduction parameters using informal sheets. This indicated that culling of animals in the study areas may results in removal of good performing animals.

Culling of animals is practiced by majority of farmers (93.8%). The major reasons for culling of animals in mixed crop-livestock production system were old age (40.6 %), poor production and reproductive performance (28.4%), disease (25%) and behavioral problems (7%). In the urban setting, there were the same reasons for culling but with different order of importance (poor production and reproductive performance (50%), diseases (31.5%), old age (15%) and behavioral problems (3.5%)). This show that there is need to develop good records keeping through training to make farmers aware of the improtant of culling that will results in good selection of animals being culled.

The estimated overall mean (mean ± SE) age at first calving for cows is 46.76 ± 0.37 months. The mean Age at first calving for cows in mixed crop-livestock is higher 48.38 ± 0.69 months than that of urban production system 45.78 ± 0.41 months. There was significant ($p < 0.05$) variation among the studied production systems in age at first calving of cows.

The age at first calving obtained in this study for cows was comparable with the value of 47.61 months reported for agro-pastoral production system (Workneh and Rowland, 2004). This is perhaps due to feed shortage in the area. This fact is in line with the report by (Ibrahim and Ololaku, 2002) who indicated that heritability of age at first calving is generally low, indicating that this trait is highly influenced by environmental factors, feed and health. Age at first calving was more affected by environmental factor than heritability. However, the result obtained in this study fall in the range reported by (Kidija, 2007) of 4-5 years and the means is 52.49 months. In addition, the result obtained is also similar with the report 4 years in pastoral and agro-pastoral areas with indigenous cattle (IPS, 2000). But the result of the current study is lower than mean value of 52 months for *Bos indicus* found at Harar milk shad reported by

(Kurtu, 2003) and similarly lower than the finding of (Elias, 2008) indicated that the overall average age at first calving of cow in Bench-Maji zone is 55.13 months.

The results of this study show that the overall mean calving interval of cows was 16.60 ± 0.14 months. The results of respondents show that the calving intervals of cows were high value 17.03 ± (0.20) months in mixed crop-livestock than that of urban production system16.17 ± (0.18) months. The result obtained in this study agrees with the findings of (Workneh and Rowland, 2004) which indicated calving interval of cows in pastoral area of Oromia region was 15.5 months for cows but it was longer for the overall calving interval of cows taken in the region, 18.6 months. The result also comparable with 19.0 ± 0.38 months the overall mean calving interval of indigenous cows in North Gondar, Amhara Region (Azage *et al,* 2009). The result of this study also partly similar with the results of (Kidija, 2007) indicated that the overall calving interval at Mieso district of Oromia is 16.01 months. In addition, this finding is higher than the work of (Elias, 2008) indicated that the Calving interval of Sheko cow in Bench-Maji zone of SNNPRS is about 463.67 days. Besides this the result also falls within the range of calving interval for Ethiopian zebu cattle of 12-22 months reported by (Mukasa-Mugerwa, 1989).

Indigenous breed of cows are generally considered as low milk producers. However, they were the major and only source of milk in the studied areas. The lactation length of cow in the studied areas depends mostly on the management objective of the herder, the herder may prolong the lactation length for the sake of continues milk production or dry off the dam at early stage for the purpose of breeding the cows. The finding of this study show the average lactation length for cows was 8.43 ± 0.11 months. The lactation length of cow in mixed crop-livestock was 8.24 ± 0.14 months which is shorter than that of urban dairy production system 8.55 ± 0.15 months. The average lactation length obtained in the present study is higher than the values reported by Abereham (2009), (CSA, 2008) and Tesfaye (2008) for local Begait cows at western zone of Tigaray (171-204.5 days), Gambella region (7 months) and Metema district (5.9 ± 0.14 months), respectively. The present result was, however, comparable with the values (5 to 12 months with an average of 9.5 months) for local cows in East Shoa Zone of Oromia (Lemma *et al*. 2005) and 8.9 ± 0.162 months in Transhumance cattle production system in North Gondar, Amhara Region (Azage *et al*, 2009). In addition, the finding of current study is also higher than 7.29 months of the overall lactation length of local cows in

Mieso district (Kedija, 2007).

An average amount of cow milk yield/head/day obtain in this study at beginning, middle, and end lactation stages was 1.69 ± 0.07 liters, 2.89 ± 0.08 liters and 1.12 ± 0.06 liters, respectively and the overall cow milk yield/head/day for the monitored cows was 1.90 ± 0.07 liters. This is not similar to the national average of 1.09 liter/day/cow (Dagena and Adugna, 1999). But result of this study was lower than the average daily milk of 2.07 liters in Gambella region reported by (CSA, 2008) and similarly lower than the average daily milk yields(4.06 and 4.47) liters at western zone of Tigaray Abereham (2009). The current study results were higher than the average milk yield of local Arsi cows 1.0 liter /head /day report by (Lemma *et al*., 2005). Milk production per day per head is very low and this is further affected by the relatively short lactation length due to forced dry off the cows and poor managements in the studied areas.

Number of services preconception of cows is varied in studied areas based on the respondents in different production systems. For instance, NSPC in mixed crop-livestock was 1.94 ± 0.07 which is higher than that of urban production system 1.68 ± 0.05. From these results the overall means of NSPC was 1.78.the finding of this study was much higher compared to the result of 1.37 numbers of services per conception in Bench-Maji zone of SNNPRS by (Elias, 2008) and similarly higher than the finding of 1.59 NSPC at Selale for crosses reported by (Kelay, 2002). But this result was lower than the overall number of service preconception 2.35 of different cross and exotic cow in Addis Ababa (Kelay, 2002). Heritability of NSPC is low and most of the variation is attributable to environmental factors. The work of (Hailemariam and Mekonnen, 1996) showed that breed and season of conception influence NSPC.

The finding of this study indicated that all dairy cattle animals (100%) in the study area are indigenous zebu breeds and have not been characterized well. The majority of the farmers prefer local cows claiming that crossbred animals are susceptible to harsh climatic condition, feed shortage and diseases. There has been no effort to improve milk production through crossbreeding and selection in the region. IPS (2000) indicated that the genetic of Ethiopia's lowland livestock have involved largely as a result of natural selection influenced by environmental factors. This has made the stock better conditioned to withstand feed and water

shortages, disease challenges and the harsh climates. Genetic improvement for productive traits in livestock, particularly in cattle, has been very slow and insignificant in the country. One of the main reasons for this is lack of well-organized and usable recorded information on the performance of both the indigenous and crossbreeds with exotic genotype to undertake structured selection and breeding programs (Azage, 2000).

The major sources of establishment of herd for household were dominated by market 58.3 and 71.5% respectively, in both mixed crop-livestock and urban production system. The most important preferred trait for dairy cows mentioned by farmers in both mixed crop-livestock and urban production system was high daily milk yield 55.8 and 66.3% respectively. Also the most preferred trait for breeding bull was dominated by high daily milk yield in both production systems. The current study results agree with the finding of (Kelay, 2002) at Selale and Addis Ababa areas. The majority of respondents 65 and 72% were not satisfied with the performance of the breeding bulls in mixed crop-livestock and urban production system. This indicated that farmers in both production systems have interest to improve their dairy cattle production and productivity.

Subsistence smallholders select particularly female breeding animals for a range of desirable attributes of their animals, but some of them attributes are related to behavior and body form of animals, which are not necessarily direct related to production functions (Dereje *et a*l, 2005)**.** In the studied areas majority (52.8 %) of the households selected dairy cows based on selection criteria of long tail that is thin at the tip. This is one of the indications that a cow is high milk yielder and can protect herself from flies. Large udder and teat is also another criterion that the herders (13.9 %) follow during selection. Equal teat and curved neck were also important criteria used by 9 % and 6.9 % of the respondents for selecting dairy type animals, respectively. Thin body, large body size , concave fore head and long face and large ear was the other criteria that 5.6 %,4.5%,3.8% and 3.5% respectively of the households described as an indication of a dairy type animal. This type of selection criteria were not reported else where in other studies. Concave and long face was another unique criteria not reported earlier.

In the mixed crop–livestock and urban production system, all of the households (100%) used local bulls for mating and used of AI still yet to introduce in the region. Bulls are commonly

run with cows all year round and breeding is thus uncontrolled. Because of this inbreeding or interbreeding among and between different local breeds were common. Mating is often random and there is no strict selection of mating pairs (Bittner *et al*., 2000). However, all farmers in both mixed and urban dairy production used different criteria to select their own bull. This results is agree with the finding of (Zewdu, 2004) in Dembia and Fogera plains as well as the western lowlands, cattle keepers practice selection of male and female breeding cattle based on preferred traits. The majority of farmers in all study sites obtain their breeding animals from their own farm and from their relatives and neighbors. The results show that the majority of farmers used to select their bulls by large body size (60.1 %), large tail (8.7%) and equal sized testicle (5.9 %), large neck (9.7 %), strong and long legs (10.8%), and long tail (4.9%) were criteria used for bull selection with dairy traits but all farmers reported that all these criteria's is depend on pedigree of the animal. In both urban and mixed crop-livestock selection of breeding bulls were dominated by large body size 66.7 and 49.1%, respectively.

Almost all the respondents in mixed and urban dairy production systems were preferred their cows to breed and delivery during wet season instead of dry season. Farmer expressed that it would be much preferred if cow calve in between July and October when availability of plenty of green feed are found. The resultant outcomes believed to be expedient in which milk yield raises up, calf grows faster, body condition of the cow remain good and the animal restore fat for endure the forthcoming dry season in a better way.

6. CONCLUSIONS AND RECOMMENDATIONS

This study was conducted at Gog district and Gambella town in Gambella region, west Ethiopia. Two production systems were identified namely urban and mixed crop-livestock, family members are the most important sources of labour and responsibilities of dairy cattle management and husbandries practices were undertaken mostly by members of the family at high status, husband and wife and also boys have significant contributions.

The dominance feeds resources were mainly natural pasture, crop residues, and Aftermath grazing and non-conventional feeds in these production systems. Conservations of feeds resources were not practiced in the region and this created feeds shortage every year during dry season particularly January to April. To alleviate the feed problems of the study area different feed utilization techniques of the available pastures could be practiced through feeds conservations, rotational grazing, cut-and-carry, community based grazing land improvement strategies such as improving the pasture through over sowing of forage species and also training and frequent extension for farmers about forage production and feeding systems should be exercised in the area.

The record keeping schemes in urban and mixed crop–livestock producers, respectively, were not much practiced by households except for very few households in urban production system were found recording some production and reproduction parameters using informal sheets. This problem of records keeping will have an effect on the animals being culled. This indicated that there is to develop records keeping in both production systems through training and create awareness about the used and important of records keeping in dairy production.

The reproductive performance s of indigenous breeds in terms of age at first calving, calving interval, numbers of services preconception and lactation length and milk yield in Gambella seem to be better compare to the other work done on indigenous animals in others areas but this cannot show the reliable picture of reproductive performance. This needs detail research on production and reproductive performances and characterization of indigenous breeds in the region.

Most of the foundation stocks of both the urban and mixed crop-livestock producers were purchased from open markets, which revealed that producers were not curious and/or did not have access to formal performance information to selection of dairy cattle (i.e. farmers relay on informal individual cow performance observation for purchase of cows and selection of replacements stock). This indicates that there is a need for a community based action to develop alternative reliable performance assessment and documentation options and needs further research on informal selection criteria used by households.

Producers were found to have different perceptions on some of preferred performance traits of dairy cattle in the studied production systems may reflect the relative improtant value in their respective localities. Milk yield performance was the preferred dairy traits in both production systems but shorter age at first calving and calving interval were preferred differently in different production systems. Therefore, production systems and interest based breeding objectives need to be defined in the context of the existing dairy production conditions and interest of local societies in the areas.

In both production systems and Gambella region in general local breeds were found and breeding by local were uncontrolled. Due to this inbreeding and interbreeding among and between indigenous breeds were common in the study areas and farmers also used to select breeding bulls based on informal selections criteria that may not be much to the preferred traits. This indicates the importance for defining a breeding program to secure the sustainability for selecting breeding bulls and replacement of breeding bulls in Gambella region.

The major constraints that affect dairy development in the study areas were diseases, Veterinary services, Lack of credit, Lack veterinary clinics, Thieves, Human power, feed, Extension services and some others like market, genotype, capital and lack of awareness. This need strategies to solve the problems of smallholder dairy development through support services in terms of accessing veterinary services, organizing input supplies (improved genetic material, feeds, selection, drugs), provision of credit, extension and training services, production and entrepreneurial skills development are key elements for success. Especial attention should be given to the diseases mainly trypanosomosis through conducting research on the epidemiology to come up with prevalence and burden of tsetse fly in order to apply

appropriates control measures in the areas. Also great attention most be given to thieves (cross border) particularly Murle by the government of Gambella and federal through mediation of a neutral ethnic group, or through the creation of an *ad hoc* 'parliamentary' body. If external conflicts could not be resolved peacefully, appropriate protection of the country border by national defense force should be done, war was the last recourse.

Generally, development of dairy production and breeding practices in the studied areas could be achieved with the contribution and integration of different stakeholders in a sustainable way.

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8. ANNEXES

DECLARATION

I declare that this thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an MSc degree at Addis Ababa University and is deposited at the university library to be made available to borrowers under rules of the library. I solemnly declare that this thesis is not presented for a degree in any others university anywhere for the award of any academic degree.

Name: Ojuni Odier Agnew

Date of Submission:

This thesis has been submitted for examinations without approval as university advisor.

Dr. Kelay Belihu: _____

Prof. Harpal Singh: _____