

# Cattle milk and meat production and marketing systems and opportunities for market-orientation in Fogera *woreda*, Amhara region, Ethiopia



# Cattle milk and meat production and marketing systems and opportunities for market-orientation in Fogera *woreda*, Amhara region, Ethiopia

*Belete Anteneh, Azage Tegegne, \* Fekadu Beyene and Berhanu Gebremedhin*

Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project,  
International Livestock Research Institute (ILRI), P. O. Box 5689, Addis Ababa, Ethiopia

\* Corresponding author e-mail: [a.tegegne@cgiar.org](mailto:a.tegegne@cgiar.org)



## Authors' affiliations

Belete Anteneh, Bureau of Agriculture and Rural Development, Amhara National Regional State, Bahir Dar, Ethiopia

Azage Tegegne, Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project, International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia

Fekadu Beyene, Hawassa University, P.O. Box 5, Awassa, Ethiopia

Berhanu Gebremedhin, IPMS, ILRI, Addis Ababa, Ethiopia

© 2010 ILRI (International Livestock Research Institute).

All rights reserved. Parts of this publication may be reproduced for non-commercial use provided that such reproduction shall be subject to acknowledgement of ILRI as holder of copyright.

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Correct citation: Belete Anteneh, Azage Tegegne, Fekadu Beyene and Berhanu Gebremedhin. 2010. *Cattle milk and meat production and marketing systems and opportunities for market-orientation in Fogera woreda, Amhara region, Ethiopia*. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 19. ILRI (International Livestock Research Institute), Nairobi, Kenya. 65 pp.

# Table of Contents

List of Tables	v
List of Figures	vi
Abbreviations	vii
Acknowledgements	ix
Abstract	x
1 Introduction	1
2 Literature review	4
2.1 Economic importance of livestock in Ethiopia	4
2.2 Dairy production systems in Ethiopia	6
2.3 Beef cattle production systems in Ethiopia	10
2.4 Milk processing and marketing in Ethiopia	11
3 Materials and methods	14
3.1 Description of the study area	14
3.2 Farming systems	15
3.3 Selection of <i>kebeles</i> and participating farmers	16
3.4 On-farm data collection	16
3.5 Data analysis	17
4 Results and discussion	19
4.1 Background and characteristics of respondents	19
4.2 Land and cattle holdings	19
4.3 Involvement of family members in dairy production	20
4.4 Characteristics of dairy production systems	20
4.5 Butter and local cheese production	23
4.6 Housing and waste management	24
4.7 Feed resources and feeding	24
4.8 Water resources	27
4.9 Cattle breeds and breeding	27

4.10 Productive performance of cattle	29
4.11 Milk use	30
4.12 Access to information and training	32
4.13 Milk and milk products marketing	32
4.14 Characterization of market participants	35
4.15 Beef cattle production and marketing	37
4.16 Participants in beef cattle marketing	39
4.17 Major constraints to cattle production in Fogera	40
4.18 Opportunities for improving cattle milk and meat production in Fogera	44
5 Summary and conclusions	46
References	49

# List of Tables

Table 1.	Trends in dairy imports to Ethiopia by dairy product (kg), January 2004 to May 2008	6
Table 2.	Trends in the value (ETB) of dairy imports to Ethiopia, January 2004 to May 2008	7
Table 3.	Milk yield performance of indigenous cattle breeds in northwestern Ethiopia	7
Table 4.	Cattle holdings of respondents in the surveyed <i>kebeles</i>	20
Table 5.	Proportion of milking and dry cows in the three production systems in Fogera	21
Table 6.	Proportion of private grazing land and crop land in the surveyed <i>kebeles</i> in Fogera	26
Table 7.	Number of milking cows and milk production (litres) per day per household	30
Table 8.	Mean ( $\pm$ S.E.) daily milk produce and use pattern per household in different <i>kebeles</i> of Fogera <i>woreda</i>	31
Table 9.	Sources of information on improved dairy and beef production in Fogera	32
Table 10.	Proportion of respondents facing butter marketing problem	34
Table 11.	Amount of butter supplied to rural markets in the dry and wet seasons and distance to markets in Fogera <i>woreda</i>	35
Table 12.	Prices (ETB) of beef cattle marketed in Fogera	39

# List of Figures

Figure 1.	Location of Fogera <i>woreda</i> in Amhara Region, Ethiopia	15
Figure 2.	Traditional butter making (left); butter (right top) and local cheese, ayib (right bottom) produce in Fogera <i>woreda</i>	24
Figure 3.	Extensive pastureland infested with <i>Asracantha longifolia</i> (locally known as amykila) weed	25
Figure 4.	Typical Fogera cattle grazing at the Andassa Livestock Research Centre	28
Figure 5.	Market channels for butter marketing in Fogera	36
Figure 6.	Market chain for beef cattle marketing in Fogera	39
Figure 7.	Farmers carrying a sick animal to a veterinary clinic	43

# Abbreviations

AI	Artificial Insemination
BOFED	Bureau of Finance and Economic Development
CSA	Central Statistics Authority
CI	Confidence Interval
CBPP	Contagious Bovine Pleuropneumonia
CL	Crop land
DDE	Dairy Development Enterprise
DA	Development Agent
EARO	Ethiopian Agricultural Research Organization
ETB	Ethiopian birr
EC	Ethiopian Calendar
EOCCFA	Ethiopian Orthodox Church Children Care and Family Affairs
ESAP	Ethiopian Society of Animal Production
FWARDO	Fogera <i>woreda</i> Agricultural and Rural Development Office
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Statistics
FMD	Foot and Mouth Disease
FLDP	Fourth Livestock Development Project
GIT	Gastro Intestinal Tract
GDP	Gross Domestic Product
HH	Household
IAR	Institute of Agricultural Research

IDRC	International Development Research Center
ILRI	International Livestock Research Institute
kg	kilogram
km	kilometre
MOA	Ministry of Agriculture
MODP	Market-Oriented Dairy Production
NAIC	National Artificial Insemination Center
NGO	Non-Governmental Organization
PA	Peasant Association
RGDP	Regional Gross Domestic Product
SAERP	Sustainable Agricultural and Environmental Rehabilitation Program
SDDP	Smallholder Dairy Development Project
SE	Standard Error
SPSS	Statistical Package for Social Sciences
TLU	Tropical Livestock Unit
TMP	Total Milk Produced
TMC	Total Milk Consumed
TMPRC	Total Milk Processed
TMS	Total Milk Sold
TVET	Technical, Vocational and Education Training Center
USD	United States dollar

# Acknowledgements

The authors would like to thank Ato Yirgalem Assegid and Ato Teshome Derso, Research and Development Officer and Research and Development Assistant, respectively at the IPMS Project, Fogera *woreda* for their full support during the study. We also thank all the staff members of the Fogera *woreda* Office of Agricultural and Rural Development (OoARD), the enumerators and data collectors. Our special thanks go to Ashagre Abate, Melese Damite, Solomon Hagos, Ayenew Guadie and Habte Welde Silassie of the *woreda* OoARD for their interest and support during the study. We would also like to thank Dr Eshete Dejen, Director of Livestock Research at ARARI, Bahir Dar for facilitating a good working relationship with the OoARD. We appreciate the technical and logistical support of Muluhiwot Getachew and Birke Enyew, IPMS Project Addis Ababa, during the course of the study. We are thankful to Ato Abebaw Getachew and Zemen Ayalew for their kind assistance in data analysis.

# Abstract

This study was conducted in Fogera *woreda*, South Gondar Zone of the Amhara National Regional State in northwestern Ethiopia in 2005/06. The aim was to characterize cattle milk and meat production and marketing systems, identify the major constraints and provide development interventions for more market-orientation. Twelve *kebeles* were randomly selected (five from the Fogera plains and seven outside the plains) based on their potential for cattle milk and meat production. A total of 480 households were sampled from these *kebeles* and focus group discussion, personal observations and administration of semi-structured questionnaires on milk and meat production practices were employed. Only 12 (2.52%) of the respondents were female-headed households. About 98.8% of cattle milk and meat production was based on traditional husbandry using indigenous cattle breeds. The Fogera cattle is the major breed used and is mainly found in the Damote, Sendeye and Tigre mender villages. The main feed resources in the *woreda* are communal grazing land and crop residues of teff, rice, finger millet, barley, wheat, chickpea, field pea and maize. The communal grazing land currently accounts for about 9602.4 ha; out of which 3418.5 ha (35.6%) is infested by a noxious weed known as *Asracantha longifolia* (amykila). Over a period of two years, large area of communal grazing land has been transformed into crop farms, mainly to rice production, and this has apparently created severe feed shortage in the *woreda*. Flooding of the plains during the wet season from Gumara and Rib rivers further reduced the availability of grazing land. In addition, large number of animals are trekked from the highlands of Fogera and adjacent *woredas* of Dera and Estie to the plains during the dry season and this has resulted in inter-breeding of the Fogera cattle breed with highland zebus and has exacerbated the feed shortage. Rice husk, a by-product from rice polishers, is becoming an important feed resource. On average, about 35 kg of rice husk is produced from a quintal of rice. The major water resources are wells (48.8%), rivers (47.2%), lake (3%), ponds (2.3%) and tap water (0.2%). Cattle are watered once a day. Trypanosomiasis, fascioliasis and schistosomiasis are the most prevalent diseases.

The average number of milking cows per household is  $1.59 \pm 0.04$  and ranged from 1.18 to 2.08, while the average private pastureland holding is  $0.18 \pm 0.09$  ha. Three dairy production systems, namely subsistence rural small-scale mixed, peri-urban and urban were identified based on use of production inputs, location and access to markets. The percentage of milking cows is higher in the rural and peri-urban (65%) than in the urban (44%) production system. Producers in the rural small-scale mixed system own 1–7 indigenous and 1–2 crossbred cows and depend on natural pasture and crop residues as major feed inputs. The total number of milking cows in this system is 764 and only 6 cows (0.79%) are crossbreds with Holstein Friesian. Milking is predominantly done by

male members of the household (97.1%), while milk processing and marketing is the sole responsibility of women. On average, about 2.9 litres of milk is produced (off-take) per day per household. Out of this, 0.6 litres (20.7%) is used for home consumption, 1.9 litres (65.5%) for processing and 0.4 litres (13.8%) for marketing. Milk is not marketed at all from Kuahir Abo, Shina, Kidist Hana, Addis Betechrstian and Wagatera *kebeles*. The peri-urban dairy producers, found in Aember town, are mainly rural farmers (95.2%), who own local and crossbred animals, have access to nearby veterinary and artificial insemination (AI) services and provide supplementary feed (agro-industrial by-products) to their animals. In Aember town, there are 68 dairy producers (43% women) and 29.4% have crossbred cows. The number of local and crossbred milking cows is 107 (78%) and 22 (17%), respectively. The average milk produced per cow per day from local and crossbred cows is 3.4 and 5.5 litres, respectively. The total amount of milk produced per day in the town is 488.2 litres, and 121 (24.8%) and 367.2 (75.2%) litres come from crossbred and local cows, respectively. Out of this total daily milk production, about 75 litres (15.4%) is sold, 79 litres (16.2%) is consumed and 334.2 litres (68.5%) is processed into butter and local cheese ('ayib'). The urban dairy production system is undertaken in Woreta town, the *woreda* capital. These smallholders own 1–2 crossbred and 1–7 local milking cows per household. There are 217 smallholder dairy producers who own 249 milking cows; out of which only 22% are crossbreds. The urban producers feed their cows with agro-industrial by-products and natural pasture, and have access to AI and veterinary services. Most of the respondents (90.6%) use natural mating and only 9.4% use AI. The sources of bulls for natural mating is either own (45.9%) or from neighbours (48.2%). Age at first calving ranges from 3 to 5 years, and the average lactation length for local breeds is 7.5 months. The average daily milk yield/cow from a local and crossbred cow is 2 and 8 litres, respectively. A total of 828 litres of milk is produced daily in Woreta town; out of which 262 litres (31.6%) is sold, 199 litres (24%) is consumed and 368 litres (44.4%) is processed into butter and local cheese.

Overall, in the *woreda*, 20.4% of the milk produced is used for home consumption, about 66.3% processed, mainly into butter and *ayib*, and only 13.3% is marketed as fluid milk. The average percentage of milk marketed per household in Woreta Zuria (47.5%) and Aember (31.5%) is higher than in other *kebeles* due to the relatively higher demand for raw milk in these towns. In the other *kebeles* that practised milk marketing, the percentage of milk marketed range from 3.3% to 18% of the produce. There is also no fluid milk marketed from Kuahir Abo, Shina, Kidist Hana, Addis Betechrstian and Wagatera *kebeles* due to traditional taboo and lack of access to markets. The prices of milk vary from Ethiopian birr (ETB)<sup>1</sup> 1.25 to 1.50 per litre. About 16.5 litres of milk is

---

1. In 2005/06, 1 USD = Ethiopian birr (ETB) 10.5.

required to produce a kilogram of butter. The price of butter fluctuates from ETB 20/kg in the wet season to ETB 28/kg in the dry season. Retail prices of butter range from ETB 22 to 30/kg depending on quality and season. The estimated amount of butter supplied to the local markets during the wet (June to September) and dry seasons (October to May) is 66,495 kg and 37,698 kg, respectively; totalling 104,193 kg/year. This volume of butter translates to an estimated 1,719,184.5 litres of potentially marketable fluid milk per annum in the *woreda*. Most of the butter is marketed to major urban centres like Addis Ababa, Bahir Dar, Dessie, Gondar and Mekelle. These figures indicate that farmers in Fogera have limited access to fluid milk market and the major milk product marketed is butter. However, 66.7% of respondents face problem of marketing butter and this is more severe during the long fasting season when most of the followers of the Ethiopia Orthodox Christians (94.5%) abstain from consuming animal products. The participants in the butter marketing chain in Fogera *woreda* are producers, rural assemblers, wholesalers, retailers and consumers and the main rural markets in the *woreda* are Woreta, Aember, Wojjarbamba, Hodgebeya, Robit (Wotemb), Maksegnit, Yifag, Wudo and Hamusit.

Regarding beef cattle production, traditional and intensive systems with respective duration of feeding of 5 and 3 months is identified. Farmers buy oxen during the dry season, especially from January to March, for traction purposes. After finishing land preparation, the oxen are fed either green grass or crop residues of chickpea, lentil, rice, beans, field pea and finger millet and sold at local markets. A bundle of grass-legume mixture, locally called 'Milcha', is sold as green feed for ETB 3–5. The body weight of beef cattle marketed during the study period ranges from 191 to 344 kg. The type of cattle supplied as beef animals are from both sex groups and their age is greater than four years. Out of 102 beef cattle, there is no Grade 1 beef cattle, only 18 (17.7%) are in Grade 2, and 71 cattle (69.6%) are in Grade 3 and the rest 13 cattle (12.7%) are very emaciated (Grade 4). From body weight and carcass measurements the estimated dressing percentage is 54.5%. Farmers in Fogera supply beef cattle to Woreta town and to rural markets in Hodgebeya, Wojjarbamba, Yifag and Aember on specific market days. Cattle supplied to markets include calves, heifers, bulls, oxen, dry and lactating cows. Farmers who often supply beef cattle are from Shina, Kidist Hana and Nabega *kebeles*. Beef marketing varied considerably across the *woreda*. In some markets such as Aember, Hodgebeya and Woreta, traders purchase cattle and trek them to Yifag, Gondar and Dembia. Cattle from Woreta and Yifag markets are transported on-hoof over about 120 km to Gondar town. The demand for beef cattle in Fogera, especially in the rural areas, is high around Christmas and Easter. About 96% of the beef producers prefer to sell their animals from May to September when prices are higher. The price of a beef cattle in Fogera during the dry season ranges from ETB 700 to 3400, while it

drops to a range of ETB 600 to 2600 during the rainy season. The proportion of male beef animals out of the beef animals supplied to the market in the year is 86%. Lack of market information reduces the efficiency of the marketing system. Producers do not maximize their returns as they do not get optimum prices. They also do not respond to price changes resulting from supply and demand variations. The lack of market transparency restricts the development of the livestock economy through hampering planning and policymaking. The availability of market information would help producers, traders and exporters to plan production operations and marketing decisions. The critical constraints to improve dairy and beef cattle production in the *woreda* are feed shortage, high disease prevalence, shortage of improved dairy breeds, poor extension, AI and veterinary services, lack of working capital, marketing problems for dairy and beef products during the long fasting periods, lack of market information system and lower purchasing power of the local consumers. Farmers in the *woreda* would benefit from dairy and beef cattle production if Bahir Dar city and its surroundings and the export market open up new market-opportunities.



# 1 Introduction

Ethiopia, with 49.3 million heads of genetically diverse cattle, has the largest population in Africa (CSA 2009). Cattle production plays an important role in the economies and livelihoods of farmers and pastoralists. The agricultural sector in Ethiopia, engaging 85% of the population, contributes 52% to the gross domestic product (GDP) and 90% to the foreign exchange earnings (CSA 2008). Cattle produce a total of 3.2 billion litres of milk and 0.331 million tonnes of meat annually (FAO 2005; CSA 2008). In addition, 14 million tonnes of manure are used annually primarily for fuel. About six million oxen provide the draught power required for the cultivation of cropland (Azage and Alemu 1998; Befekadu and Birhanu 2000). Livestock are therefore closely linked to the economic, social and cultural lives of million of resource-poor farmers for whom animal ownership ensures varying degrees of sustainable farming and economic stability.

Ethiopia has a huge potential to be one of the key countries in dairy production for various reasons (Pratt et al. 2008). These include a large population of milk cows in the country estimated at 9.9 million (CSA 2008), a conducive and relatively disease free agro-ecology, particularly the mixed crop–livestock systems in the highlands that can support crossbred and pure dairy breeds of cows (Ahmed et al. 2003), a huge potential for production of high quality feeds under rainfed and irrigated conditions, existence of a relatively large human population with a long tradition of consumption of milk and milk products and hence a potentially large domestic market (Holloway et al. 2000), existence of a large and relatively cheap labour force and opportunities for export to neighbouring countries and beyond.

Milk and milk products play a very important role in feeding the rural and urban population of Ethiopia and have a high nutrition value and is daily produced, sold for cash or readily processed. It is a cash crop in the milk-shed areas that enables families to buy other foodstuffs, contributing significantly to the household food security. Given the long tradition of using milk and milk products by the Ethiopian society, there is no doubt that increasing smallholder dairy production and productivity would bring about a conspicuous impact on improving the welfare of women, children and the nation's population at large. It also constitutes a significant proportion of the value of all livestock food products in Ethiopia (about 56%), while livestock food products constitute an important proportion of the value of total food products in the country (CSA 2008).

Meat production and consumption is also important in the Ethiopian economy. The annual contribution of ruminants to meat production in Ethiopia is estimated at over 3.2 million tonnes, representing over 72% of the total meat production. The Livestock

Marketing Authority (LMA 2004) estimated the annual potential for export at 72,000 t of meat with an equivalent value of USD 136 million. NEPAD–CAADP (2005) reported that the Middle East and North African countries which are considered important for the country's export in livestock and livestock products are Saudi Arabia, United Arab Emirates, Bahrain, Yemen, Jordan, Kuwait, Oman, Qatar, Iran, Syria and Egypt. Their annual demand is estimated at USD 1.1 billion consisting of 206,846 t of meat and 12 million heads of live animals (cattle and shoats). According to Workneh (2006), the estimated national off take rates of 10% for cattle, pastoral areas of the country alone, could produce 734,000 heads of beef cattle per annum. When these are compared to the demand in the Middle East, they meet only 42% for beef, however, the live beef cattle supplies are well over the demand (144%), requiring new markets outlets.

The annual outflow of beef cattle from Ethiopia through informal market is very huge. The immediate destinations of this illicit export are Djibouti, Somalia and Kenya which are further re-exported after meeting domestic demands to the Middle East countries (NEPAD–CAADP 2005). The legal export of both live animal and processed meat is thus constrained due to shortage created by the illicit export. Recent studies estimate annual illegal flow of livestock through boundaries reaches as high as 320,000 heads of cattle (Workneh 2006). This being the potential for export, the actual performance has remained very low, leaving most (55 to 85%) of the projected livestock off-take for the unofficial cross-border export and the domestic market.

Most of the local cattle used for milk and meat production in Ethiopia are zebu breeds. Among these, the Fogera and Horro are known as milk producers, the former being reared round Lake Tana in Amhara Regional State and the later in Eastern Wollega in Oromia Regional State. The Boran, originating in the Borana plateau of southern Ethiopia, is renowned for its beef production well beyond the boundaries of Ethiopia (Alemayehu 2002).

Although the livestock sector has a significant contribution to the Ethiopian economy, production per animal is extremely low. The average lactation milk production for the indigenous cows ranges from 494–850 kg under optimum management. More importantly, the total milk production from about 10 million milking cow is estimated at about 3.2 billion litres, which is translated into 1.54 litres per cow per day (CSA 2008). In Ethiopia, the current per caput consumption of milk and meat is 16 litres and 13.9 kg/year, respectively; being lower than the African and the world per capita averages, which are 27 kg/year and 100 kg/year, respectively (FAO 2009).

With an annual human population growth rate of 2.4%, the present 77.4 million Ethiopia's human population will increase to about 149.3 million by the year 2040 (FAO

2005). The rural to urban ratio will also continue to change and is expected to increase in favour of urban population in the coming 25 years. According to CSA (1996) projection, by the year 2020 the rural and urban distribution of 84.7% and 15.3% will gradually reach 80.1% and 19.9%. Thus, the demand for animal products is expected to increase substantially with the projected growth in human population, rapid urbanization and growth in per capita income.

In Amhara National Regional State, the agricultural sector contributed nearly 64% to the regional GDP between the period 1994 to 2001 (BOFED 2004). The crop sector takes the lion's share (61%) followed by livestock (27%) and forest products (12%). Macroeconomic studies carried at regional level (BOFED 2003) estimated the Amhara Regional GDP (RGDP) to be close to ETB 13.3 billion, of which agriculture accounted for ETB 7.9 billion, which is 59.4% of the RGDP. Likewise, in 2002, the livestock subsector contributed an estimated ETB 2.2 billion, accounting for about 28% of the regional agricultural GDP, which is close to 17% of the total RGDP.

The Fogera cattle in Amhara Region are an important indigenous animal with huge potential for dairy and meat production. Although the breed has so far been characterized phenotypically and its peculiar features are known for milk, meat and draught power, the milk and meat production and marketing system in Fogera *woreda*, its place of origin, has not yet been characterized and well documented. Therefore, this study is undertaken with the following objectives:

1. To characterize cattle milk and meat production systems
2. To examine milk and milk products and beef cattle marketing systems
3. To study production inputs/services available in the *woreda* for milk and meat production and marketing
4. To assess milk and beef production and marketing constraints and to identify possible interventions for more market-orientation of the production system.

## 2 Literature review

### 2.1 Economic importance of livestock in Ethiopia

Livestock have diverse functions in the livelihood of farmers in the mixed crop–livestock systems in the highlands and pastoralists and agro-pastoralists in the lowlands of Ethiopia. Livestock provide food in the form of meat and milk, and non-food items such as draught power, manure and transport services as inputs into food crop production and fuel for cooking. They are a source of income, which can be used by rural populations to purchase basic household needs and agricultural inputs. In the rural areas of many developing countries, financial services such as credit, banking and insurance are virtually non-existent. In these areas, livestock play an important role as a means of saving and capital investment, and they often provide a substantially higher return than alternative investments. A combination of small and large livestock that can be sold to meet petty-cash requirements to cover seasonal consumption deficits or to finance large expenditure represents a valuable asset for the farmer (Sansoucy et al. 1995). The contributions of livestock can equally be well expressed at household level by its role in enhancing income, food security and social status (Winrock 1992; Ehui et al. 1998). The contribution of livestock and livestock products to the Ethiopian economy is also significant, accounting for 40% of the agricultural gross domestic product, excluding the value of draught power, fuel, manure and transportation. Livestock and livestock products are also important and significant sources of foreign exchange earnings.

In the mixed crop–livestock systems of the Ethiopian highlands, livestock production is subordinate, but economically complementary to crop production. In this ecological zone, livestock, especially cattle, provide traction, which is a vital contribution to the overall farm labour requirement. Livestock also provide meat, milk, cash income and manure, and serve as a capital asset against risk. Within the integrated crop–livestock production systems, animals play a particular vital role, the extent of which is dependent on the type of production system, animal species and scale of the operation. Dairy production is becoming an increasingly important integrated system in many countries, in which this component generates significant, and more importantly, daily cash income, as well as contributing to the improvement of the livelihoods of very poor people and the stability of farm households. It is for these reasons that dairying in developing countries is considered to be an important instrument of social and economic change, and is identified with rural development.

In the semi-arid low lands, cattle are the most important species because they supply milk for the subsistence of the pastoral families. In the more arid areas, however, goats

and camels are the dominant species reared. The former provides milk, meat and cash income, while the later provides milk, transport and, to a limited extent, meat to the nomadic pastoral population (Mbabane 1997).

Cattle are kept for multiple purposes and the emphasis on use varies with the production system. In both crop–livestock and agro-pastoral systems, animal traction ranked first, followed by milk and reproduction. Manure production is also considered as a secondary important by-product by most crop–livestock and agro-pastoralist farmers. In contrast, in pastoralist systems, reproduction/breeding requirements received higher ranks and for female animals breeding outranked the importance of milk production (Workneh and Rowlands 2004).

Women are usually responsible for feeding animals, cleaning barns, milking, processing milk and marketing of livestock products. Young children, especially girls between the ages of 7 and 15, are mostly responsible for managing calves, chicken and small ruminants and older boys are responsible for treating sick animals, constructing shelter, cutting grass and herding of cattle and small ruminants. The role of women in managing animals that are confined during most of the year is substantial and they are critically involved in removing and managing manure, which is made into cakes and used by the household or sold as fuel (Azage 2004). In the highlands of Ethiopia, smallholders rear cattle, primarily for the supply of oxen power for crop production. Milk production, cash source, manure and fuel are considered as secondary. Cattle and equine play a vital role in smallholder farms for crop cultivation and transportation (Alemu 1998). Livestock products, especially dairy, can make a unique contribution to human nutrition to the poor in developing countries by providing micronutrients in bio-available form such as vitamin A, carbohydrates, protein and calcium (Ahmed et al. 2003).

The value of output from livestock in Ethiopia was estimated at around ETB 12 billion in 2000 and accounted for about 45% of the value of all agricultural output excluding the contribution of animal draught power. It was also noted that, at constant prices (1995 USD), the value of output from livestock grew nearly by 22% between 1980 and 2000, and this increase (1.1% per annum) compares well with the growth of the value of agricultural output (FAO 2003). Similarly, the value of output from livestock increased by a factor of 3.75 from ETB 9.97 billion to ETB 37.38 billion between 1999/2000 and 2008/09 (MoFED 2010). The country also earned a total of USD 83.12 million between 2004 and 2007 from the export of cattle (FAO 2009). Data collected from the Ethiopian Custom and Revenue Authority (Tables 1 and 2) show that import of dairy products in Ethiopia increased from 1.3 million kg in 2004 to 1.77 million kg in 2009 and spent ETB 42.1 million and 100.57 million, respectively to satisfy the domestic demand for milk and milk products.

**Table 1.** Trends in dairy imports to Ethiopia by dairy product (kg), January 2004 to May 2008

Dairy product	Year					
	2004	2005	2006	2007	2008	2009
Liquid milk and cream	8994	17,865	18,326	38,519	322,900	119,019
Skimmed milk powder	558,142	335,727	594,655	555,220	535,854	812,793
Whole milk powder, unsweetened	370,144	735,874	1,070,915	717,412	545,019	718,781
Whole milk powder, sweetened	221,200	159,732	222,217	51,674	106,224	0.00
Evaporated milk	1987	11,622	29,891	10,714	1513	0.00
Condensed milk	58,544	268,426	103,000	23,661	66,328	70,104
Yoghurt	8012	5060	8822	10,208	11,814	7141
Whey and whey products	278	0.00	157,943	13,767	32,704	0.00
Butter and butter products	11,362	3524	27,154	20,327	17,665	32,706
Cheese (fresh, grated, or processed)	65,463	62,695	70,738	99,285	92,528	9140
Casein and caseinates	2256	37,514	35,653	31,912	21,008	0.0
Total	1,306,382	1,638,038	2,339,314	1,572,700	1,753,557	1,769,685

Source: Ethiopian Custom and Revenue Authority.

## 2.2 Dairy production systems in Ethiopia

There are four major milk production systems in Ethiopia. These are pastoral and agro-pastoral, smallholder crop–livestock mixed system, urban and peri-urban, and intensive dairy farming (Azage and Alemu 1998). Pastoralist and smallholder farmers produce 98% of the country's total milk production (CSA 2008). Total milk production in 2005 was estimated at 1.5 million tonnes which is equivalent to USD 398.9 million (FAOSTAT 2007). The majority of milking cows are indigenous breeds which have low production performance. The average cow lactation milk yield is 524 litres over a lactation period of 239 days. About 238 litres are used for human consumption, while the remaining 286 litres are suckled by the calf. The average age at first calving is 53 months and average calving interval is 25 months. Cows produce three to four calves before leaving the herd at 11–13 years of age. Cows are kept to provide milk primarily for household consumption and reproduce for production of draught oxen and replacement heifers. Surplus milk is sold, usually by women, who use the regular cash income to buy household necessities or to save for festival occasions. As shown in Table 3, daily milk yield of some of the indigenous cattle breeds in northwestern part of Ethiopia has been recorded by Zewdu (2004). For example, the minimum and maximum daily milk yield of the Fogera breed was 1.39 litres and 4.63 litres, respectively.

**Table 2.** Trends in the value (ETB) of dairy imports to Ethiopia, January 2004 to May 2008

Dairy product	Year					
	2004	2005	2006	2007	2008	2009
Liquid milk and cream	39,293	121,470	107,418	397,208	9,877,969	1,519,543
Skimmed milk powder	20,333,539	10,783,619	20,357,370	20,415,804	27,230,642	45,176,048
Whole milk powder, unsweetened	13,617,370	26,616,610	34,056,606	25,518,485	31,448,855	50,617,263
Whole milk powder, sweetened	4,704,511	3,385,802	5,636,837	1,768,806	3,616,730	0.0
Evaporated milk	46,650	246,636	611,792	211,154	24,421	0.0
Condensed milk	1,283,798	6,305,255	2,265,831	235,110	3,108,452	737,891
Yoghurt	106,456	102,881	199,167	226,161	333,505	321,287
Whey and whey products	9827	0.00	3,834,619	338,479	512,147	0.0
Butter and butter products	245,901	101,677	302,831	503,183	819,724	1,409,694
Cheese (fresh, grated or processed)	1,609,736	1,717,567	2,015,762	2,806,279	3,345,196	792,656
Casein and caseinates	78,945	1,231,804	988,312	957,799	1,217,111	0.0
Total	42,076,024	50,613,321	70,376,546	53,378,467	81,534,750	100,574,383

Source: Ethiopian Custom and Revenue Authority.

**Table 3.** Milk yield performance of indigenous cattle breeds in northwestern Ethiopia

Site	First lactation (litres)				Second lactation (litres)			
	N	Min	Max	Mean	N	Min	Max	Mean
Dembia	18	225.0	1050.0	515.0	17	240.0	720.0	469.7
Fogera	14	315.0	1320.0	635.4	14	360.0	1680.0	760.7
Metema	12	225.0	570.0	395.0	12	300.0	495.0	379.2
Semein	12	97.5	190.0	121.1	12	135.0	210.0	191.7
Wegera	35	150.0	750.0	327.3	35	225.0	630.0	393.6
Overall	91	97.5	393.6	393.6	90	135.0	1680.0	436.2

Source: Zewdu (2004).

Dairy production is a critical issue in Ethiopia—a livestock-based society where livestock and its products are important sources of food and income. However, dairying has not been fully exploited and promoted. Due to the low disease pressure and conducive agro-climatic conditions for cultivation of feed, the greatest potential for dairying is expected

in the highlands of Ethiopia. High population densities and animal stocking rates, as well as easy access to markets, also make it attractive to invest in market-oriented dairy production in peri-urban areas of these regions (Tangka et al. 2002).

### 2.2.1 Pastoral system

Even though information on both absolute numbers and distribution vary, it is estimated that about 30% of the livestock population in Ethiopia are found in the pastoral areas. The pastoralist livestock production system which supports an estimated 10% of the human population covers 50–60% of the total area mostly lying at altitudes ranging from below 1500 masl. Pastoralism is the major system of milk production in the lowlands. Cows, camels and goats are the major dairy animals used for milk production by pastoralists. However, availability of milk is dictated by the shortage and erratic nature of the rainfall and fluctuations in availability of feed (Ketema and Tsehay 2004). Pastoralists rely on milk for food and also use animals to generate wealth. Animals are consequently important in the social value system that promotes flexibility in resource use (Kedija et al. 2008).

### 2.2.2 The highland smallholder crop–livestock system

The Ethiopian highlands possess a huge potential for dairy development. These areas occupy the central part of Ethiopia and cover about 40% of the country's land area (approximately 490,000 km<sup>2</sup>). In these areas agricultural production system is predominantly subsistence smallholder mixed farming, with crop and livestock husbandry typically practised within the same management unit. In this farming system, the entire feed requirement for ruminant livestock is derived from native pasture and the balance comes from crop residues and stubble grazing. The main source of milk is from the cow.

As Walshe et al. (1991) pointed out, where there is access to market; dairying is preferred to meat production in the highlands because it makes more efficient use of feed resources and provides a regular income to the producer. It is also labour intensive and supports substantial employment in production, processing and marketing. Higher level of production than those achieved in traditional tropical systems, whether from cattle, camels or small ruminants, often require the introduction of specialized dairy breeds and increased level of inputs (nutrition and health care) and good linkages to market both for milk and input acquisition. Thus, the intensification of smallholder dairy production system through the adoption of dairy production technologies is generally concentrated in areas with good infrastructure close to major markets, although less intensive production may occur in other, more distant areas (Walshe et al. 1991). These market

factors, therefore, play a major part in determining the type of dairy production systems found in the tropics, and they are particularly important in influencing smallholder dairy development (Falvey and Chantalakhana 1999).

### 2.2.3 Urban and peri-urban system

This system is developed in and around major cities and towns which have high demand for milk. In this system the main feed resources are grass hay, crop residues and agro-industrial by-products. In this system milk is a means of additional cash income. Most of the improved dairy stock in Ethiopia are used for this production system. One of the largest sources of milk in Addis Ababa/regional towns is that from intra-urban milk producers. The producers deliver milk to consumers or consumers may collect it at the producers' gate. Studies indicate that in terms of volume, 71% of intra-urban producers sell milk directly to consumers (Belachew et al. 1994; Tsehay 2001).

### 2.2.4 Intensive commercial system

This is a more specialized dairy farming practised by state sector and very few individuals on commercial basis. These are concentrated in and around Addis Ababa and other regional capitals and are basically based on exotic high grade or purebred stock. Although these urban, peri-urban and intensive dairy farmers are important and regular suppliers of milk to major urban centres, they produce only 2% of the total milk production of the country.

All smallholder dairy production systems in urban areas and in mixed crop–livestock system are labour intensive, where milking is done by hand, and often done twice a day. Production on most smallholder farms relies heavily on family labour. The milk production levels also vary between different dairy breeds. On average, crossbred cows produce about eight litres/per day per cow and the indigenous cows produce some two litres/per day per cow. A number of production constraints seriously affect smallholder dairy production. Factors that hamper milk production in these systems include lack of capital to acquire crossbreds, lack of full information on breeds, inadequate feed base, limited access to land, high cost of water and bought-in feeds and shortage of cash to buy concentrate feeds (Bayer and Waters-Bayer 1998).

In general, milk production in Ethiopia is low. The indigenous zebu produces about 400–680 kg of milk/cow per lactation compared to grade animals that have the potential to produce 1120–2500 litres over 279-day lactation. The production and distribution of crossbred heifers, the provision and distribution of dairy stocks, the provision and strengthening of AI services, and/or bull services 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 120,000 dairy animals with exotic genetic inheritance. So far, only one governmental institution, the National Artificial Insemination Center (NAIC) provides AI services in the country (Ahmed et al. 2003).

## 2.3 Beef cattle production systems in Ethiopia

According to the Fourth Livestock Development Project (MOA 1996a), there are three types of cattle fattening systems in Ethiopia. These are traditional, by-product-based fattening and the Hararghe type of fattening. In the traditional system, oxen are usually sold after the ploughing season while they are in poor body condition. Meat yields are low, the beef is of poor quality and returns to farmers are often inadequate even to buy a replacement ox. Cattle in the lowlands are rarely fattened and are often sold in poor body condition and at low prices. The by-product-based fattening system is a type in which agro-industrial by-products such as molasses, cereal milling by-product and oilseed meals are the main sources of feed. In the Hararghe fattening system, farmers buy young oxen from the adjacent lowlands pastoral areas, use them for ploughing for several years, and then fatten and sell them before they become old and emaciated. The system is largely based on cut-and-carry feeding of individually tethered animals. Grazing is rare. Fattening enterprises in western parts of the country typically take immature feeder animals and bring them to market weight for sale to slaughter. Cattle in these enterprises normally enter the feedlot at well under one year old and are fattened for six months. Smallholder cattle fattening is also a traditional occupation in some regions in Ethiopia, e.g. in Hararghe Zone of the Oromia Region where locally named Harar beef is produced. Fattened cattle from Harar fetch a premium price of up to 50% over other condition cattle in the Addis Ababa market.

Fattening activity in the Amhara Region, however, differs substantially from the above-mentioned enterprises. Smallholder farmers commonly fatten mature and therefore much older animals (5 to 7 years old) for short durations (usually three months). Ordinarily, farmers fatten their draught oxen so that they can fetch better price when brought to market. On the other hand, some farmers purchase oxen specifically to fatten and sell them so as to get higher price per weight margins on each fattened animal. In such cases, animals are purchased based on their large skeletal frames and body conformation. In any case, whether purchased or own animals are used for fattening purposes, they have already reached their full skeletal size (BoARD 2004).

## 2.4 Milk processing and marketing in Ethiopia

Studies indicate that butter making is an ancient practice that dates back as far as 2000 BC to the Egyptian civilization. Butter making may have begun at a similar time in Ethiopia. The traditional Ethiopian practice is to accumulate the milk for two to three days until it sours. A clay pot or calabash is then used to churn the sour milk. Butter is used for cash generation, cooking Ethiopian dishes, and medicinal and cosmetic purposes (e.g. application to the braided hair of women). In almost all societies of Ethiopia, women are responsible for butter making. The contribution of dairy products to the gross value of livestock production is not known, but in peri-urban areas about 20% of average income is estimated to be derived from dairy products (Winrock 1992).

In the central highlands of Ethiopia (Selale, Debre Zeit and Holetta areas), smallholder milk processing is based on sour milk. The milk for processing can be either from a single milk animal or an accumulation from a large number of animals. The equipment commonly used is clay pot and a stick with three to six finger-like projections at one end (locally called 'mesbekia' in Amharic and 'erba' in Oromiffa). Some households use only one of the materials, while others use them in combination. The types of sour milk processing materials and methods could be characterized and grouped into three types.

*Type 1:* Sour milk is agitated by placing the churn (clay pot) on a mat on the floor and rocking it back and forth. When the churn is filled with milk, usually about half of the volumetric capacity of the churn the opening is sealed by a piece of skin, leather or plastic stretched over the opening of the churn. Then the churn is shaken. The mat can be unprocessed skin or hide, sacks, grass, cereal straws, worn out garments or other similar material. This is common around Holetta and Debre Zeit areas.

*Type 2:* Sour milk is stirred with mesbekia by inserting the end with the projections in the sour milk inside the clay pot and using the palms of both hands to rotate the stick. In this case, the clay pot is not moved. This is common around Selale area.

*Type 3:* First, the sour milk is stirred for some time with mesbekia and agitated by rocking the sour milk in the clay pot back and forth until milk fat is received in the form of butter. This is practised more around Holetta and Debre Zeit areas (Zelalem and Inger 2000).

In southern Ethiopia, Fekadu and Abrahamsan (1994) reported that milking is performed one to three times a day, and after milking, the milk is transferred into a smoked clay pot and kept closed at room temperature of about 20–22°C in the house. Milk from the evening milking is added to the morning milk and kept until the next morning. The quality of the curd formed is visually evaluated and readiness of the curd for churning is

determined by the experienced female member of the household. The churning operation starts after stirring the content and transferring to another smoked clay pot. The clay pot is agitated until butter grains start to form. The developed gas is released every 2–3 minutes by opening the top of the churning during the first 10–15 minutes of the churning operation. The churning operation, a back and forth movement, is manually performed in a traditional way.

In the Borana area of southern Ethiopia, milk is churned to make butter after a minimum of one-day of fermentation. Milk is usually churned in the morning during warm weather, as the Borana appreciate the role of cooler temperatures in butter production. The 'gorfa' (one of the milk containers) is filled to 50–70% capacity with fermented milk and is cradled by a woman who gently rocks it back and forth (Ephraim and Tarik 1987).

In pastoral areas, as few agro-pastoralists grow crops, most food stuffs are purchased. Surplus milk is shared with neighbours or bartered, but is rarely sold except by households living close (<5 km) to main roads and urban centres where there is demand for fresh and fermented milk and butter. In the Borana pastoral system, the frequency and amount of dairy products traded depended on herd size and distance to the market; butter replaces liquid milk with increasing distance and women from households with large herds trading more often. Butter is often sold to truck drivers and bus passengers *en route* to Addis Ababa, some 500 km away (Coppock 1994).

In urban areas, where there is a good demand for fresh milk, the surplus can readily be sold. Around Addis Ababa, there is an organized milk collecting system 120 km along the roads leading to the capital. In the rural areas far away from the main roads, the possibility of selling fresh milk is more limited. In addition, followers of the Ethiopian Orthodox Church abstain from consuming milk and animal products during the fasting periods. The surplus milk has thus to be converted into butter and cottage cheese (*ayib*) and is usually sold in local markets (Debrah and Birhanu 1991). Fresh milk is mainly distributed through the formal and informal marketing systems. The informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighbourhood and sales to itinerate traders or individuals in nearby towns. Milk is transported to towns on foot, on back of donkeys and horses or by public transport (Debrah and Birhanu 1991).

Dairy producers in the Addis Ababa milkshed have a variety of milk outlets for their production. A substantial amount of the milk marketed by producers, some 75% goes through informal channels; defined here as those channels which avoid taxation and quality controls. These include direct sale to individuals, sales to institutions, sales to private milk traders, to retail outlets, and to informal dairy processors. Currently, a

number of dairy processing plants have formal outlets for liquid milk and operate a system of milk collection and cooling centres along the major roads radiating from the capital.

The farm-to-house arrangement for milk marketing usually involves a contractual type of arrangement in which individual producers may offer to deliver raw milk directly to the consumers at their homes or at some convenient location. This arrangement is especially common in the case of milk producers who are located in and around large cities, such as Addis Ababa. Rural areas which are distant to big cities have limited or little, if any, markets for liquid milk and milk surplus in such areas is converted into butter and/or ghee, and sometimes local cheese (ayib), and sold in local markets. Such sales in local markets are usually made through established local traders, who may buy directly from producers at farm-gate. Processing of butter, ghee and local cheese vary within and between places, usually depending on season. Hence prices tend to be highest during the dry season (Debrah and Birhanu 1991).

## 3 Materials and methods

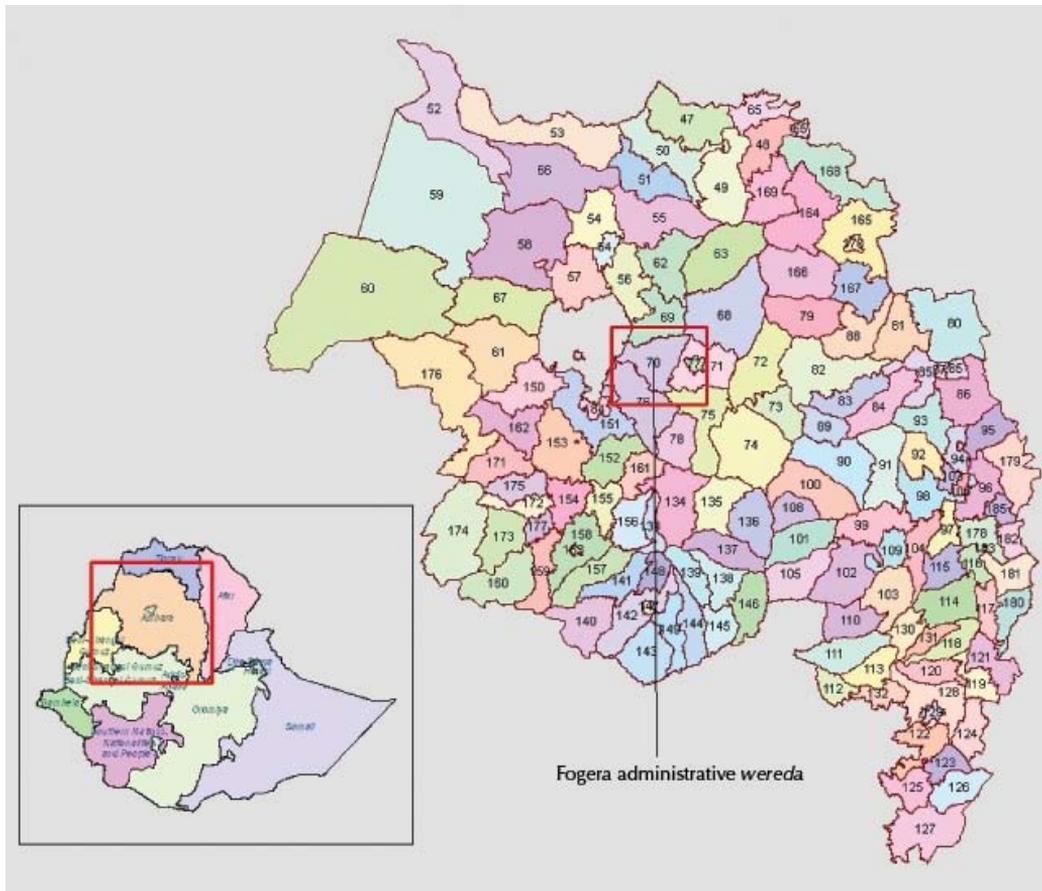
### 3.1 Description of the study area

The study was conducted in Fogera *woreda*, located in South Gondar Zone of the Amhara Regional State in 2005/06. Woreta is the *woreda* capital and is found 625 km from Addis Ababa and 55 km from the regional capital, Bahir Dar. Woreta and Aember are the two major towns in the *woreda*. The *woreda* has 17 km of asphalt road that crosses the town, and 38 km of all weather road and 67 km of dry weather road. The *woreda* is divided into 25 rural and 5 urban *kebeles*. The total land area is 117,414 ha, out of which 54,471.76 ha are crop land, 9602.36 ha are grazing land, 2190 ha are forest land, 251 ha are covered with perennials. About 7075 ha are used for construction, 4375 ha are wasteland and the rest 1698 ha are swampy areas. Flat land accounts for 76% of the total land area, while mountain and hills and valley bottom account for 11% and 13%, respectively. The *woreda* is one of the 8 *woredas* bordering Lake Tana and has an estimated water body of 23,354 ha. Altitude ranges from 1774 to 2410 masl and is predominantly classified as Woinadega ecology. The mean annual rainfall is 1216.3 mm and ranges from 1103 to 1336 mm. The average temperature is 19°C. Belg and Meher are the two cropping seasons, with the short and long rainy periods, respectively. According to IPMS (2005), the human population of Fogera is estimated at 236,553. Out of this, 121,424 (51.3%) are male and 208,898 (88.3%) live in rural areas with farming as their primary occupation. The number of agricultural households is 42,746.

Gumara and Rib are the two major rivers that are of great economic importance in the *woreda*. Gumara River passes through Fuafuat Gajera, Kinti Merewa, Abagunde Sendega, Aba Kiros, Bebeks, Quahr Michiel, Shina, Kidist Hana, Wagatera and Guramba *kebeles* and Rib River passes through Wetemb, Addis Betechrstian, Rib Gebriel, Debasi Fatra, Abana Kokit, Shaga, Naber and Shina *kebeles* and drains into Lake Tana. These rivers are mainly used for irrigation during the dry season for the production of horticultural crops, mainly vegetables. Some farmers also use irrigation to produce cereals and pulses.

In Fogera *woreda*, there are 157,128 cattle, 7607 sheep, 27,867 goats, 13,187 asses, 339 mules, 246,496 chicken and 21,883 beehives. Only 2831 (1.8%) of the cattle population are found in urban areas (CSA 2008). The dominant cattle are the indigenous breeds and during the study period only 165 Fogera × Holstein crossbreds were found in the *woreda*. The feed resources include natural pasture, green fodder, crop residues, improved forages, grass hay, industrial by-products and household waste (IPMS 2005). According to Zewdu (2004) the major livestock diseases are Foot and Mouth disease (FMD) (Aftegir), blackleg (Abasenga), anthrax (Kurba), lumpy skin disease (Ekek), Contagious Bovine

Pleuropneumonia (CBPP) (Yesal beshita), trypanosomiasis (Gendi), mastitis (Yetut beshita) and dermatophilosis (Yekoda beshita).



**Figure 1.** Location of Fogera woreda in Amhara Region, Ethiopia.

### 3.2 Farming systems

The *woreda* grows diverse annual and perennial crops. According to IPMS (2005), the *woreda* is broadly classified into two farming systems. The rice/fish/livestock system is found north of the main road transecting the *woreda*. This area is known as the Fogera Plains and is used for livestock grazing. The area gets flooded during the wet season and is not accessible. Farmers along the coasts of Lake Tana are also fishermen. Rice production was introduced some five years ago in the plains and currently about 4516 ha of land is under rice cultivation using the X-Jigna variety. About 14 *kebeles* are involved in rice production and this supports about 11,000 households. The mean rice yield is estimated at about 35 qt/ha and ranges from 20 to 80 qt/ha depending on the land type and management practices. According to the *woreda* OoARD, there is a potential to expand rice production to 28,000 ha of land. Rice straw is used as animal feed and for

roof thatching. Rice hull and rice bran, often mixed with a local brewer's grain known as 'attela', are used as animal feed. The rice system is well integrated with fish production from Lake Tana and cattle production in the plains. In addition, teff, maize, noug, safflower, chickpea, lentil, fenugreek, basil and coriander are grown. In the dry season, horticultural crops mainly onion, garlic, hot pepper and tomatoes are grown under small-scale irrigation. During the dry season, most of the area is left for livestock grazing. The major animal diseases in this system are trypanosomiasis, liver fluke and gastro-intestinal parasites. Biting flies are also a major problem and restrict animals from grazing.

The cereal/horticulture/apiculture system is found in the southern part of the road transecting the *woreda*. The terrain varies from relatively flat bottomlands to mid and high altitude areas. This system is dominated by cereals (maize, finger millet, teff), horticultural crops (mainly hot pepper), and oil crops (mainly noug). Cattle, sheep, goats and poultry are the major livestock in the area. There is a long tradition of honey production in the *woreda* and some farmers own up to 250 traditional beehives (IPMS 2005).

### 3.3 Selection of *kebeles* and participating farmers

The study was undertaken in 12 randomly selected *kebeles*, all of which are found in the moist Woinadega agro-ecology, and 40 heads of households were randomly selected and interviewed from each *kebele*, therefore, a total of 480 farmers were included in the study. Field survey was conducted using a random open-ended discussion with the selected farmers. In this discussion, agricultural extension staff especially livestock experts and *kebele* development agents were involved. Elders and farmers who have better experience in milk and beef production participated in the discussion.

### 3.4 On-farm data collection

Data were collected by interviewing farmers using a structured questionnaire, and personal observations were made on feeding and housing of dairy and beef animals, hand milking, milk processing, marketing of raw milk and butter, and beef animals. Observations were also made on the health services given by the governmental and private clinics. Data on milk production in the peri-urban and urban areas and beef production and marketing in the rural livestock markets were also collected. To estimate the milk off take, milk harvested from milking cows was randomly measured using a local container with half-litre capacity. Recording was done for 15 days.

### 3.4.1 Data collection with a semi-structured questionnaire and discussion with key informants

Information was collected from 480 heads of households using a questionnaire. Animal science students from Woreta ATVET College were trained and involved in data collection. The overall purpose of the interview was to understand the production environment; decision-making process on cattle milk and beef production system, and to analyse the constraints and explore the opportunities for market-orientation of cattle milk and meat production system in the study area. After the interview was completed, data were also collected from key informants using open-ended discussion at each *kebele* together with the *woreda* livestock experts and development agents on milk and meat production, inputs, marketing constraints and intervention measures.

### 3.4.2 Data collection through personal observation

In the interviewed *kebeles*, the following observations were made:

- appearance of animals to estimate their body condition during the dry and wet seasons
- procedures of milk production starting from hand milking, handling and processing of milk
- information was collected on access to information and governmental and private health and AI services
- three livestock markets (Woreta, Hodgebeya and Aember) were selected to record prices of beef animals
- amount and price of butter supplied to rural markets such as Aember, Hodgebeya, Wojjarbamba, Meneguzer, Robit, Maksegnit was recorded
- data were also collected from producers, caterers, rural assemblers, retailers and wholesalers on marketing of milk, butter and live animals.

Heart girth measurement was taken from 102 cattle using a measuring tape to estimate body weight of animals provided for slaughter in the Municipality's slaughtering slab and estimation of dressing percentage of cattle. Cattle were graded as Grade 1: excellent, Grade 2: good; Grade 3: fair and Grade 4: emaciated. The slaughtering service which was given by the municipality abattoir and the backyard slaughtering were observed, slaughtering procedures at the backyard and hygienic practices were also recorded.

## 3.5 Data analysis

Data were managed in such a way that the qualitative as well as quantitative variables were selected. The data collected by semi-structured questionnaire were entered into MS-

Excel and analysed using SPSS (version 10; 1999). The qualitative parameters included, among other things, the involvement of family members in dairy production, the background of the cattle owner, source of information for dairying, cattle housing, types of feeds and feeding, type of cattle drinking water resources, type of breeds and breeding techniques, dairy and beef cattle performance reasons, dairy products marketing, beef marketing, characterization of market participants, main constraints for dairy and beef production and opportunities for improving dairy and beef production.

The quantitative parameters included were family size, cattle number, number of milking cows, area of crop and private pastureland, amount of milk produced, consumed and collected for processing, lactation length, weaning age of calves, milk utilization pattern and beef production. Descriptive statistics, correlations and regression statistical methods were used. The correlations between milk production, number of milking cows, pastureland and family size and milk yield were analysed.

## 4 Results and discussion

### 4.1 Background and characteristics of respondents

The total human population in the surveyed rural *kebeles* is 3540, out of which 2322 (65.5%) are in their productive age (15–60 years). From the total 457 respondents, about 95.2% are employed in farming activities. Pensioners (3.1%), businessmen (1.04%) and civil servants (0.62%) constitute small proportion. Only 12 (2.52%) of the respondents are female-headed households. The average age of the respondents is 44 years and ranges from 22 to 77 years. Out of the total population in the surveyed *kebeles*, 33% are under the age of 15 years. This age group is mainly involved in livestock management activities. Most of the households are involved in dairy and/or beef production. The overall average family size is 6.32 and ranges from 4.22 in Shina to 7.6 in Woreta Zuria *kebele*.

### 4.2 Land and cattle holdings

In the surveyed *kebeles*, most of the farmers own 1.01 to 2 and 0.1 to 0.5 ha of crop land and pasturelands, respectively. The highest and lowest land holding under crops is 5.75 and 0 ha, respectively, while the respective land holdings under pasture is 1 and 0 ha. The majority of respondents have private pastureland ranging from 0.1 to 0.5 ha. Respondents who have better land under crops have better pasturelands as well, i.e. they allocate a plot of land around their homestead for animal feeds production. In general, 42.3% of the respondents do not allocate any land for pasture, while 57.7% allocate more than 0.25 ha.

The total cattle population in the surveyed *kebeles* is 3492; and the number of milking cows is 764 (21.9%). From the total 457 respondents, 83.6% own 1 to 3 milking cows, and only 4.8% own 4 to 7 cows. The average number of milking cows in a household is 3.2 TLU and ranges from 0.82 to 1.45 TLU; the highest being in Addis Betechristian *kebele* and the lowest in Wagatera *kebele*. The average proportion of the milking cows out of the total cattle herd in the households is 21.9% and ranges from 15 to 31.5%; the highest being in Wagatera and the lowest in Abuatihua *kebele*. This may be due to the fact that farmers found in the periphery of Lake Tana prefer to own more milking cows than the others.

The amount of milk produced and the number of milking cows per household is positively correlated ( $r = 0.61$ ;  $P < 0.01$ ). Milk produced per household and area under pasture owned by a household have a low but positive correlation ( $r = 0.10$ ;  $P < 0.05$ ). Correlations between milk produced per household and area under crops and family size

of the households were not significant. Even though the respondents, especially those in the rural mixed systems, do not have enough pastureland, they would like to have more milking cows in their herds. Cattle ownership of the respondents is presented in Table 4.

**Table 4.** *Cattle holdings of respondents in the surveyed kebeles*

Number of cattle	Percentage of respondents
1–7	60.4
8–14	34.5
15–24	4.1
25–28	0.83

### 4.3 Involvement of family members in dairy production

Dairy production activities are done by both male and female members of the family and children above six years of age. Cattle herding is mostly undertaken by boys and girls between 6 and 14 years of age. About 54.4% of the boys in the age range of 6–10 years are involved in cattle herding. Milking, milk processing, cleaning and selling of milk and butter is performed by adult male and female.

All cows are hand milked, and milking of cows is mostly (97.1%) done by males. However, women milk the cows when the husband is not around. On the other hand, women are solely responsible for milk processing, barn cleaning and marketing dairy products. Processing of the sour milk into butter is done by the wife (93.2%) and/or daughters and in few cases by hired labour (6.8%). As long as there is sufficient family labour, hired labour is kept to the minimal. During the rainy season, male family members swim across the flood plains to Woreta town to sale dairy products, particularly butter.

### 4.4 Characteristics of dairy production systems

Based on production inputs used, location and access to markets, three dairy production systems are identified in Fogera *woreda*. These are: a) rural small-scale (mixed subsistence), b) peri-urban and c) urban dairy production systems. The number of milking and dry cows in these three production systems during the study is presented in Table 5. The percentage of milking cows in the three production systems is 60%. It is interesting to note that the percentage of milking cows is more than 65% in the rural and peri-urban systems, while it is about 44% in the urban production system. This may be due to poor feeding system and low fertility of cows in the more intensive urban production system.

**Table 5.** Proportion of milking and dry cows in the three production systems in Fogera

Production system	No. of households	No. of cows	
		Milking	Dry
Rural small-scale (mixed subsistence)	480	764 (66.8%)	378 (33.2%)
Peri-urban	68	129 (67.2%)	63 (32.8%)
Urban	217	249 (43.8%)	319 (56.2%)
Total	765	1142 (60.0%)	760 (40.0%)

Numbers in brackets are percentages.

#### 4.4.1 Rural small-scale dairy production system

The rural small-scale mixed system mainly uses indigenous breeds, grazing of natural pasture and crop residues as major inputs. Rural small-scale mixed subsistence dairy production in Fogera is undertaken by subsistence farmers who own 1–7 indigenous and 1–2 crossbred cows. There are only six crossbred lactating cows (0.79%) in this system. The total number of milking cows in this system is 764. The traditional smallholder system in rural Ethiopia produces 97% of the total national milk production using the indigenous cattle breeds. This sector is largely dependent on low levels of inputs and indigenous breeds, which produce about 400–680 kg of milk/cow per lactation length (Tsehay 2001). Apart from a few crossbred dairy cows distributed by various projects, the system is largely based on low producing indigenous breeds of zebu cattle (Staal and Shapiro 1998). According to key informants in the current study, the typical Fogera breed is mainly found in the Damote, Sendeye and Tigre mender villages.

In this production system, milking cows are allowed to graze together with the total herd and there is no special feeding regime to these cows. Calves are allowed to suckle partially for the first five to ten minutes to stimulate milk let-down. The newly born calves in the rainy season suckle their dam for 30–40 days and then after are allowed to graze around the homestead. Calves born during the dry season, however, are given supplementary feed mainly barley flour, locally called 'enshurshur' between 10:00–11:00 am.

Milkers wash their hands before milking only during the morning milking but not during the evening due to tradition. In this system, 97.1% of the respondents indicated that milking is done by the husband, while milk processing and marketing of dairy products is done by women only. On average about 2.9 litres of milk is produced (off-take) per day per household. Out of this, 0.6 litres (20.7%) is used for home consumption, 1.9 litres (65.5%) for processing into butter and only 0.4 litres (13.8%) for marketing. Milk suckled by calves is not recorded during the study. Milk is not marketed at all from Kuahir Abo, Shina, Kidist Hana, Addis Betechrstian and Wagatera *kebeles*. Though a few farmers

from these *kebeles* would like to sell raw milk, the long distance and the waterlogged plain hinder them access to markets during the rainy season. According to Getachew and Gashaw (2001), about 68% of the total milk produced in rural Ethiopia is used for household consumption in the form of fresh milk, butter, cheese and yogurt, while the rest is given to calves or wasted.

#### 4.4.2 Peri-urban dairy production system

Alembert is a small town, located 25 km northwest of the *woreda's* capital and has a peri-urban dairy production system. The producers are mainly rural farmers (95.2%), retired persons (3.1%), businessmen (1%) and civil servants (0.6%). This system uses local and crossbred animals, have access to nearby veterinary and AI services, and agro-industrial by-products (bran, oil seed cakes).

In Alembert town there are 68 dairy farmers (43% women), and 29.4% have crossbred cows. The number of local and crossbred cows in this area is 107 (78%) and 22 (17%), respectively. The feed resources in Alembert town are natural communal and private grazing, hay, noug cake and the crop residues of teff, maize, and finger millet. According to Tsehay (2001), urban and peri-urban milk production systems in Ethiopia are located near or in the proximity of Addis Ababa and regional towns and take the advantages of the urban market. The average milk produced per day per cow from local and crossbred cows is 3.4 and 5.5 litres, respectively. The total amount of milk produced per day from crossbreeds and local cows is 121 and 367.2 litres, respectively. Out of the total milk produced per day (488.2 litres), 75 litres (15.4%) is sold, 79 litres (16.2%) is consumed at home and 334.2 litres (68.5%) is processed into butter. The producers deliver raw milk to Woreta and Debre Tabor towns. The average daily milk off-take from local and cross breed cows is two and seven litres, respectively. The average lactation length for local and crossbred cows is estimated at 8 and 10 months, respectively. In this system, milk producers face raw milk marketing problem due to the low demand and long fasting periods, and prefer to collect milk for further processing into butter and local cheese (*ayib*).

#### 4.4.3 Urban dairy production system

The urban dairy production system is undertaken in the *woreda's* capital, Woreta town and the level of milk production is mainly determined by the number of milking cows. There are 217 smallholder dairy producers in the town. These producers own a total of 249 milking cows out of which 78% are local breeds, while the remaining are crossbred cows. These smallholders keep 1–2 crossbred and 1–7 local milking cows per household.

Crossbreds are produced from bull service from Abaregay Yifag bull station and the Ethiopian Orthodox Church Child Care and Family Affairs (EOCCFA) dairy farm of the Woreta branch. The small dairy producers also buy pregnant and lactating crossbred cows from private dairy farmers in Debre Tabor town. Unlike the rural dairy producers, the urban producers feed their lactating cows with agro-industrial by-products such as noug cake, wheat bran, hay, by-products of local breweries and natural pasture. They also have access to AI and veterinary services.

The average daily milk yield/cow from local and crossbred cows is two and eight litres, respectively; being higher than the other two production systems. Getachew and Gashaw (2001) also indicated that urban and peri-urban dairy production systems in Ethiopia are more market-oriented and mainly based on the use of grade and crossbred animals that have the potential to produce 1120–2500 litres over 279-day lactation period. Milk utilization in Woreta town is different from the rural and peri-urban areas. In Woreta, about 828 litres of milk is produced daily; out of which 262 litres (31.6%) is sold, 199 litres (24%) is used for household consumption and 368 litres (44.4%) is processed into butter and local cheese. The share of marketable milk in Woreta is higher than the other two production systems.

## 4.5 Butter and local cheese production

Under normal storage conditions in the tropics, milk sours within 4–5 hours. The souring retards the growth of undesirable organisms and makes separation of fat easier. In Fogera, milk is fermented for 3 to 5 days either in a gourd (locally known as gourn) or a clay pot. It has a capacity of holding about 10 litres of fermented milk. The gourd or clay pot is smoked using dried branches and barks of *Terminalia browni* tree and this process is believed to add flavour to the product and kills micro-organisms. Butter is made from sour milk (ergo) which is thoroughly mixed by a wooden stick (locally called mesbekia) and is transferred into the churning gourd or clay pot at about 70% of its holding capacity. About 7–10 litres of milk (2.5 girera—small gourd) is used in a single churn. Before churning starts, the gourd or the clay pot is tied on to a tripod stand or fixed poles and then moved back and forth (Figure 2) until the break even point is reached which was checked either by the louder sound (a change in the pitch of sound) of the churn or opening the top cover of the gourd or clay pot. Formation of the butter grains is checked through a hole made at the neck of the gourd by inserting a stick and taking out a sample. About 600 gm of butter is produced from 10 litres of milk, i.e. about 16.5 litres of milk is required to produce a kilogram of butter. After removing the butter produced, the buttermilk is heated gently and slowly in a clay pot and is allowed to cool down and then separated into local cheese (ayib) and whey.



**Figure 2.** Traditional butter making (left); butter (right top) and local cheese, ayib (right bottom) produce in Fogera woreda.

Efficiency of butter making is markedly influenced by temperature and acidity of the sour milk. If it is too cold, butter formation is delayed and the grains become small and difficult to handle. If the temperature is too high, the yield of butter is reduced because a large proportion of the fat remains in the buttermilk, and the butter will be spongy and of poor quality. Sour milk should be churned between 10 and 12°C in the hot season and between 14 and 17°C in the cold season. The time taken to churn butter using gourd (gourna) ranges from 25 to 60 minutes and that of the clay pot ranges from 60 to 80 minutes. The amount of milk collected per churn ranges from 5–10 litres, and the amount of butter produced per churn ranges from 200–600 gm.

## 4.6 Housing and waste management

Out of 480 respondents, 307 (64%) provide houses or some form of shelter to their cattle. It is only oxen that are housed due to regular threat of theft. The rest of the cattle are tethered either on communal grazing land or in fences near the homestead. Lack of shelter to most of the animals exposes them to cold stress during the rainy season which directly affects productivity of the animals. Almost all the respondents (98.1%) use dung as a source of fuel and only 1.9% use it as manure on their cropland. Dried cow dung (manure cake) is also marketed in the *woreda*.

## 4.7 Feed resources and feeding

The main feed resources in the *woreda* are communal grazing, crop residues and crop aftermath. The feed resources used for dairy cattle are private and communal grazing

lands, crop aftermath, crop residues of cereal and pulse crops (teff, rice, maize, finger millet, barley, wheat, chickpea, field pea), grass hay and agro-industrial by-products. Out of 477 respondents, 94.5% produced their own feed either from own pasture, crop residues and crop aftermath, while the rest purchased feeds especially pastureland from other farmers either for free grazing and/or cut-and-carry feeding systems. Improved forage production is not a common practice in the *woreda*. The main reasons for limited use of improved forages as identified by the respondents are insufficient land, shortage of labour due to allocation of the family labour for other farming activities, lack of information and lack of inputs such as forage seeds.

Communal grazing land in Fogera covers about 9602.4 ha; out of which 3418.5 ha (35.6%) is infested by *Asracantha longifolia* (locally known as amykila) weed (Figure 3). This is an annual plant often found in swampy or poorly drained areas with black soils. It grows erect to a height ranging from 15 to 50 cm. It has hairy leaves and sharp spines that prevent cattle from grazing. This weed, however, is not a problem in privately owned pasturelands because farmers remove it by hand before the flowering stage between July and August.



**Figure 3.** Extensive pastureland infested with *Asracantha longifolia* (locally known as amykila) weed.

There is sever shortage of feed resources in the *woreda*, and this is due to multiple reasons. One of the reasons is transformation of grazing lands into crop farms. Over the last five years, large areas of communal grazing land have been transformed into crop farms. The second reason is inundation of large grazing lands with floods from Gumara and Rib rivers during the wet season. Very few farmers practice grazing and/

or cut-and-carry system of feeding from private paddocks. These paddocks usually are either in between the farmlands or in very marginal areas where there is poor sward growth and species composition. The third reason is weed infestation of large areas that are potentially productive. The fourth reason is trekking of cattle from the highlands of the Fogera and adjacent *woredas* of Dera into the Fogera plains during the dry season, especially from January to May. This has created competition for feed resource and has resulted in overgrazing. Such practice, however, has been decreasing over the years due to the high stocking rate and undesirable interbreeding of cattle.

As indicated in Table 6, the proportion of the private pastureland is smaller in areas such as Wagatera where natural communal pasture is more available. The average area of the cropland is highest in Addis Betechrstian *kebele* and a better area of private pastureland. The average number of cattle per household is also highest in this *kebele*. But, milk produced per household per day is not the highest due to lack of improved breeds and poor management. Farmers use different grazing systems on either private or communal pasturelands. Dairy producers who use zero grazing are located around peri-urban and urban areas. Those who use semi-grazing system, supplement cattle with crop residues during periods when these feed sources are more abundant.

**Table 6.** Proportion of private grazing land and crop land in the surveyed kebeles in Fogera

<i>Kebeles</i>	Average crop land per HH, ha	Average pastureland per HH, ha	Percentage of pastureland
Kuahir Michael	1.97	0.12	5.70
Shaga	1.54	0.12	7.20
Kuahir Abo	1.69	0.15	7.10
Shina	1.65	0.2	9.03
Kidist Hana	1.55	0.16	9.00
Addis Betechrstian	3.46	0.32	8.40
Wojiarbamba	2.12	0.16	7.01
Wagatera	1.32	0.05	2.70
Meneguzer	2.16	0.12	5.20
Woreta Zuria	2.34	0.30	11.3
Alember	0.9	0.12	11.7
Abuatihua	2.11	0.31	12.8
Average	1.90	0.18	8.70

Rice husk is produced as a by-product from rice polishers in Woreta town. On average, 32–36 kg of rice husk is produced from a quintal of rice. Hotel owners and local breweries use rice husk as fuel for cooking. Although some dairy producers feed their cows with rice husk *ad libitum*, most of the farmers revealed that they do not use it as cattle feed, rather they sale it to the rice polishers at a charge of ETB 0.10 cents/kg.

Traders from Gondar, Woldya, Dessie, Nekemt and Dangila areas buy rice husk from Fogera and use it for beef cattle fattening in their respective areas. At the time of peak rice production, rice polishers collect 3400–5420 kg of husk per day from farmers and the amount reduces to 2400–3400 kg per day during the slag period. The amount of rice husk produced by these polishers has been increasing over the years. The average DM, TDN, CP, CF content of rice husk is 91, 70, 13 and 12%, respectively (MoA 1996b).

## 4.8 Water resources

Farmers use different water resources for their cattle. Out of the total respondents, 48.8% use water from wells, 47.2% from rivers, 3% from Lake Tana, 2.3% from ponds and 0.2% from tap water. Cattle are watered once a day between noon and 2 pm. The distance to watering points ranges from 100 meter to 5 km. All age and sex group of cattle are watered together. In areas where wells are used, farmers take out the water and put in a wooden trunk or/and plastic containers. During the dry season, there is a scarcity of water in *kebeles* that use wells.

## 4.9 Cattle breeds and breeding

### 4.9.1 Breeds

In Ethiopia, 99.4% of the total cattle population is composed of indigenous breeds. In Fogera *woreda*, the major cattle breeds are Fogera, Simada, Worie and Agew (Zewdu 2004). The Simada, a well-known cattle breed, is preferred by the community because of its relatively smaller body size and lower market prices for buyers. It is also known to have shorter calving interval. However, 50.4% of the respondents revealed that Simada breed do not tolerate the heavy fly burden and the swampy grazing land of the area. As a result, it is crossed with Fogera breed to improve its adaptability to the plains. Although Alberro and Hailemariam (1982) classified all the cattle population around Lake Tana as Fogera breed type, a rapid field survey by Workneh and Rowlands (2004) revealed that true Fogera cattle are found only in villages of Dera and Fogera *woredas*, along the coastal flanks of Lake Tana. This was supported by Zewdu (2004) who reported that the Fogera cattle breed is concentrated between the Gumara and Rib rivers as well as along the main road from Bahir Dar to Gondar. According to key informants in the focus group discussions, pure Fogera cattle are currently found in relatively large numbers in Kidist Hana, Wagatera, Shina, Nabega, Shaga and Avona kotit rural *kebeles* in Fogera *woreda* and in Zera-gigna, Korata and Fisa, Mitseli rural *kebeles* in Dera *woreda*.

The Fogera cattle, reared round Lake Tana, in Amhara Region (Zewdu 2004) and the Horro cattle, reared in Eastern Welega of Oromia Region (Alemayehu 2002),

are considered as good milk producers in Ethiopia. The Fogera breed (Figure 4) is characterized by pied coat of black-and-white or black-and-grey with short, stumpy, pointed horns. The hump ranges from thoracic to cervico-thoracic hump and the dewlap is folded. Peculiar patchy and spotted coat colours of red and white and/or black and white are the distinguishing coat colours for the Fogera breed (Zewdu 2004). The size is moderate to large and has docile temperament. The breed is used for draught power, milk and meat production (Rege and Tawah 1999). The Fogera plains get heavily flooded during the rainy season from July to October; and until the early 1990s, farmers trekked their cattle to the well-drained highlands. During the dry season, cattle from other *kebeles* within the *woreda* and adjacent *woredas* are trekked to the Fogera plains in search of better grazing areas. This system has increased the grazing pressure on the marshy pasturelands. The movement of Fogera cattle to the upland drained areas has now ceased due to land scarcity. In both cases, there was a deliberate as well as unintended interbreeding between the Fogera and other cattle types.



**Figure 4.** Typical Fogera cattle grazing at the Andassa Livestock Research Centre.

Out of the 480 respondents, only 1.25% own Zebu × Holstein Friesian crossbreeds, and they are found only in the urban centres. The main sources of crossbred animals are government ranches in Metekel, Debre Tabor (Abaregay) and Addis Zemen (Yifag), and some private individuals. Even though the government ranches play a role in the provision of crossbred animals, their efficiency is so low that they have not been able to meet the demand. Although Fogera *woreda* is only 50 km from Bahir Dar town, where

there is good demand for milk and milk products, excess marketable fluid milk has not been produced due to various technical and socio-economic constraints.

## 4.9.2 Breeding methods

### Natural mating

Out of 480 respondents, 90.6% use natural mating and only 9.4% have access to artificial insemination. The sources of bulls for natural mating are own (45.9%), neighbour (48.2%) and EOCCFA (5.8%). Farmers who use natural mating keep their own superior Fogera bulls in their herds since the breed is believed to have better genetic potential for milk, meat and traction. Most of the farmers breed their cows by any bull available in the herd. Some farmers who have superior bulls do not volunteer to give their bulls to their neighbours for breeding service because of concern of transmittable diseases. The dairy farm owned by Woreta branch of the EOCCFA provides bull services to some farmers who live around Woreta town and charges ETB 5 for a single mating.

### Artificial insemination (AI)

The OoARD is the sole provider of AI service in the *woreda*, and only 9.4% of the respondents use this service. Over a 10 months period, 192 artificial insemination services were given out of which 76 cows (39.6%) conceived. Due to the low pregnancy rate to AI, farmers prefer to breed their cows naturally to crossbred bulls. There was no recorded data in the *woreda* OoARD on the number of calves born using AI. Although eight farmers were trained on AI by the OoARD, all of them shifted to other duties without giving any service. According to Desalegn et al. (2009), the average annual number of AI in Ethiopia from 1991 to 2008 was 20,649 and the number of insemination per technician per year averaged 312. The number of AI in and around Addis Ababa ranged from 8756 to 9138 per year between 2005/06 and 2007/08. This indicates that about 44% of the total AI activity takes place in and around Addis Ababa.

## 4.10 Productive performance of cattle

The average number of milking cows per household in Fogera is 1.6 (Table 7); the highest is in Wojjarbamba (2.15) and Addis Betechrstian (2.08) rural *kebeles*, while the lowest is in AleMBER and Abuatihua rural *kebeles*, with 1.18 milking cows each. The average daily milk production per household is 2.76 litres and ranged from 0 to 40 litres. The highest daily milk production per household (4.7 litres) was recorded in Woreta Zuria rural *kebele* and the lowest (1.1 litres) at Kuahir Michael rural *kebele*.

**Table 7.** Number of milking cows and milk production (litres) per day per household

<i>Kebeles</i>	Number of milking cows				Total milk produced			
	No. of HHs	Min	Max	Mean	No. of HHs	Min	Max	Mean
Kuahir Michael	40	1	4	1.70	40	0.25	4	1.10
Shaga	40	0	5	1.20	40	0	16	2.30
Kuahir Abo	40	0	4	1.70	40	2	8	3.60
Shina	40	0	4	1.70	40	0	8	2.10
Kidist Hana	40	0	3	1.50	40	0	3	1.50
Addis Betechrstian	40	0	5	2.08	40	0	10	2.90
Wojiarbamba	40	0	5	2.15	40	1	10	4.50
Wagatera	40	0	3	1.45	40	0	8	3.40
Meneguzer	40	0	3	1.45	40	1	3	1.60
Abuatihua	40	0	4	1.18	40	0	7	2.02
Woreta Zuria	40	0	7	1.83	40	0	40	4.70
Alember	40	0	4	1.18	40	0	10	3.40
Total	480	0	7	1.60	480	0	40	2.76

The reason for this is that dairy farmers in Woreta Zuria are more business-oriented and the demand for raw milk is relatively higher. These urban farmers use improved dairy breeds, use production inputs such as concentrate feeds and have access to AI and veterinary services. There are two farmers who deliver raw milk daily and earn a gross income ranging from ETB 425 to 500 per month.

Among the rural farmers, only 1.2% regularly deliver milk to cafeterias and individuals in Woreta town. This supply is also restricted to the morning milking. One farmer around Woreta town who has a crossbred cow produces 3000 litres over a 10 months period and earns about ETB 4500 from milk sale. In Kuahir Michael rural *kebele* feed is scarce due to weed invasion of a vast area of pastureland. On the other hand, in Kidist Hana, Wagatera and Meneguzer rural *kebeles*, the highest number of lactating cows per household did not exceed 3 and the highest milk production per household was 3, 8 and 3 litres, respectively. According to EARO (1999), the lactation milk yield of Boran, Horro, and Barca cattle is estimated at 494, 675 and 559 kg, respectively. The Arsi and Fogera breeds have higher lactation yield of 872 kg.

## 4.11 Milk use

As indicated in Table 8, there is variation in milk use pattern between households in the surveyed *kebeles*. The highest and lowest amount of milk produced per household per day is 40 and 0.25 litres, respectively. Out of the total respondents, 48.7% produced 0.25

to 2.5 litres, 30.6% produced 3 to 5 litres and the rest produced 6 to 40 litres of milk per day. Overall, 20% of the milk produced is used for home consumption, about 66.3% processed mainly into butter, and only 13.3% is marketed as fluid milk. There is variation between *kebeles* in the average amount of milk consumed per household. The highest milk consumption is recorded in Meneguzer rural *kebele* (31.3%) followed by Kuahir Abo (28.6%) *kebele*, while the lowest is in Abuatihua (10%) rural *kebele*.

**Table 8.** Mean ( $\pm$  S.E.) daily milk produce and use pattern per household in different *kebeles* of Fogera woreda

<i>Kebeles</i>	Milk produced Mean $\pm$ S.E.	Milk consumed Mean $\pm$ S.E.	Milk processed Mean $\pm$ S.E.	Milk sold Mean $\pm$ S.E.
Kuahir Michael	1.10 $\pm$ 0.10	0.29 $\pm$ 0.02 (26.4)	0.66 $\pm$ 0.11 (60.0)	0.15 $\pm$ 0.09 (13.6)
Shaga	2.30 $\pm$ 0.40	0.22 $\pm$ 0.06 (9.6)	1.60 $\pm$ 0.35 (69.6)	0.41 $\pm$ 0.15 (17.8)
Kuahir Abo	3.60 $\pm$ 0.30	1.03 $\pm$ 0.09 (28.6)	2.60 $\pm$ 0.19 (72.2)	0
Shina	2.10 $\pm$ 0.27	0.37 $\pm$ 0.03 (17.6)	1.75 $\pm$ 0.25 (83.3)	0
Kidist Hana	1.50 $\pm$ 0.12	0.26 $\pm$ 0.02 (17.3)	1.25 $\pm$ 0.11 (83.3)	0
Addis Betechrstian	2.90 $\pm$ 0.29	0.73 $\pm$ 0.09 (25.2)	2.23 $\pm$ 0.22 (76.9)	0
Wojiarbamba	4.50 $\pm$ 0.35	0.95 $\pm$ 0.12 (21.1)	3.43 $\pm$ 0.28 (76.2)	0.15 $\pm$ 0.11 (3.3)
Wagatera	3.40 $\pm$ 0.28	0.85 $\pm$ 0.08 (25.0)	2.60 $\pm$ 0.25 (76.5)	0
Meneguzer	1.60 $\pm$ 0.12	0.50 $\pm$ 0.03 (31.3)	1.02 $\pm$ 0.09 (63.8)	0.06 $\pm$ 0.03 (3.8)
Abuatihua	2.00 $\pm$ 0.26	0.20 $\pm$ 0.05(10.0)	1.46 $\pm$ 0.18 (73.0)	0.36 $\pm$ 0.20 (18.0)
Woreta Zuria	4.70 $\pm$ 1.26	0.49 $\pm$ 0.09 (10.4)	1.99 $\pm$ 0.30 (42.30)	2.23 $\pm$ 1.20 (47.5)
Alembor	3.40 $\pm$ 0.41	0.83 $\pm$ 0.10 (24.4)	1.53 $\pm$ 0.24 (45.0)	1.07 $\pm$ 0.30 (31.5)
Average	2.79 $\pm$ 0.13	0.56 $\pm$ 0.02 (20.0)	1.85 $\pm$ 0.07 (66.3)	0.37 $\pm$ 0.11 (13.3)

Numbers in brackets indicate percentages of produce.

Although a large proportion of the milk produced is processed mainly into butter, there are variations between *kebeles* in the percentage of milk processed. This is dependent on distance and access to markets. Respondents in Shina and Kidist Hana rural *kebeles* process the highest percentage (83.3%) of the milk produced into butter. About 72 to 77% of the milk produced in Kuahir Abo, Addis Betechrstian, Wojiarbamba, Wagatera, Abuatihua rural *kebeles* is processed, while 60 to 70% of the milk produced in Kuahir Michael, Shaga and Meneguzer rural *kebeles* is processed. The percentage of milk processed in Woreta Zuria (42.3%) and Alembor (45%) towns is lower than the other rural *kebeles* due to the relatively higher demand for fluid milk. In the rural *kebeles* that practice milk marketing, the percentage of milk marketed ranges from 3.3% to 18% of the total produce. It is also interesting to note that there was no fluid milk marketing at all from Kuahir Abo, Shina, Kidist Hana, Addis Betechrstian and Wagatera rural *kebeles* due to traditional taboo and the long distance to markets. These figures indicate that farmers in Fogera have limited access to fluid milk markets and the major milk product marketed is butter.

The average amount of milk consumed per head is 0.25 litres and ranges from 0.07 litres at Kuahir Michael to 0.60 litres at Wojiarbamba. These differences could be due to difference in the amount of milk produced in the household. Dairy products consumed in the household are fresh whole milk, fermented (sour) milk (locally called ‘ergo’), local cheese (ayib) and buttermilk (wogemit or arera). Adult men and women who are followers of the Ethiopian Orthodox Church do not consume dairy products during the fasting season and fasting days of the week (Wednesdays and Fridays). During the fasting season, milk is processed into butter and local cheese and is accumulated and matured until the end of the fasting period.

## 4.12 Access to information and training

Farmers in Fogera get information on dairy and/or beef production from different sources. As indicated in Table 9, out of 480 respondents, 41.7, 30 and 17% get information on improved dairy production from development agents of the OoARD, parents and regional radio, respectively. Respondents indicated that they do not have any form of training on dairy production. Two NGOs, i.e. the Ethiopian Orthodox Church for Children and Family Affairs of the Woreta branch and the Seventh Day Adventist Church provide information on dairy and beef cattle production. On the contrary, most farmers (94.2%) do not get any information about beef production and perhaps that is why involvement of farmers in improved beef production is very low. It is noted that the OoARD gives more emphasis to dairy than beef production (see Table 9).

**Table 9.** Sources of information on improved dairy and beef production in Fogera

Source	Dairy		Beef	
	Number of respondents	Percent	Number of respondents	Percent
Radio (regional)	84	17.5	2	0.4
OoARD	200	41.7	18	3.8
NGOs	1	0.2	1	0.2
Parents	144	30.0	6	1.3
Training	24	5.0	1	0.2
No information	27	5.6	451	94.2
Total	480	100	479	100

## 4.13 Milk and milk products marketing

### 4.13.1 Milk marketing

Milk marketing in Fogera is informal, and the participants are producers, caterers and consumers. The major producers who participate in fluid milk marketing are those who own crossbred cows. The dominant informal milk marketing is based on contractual

agreement between the producer and the client. Prices are negotiated and the milk is delivered on a daily basis. The producer is paid at the end of the month. Milk producers in Fogera often face market problem, particularly during the fasting season. In this *woreda*, about 94.5% of the population are followers of the Ethiopian Orthodox Church and abstain from consuming livestock products during the fasting season. During this period, producers are forced to sell their dairy products at very low prices. In addition, because of limited rural road networks and the absence of milk collection systems and processing facilities in the *woreda*, the flow of fluid milk from surplus producing rural *kebeles* to urban centres is difficult.

The amount of milk marketed from the rural *kebeles* is very low due to the traditional taboo that forbids sale of milk from local cows. There is no fluid milk marketed from Kuahir Abo, Shina, Kidist Hana, Addis Betechristian and Wagatera *kebeles*. The amount of milk delivered to the market per household is higher from Woreta Zuria and Aember *kebeles*. These farmers own crossbred cows and have a better market access for raw milk. The price of one litre of milk varies from ETB 1.25 to 1.50. The marketable amount of milk could be increased by organizing and strengthening dairy co-operatives to collect and deliver milk to consumers and by stimulating demand.

There are 14 caterers in Woreta and Aember towns who purchase milk, and 35.7% of which have regular suppliers. During the study period, a total of 247.5 litres of milk was supplied per day to these caterers in Woreta and Aember towns. The caterers occasionally reject milk of inferior quality when the producers bring adulterated milk in unhygienic containers. Farmers use small to medium sized gourds (locally known as girera) with capacity of 1 to 4 litres to deliver milk. There are 78 milk producers from rural *kebeles* who have shown interest to market fluid milk, but were hampered by the long distance to the nearest market. Producers use different criteria for selecting market outlets. Out of the 480 respondents, 387 (80.6%) use price, 31 (6.5%) distance, 17 (3.5%) reliability and 11 (2.3%) long term contract as criteria for selecting market outlets. The rest 7.1% do not sell milk or milk products at all.

#### 4.13.2 Butter marketing

Out of the total butter produced, about 25% is consumed and used for cosmetics at the household level and the remaining is marketed. Women accumulate the butter produced from 3–5 churnings before marketing. About 85% of the women also sell butter immediately to the market. In the rural markets of Fogera, the price of butter fluctuates depending on the season, and ranges from ETB 20/kg in the wet season to about ETB 28 in the dry season. Retail prices range from ETB 22 to 30 depending on quality and market

demand. Butter price is highest around Easter and other festivals and lowest during the fasting period by the followers of the Ethiopian Orthodox Church.

Out of the total respondents, 66.7% face problem of butter marketing and this becomes more severe during the long fasting season when most of the Christians (94.5% of the *woreda* population) abstain from consuming animal products (Table 10).

**Table 10.** *Proportion of respondents facing butter marketing problem*

<i>Kebeles</i>	Farmers who face marketing problem		
	No. of HHs	Yes	No
Kuahir Michael	40	1 (2.5)	39
Shaga	40	18 (45.0)	22
Kuahir Abo	40	0	40
Shina	40	39 (97.5)	1
Kidist Hana	40	40 (100)	0
Addis Betechrstian	40	35 (87.5)	5
Wojiarbamba	40	20 (50)	20
Wagatera	40	39 (97.5)	1
Meneguzer	40	40 (100)	0
Abuatihua	40	30 (75)	10
Woreta Zuria	40	21 (52.5)	19
Alember	40	37 (92.5)	3
Average	480	320 (66.7)	160

Numbers in brackets are percentages.

Participants in the butter marketing chain in Fogera *woreda* are producers, rural assemblers, wholesalers, retailers and consumers. Producers bring butter to the market places on specific market days by walking for up to four hours. The market places are Woreta, Alember, Wojiarbamba, Hodgebeya, Robit (Wotemb), Maksegnit, Yifag, Wudo and Hamusit. The producers sell their butter to rural assemblers, wholesalers, retailers and/or consumers. The number of rural assemblers is the highest in Alember (102) followed by Kinti (50). Alember is the main butter market in the area and assemblers from Alember, Woreta and Debre Tabor towns participate in this market. About 40 to 45 rural assemblers exist in Wotemb, Wojiarbamba and Maksegnit *kebeles*. The total amount of butter supplied to the rural markets is estimated from the amount of butter collected by each rural assembler. The peak production season for butter around Alember is from June to September. The estimated amount of butter supplied to markets in Fogera during the wet (June to September) and dry seasons (October to May) is 39,360 and 11,268 kg, respectively (Table 11).

**Table 11.** Amount of butter supplied to rural markets in the dry and wet seasons and distance to markets in Fogera woreda

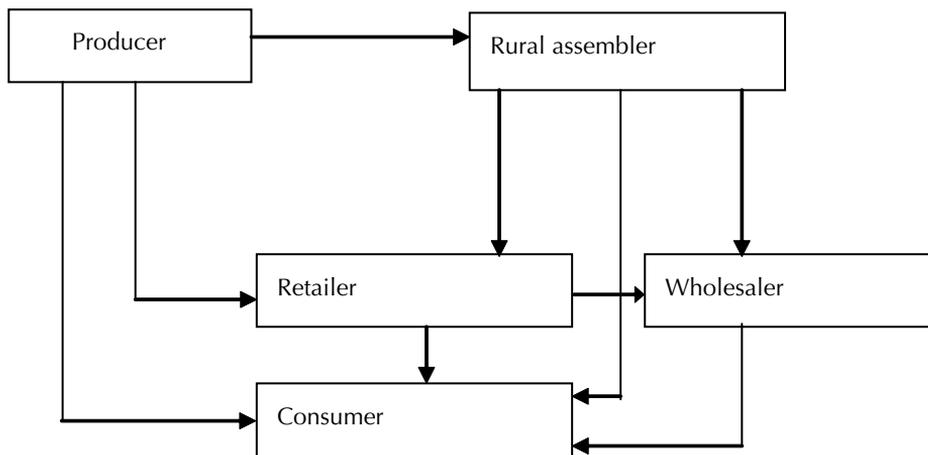
Name of market	Amount of butter supplied (kg)			From-to	Distance (km)
	Dry season	Wet season	Total		
Wotemb	1828	6400	8228	Alember–Wotemb	15
Wojiarbamba	2285	8000	10,285	Alember–Wojiarbamba	10
Kinti	1920	6720	8640	Alember–Kinti	16
Maksegnit	915	3200	4115	Woreta–Maksegnit	15
Hodgebeya	11,760	8400	20,160	Woreta–Hodgebeya	15
Nabega	7879	5628	13,507	Woreta to Nabega	20
Meneguzer	1105	885	1990	Woreta–Meneguzer	12
Alember	4320	15,040	19,360	Alember	0
Woreta	5686	12,222	17,908	Woreta	0
Total	37,698	66,495	104,193		

One of the retailers at Alember collects butter from the rural assemblers who collect butter at Alember, Wotemb, Wojiarbamba, Kinti and Maksegnit rural markets. This particular retailer has 40–50 regular clients from Zeng, Wotemb, Addis Betechristian and Sinko *kebeles* who deliver butter to his shop on every market day. During the survey period, 400–550 kg of butter is delivered per day at Alember, especially on Saturdays. Out of this amount, 300 kg (63%) is collected by rural assemblers who came from Debre Tabor, 200 kg (42%) from Woreta and the rest by the retailer in Alember. Some assemblers who came from Aringo and Debre Tabor towns face financial shortage to purchase on their own. During the wet season, one of the retailers at Alember market collects about 400–500 kg/month and delivers to Addis Ababa and additional 300 kg/month to Dessie, Gondar and Bahir Dar markets. Since the main highway from Bahir Dar to Djibouti passes through Alember town, the retailer also sells butter to heavy truck drivers.

#### 4.14 Characterization of market participants

The market channels for butter are presented in Figure 5. The characteristic of market participants is as follows.

*Producers:* Butter producers in the rural parts of Fogera travel 5–35 km on foot to Woreta market. During the dry season women travel on foot as far from the shores of Lake Tana to market their butter in Woreta town, while during the rainy season (July–October) only men take the responsibility of marketing butter due to the flooding problem from Rib and Gumara rivers which are found in the northern and southern tips of the *woreda*. During the rainy season, men swim across these rivers and then walk for about 1 to 8 hours before they reach the Woreta market.



**Figure 5.** Market channels for butter marketing in Fogera.

*Rural assemblers:* The rural assemblers come mainly from Debre Tabor and Woreta towns. These rural assemblers are composed of unemployed adults (86%) and students (14%). About 30% of the adults are female. On average, a rural assembler buys 7–10 kg of butter in one market day, and hands over to retailers and/or wholesalers found in the towns. On the basis of their capital, these rural assemblers are of three types:

- those who buy and collect butter using their own money. In this case, each rural assembler carries ETB 200–300 and buys 7–10 kg of butter from the market.
- those who borrow half of their capital from retailers. This group hands over the butter to the retailers who provided the advance money.
- those who use group credit for petty trading from microfinance institutions in Debre Tabor town.

Rural assemblers purchase butter in rural markets directly from producers and they sell the butter to retailers, consumers and wholesalers in Debre Tabor at a higher price. The rural assemblers buy butter for ETB 20/kg from the producers during the wet season and sell to retailers and wholesalers for ETB 22–24/kg. In the dry season, rural assemblers purchase butter from producers for ETB 22–24/kg and sell for ETB 26–27/kg. The wholesalers buy at ETB 22–24/kg from the producers or at ETB 25/kg from retailers and sell to consumers for ETB 28–30/kg. During the wet season, the buying and retailing prices of butter are ETB 20 and 22–24/kg, respectively. During the dry season the respective prices are ETB 23–24 and 28–30/kg. The butter assembled in and around Aember is marketed to Tigray, Addis Ababa, Gondar, Dessie, Bahir Dar towns, and to Djibouti.

Butter assembling at Woreta town is slightly different from that of Aember. During summer, the assemblers move out of Woreta town to buy the butter from the producers.

These assemblers collect butter along the main roadside and buy butter on market days from 8:00–11:00 am. They hand over the butter to retailers in town. During the dry season they buy butter from the rural markets such as Hodgebeya and Maksegnit. Accessible markets for Woreta town are Hodgebeya, Nabega, Meneguzer, Aember and Wojiarbamba. Even though there are no wholesalers in Woreta town, the butter delivered to the market is collected by the rural assemblers. There are four retailers in Woreta out of which one is female.

Butter produced from the Fogera plains in Nabega, Wagatera, Kidist Hana, Shaga, Shina and Kuahir Abo rural *kebeles* is locally known as Toka. Toka is unclean, not well washed, with the butter milk not well separated from the butter grains and has whitish colour. This type of butter is not preferred by consumers. The main reason why farmers do not wash it is to increase the weight of the product. Consumers prefer relatively matured butter, locally known as 'Key Kibe', produced in the highland areas.

## 4.15 Beef cattle production and marketing

### 4.15.1 Beef cattle production

In Fogera, farmers buy oxen during the dry season especially from January to March for traction purposes. After finishing land preparation, the oxen are fed either grass from privately owned pasture by cutting two to three times in a day or crop residues of chickpea, lentil, rice, beans, field pea and finger millet. There are two types of beef cattle production, traditional and intensive, and the respective duration of feeding is 5 and 3 months. About 96% of beef cattle producers prefer to sell their animals from May to September when price is higher.

Farmers traditionally fatten oxen after the completion of tillage by feeding grass for one to three months. These fattened animals fetch prices ranging from ETB 1100 to 1800 at local markets. Farmers revealed that the major constraints to cattle fattening are shortage of capital and feed. Most of the farmers prefer to buy 2 to 4 years old oxen and bulls due to their relative faster growth rates. Grass fattening is the type of fattening on natural pasture in and around churches. Farmers in the surveyed *kebeles* buy oxen from Woreta and Ambesame markets or they finish the cattle they own. The types of feeding systems are of two types. These are grazing freely on preserved private pasture up to finishing and cut-and-carry system using private pastureland. It is common to get farmers coming to Woreta early in the morning with their bundle of grass-legume mixture, locally called 'Milcha', for sell as green feed. It costs ETB 3–5 per bundle and is more abundant during the wet season. Around Gondar town, however, the type of fattening is intensive and beef producers feed their cattle on cotton seed cake and the haulms of peas and beans and

finish their cattle in a relatively shorter period of time. Cattle fattening is a time-bound activity and is adjusted to the needs of their regular buyers.

#### 4.15.2 Beef cattle marketing

Data were collected from three livestock markets to assess body weight, current price and body condition of beef animals in the *woreda*. Data were collected from 156 animals from March to May during six market days and body weight was estimated from heart girth measurements. The highest body weight recorded was 344 kg and the lowest was 191 kg. The types of beef cattle supplied are from both sex groups and their age was more than 4 years. Data were also collected for 23 days from the Woreta Municipality abattoir in order to grade the beef animals slaughtered. Out of 102 cattle, there was no Grade 1 beef cattle, only 18 (17.7%) were in Grade 2, and 71 cattle (69.6%) were in Grade 3 and the rest 13 cattle (12.7%) were very emaciated (Grade 4). The estimated dressing percentage is 54.5%.

Farmers in Fogera supply beef cattle to Woreta town and to rural markets in Hodgebeya, Wojjarbamba, Yifag and Aember on specific market days. Cattle supplied to markets include calves, heifers, bulls, oxen, dry and lactating cows. Farmers who often supply beef cattle are from Shina, Kidist Hana and Nabega *kebeles*. Beef cattle marketing varies considerably across the *woreda*. In some markets such as Aember, Hodgebeya and Woreta, cattle traders purchase cattle and trek them to Yifag, Gondar and Dembia. Cattle from Woreta and Yifag markets are transported on hoof over 120 km to Gondar town. The butcher houses in Woreta town also purchase from the local markets. Demand for beef cattle in Fogera, especially in the rural areas, increases around Christmas and Easter holidays.

The price of beef cattle in Fogera during the study period ranged from ETB 700–2000. During the dry season, prices range from ETB 700 to 3400 per animal, while during the rainy season prices fall to a range of ETB 600 to 2600 per animal (Table 12). About 86% of the beef cattle supplied to the markets are male, which are often marketed after fulfilling the traction requirements of farmers. Beef cattle at Woreta market do not fetch as good price as in Bahir Dar market, probably due to the low purchasing power of consumers in Fogera.

In Ethiopia, there are about 120 livestock market centres recognized by the Ministry of Agriculture and Rural Development. Most of these places do not have well-organized livestock marketing infrastructure to offer basic watering, feeding, resting and quarantine facilities. The situation is worse in pastoral areas, where only some have perimeter fencing to facilitate tax collection. In Ethiopia, livestock and their products marketing

system is generally underdeveloped. The low level of infrastructure and facilities is not conducive for efficient marketing. Transportation is often on hoof, which leads to considerable weight loss of animals as well as physical injuries and illness. Trucking is very limited and used only during holidays and festivals to move finished cattle and small stock to urban centres. Poor infrastructure development also hampers the flow of stock from pastoral areas to consumption sites.

**Table 12.** Prices (ETB) of beef cattle marketed in Fogera

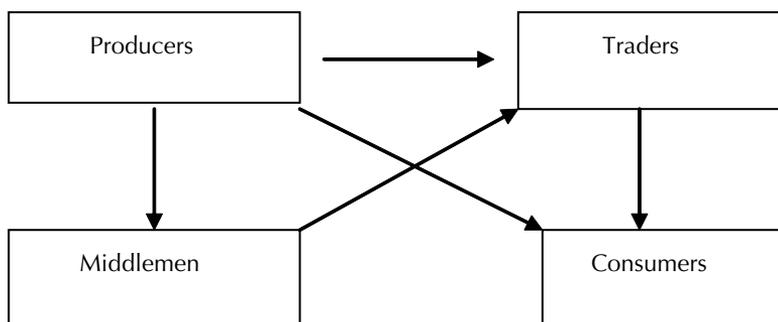
Price	Grade 1		Grade 2		Grade 3		Grade 4	
	Ox/bull	Cow	Ox/bull	Cow	Ox/bull	Cow	Ox/bull	Cow
Maximum	NA	NA	1800	1600	1200	900	700	600
Minimum	NA	NA	1600	1550	1100	840	600	480

NA – Not available; Grade 1 – Excellent; Grade 2 – Very Good; Grade 3 – Good; Grade 4—Emaciated.

Lack of market information reduces the efficiency of the marketing system. Producers do not optimize their returns to investment. They also do not respond to price changes resulting from supply and demand variations. Lack of market transparency also restricts the development of the livestock economy. Availability of market information will help producers, traders and exporters to plan production operations and marketing decisions. It would also make a valuable contribution towards improving government planning and policymaking for the livestock sector.

### 4.16 Participants in beef cattle marketing

Participants in beef cattle marketing in Fogera are producers, middlemen or brokers, traders and consumers (Figure 6). Middlemen and traders often come from Dembia and Gondar towns whereas the primary consumers are those from the *woreda* itself.



**Figure 6.** Market chain for beef cattle marketing in Fogera.

*Producers:* Basically the main beef producers in Fogera are rural farmers. Producers from adjacent Dera and Farta *woredas* also market their animals in Woreta town. There are two types of beef cattle producers. These are:

- a. Producers that supply Grade 2 beef cattle—Farmers in this group do have relatively longer fattening experience. The proportion of these producers accounts for only 15%. Producers plan to sell their beef animals from August to October, when the demand for beef animals is high and the supply of beef animals to the market is low. These producers feed their cattle on either free grazing or by cut-and-carry system particularly from July to October. During these months, a male beef animal in Grade 2 could fetch ETB 1600–1800 and females ETB 1300–1500 (Table 12).
- b. Producers that supply Grades 3 and 4—These producers are not concerned about getting good profit. They supply emaciated sterile female, bulls and draught oxen as beef animals. The proportion of these producers is 85%.

*Traders:* Cattle traders come to markets in Fogera from Bahir Dar, Dembia and Gondar. These traders come at any time and buy beef animals and trek them to Gondar market for profit making. At Fogera livestock market, beef cattle buyers are traders, butchers and farmers. Butchers are of two types on the basis of their capital. Some of them buy good beef cattle at higher prices whereas others buy emaciated animals at lower prices. Cattle of good body condition and younger age are preferred at the market. Almost all traders do not take coat colour as a criterion for selection of beef animals. Well-fattened beef animals are supplied to the markets from August to October.

*Butchers and hotel owners:* These service providers buy beef animals directly from the producers. These can be classified into two categories.

- a. Those who buy Grade 2 beef animals. These are economically better off and can afford to buy male beef animals for up to ETB 1800 and females for ETB 1500.
- b. Those who buy Grades 3 and 4 beef animals. These are very emaciated animals and have lower body weight.

*Consumers:* Consumers are rural farmers and urban dwellers who buy beef animals in groups especially during holidays.

## 4.17 Major constraints to cattle production in Fogera

### 4.17.1 Shortage of feed

The main feed resources for milk and meat production in Fogera are communal and private grazing lands. These feed resources are managed in a traditional way and all species of livestock graze together. During the rainy season, the pastureland in the Fogera plains are flooded with water coming from Gumara and Rib rivers, further limiting the

availability of feed. During the dry season, crop residues are the major feed resources. Conversion of grazing lands into crop farms is one of the main reasons for feed scarcity.

Cattle largely depend on grazing or crop residues that are of poor nutritive value. Cattle are allowed to graze aftermaths of rice, teff, finger millet and maize. In addition, the natural pastures of Wagatera, Kidist Hana, Shina, Shaga, Aduatihua and Nabega rural *kebeles* are heavily invaded with *Asracanta longifolia* (amykila) weed making it difficult for cattle to graze due to the strong spikes. Currently, 3456 ha of communal grazing land in the marshy areas are invaded with this weed. Moreover, the natural pastures are overgrazed by cattle trekked from Wonchit, Anbesame, Chantebabary, Wanzaye, Geregera and Zara Michael *kebeles* in the adjacent Dera *woreda*; and Gura, Avona Kotit, Sifatra and Rib Gebriel *kebeles* of the Fogera *woreda* itself. Out of 480 respondents, 203 (42.3%) do not own private pastureland.

Urban producers do not have enough grazing lands and costs of feeds are very high. During the study period, the price of a quintal of oil seed cake increased from ETB 50 to 70. There is a competition for grazing lands between rural farmers living at the periphery of Woreta and Alember towns and urban producers. Although large quantities of rice husk is produced by rice polishers most of it is not used as a feed resource due to lack of knowledge. Use of such resource requires expert advice and extension work. In addition, there is no improved fodder production in the rural as well as the urban areas of the district. Insufficient land and labour, lack of inputs such as forage seeds and lack of information are the reasons mentioned by the farmers for not growing improved forages.

Farmers revealed that due to the severe feed scarcity heifers do not show heat up to the age of four to five years. In the highlands of the *woreda*, shortage of feed and grazing land are the main limiting factors for the poor reproductive and productive performance of cattle. Many farmers are forced to sell their cattle during the dry season due to feed scarcity.

#### 4.17.2 Shortage of improved dairy animals

Local zebu animals are the predominant cattle breeds used for both milk and meat production in the *woreda*. There is no systematic selection and breeding in place. There is no controlled breeding and the Fogera breed has been interbred with other zebu cattle breeds/types. Many farmers breed their cows with any bull available in the herd. Artificial insemination service is available at the OoARD for crossbreeding purposes to improve milk production. However, the service is limited to urban and peri-urban areas only. The number of AI services given over a 10 months period (September 2004–June 2005) was only 192 and there is no record on pregnancy rates. Cows that failed to conceive after AI

are naturally mated to crossbred bulls owned by the Ethiopian Orthodox Church Children Care and Family Affairs of the Woreta branch for a charge of ETB 5 per service. Even though there are two bull stations established by the BoARD in Debre Tabor and Addis Zemen towns, most farmers do not have access to the breeding service. Availability and high price of crossbred dairy animals is one of the limiting factors for the expansion of dairying in the *woreda*. The price of a crossbred heifer ranges from ETB 3000 to 5000.

#### 4.17.3 Disease challenges and weak veterinary services

Secondary data collected from private and governmental veterinary clinics showed that a number of diseases affect cattle production in Fogera *woreda*. The most prevalent diseases noted during this study were trypanosomiasis and internal parasites (schistosomiasis, fasciolosis (*F. hepatica*) and lungworm). According to Mulualem (1998), the prevalence of fasciolosis is very high in Fogera (84.2%), Dera (83.0%) and Libikemkem (82.2%) districts that boarder Lake Tana. The peak infestation period for these diseases is from September to October. The main ectoparasite is tick, especially *Amblyoma* spp, which causes babesiosis. Mange mites are also important ectoparasites that affect cattle production. Regarding the occurrence of diseases, 87% of respondents agreed that the major diseases such as trypanosomiasis and fasciolosis occur during the dry season from September to May. Trypanosomiasis, which is prevalent in 50% of the surveyed *kebeles*, seriously affects milk and meat production.

Preventive methods employed by farmers vary depending on the type of the disease. In general, routine preventive measures were provided by both government and private veterinary clinics that provide vaccination and treatment services. Farmers complained about the high cost of trypanocidal drugs sold by private drug vendors. According to Alekaw (2004), trypanosomiasis in Fogera is caused by biting flies (*Tabanid* spp.) which becomes a heavy burden on cattle while they graze in the marshy areas. Farmers revealed that biting flies become more abundant from October to December and relapse during the dry season from April to May when animals lose body weight and are in poor body condition. According to the *woreda* veterinarians, infestation by these biting flies starts in mid-August and decreases at the end of October. To minimize the effects of the flies, 41.5% of the respondents keep their animals inside houses from 9:00–11:00 am and from 1:00 pm to 3:00 pm, and burn dried cow dung to smoke out the flies. This causes loss of grazing time and decreases animal productivity. During the night, another biting fly, locally known as 'guasha', makes cattle restless.

Veterinary service is given in Fogera by three government and one private clinics. There are also three private drug vendors. Vaccination service is provided only by the

government clinics. Even though the livestock population in the *woreda* is high, the veterinary service is not adequate. The drugs supplied by the OoARD are inadequate and about 75% of the farmers buy drugs from private drug vendors at higher prices. In Fogera, only two clinics have microscopes to conduct disease diagnosis. Although there are 11 animal health technicians who provide service in the *woreda*, the number is not adequate compared to the livestock population and size of the *woreda*. Farmers often have to trek their cattle 5–10 km to get to the nearest health clinic. Sometimes, farmers have to carry seriously sick animals to veterinary clinics (Figure 7).



**Figure 7.** Farmers carrying a sick animal to a veterinary clinic.

#### 4.17.4 Weak extension services

Cattle fattening is based on grazing on natural pasture and crop residues and as such intensive cattle fattening is not practised in Fogera. The best way to help farmers understand and accept new concepts is to demonstrate to them on small scale in their own environment. During the open-ended discussions, most of the farmers revealed that they still do not practice improved cattle fattening and dairy production due to lack of knowledge. Since feed scarcity is also the main problem in Fogera, stronger extension

services and trainings on forage production (especially backyard forage production) is vital. Extension activities should focus on feed resource management such as communal and private grazing land improvements (clearing unpalatable species and weeds, e.g. amykila), rotational grazing and fodder conservation system (haymaking), irrigation and over sowing of the improved forage species. Training of farmers on feeding regimes, hygienic milk production starting from hand milking to delivering the raw milk to the market and also marketing information through extension is vital for dairy development in the *woreda*.

#### 4.17.5 Shortage of working capital

Smallholder farmers need support of working capital if they are to be engaged in cattle fattening and dairy production. Farmers who are willing to involve in fattening and/or dairy production are not able to purchase animals due to lack of capital. Farmers found in the Fogera plain (Wagatera, Kidist Hana, Shina, Shaga and Nabega) who have better pasturelands do not get any credit service from any institution. Microfinance institutions need to review their lending programs to ensure farmers interested in livestock enterprises benefit from their services. Formation of farmers' cooperatives could also be one strategy to pool resources together to have a better voice in accessing credit and such an option need to be explored in the future.

### 4.18 Opportunities for improving cattle milk and meat production in Fogera

- *Large market opportunities*—Fogera district is one of the adjacent *woredas* to the regional capital, Bahir Dar city, which has a population of about 170,000. The *woreda* capital, Woreta, is only 55 km from the capital city. In addition, the tarmac road that passes to Gondar city, with a population of about 200,000, and the Sudan passes through Woreta town. The main road to Addis Ababa, via Debre Tabor and Dessie towns, also crosses the *woreda*. Two export abattoirs, one in Bahir Dar and the other one in Mekelle cities, are under construction and will be completed soon. All these offer a huge local and export market opportunities from beef and dairy production in Fogera *woreda*.
- *Huge production potential*—The total land area of the *woreda* is estimated at 117,414 ha, out of which 54,471.76 ha is crop land, 9602.36 ha grazing land. There is a huge cattle population estimated at 157,128 heads. The people of Fogera *woreda*, estimated at 236,553, have a long tradition of raising and managing cattle and use them for traction power, meat and milk production.
- *Conducive climatic condition*—Altitude in Fogera ranges from 1774 to 2410 masl and is predominantly classified as Woinadega ecology with an average

temperature of 19°C. The mean annual rainfall is 1216.3 mm and ranges from 1103 to 1336 mm.

- *Large feed and water resources*—There is large and extensive grazing area and large quantities of crop residues of cereal and pulse crops (maize, rice, finger millet, pulses etc.) and oil crops (noug, linseed, sunflower etc.) are produced. Various types of improved forages can also be grown in the *woreda*. The *woreda* receives plenty of rainfall (1320 mm per annum) and has plenty of water resources (Lake Tana, rivers, underground wells). The estimated water body is 23,354 ha, which could be effectively and efficiently utilized.

## 5 Summary and conclusions

The overall purpose of this study was to characterize cattle production and marketing system and to analyse the constraints and the opportunities for market-orientation of cattle milk and meat production system in Fogera *woreda*, Amhara Regional State. The study involved 12 *kebeles* which are found in the moist Woinadega agro-ecology. A total of 480 farmers (40 households per *kebele*) representing 48% of the total number of *kebeles* in the *woreda* were randomly selected and interviewed. Field survey was also conducted with open-ended discussion with the farmers, agricultural extension staff especially livestock experts and *kebele* development agents. To estimate the milk off take, milk harvested from milking cows was randomly measured for 15 days. Data were collected by interviewing farmers using a structured questionnaire, and personal observations were made on feeding and housing of dairy and beef animals, hand milking, milk processing, marketing of raw milk and butter, and beef animals. Observations were also made on the health services given by the governmental and private clinics. Data on milk production in the peri-urban and urban areas and beef production and marketing in the rural livestock markets were also collected using formats developed. Information was collected from 480 heads of households using a questionnaire and data collecting formats developed to collect information on milk and beef production and marketing. Data were collected on heart girth measurement of 102 cattle slaughtered in the Municipality slaughterhouse to estimate body weight and dressing percentage.

Even though Fogera *woreda* is dominantly characterized by mixed crop–livestock subsistence farming system, the extent of crop and livestock integration varied between rural and urban areas. The indigenous cattle breed, the Fogera, is found in this *woreda* and the number of pure Fogera cattle is dwindling. The breed is well known for its potential for dairy and beef production. Currently, pure Fogera cattle are found in Sindeye, Tigremender and Damote villages. In other *kebeles* where the breed was found, there were interbreeding with other indigenous breeds such as the Estie and Simada during communal grazing in the Fogera plains. Cattle were the dominant species in the district followed by goats and sheep. The average cattle holding per household ranges from 4.6 to 9.73 heads, while the number of milking cows ranges from 1.18 to 2.08. Cattle milk and meat production in the *woreda* is based on traditional practices of herding, feeding, watering, housing, milk processing, slaughtering, marketing and most of the activities are labour intensive.

This study revealed that although Fogera *woreda* produces large quantities of milk, the butter production and marketing system is the dominant one. It is estimated that overall 66.3% of the milk produced is processed into butter. Fluid milk production and

marketing is limited to Woreta and Aember towns and the total amount of fluid milk produced and marketed does not exceed 1000 litres per day. This volume does not fulfil the daily requirements of local consumers and passers-by as Woreta town is located on the main highway from Gondar to Addis Ababa. Most of the milk producers who own crossbred animals are restricted to urban and peri-urban areas. Milk from local cows is not marketed in the rural parts of the *woreda* for various (cultural and poor access to markets) reasons. In the rural parts of the *woreda*, the dominant system is the butter system. An estimated 104,193 kg of butter is marketed in the *woreda* per year. This translates to 1,719,185 litres of milk.

For beef cattle production in Fogera, farmers buy oxen during the dry season especially from January to March for traction purposes. After finishing land preparation, the oxen are fed either grass from the privately owned pasture by cutting two to three times in a day or crop residues of chickpea, lentil, rice, beans, field pea and finger millet. There are two types of beef cattle production, traditional and intensive, and the respective duration of feeding was 5 and 3 months. It was noted that 96% of the beef producers prefer to sell their animals from May to September when price is higher.

Beef cattle marketing in the *woreda* is restricted to Woreta and Aember towns. Farmers traditionally fatten cattle specially oxen after the completion of tillage by feeding grass for one to three months. Then they sell the beef animals at prices ranging from ETB 1100 to 1800 at local markets. The data were collected from 156 animals from March to May in 6 market days and body weight was estimated from heart girth measurements. The highest body weight recorded is 344 kg and the lowest 191 kg. The type of cattle supplied as beef animals were from both sex groups and their age is greater than four years. Data were also collected for 23 days from the Woreta Municipality abattoir in order to Grade the beef animals slaughtered. Out of 102 cattle, only 18 (17.7%) were in Grade 2; and 71 cattle (69.6%) were in Grade 3 and the rest 13 cattle (12.7%) were very emaciated (Grade 4). From the live weight and carcass measurements the estimated dressing percentage is 54.5%.

Though the district has a great potential for dairy and beef production, constraints such as feed scarcity, disease prevalence, shortage of improved breeds, weak extension education services, inadequate credit services and lack of proper marketing are the main ones. To alleviate the feed problems of the study area different feed utilization techniques of the available pastures could be practised (e.g. rotational grazing, cut-and-carry). Community based grazing land management and improvement strategies such as weed clearing, improving the pasture through over-sowing of forage species and training and frequent extension education of farmers on forage production and feeding systems should be

exercised in the area. Improving the nutritive value of crop residues and enhancing the fodder conservation and utilization is critical to beef and dairy production.

In addition, genetic improvement might also be a crucial issue to boost the milk production of the *woreda*. Strengthening artificial insemination services and community based genetic improvement program would have important role in upgrading the genotype of the indigenous breeds. Conservation of the Fogera breed should also be taken into consideration in order to maintain the genetic merits of the breed.

Strengthening veterinary drug supply and services through participation of both public and private services would also be an essential step to enhance disease control and improve animal productivity and production in the area. Strengthening of farmers' cooperatives in the participation of input supply such as drugs, artificial insemination and health service deliveries would play crucial role in improving milk and meat production. Facilitating credit services targeted to improve dairy and beef cattle production and marketing should also be considered.

Frequent extension services on improved milk and meat production to enhance the knowledge and skills of farmers and other actors in the value chain is essential and critical. Market linkage, market promotion and provision of up-to-date market information at different market sites would also be an important component to enhance dairy and beef production.

## References

- Ahmed MM, Bezabih Emanu, Jabbar MA, Tangka F and Ehui S. 2003. *Economic and nutritional impacts of market-oriented dairy production in the Ethiopian highlands*. Socio-economics and Policy Research Working Paper 51. ILRI (International Livestock Research Institute), Nairobi, Kenya. 27 pp.
- Alberro M and Haile Mariam S. 1982. The indigenous cattle of Ethiopia. I. *World Animal Review* 41.
- Alekaw Sinshaw. 2004. Epidemiology of animal trypanosomiasis in three highlands of Ethiopia bordering Lake Tana. MSc thesis. Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia.
- Alemayehu Mengistu. 2002. *Forage production in Ethiopia: A case study with implications for livestock production*. ESAP (Ethiopian Society of Animal Production), Addis Ababa, Ethiopia. 106 pp.
- Alemu G/Wold. 1998. Role of draft oxen power in Ethiopian agriculture. In: First national oxen traction research review and strategy workshop organized by Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia and ILRI (International Livestock Research Institute), Nairobi, Kenya, 3–5 December 1997. pp. 9–15.
- Azage Tegegne. 2004. Urban livestock production and gender in Addis Ababa, Ethiopia. *Urban Agriculture Magazine (The Netherlands)* 31–32.
- Azage Tegegne and Alemu G/Wold. 1998. Prospects for peri-urban dairy development in Ethiopia. In: Proceedings of 5<sup>th</sup> national conference of Ethiopian Society of Animal Production (ESAP), 15–17 May 1997, Addis Ababa, Ethiopia. p. 248.
- Bayer W and Waters-Bayer A. 1998. *Forage husbandry*. Wageningen University, the Netherlands. 207 pp.
- Befekadu Degfe and Birhanu Nega. 2000. *Annual report on the Ethiopian economy*. Volume 1. The Ethiopian Economics Association, Addis Ababa, Ethiopia. 429 pp.
- Belachew Hurrisa. 2003. Livestock marketing and pastoralism. In: *Proceedings of the 3<sup>rd</sup> national conference on pastoral development in Ethiopia: Pastoralism and sustainable development, held 23–24 December 2003, Addis Ababa, Ethiopia*.
- Belachew H, Mahmud A, Teferi HL and Lemma A. 1994. *Dairy products marketing survey in Addis Ababa and the surrounding regions*. Dairy Development Enterprise, Addis Ababa, Ethiopia.
- BOFED (Bureau of Finance and Economic Development of Amhara Region). 2003. Annual report. BOFED, Bahir Dar, Ethiopia. 56 pp.
- BOFED (Bureau of Finance and Economic Development of Amhara Region). 2004. Annual report. BOFED, Bahir Dar, Ethiopia.
- Coppock DL. 1994. *The Borana plateau of southern Ethiopia: Synthesis of pastoral research, development and change, 1980–91*. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 418 pp.
- Debrah S and Birhanu Anteneh. 1991. *Dairy marketing in Ethiopia: Markets of first sale and producers market patterns*. ILCA Research Report 19. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.
- Desalegn G/Medhin, Merga Bekana, Azage Tegegne and Kelay Blihu. 2009. Status of artificial insemination service in Ethiopia. A paper presented at the 17<sup>th</sup> annual conference of the Ethiopian Society of Animal Production (ESAP), 24–26 September 2009, held at the head quarters of the Ethiopian Institute of Agricultural Research (EIAR), Addis Ababa, Ethiopia. pp. 87–104.

- EARO (Ethiopian Agricultural Research Organization). 1999. Livestock research strategy. EARO, Addis Ababa, Ethiopia. (unpublished).
- Ehui S, Li Pun H, Mares V and Shapiro BI. 1998. The role of livestock in food security and environmental protection. *Outlook in Agriculture* 27(2):81–87.
- Ephraim Bekele and Tarik Kassaye. 1987. *Traditional Borana milk processing—Efficient use of subtle factors needs further research work*. ILCA Newsletter 6(4):4–5. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.
- Falvey L and Chantalakhana C. (eds). 1999. *Smallholder dairying in the tropics*. ILRI (International Livestock Research Institute), Nairobi, Kenya. 462 pp.
- FAO (Food and Agriculture Organization of the United Nations). 2003. *Production yearbook*. FAO, Rome, Italy. 233 pp.
- FAO (Food and Agriculture Organization of the United Nations). 2005. *Production yearbook*. FAO, Rome, Italy.
- FAO (Food and Agriculture Organization of the United Nations). 2009. *Production yearbook*. FAO, Rome, Italy. <http://faostat.fao.org/default.aspx>.
- FAOSTAT. 2007. <http://faostat.fao.org/default.aspx>.
- Fekadu Beyene. 1994. Present situation and future aspect of milk production, milk handling and processing of dairy products in southern Ethiopia. Farm made milk products in southern Ethiopia: 1. Chemical and microbial quality. PhD thesis. Department of Food Science, Agricultural University of Norway.
- Getachew Felleke and Gashaw Geda. 2001. The Ethiopian dairy development policy: A draft policy document. Ministry of Agriculture/AFRDRD/AFRDT. FAO (Food and Agriculture Organization of the United Nations)/SSFF, Addis Ababa, Ethiopia.
- Holloway G, Nicholson C, Delgado C, Staal S and Ehui S. 2000. *How to make a milk market: A case study from the Ethiopian highlands*. Socio-economics and Policy Research Working Paper 28. ILRI (International Livestock Research Institute), Nairobi, Kenya. 28 pp.
- IPMS (Improving Productivity and Market Success of Ethiopian Farmers). 2005. Fogera Pilot Learning *woreda* diagnosis and programme design report. IPMS, Addis Ababa, Ethiopia.
- Kedija Hussen, Azage Tegegne, Mohammed Yousuf Kurtu and Berhanu Gebremedhin. 2008. *Traditional cow and camel milk production and marketing in agro-pastoral and crop–livestock mixed systems: The case of Mieso District, Oromia Region, Ethiopia*. IPMS Working Paper No. 13. ILRI (International Livestock Research Institute), Nairobi, Kenya. 56 pp.
- Ketema H and Tsehay R. 2004. *Dairy production systems in Ethiopia*. Ministry of Agriculture, Addis Ababa, Ethiopia.
- LMA (Livestock Marketing Authority). 2004. *Meat exports market study*. MoARD (Ministry of Agriculture and Rural Development), Addis Ababa, Ethiopia.
- Mbabane. 1997. *Livestock development policies in eastern and southern Africa. Proceedings of a seminar organized by CTA/IBAR and the Ministry of Agriculture and Co-operatives held 28 July–August 1997, Mbabane, Swaziland*.
- MOA (Ministry of Agriculture). 1996a. *Fattening extension manual*. MOA, Animal and Fishery Resource Main Department, FLDP (Fourth Livestock Development Project), Addis Ababa, Ethiopia. 83 pp.
- MOA (Ministry of Agriculture). 1996b. *Dairy extension manual*. MOA, Animal and Fishery Resource Main Department, Addis Ababa, Ethiopia. 97 pp.
- MOA (Ministry of Agriculture). 1998. *The role of village dairying co-operative in dairy development: Prospects for improving dairy in Ethiopia*. MOA, Addis Ababa, Ethiopia.

- NEPAD–CAADP (New Partnership for Africa’s Development–Comprehensive Africa Agriculture Development Programme). 2005. Ethiopia: Investment project profile ‘Live Animal and Meat Export’—Preliminary options outline. 3 pp.
- Rege JEO and Tawah LC. 1999. *The state of Africa cattle genetic resource II. Geographical distribution, characteristics and uses of present day breeds and strains*. Animal Genetic Resource Information. ILRI (International Livestock Research Institute), Nairobi, Kenya.
- Sansoucy R, Jabbar M, Ehui S and Fitzhugh H. 1995. The contribution of livestock to food security and sustainable development. In: Wilson R, Ehui S and Mack S (eds), *Livestock development strategies for low-income countries. Proceedings of the joint FAO/ILRI roundtable on livestock development strategies for low-income countries, 27 February–2 March 1995*. ILRI (International Livestock Research Institute), Addis Ababa, Ethiopia.
- SPSS. 1999. Base 10.0 User’s Guide, SPSS Inc., Chicago, Illinois, USA.
- Staal SJ and Shapiro BI. 1998. *Smallholder dairying under transaction costs in east Africa*. ILRI–LPA, Brief No. 6. ILRI (International Livestock Research Institute), Nairobi, Kenya.
- Staal SJ, Pratt AN and Jabbar M. 2008. *Dairy development for the resource poor. Part II: Kenya and Ethiopian dairy development case studies*. PPLPI (Pro-poor Livestock Policy Initiative) Working Paper No. 44–2. ILRI (International Livestock Research Institute), Nairobi, Kenya.
- Tangka DK, Emerson RD and Jabbar MA. 2002. *Food security effects of intensified dairying: Evidence from the Ethiopian highlands*. Socio-economics and Policy Research Working Paper 44. ILRI (International Livestock Research Institute), Nairobi, Kenya. 68 pp.
- Tsehay Redda. 2001. Small-scale milk marketing and processing in Ethiopia. In: Rangnekar D and Thorpe W (eds), *Smallholder dairy production and marketing—Opportunities and constraints. Proceedings of a South–South workshop held at NDDDB, Anand, India, 13–16 March 2001*. NDDDB (National Dairy Development Board), Anand, India, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 538 pp.
- Walshe MJ, Grindle J, Nell A and Bachmanu M. 1991. *Dairy development in sub-Saharan Africa*. Washington, DC, USA. 94 pp.
- Winrock. 1992. *Assessment of animal agriculture in sub-Saharan Africa*. Winrock International Institute for Agricultural Development, Morrilton, Arkansas, USA. 125 pp.
- Workneh Ayalew. 2006. Getting the incentive right: Concerns associated with expansion of cattle export markets in Ethiopia. *Ethiopian Journal of Animal Production* 6(2):99–103.
- Workneh Ayalew and Rowlands J. 2004. *Design, execution and analysis of the livestock breed survey in Oromiya regional State, Ethiopia*. OADB (Oromiya Agricultural Development Bureau), Addis Ababa, Ethiopia, ILRI (International Livestock Research Institute), Nairobi, Kenya. 260 pp.
- Zelalem Yilma and Inger. 2000. Milk production, processing, marketing and the role of milk and milk products on the smallholder farm’s income in the central highlands of Ethiopia: Pastoralism and agro-pastoralism, which way forward? In: *The proceedings of the 8<sup>th</sup> annual conference of Ethiopian Society of Animal Production (ESAP), 24–26 August 2000, Addis Ababa, Ethiopia*.
- Zewdu Wuletaw. 2004. *Indigenous cattle genetic resource, their husbandry practices and breeding objectives in northwestern Ethiopia*. MSc thesis. Alemaya University, Ethiopia.

**ILRI**

INTERNATIONAL  
LIVESTOCK RESEARCH  
INSTITUTE

[www.ilri.org](http://www.ilri.org)

International Livestock Research Institute



Canadian International  
Development Agency

Agence canadienne de  
développement international



በኢትዮጵያ ፌዴራል ዲሞክራሲያዊ ሪፐብሊክ  
የግብርናና ገጠር ልማት ሚኒስቴር

Federal Democratic Republic of Ethiopia  
MINISTRY OF AGRICULTURE AND  
RURAL DEVELOPMENT