

Smallholder Dairy Production System and Emergence of Dairy Cooperatives in Bahir Dar Zuria and Mecha Woredas, Northwestern Ethiopia

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Abstract: The study was conducted in Bahir Dar Zuria and Mecha woredas of the Amhara Regional State and aimed at assessing the dairy production system and constraints associated to milk production and the emerging dairy cooperatives in the districts. A single-visit-multiple-subject formal survey technique was used to collect data from 150 households (75 from each district). Mixed crop-livestock production system was found to be the dominant farming system in the study area. The major cattle breeds kept by farmers in the study area were local Zebu cattle and crossbred (Zebu x Holstein-Friesian) animals. The major feed resources were natural pasture (grazing), hay, crop residues and by-products of the local beverages Tella (Atella) and Arekie (Brinti). The major constraints to milk production in the study area were feed shortage, disease prevalence and low milk yield of local cows. In recent years, dairy cooperatives started to emerge in the area especially in the Bahir Dar district. Lack of market, low product price and less demand for dairy products especially during fasting times are the major constraints encountered by the dairy cooperatives. Thus, strong extension work is needed to educate farmers in the region and create awareness about the importance of developing the dairy sector.

Key words: Constraints • Dairy cooperatives • Marketing • Milk production

INTRODUCTION

Ethiopia possesses about 38.75 million heads of cattle [1]. Despite the large cattle population and the prevailing favorable climatic conditions and resources for livestock production, current milk production is low which is reflected in the low per capita milk production and increasing trend in import of milk and milk products [2].

Like most developing countries, Ethiopia's increasing human population, urbanization trends and rising household incomes are leading to a substantial increase in the demand for livestock products, particularly milk and meat. In order to meet the growing demand for milk in Ethiopia, milk production has to grow at least at a rate of 4 percent per annum [3]. Bridging this wide gap calls for the design of appropriate and sustainable dairy development strategies based on socio-economic, institutional and agro-ecological circumstances that build on the demand of consumers and the needs and opportunities of producers [4].

The mainstay of the population in the Amhara region is rain-fed subsistence agriculture and about 73 percent of smallholders practice mixed crop-livestock farming, 19 percent practice crop cultivation, while the remaining

8 percent undertake livestock rearing [5]. Like other parts of the region, milk production is an integral part of the farming system in West Gojam Zone. Local milk production is mainly from indigenous Zebu cattle which are kept by about half a million smallholder farming households [1] most of whom are poor.

Even if the area has potential for production of milk and milk products, little is known about the existing dairy production system, constraints and opportunities associated with dairying in the area. In order to design relevant development strategies that suit to the area, it is essential that researchers and dairy development agents understand the existing situations. Identification of prevailing problems and understanding of the existing dairy production system in the area is vital to devise appropriate development interventions. Furthermore, assessment of the emerging dairy cooperatives especially their contribution as option for market entry point for smallholder dairy producers may help develop the dairy sector in the area. The objective of this study was, therefore, to assess the dairy production system and constraints associated with milk production and the emerging dairy cooperatives in Bahir Dar Zuria and Mecha woredas.

MATERIALS AND METHODS

Description of the Study Area: The study was conducted in Bahir Dar Zuria and Mecha woredas (woreda is an administrative district that consists of many peasant associations depending on its size) of the West Gojam Zone in Amhara Regional State from July 2006 to April 2007. The areas are characterized by uni-modal rainfall pattern, with rainfall distributed over the growing season (mid-May to mid-October). These two woredas are selected purposively based on their potential for production of milk and milk products.

Bahir Dar Zuria: The area is located at a distance of 564 km north-west of the capital Addis Ababa. It is situated at an altitude ranging from 1700-2300 meters above sea level and has area coverage of 151,119 ha [6]. The area receives an average annual rainfall ranging from about 820 to 1250 mm. The minimum and maximum daily temperatures of the area are 10 and 32°C, respectively [6]. The major crops grown in the area were wheat, barley, millet, teff and maize [6].

Mecha: Mecha woreda is located at 524 km north-west of Addis Ababa. It is situated at an altitude ranging from 1800-2500 meters above sea level and has area coverage of 159,898 ha. The area receives an average annual rainfall that ranges from about 820 to 1250 mm [7]. The minimum and maximum daily temperatures of the area are 17 and 30°C, respectively. The major crops grown in the area were wheat, barley, millet, teff and maize [7].

Sampling Procedure: Both secondary and primary data sources were used for the study. Primary data sources included the household heads and dairy cooperatives in the respective woredas. The secondary data were taken from the respective woreda agricultural offices, zonal office of agriculture and NGOs operating in the respective woredas and from documents that have been written about the study area.

The target sampling population was defined as all households in the study area who owned both local (Zebu cattle) and crossbred (Zebu x Holstein-Friesian) cows, produce milk and process dairy products. A total of 10 peasant associations (PAs), five (15% of the total) from each woreda were randomly selected. From the list of registered members of each PA, households who owned indigenous and crossbred lactating cows and produce milk were purposively selected and of these only 15

households from each PA were randomly selected and interviewed. Accordingly, a total of 150 households (75 from Bahir Dar Zuria and 75 from Mecha) were individually interviewed using a semi-structured questionnaire. Each informant was asked both closed and open-ended questions.

Data Collection: A single-visit-multiple-subject formal survey [8] was conducted to collect data on milk production system, cattle type and number, age and sex of animals, cattle feeding and management, reproduction, constraints associated with milk production, types of dairy products manufactured and methods of handling, processing and marketing of milk and milk products.

To assess the contributions of dairy cooperatives as option for market entry point to smallholder producers, a separate semi-structured questionnaire was developed and information about date of establishment, number of members, capacity of buying, processing and marketing of milk and milk products, number of milk collection sites and associated constraints were collected.

Statistical Analysis: Descriptive statistics such as means, frequency distributions and percentages were used to analyze the data using SPSS software version 12.0. Preliminary analysis of data collected showed no significant differences between the two locations for the variables considered. Thus, the statistical analysis was based on the combined values of each variable from the two woredas.

RESULTS AND DISCUSSION

Demographic Characteristics: The household size, age group and educational status per household in the study area are shown in Table 1. The average family size per household was 7.7 (8.2 in Bahir Dar Zuria and 7.2 in Mecha woreda). The proportion of children (1- 14 years of age) per household was 34.4% while that of older people (> 55 years of age) was 25.4%. The active working force (15-55 years of age) in the study area constituted 40.2%. The higher proportion of the working age group is important to undertake agricultural activities. The educational status of the household members was diverse; the majority of the household members were illiterate (i.e., do not read and write). This will have a negative effect on the development of the dairy sector in the area and thus farmers need to be given training on modern dairy farming practices.

Table 1: Average household size, age category and educational status per household in the study area (n = 150)

Variables	Mean ± SD
Household size	7.71
1-14 years of age	2.65 ± 1.07
15-55 years of age	3.1 ± 1.55
> 55 years of age	1.96 ± 1.08
Educational status of households	
Illiterate	2.41 ± 1.35
Reading and writing	1.28 ± 1.60
1-4 grade	1.33 ± 0.80
5-8 grade	1.27 ± 0.99
9-12 grade	1.42 ± 0.94

n = Number of respondents; SD = Standard deviation.

Land Holding and Land Use Pattern: The average land holding per household in the study area was 2.7 ha. Greater proportion (1.65 ha) of land owned per household was allocated for crop production. In addition, households also allocate portion (0.51 ha) of their land for pasture production and this is inline with the report of Yitaye *et al.* [9]. Given the limited communal grazing land in the study area, allocation of land for pasture production is a practice that needs to be encouraged and it is an opportunity to develop small-scale dairy production in the area.

Livestock Holding: The herd structure and composition per household in the study area are indicated in Table 2. The average livestock holding per household in the study area was 9.85 TLU (Tropical Livestock Unit). The major livestock species kept by farmers in the study area was cattle and the predominant breeds include indigenous Zebu cattle and crossbred (Zebu x Holstein-Friesian) animals. In addition, farmers also own sheep, goats, donkeys and mules.

Husbandry Practices

Purpose of Keeping Cattle: The major farming activity in the study area was crop production followed by cattle rearing. Cattle are the most important component of the mixed-farming system in the study area since they provide draught power, milk, meat and income to the farmers. These functions were reported by Mukasa-Mugerwa [10] in the central highlands of Ethiopia and Yitaye *et al.* [11] in southern Ethiopia.

The major purpose of keeping cattle in the study area was to provide draught power followed by milk production. Cows provide the only source of milk whereas milk from small ruminants is not consumed in the area because of cultural taboo.

Table 2: Herd structure and composition per household in the study area

Types of livestock	Local breed		Crossbreds		Overall Mean
	n	Mean ± SD	n	Mean ± SD	
Cattle		7.43		1.33	8.85
Pregnant	42	1.02 ± 0.43	17	0.31 ± 0.15	1.33
Lactating	65	1.1 ± 0.48	20	0.39 ± 0.12	1.48
Dry cows	16	0.91 ± 0.40	6	0.22 ± 0.12	1.13
Heifers	54	0.71 ± 0.29	11	0.22 ± 0.11	0.93
Bulls	47	1.01 ± 0.49	4	0.05 ± 0.12	1.06
Oxen	73	2.23 ± 0.77	3	0.02 ± 0.16	2.24
Female calves	48	0.22 ± 0.10	12	0.07 ± 0.11	0.29
Male calves	54	0.25 ± 0.11	12	0.07 ± 0.06	0.31
Sheep	34	0.28 ± 0.17			0.28
Goats	10	0.23 ± 0.13			0.23
Donkeys	56	0.36 ± 0.13			0.36
Mules	20	0.24 ± 0.06			0.24
Total		8.52		1.33	9.85

n = number of respondents; SD = Standard deviation; The values in the Table are equivalents of Tropical Livestock Unit (TLU) of each class and/or species of animals.

Table 3: Division of labour among family members in the study area (n = 150).

Activity	Responsible family members (% of total respondents)			
	Men	Women	Children	Hired labor
Herding	25.47	10.20	31.99	32.35
Milking	50.40	23.67	12.5	13.44
Milk processing	na	71.98	28.02	na
Barn cleaning	4.83	43.95	24.49	26.76
Sale of dairy products	14.34	73.5	12.16	na
Sale of animals	89.49	7.39	3.11	na
Stall-feeding	34.63	9.44	32.45	23.49

na = not applicable; n = number of respondents

Source and Division of Labor: Table 3 shows the division of labor among family members with respect to cattle husbandry in the study area. Family members were the major source of labor to farm households. Milking is done mainly by men and it is contrary to the practice in other parts of the country [12-14] where female members of the household undertake milking. Moreover, sale of live animals and stall feeding of animals are undertaken mostly by men. On the other hand, milk processing, sale of dairy products and barn cleaning are performed by female members of the household. Herding of cattle is the responsibility of children or hired labor.

Feeding Management: The major sources of feed for cattle in the study area were natural pasture, hay, crop residues and non-conventional feedstuffs (local brewery by-products) (Table 4). Generally, crop residues from cereals such as finger millet, teff, grass pea and maize form the basal diets of the animals. This result is inline with the findings of Seyoum *et al.* [15] who reported that the major basal feed resources for cattle in the highlands of Ethiopia are natural pasture, crop residues and stubble grazing.

In the study area, communal grazing lands provide the major feed to cattle followed by crop residues and hay. Moreover, farmers keep portion of their land for pasture production and grazing. Similar practice is followed by farmers in North Gonder Zone where farmers allocate part of their land for pasture production [16].

The use of improved forages such as Napier grass and *Sesbania* is not common in the study area and concentrate feeding is generally low. However, those respondents who owned crossbred cows feed concentrate feeds like noug (*Gizotia abyssinica*) seed cake and wheat bran to their animals. On the contrary, no concentrate was given to local cattle in the study area.

Other important feed resources in the surveyed areas were local brewery by-products namely *Atella* and *Brinti*, by-products of the traditional beverages *Tella* and *Arekie*, respectively both in wet and dry seasons of the year (Table 4). According to the respondents, *Brinti* is frequently used supplement as compared to *Atella* and farmers use them as substitute to conventional concentrate feeds. In view of the high costs of concentrate feeds, use of these non-conventional feedstuffs might be a viable alternative; however, effects of these feedstuffs on milk yield and composition need to be investigated before recommending them for dairy cows.

Table 4: Reported feed resources in the study area (n = 150)

Feed resources	Percent of total respondents
Communal grazing	23.52
Crop residues	18.29
<i>Atella</i> and <i>Brinti</i> ^a	15.62
Hay	14.48
Private grazing land	12.72
Improved forage	9.30
Concentrates	6.09

n = number of respondents; ^a*Atella* and *Brinti* are by-products of traditional beverages *Tella* and *Arekie*, respectively.

Table 5: Pre-weaning feeding and weaning practices in the study area

Descriptions	Percent of total respondents
Pre-weaning feeding (n = 150)	
Bucket feeding (crossbred calves only)	10
Suckling	
Local calves	80.7
Crossbred calves	9.4
Weaning age (months) ^a	
Local calves (n = 150)	11.8
Crossbred calves (n = 34)	8.1

n = number of respondents; ^aValues for weaning age are mean values of weaning age (months) reported by respondents.

Feed shortage occurs both in the dry and in the wet season; however, the shortage was severe during the dry season. Out of the total respondents, 95.4% encountered seasonal feed shortage. To overcome the seasonal shortage of feed, the communities have developed their own coping mechanisms such as feed conservation in the form of hay and storing stack of crop residues.

Calf Rearing: After parturition, cows are not milked for about two weeks during which calves are kept with and allowed to suckle their dams freely. Milking commences after two weeks of calving and the calves are allowed to suckle their dams for short time before and after milking. In the traditional dairy production system, calf suckling is recommended because it results in higher milk yield and long lactation length of the dam, higher pre-weaning gain of the calf and higher weaning weight [17, 18].

The majority of the respondents practiced partial pre-weaning feeding of calves (Table 5). Bucket feeding of milk is practiced before weaning mainly by farmers who owned crossbred cows. The overall average weaning age of local calves was 11.8 months, that is, the calves suckle their dams up to the end of the lactation period while for crossbred calves the average weaning age was 8.1 months (Table 5).

Milk Production and Reproductive Performances of Cows:

First calving marks the beginning of a cow's productive life and influences both the productive and reproductive life of the female, directly through its effect on her lifetime calf crop and milk production and indirectly through its influence on the cost invested for up-bringing [10]. The respondents in the study area confirmed that the average age at first calving (AFC) for the indigenous cows was 4.8 years. This figure is greater than the mean value of 3.6 years reported for tropical cows found in a number of traditional systems [10]. A report by Addisu [19] indicated that the AFC of Fogera breed was 47.6 ± 0.77 months at Metekel Ranch. The corresponding values reported for crossbred cows in the study area was 3.1 years which is shorter than that reported by Addisu [19] for 50% Fogera-Friesian crosses which was 3.37 years. Farmers in the present study capitalized that AFC is highly influenced by the nutritional status of the cows. Thus, improvement of the quality and quantity of feed offered and the overall management of cows would result in shorter AFC of dairy cows in the study area.

The daily milk yield and lactation length of local and crossbred cows in the study area are shown in Table 6. Milk yield of local cows per day in the study area was on the average 2.0, 1.2 and 0.6 liters for the first, second and third lactations, respectively with an overall average of 1.2 liters per day. The average daily milk yield of crossbred cows was 7.3, 5.5 and 3.5 liters for the first, second and third lactations, respectively with an overall average of 5.2 liters per day. The reported average daily milk yield of local cows in the present study is lower than the value reported by ILDP [20] which was 4 liters and that reported by CSA [1] which was 1.23 liters elsewhere in the country. In addition to improved nutrition and management, selection for milk yield traits within the indigenous breeds may be devised as a long-term objective in order to increase milk yield from indigenous cattle. However, in order to meet the immediate demand for milk, crossbreeding indigenous cattle with exotic cattle breeds can be planned and implemented in the study area.

The overall average lactation length of local and crossbred cows was 9.8 and 10.1 months, respectively in the study area (Table 6). The lactation length of the indigenous cows observed in this study is longer than the national average of 7 months [1]. The lactation length of crossbred cows observed in this study is slightly shorter than the lactation length of 11.7 months reported for crossbred cows in the central highlands of Ethiopia [21]. In general, the lower average daily milk yield per cow and the variation in lactation length observed in the present

Table 6: Reported daily milk yield and lactation length of cows in the study area

Variables	n	Mean \pm SD
Milk yield of local cows (liters/day)		
1 st lactation	75	2.0 \pm 1.33
2 nd lactation	75	1.2 \pm 0.44
3 rd lactation	75	0.6 \pm 0.30
Milk yield of crossbred cows (liters/day)		
1 st lactation	34	7.3 \pm 2.12
2 nd lactation	34	5.5 \pm 1.93
3 rd lactation	34	3.5 \pm 1.35
Lactation length (months)		
Local cows	75	9.8 \pm 2.26
Crossbred cows	34	10.1 \pm 1.73

n = number of respondents; SD = Standard deviation.

Table 7: Milking frequency and milking procedure in the study area (n = 150)

Variables	Percent of total respondents
Milking frequency	
Morning and evening	86.7
Evening only	13.3
Milking procedure	
Washing hands and vessels	100
Udder washing before milking	18
Do not wash udder	82
Use of towel	
Use of individual towel	2
Use of common towel	8.9
Don't use towels	89.2
Milking cows upon death of calves	95.4

n = number of respondents

study may be attributed to feed shortage and poor genetic potential of the sample population and disease prevalence in the area. Among others, mastitis was one of the prevalent diseases reported in the area and hence could contribute to the low milk production observed. Thus, in order to improve milk production performance of cows in the study area appropriate intervention measures aimed at alleviating the above mentioned problems should be devised by all concerned bodies.

Milking Procedure and Frequency of Milking: In the study area cows are hand milked and calves are allowed to suckle their dams prior to as well as after milking. The respondents noted that they also milk their cows in the absence of their calves (Table 7). In the study area cows are milked on the average twice a day.

The majority of the respondents in the study area do not follow sanitary milking practices (Table 7). All respondents reported that they wash their hands and milk vessels before milking cows; however, washing of udders

Table 8: The major constraints to milk production in the study area (n=150)

Factors	% of total respondents
Low milk yield	20.2
Disease prevalence	19.9
Feed shortage	18.3
Low milk price	15.9
Lack of market	12.6
Shortage of labor	7.9
Inadequate AI services and maintenance of exotic blood level	5.3

n=number of respondents; AI = Artificial Insemination

and use of towel to clean the udder are not practiced by the majority of the farmers. Moreover, milkers dip their fingers into the vessel containing milk and moistening teats of the cows to facilitate milking. This practice may cause microbial contamination of the milk from the milker's hand and thus farmers need to be given training on sanitary milking practices and basic milk hygiene.

Constraints to Milk Production: Cattle productivity in the study area is affected by a number of factors. The most important constraints associated with milk production as prioritized by the farmers were feed shortage, disease prevalence, poor genetic potential of local cows for milk production, inadequate artificial insemination services, lack of milk collection centers and shortage of farm labor (Table 8). The most prevalent diseases reported in the area include trypanosomiasis, mastitis, dermatophilosis and anthrax. The interaction of these constraints affects the overall milk production in the area.

The demand for crossbred cows in the study area was high but supply is far below the demand. Furthermore, those farmers who own crossbred cows complain about inadequate artificial insemination services and the difficulty to maintain the blood level of the cows around 50% of exotic inheritance. Therefore, to alleviate these problems and increase milk production, integrated work between all actors viz., farmers, extension workers, veterinarians and researchers aimed at genetic improvement of local cows either by selection or crossbreeding with improved breeds, better health management, supplementing poor quality feed resources particularly crop residues with concentrate feed and/or improved forage species, efficient heat detection and timely insemination and development of organized market are necessary.

Emergence of Smallholder Dairy Cooperatives: At the time of the survey work, two dairy cooperatives were found in Bahir Dar Zuria woreda; one in Sebatamit rural kebele and the other in Andassa rural kebele. Abay Zuria dairy cooperative, which is found in Sebatamit kebele (7 km from Bahir Dar town), was established in August 2005. It had 21 founding members with 4000 Birr gross capital of establishment and the number of members increased to 34 in 2006. The average volume of milk collected per day in this cooperative ranged from 90-130 liters depending on availability of milk. On the other hand, Addis Alem dairy cooperative, which is found in Andassa kebele (22 km from Bahir Dar town), was established in May 2004. It had 14 founding members with 3000 Birr gross capital of establishment and in 2006 the number of members reached 37. The average volume of milk collected per day in the Addis Alem cooperative ranged from 70 – 110 liters. The objective of establishing these two dairy cooperatives was to facilitate milk marketing in the area.

Both cooperatives collect milk (both local and crossbred cows' milk) from members as well as non-members at a fixed price. When receiving the milk, both cooperatives test the specific gravity of milk using lactometer to check possible adulteration of milk with water. The cooperatives collect only morning milk due to lack of cooling facilities at the centers. After collection, they separate the cream from the whole milk. The cream is used for butter making after 2-3 days of natural fermentation using hand driven wooden churn. While the skim milk is used either for direct sale or converted into *Ayib* (a traditional cottage cheese).

At both cooperatives four types of dairy products were sold: fresh whole milk, skim milk, butter and *Ayib*. Liquid milk is stored in stainless steel container. Butter and *Ayib* are sold to consumers by weighing and wrapping it in a plastic material. The marketing outlets used by the cooperatives were individual consumers and retailers. The purchasing price of fresh whole milk from the producers and selling price of the milk products produced at the cooperatives are shown in Table 9.

The most important constraints encountered by the dairy cooperatives were: lack of market access, low product price, less demand for dairy products especially during fasting time, lack of cooling facilities coupled with lack of electric power supply and frequent breakage of cream separator in their order of importance.

In the tropics, the existence of relatively high transaction costs coupled with perishable nature of milk play a central role in limiting dairy production and

Table 9: Selling price of dairy products produced at the dairy cooperatives

Types of dairy products	Addis Alem dairy cooperative		Abay Zuria dairy cooperative	
	Purchasing price	Selling price	Purchasing price	Selling price
Fresh whole milk (Birr/liter) ^a	1.50	2.50	1.50	2.80
Skim milk (Birr/liter)	np	1.50	np	1.80
Ayib (Birr/kg)	np	3	np	4
Butter (Birr/kg)	np	24	np	24

np = not purchased; ^aThe exchange rate of US Dollar to Ethiopian Birr at the time of this study was 1 US \$ = 9.03 Birr

marketing [22]. Under such conditions, milk cooperatives are advantageous as they are able to market large volumes and sufficiently reduce transaction costs. Thus, supporting the emerging dairy cooperatives in the area by provision of technical and infrastructural support may help to improve dairy development and increase income of farmers.

CONCLUSION

The dairy sector of the area is characterized by a small-scale subsistence milk production system and constrained mainly by low genetic potential of indigenous cows, disease prevalence and feed shortage. Thus, strategies designed to develop the dairy sector should take into account the existing production characteristics of the area and should focus on a systematic approach to alleviate the identified constraints by involving all stakeholders in the formulation and implementation of improvement strategies. Moreover, the emerging dairy cooperatives in the area should be encouraged and support should be provided to members of these cooperatives by the regional government or other concerned bodies.

ACKNOWLEDGEMENTS

This study was funded by the Amhara Regional Agricultural Research Institute.

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