

Handling and marketing of dairy products in and around Bahir Dar Milkshed Areas, Ethiopia

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Abstract. *Sisay T, Alemayehu K, Haile M. 2018. Handling and marketing of dairy products in and around Bahir Dar Milkshed Areas, Ethiopia. Trop Drylands 2: 48-58.* Despite the great importance of milk in feeding the rural and urban population of Ethiopia, milk handling practices and marketing systems in the country are not well developed. This study was conducted to assess handling, processing and marketing of milk and milk products using 180 sample households in the formal survey with a pre-tested structured questionnaire. Market channels and chains of milk and milk products were described using market data from sample households, key informants and sale records. Overall, 45.6% of the sample households supplied milk for market with the highest in Bahir Dar City, followed by Tis Abay and lowest proportion was in Sebatamit rural *kebele*. Overall, the average amount of milk daily supplied to market was 6.6 liters/household and the figure in Bahir Dar City, Sebatamit and Tis Abay rural *kebeles* were 9.7, 5.6, and 2.33 liters, respectively. Daily milk was delivered through cooperative and other sale outlets as farm gate, customers' gate on delivery system and farm shop. Season, location and interaction of these factors had highly significant ($P \leq 0.01$) effects on volume of milk monthly collected at cooperatives. Different market channels, outlets, and agents were identified for various dairy products; butter being with the longest channel, followed by marketing of milk and low-fat milk/semi-skim milk to pass through about three channels. Milk supplied to market was generally constrained by feed shortage, lack of improved breed, unreliable milk market, unattractive price and producers' limited awareness. Dairy cooperatives generally created milk market outlets and supplied various processed milk products to market; of which low-fat milk (semi-skim milk) was sold in its fresh state which might be used as a less expensive product. Hence, the paramount role of the cooperatives in the area is to strengthen the linkage between producers and consumers, which in turn provides reliable milk market and benefits producers from market opportunity of dairying.

Keywords: Bahir Dar, dairy products, handling, marketing, processing

INTRODUCTION

Milk plays a very important role in feeding the rural and urban population of Ethiopia. It is produced daily, sold for cash or readily processed and is a cash commodity in the milk-shed areas that enables families to buy other foodstuffs and significantly contributes to the household food security (MOA 1996). Despite huge potential and substantial development efforts to get the dairy subsector growing, there is a chronic shortage of the product in the country that calls for production more and above the domestic needs (Azage and Asfaw 2004). Milk marketing system in Ethiopia is not well developed where only 5% of milk production in rural areas is marketed as liquid milk (Getachew 2003). Large-scale marketing and processing of milk are limited to the area around Addis Ababa (i.e. the Addis Ababa milk shed). Currently, there are few milk processing plants in Ethiopia, including *Sebeta* Agro-Industry, *Lame*, *Family*, etc. owned by private sector (SNV 2008). Some of the processed products supplied to market are pasteurized fluid milk, table butter, hard cheese, yogurt, and cottage cheese (*ayib*) (SNV 2008).

According to CSA (2005), milk production in Amhara Region, Ethiopia was estimated at 466.7 million liters of

which 2.4% was marketed as liquid milk, 49.8% was self-consumed and the rest 54.1% was processed to butter and other derivative dairy products. Accordingly, dairy potential areas in the region are identified and categorized into five milk shed areas, namely Bahir Dar, Dessie, Debre Berhan, Gondar and Debre Markos with each milk shed is targeted to centering the rapidly growing urban population and the rising demands for milk and milk products (BoARD 2004). In respect to this, establishment of dairy cooperatives in the milk shed areas emerged as one way of addressing the vast majority of smallholder producers. Thus, a total of about ninety dairy cooperatives and two dairy unions of which one is project-supported mini-dairy plant are found in the region at present (ARSCPA 2006). The Bahir Dar milk shed, besides its potential of supplying milk to Bahir Dar, dairy farms in the area have also a long time experience on dairy extension, technical support as well as service provision on breed improvement and animal health through different stakeholders. The study area, within Bahir Dar milk shed, is found along the main route from Bahir Dar City to Tis Abay South-East of Bahir Dar. Dairy cooperatives are emerged and come into existence to promote and foster milk production and marketing as a tool to realize market opportunities created in the area.

Despite emergence of cooperatives to facilitate milk market linkages, little is known about producers' handling, processing, and marketing practices as well as performance of cooperatives in the study area. Yitaye (2008) in their studies recommended the need to establishing, expanding and providing institutional support to dairy marketing cooperatives to advance the recent trend in commercialization of subsistence production with a good potential to catalyze market participation. In order to design relevant development plan for the area, it is a prerequisite to understand the prevailing situations. For the research to be effective and address the targeting groups, identifying the problems and understanding of the producers' handling, processing, and marketing practice of dairy products as well as evaluating the performance of cooperatives on monthly milk collection and processing efficiency in the study area is essential to open up way of mitigating the problems. In due concern, the present study was conducted to generate pertinent information on these and other relevant issues that may benefit future development plan strategies for smallholder dairy productions in the milk shed.

The objectives of this study were: (i) To assess the prevailing traditional handling and processing of milk and milk products in the studied milk shed areas. (ii) To describe the marketing system as well as channels observed in the marketing of milk and milk products. (iii) To evaluate performances of dairy cooperatives operating in the studied areas. (iv) To identify constraints and opportunities of dairying in the areas.

MATERIALS AND METHODS

Description of the study areas

The study was conducted in Bahir Dar city administration and its adjacent area of Bahir Dar Zuria *woreda* of Amhara Regional state (Figure 1). Bahir Dar city administration has an altitude ranging from 1700 to 1840 meters above sea level (m.a.s.l). Bahir Dar City is the capital of Amhara regional state, located 565 km northwest of Addis Ababa. It is situated at an altitude of 1840 m.a.s.l. The area receives an average annual rainfall ranging between 850-1250mm with the minimum and maximum average daily temperatures of 10-32°C, respectively (BoARD 2006). Bahir Dar City is constituted of 17 urban *kebeles*. The human population of the town is estimated at 199,210 (CSA 2008).

Bahir Dar Zuria *woreda* is situated at an altitude ranging from 1700-2300 m.a.s.l. The *woreda* is constituted of 29 rural *kebeles* and has area coverage of 116,667 hectares. The human population is estimated at 245,820 (WoARD 2006). In the *woreda*, cattle population is estimated at 121,886 (CSA 2003). The major crops grown in the area are wheat, barley, millet, *teff*, and maize (WoARD 2006). In the area, both crop-livestock and livestock production systems are found, even though the mixed production system dominates.

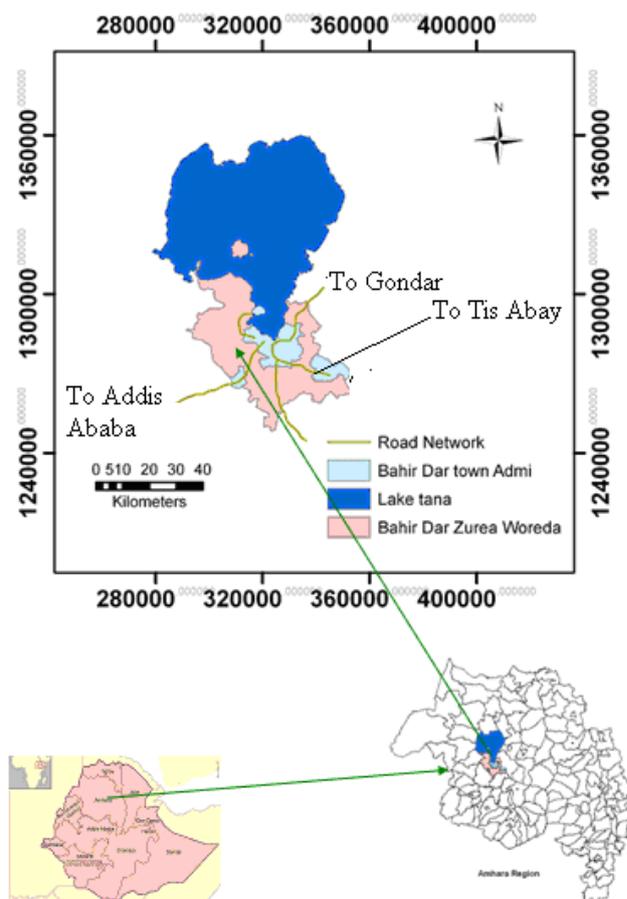


Figure 1. Location of the study area (Map of Ethiopia, Amhara Region, Bahir Dar city administrative and Bahir Dar Zuria *woreda*)

Sampling procedures and data collection

Questionnaire-based survey work

A three-stage purposive sampling procedure was conducted to select 180 specific dairy producers for this study. The primary sampling units, represented by dairy producers along the main route Bahir Dar to Tis Abay within the radius 32km Southeast of Bahir Dar, were selected. Finally, from census recording, individual households were selected at random. A total of 180 sample units (dairy producers) were selected, where 45, 65 and 70 dairy producers from Bahir Dar City, Sebatamit and Tis Abay rural *kebeles*, respectively. To assess producers' handling and processing practices and identify the type of dairy products produced, marketed as well as constraints of milk market in the area, farmers/producers were interviewed using semi-structured questionnaire.

Cross-sectional survey was employed with one-visit multiple subject interview (ILCA 1990). Information collected includes household characteristics, cattle number by breed, milk handling practices, daily milk output, and allocation during survey, marketing data, monthly income from milk product sale, participation in the cooperative and benefits, credit access, determinants for marketable milk supply, constraints and opportunities of dairy marketing. In

addition, related information such as productive and reproductive performance of cow, breeding method, major supply of feed resources in dry and rainy seasons. On the other hand, marketing of milk and milk processed products like butter, skim milk (defatted milk), sour milk (*Ergo*) as well as cottage type cheese (*ayib*) were studied at other marketing agents. Separate semi-structured informal interview checklists were used for the mobile traders, whole seller groups and dairy cooperative. Generally, ten mobile traders at Sebatamit participated in skim milk marketing and Tis Abay rural *kebeles* in butter marketing, respectively and at Bahir Dar City ten whole butter sellers were interviewed using separate semi-structured questionnaires to acquire and develop general information about the marketing of milk processed products in the area.

Performance evaluation of dairy cooperatives in the study area

To evaluate the performance of milk collection and unit price of milk paid at the cooperatives, recorded secondary data over the last five months were gathered from Bahir Dar City and *Abay Zuria* cooperatives, which had consistent recordings for the study period considered. To analyze monthly milk collection and unit price (in birr) paid over the period of five months, 8 observations in total on monthly milk volume collected and unit price paid (12 observations for each of the two variables from each of these two cooperatives) were collected for two seasons: dry season (October to April) and rainy season (May to September).

Data analyses

Statistical Package for Social Science (SPSS, 12 ver.2001) was used to analyze the data collected through the survey. Survey results were reported using descriptive statistical tools such as means, percentages, standard deviations, and frequencies. Performance of cooperative in promoting milk market access to producers' milk as well as for their substantial development; monthly milk volume collected and average unit price paid per liter of milk collected per cooperative was analyzed using general linear model (GLM) based on season and location of dairy cooperatives. In addition, processing efficiency for creaming and cream churning at cooperatives were analyzed based on sample collected for milk, skim milk obtained as well as cream churned at cooperatives. For the average milk volume monthly collected as well as unit price paid (in birr) per liter of milk collected at dairy cooperatives the factors were season (dry and rainy season) and location of dairy cooperatives as (Bahir Dar City and *Abay Zuria*) included into the model as fixed factors. Interactions between factors were removed from the model if they did not show a significant ($P < 0.05$) effect, following step-down procedures.

Mean comparisons were done using Turkey's method for variables if the F values showed a significant difference. Levels of significance are considered 5% and 1%. Data related to selling outlets for dairy product type collected to identify the dairy marketing system, channels and agents were analyzed using descriptive statistics of

(SPSS, 12 ver.2001). In addition, the data collected with rapid market appraisal (RMA) and recorded at four selected sale points of the three dairy cooperatives reported with flow charts. The model used to analyze monthly volume of milk collected and average unit price paid per liter by cooperatives was as follows:

$$Y_{ijk} = \mu + S_i + L_j + (SL)_{ij} + e_{ijk}$$

Where, Y_{ijk} = Monthly milk volume received or price paid per liter by the k^{th} cooperative at the i^{th} season and j^{th} dairy cooperatives (location); μ = Overall mean; S_i = the fixed effects of i^{th} season (i = rainy, dry season); L_j = the fixed effects of the j^{th} location of dairy cooperative (j = 1,2); $(SL)_{ij}$ = the interaction effect of the i^{th} season and j^{th} location of the dairy cooperative; e_{ijk} = the random error observed with ij^{th} observations

RESULTS AND DISCUSSION

Household socio-economic characteristics

Landholding

The average landholding was 1.67 ha and 1.37 ha per household for Sebatamit and Tis Abay rural *kebeles*, respectively. Obviously, land is one of the major important production factors for undertaking farming activities. However, it is a big issue and challenge in Bahir Dar City and the other two study sites, which might be resulted from increased human population of the rural areas. This calls for developing specific policy scheme to promote the potential contribution of dairy in the area. Even in Bahir Dar City, more than 77% of the interviewed households were running the dairy farming within their own backyard, and 4.4% were within their rented residence, whereas 17% of the interviewed households obtained land from the municipality for temporary dairy farming. In general, such practice, however, together with other factors might have caused some hygienic risks. Similarly, Yitaye (2008) reported in the north-western Ethiopian highlands of the urban dairy production system that 80.7% of the respondents were keeping their dairy cattle within their confined residence.

Cattle holding and milk production

Cattle holding

The overall average cattle holdings were 6.88 (± 0.275) heads, and higher average cattle holdings were noticed at Sebatamit (7.23 heads) and Tis Aby rural *kebeles* (7.19 heads) than Bahir Dar City (Table 1). The average number of cattle holding per household and the proportion of cows constituting the cattle herd across study sites could be seen in connection with the size of land holdings in the rural *kebeles* as well as the location of milk production area-urban market center. Higher proportion (64.44%) of the cows in Bahir Dar City constitute the cattle herd and of which crossbred type cows constitute its larger proportion (84.75%). The reason might be partly due to the location that Bahir Dar milk shed is close to the urban market center, Bahir Dar City as well as the access to artificial

insemination service delivery. A similar study in the north-western Ethiopian highlands of the urban production system reported a significantly higher proportion of crossbred cows (Yitaye 2008).

Considering milking cows, it was higher in Bahir Dar City (2.62 heads) than the other two study sites of the total cows (Table 1), which might be due to better management practices of producers in feeding, health care, breeding, and other related activities. In addition, the larger proportion (87.3%) of milking cows in Bahir Dar City constituted with crossbred of indigenous Zebu and Holstein Friesian contrary to Tis Abay and Sebatamit rural *kebeles*, respectively. Access to artificial insemination service delivery, educated household heads, and the location could partly attribute to use of improved dairy type breed.

Overall daily milk off-take per cow was 1.23 (0.395) and 5.46 (0.223) liters for local and crossbred cows, respectively. A higher daily milk off-take per cow of local and crossbred was observed at Bahir Dar City and was the lowest at Sebatamit rural *kebele* (Table 2). Overall mean daily milk off-take per cow of both breed types was almost consistent with the average values (1.2 and 5.2 liters) for local and crossbred cows reported for Bahir Dar milk shed area (Asaminew 2007).

Milk production

Milk seller producers in Bahir Dar City, Tis Abay, and Sebatamit rural *kebeles* accounted for 97.8, 41.4 and 13.8% of the sample households, respectively with an average daily milk output of 7.6 ± 0.79 liters per household (Table 3). Average amount of milk daily produced for milk seller producers was significantly greater in Bahir Dar City and lower for Tis Abay. The difference might partly be due to higher number of crossbred milking cow holdings in Bahir Dar City than that of the other two study sites. This, among other factors, could possibly be attributed to the marked difference in the daily milk output (liters) per household among the studied sites. However, the relatively higher average value in Sebatamit than in Tis Abay might be due to small number of seller producers as well as these

producers possessing mainly crossbred cows. Daily milk output per household for not milk seller (exclusively milk processor) producers had an overall average of 1.9 ± 0.15 liters. Relatively higher and lower (2.3 and 1.6 liters, respectively) average volume of milk daily were produced in Tis Abay and Sebatamit rural *kebeles*. The relatively higher number of milking cow holdings per household at Tis Abay than Sebatamit rural *kebele* (Table 1) might have partly attributed to the relatively greater volume of milk daily produced. Generally, the overall daily milk output in the studied areas was 4.5 ± 0.42 liters per household and this is highest in Bahir Dar City than the other two studied sites. Significantly higher number of crossbred milking cow holdings per household in Bahir Dar City than the other two sites might have attributed to the larger volume of milk daily produced per household.

Handling and processing practices of milk

Handling practices of milk

Overall, the majority of the respondents reported the practice of milker's hand washes before milking. On the other hand, however, the practice of udder washing is almost insignificant with Bahir Dar City had relatively higher proportion of the sample households practicing udder washing before milking than the other two studied sites (Table 4). In general, lower proportion of the sample households in this study practiced udder washing for sanitary milking is consistent with the reports in Bahir Dar milk shed area, that majority of respondents do not follow sanitary milking practices (Asaminew 2007). However, Yitaye (2008) on the contrary, reported for northwestern Highlands of Ethiopia 94% of the respondents wash udder before milking in urban and peri-urban production systems. This variation might be due to the target population used for the study as well as area differences. The poor hygienic practice observed in this study is possibly indicating the gap in producers' awareness of sanitary practice on milk handling. To address the issue, it seeks training and extension service delivery targeted at skill development of the producer.

Table 1. Mean (\pm S.E) cattle holdings by breed type across three study sites in Amhara region, Ethiopia

Cattle category	Study sites			Overall
	Bahir Dar City	Sebatamit rural <i>kebele</i>	Tis Abay rural <i>kebele</i>	
Total cattle/HH	5.91 (0.389)	7.23 (0.378)	7.19 (0.555)	6.88 (0.275)
Indigenous Zebu type	0.84 ^a (0.275)	6.54 ^b (0.377)	6.74 ^b (0.6)	5.19 (0.335)
Crossbred type	5.07 ^b (0.448)	0.69 ^a (0.181)	0.44 ^a (0.15)	1.69 (0.203)
Total cows/HH	2.62 (0.212)	2.31 (0.153)	2.81 (0.202)	2.58 (0.11)
Milking cows/HH	2.05 (0.176)	1.58 (0.088)	1.8 (0.148)	1.79 (0.081)
Indigenous Zebu	0.26 ^a (0.095)	1.31 ^b (0.1)	1.64 ^b (0.162)	1.17 (0.088)
Crossbred	1.79 ^b (0.19)	0.27 ^a (0.083)	0.17 ^a (0.055)	0.62 (0.08)

Note: ^{a,b} Row means with different superscript letters are significantly different ($P \leq 0.05$), HH: Household

Table 2. Mean (\pm S.E) daily milk off-take/ cow and average lactation length of cows across three study sites in Amhara region, Ethiopia

Variables	Study sites			Overall (n = 180)
	Bahir Dar City (n=45)	Sebatamit rural <i>kebele</i> (n = 65)	Tis Abay rural <i>kebele</i> (n =70)	
Daily milk off-take (L/cow)				
Zebu type cow	1.7 (0.182)	1.05 (0.046)	1.33 (0.04)	1.23 (0.29)
Crossbred cow	5.88 (0.297)	4.32 (0.21)	4.95 (0.349)	5.46 (0.22)

Table 3. Average daily milk production (\pm SE) per household across three study sites in Amhara region, Ethiopia

Description	Study sites ¹			Averages
	BDT	SRK	TARK	
Households (%)				
Milk seller	97.8	13.8	41.4	45.6
Average daily milk output (liters)/ HH	10.5 ^c	6.6 ^{abc}	3.4 ^a	7.6 (0.79) ²
Milk processors	2.2	86.2	58.6	54.4
Average daily milk output (liters)/ HH	4.5	1.6	2.3	1.9 (0.15)
Total average daily milk output (liters)/ HH	10.4 ^b	2.2 ^a	2.7 ^a	4.5 (0.42) ³

Note: ¹ Row means with different superscript letters are significantly different for the considered variables ($p < 0.05$), ² Average daily milk output (liters)/HH for milk seller producers, ³ Overall daily milk output (liters)/HH for the study area, BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*, HH: Household

Table 4. Milk handling practices of sample households in the study sites

Variables	Study sites			Overall (n=180)
	BDT (n=45)	SRK (n=65)	TARK (n=70)	
Udder washing practice (%)				
Before and after milking	17.8	7.4	1.4	7.8
Before milking	40	1.5	5.7	12.8
If only udder contaminated	40	32.3	24.3	1.1
Milker's hand wash before milking (%)	95.6	98.5	100	98.3
Utensil cleaning frequency (%)				
Just before and after milking	95.6	49.2	52.9	62.2
Once in a day	-	40	42.9	31.1
Once every 2 to 3-days	4.4	10.8	4.3	6.7
Household used milking utensil (%)				
Gourd	13.3	96.9	100	77.2
Plastic	68.9	-	-	17.2
Gourd and plastic	17.8	3.1	-	5.6
Total	100	100	100	100

Note: n: number of respondents, BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*

Overall, the majority (62.2%) of dairy producers in the studied areas wash utensils before and after each milking. Majority (95%) of the sample households in Bahir Dar City did it in a day both before and after each milking, and quite larger proportion of the sample households at the other two study sites practiced cleaning once a day and even every two to three days interval (Table 4). Urban dairy producers acquainted with sanitary importance might have attributed to the difference in the practice of cleaning milking utensils in a day among the three studied sites. In this respect, differences were observed in the frequency of cleaning milk utensils in a day among study sites. Such practice of cleaning milk utensil in a day in Sebatamit and Tis Abay rural *kebele* coupled with substandard hygienic practice of milking could render milk spoilage, wastage and even might have resulted in consumers' health hazards.

Overall, 77.2% and 17.2% of the sample households used gourd and plastic containers, respectively for milking purposes and the rest (5.6%) used both types. Almost all the sampled households in Sebatamit and Tis Abay rural *kebeles* used gourd as opposed to sampling households in Bahir Dar City (Table 4). In a study, but for different

production systems, the use of gourd by the majority (62%) of peri-urban producers, while 83% of urban producers used plastic containers reported for northwestern Ethiopian highlands by Yitaye (2008), was consistent with the overall result and for Bahir Dar City, respectively in the present study.

Milk processing practices

Overall fermentation time for milk at room temperature was 4.1 days and this varied from the longest (4.5 days) at Bahir Dar City to the shortest at the other two study sites (Table 5) which was mainly due to ambient temperature differences of the corresponding study sites. This could possibly favor the activity of lactic acid bacteria, which in turn results to shorten fermentation time of milk, while the relatively lower ambient temperature in Bahir Dar City might have possibly extended milk fermentation time.

Overall, the average amount of fermented milk required to produce a kg of butter was 21.2 (\pm 0.26) liters, and the highest (24.3L) was in Bahir Dar City with the lowest at Tis Abay rural *kebele* (20.2 L) (Table 5). Large number of crossbred milking cow holdings per household in Bahir Dar City as opposed to the other study sites, together with other factors might have attributed to an average volume of fermented milk required to produce a kilogram of butter is different. An average volume of milk (18.1 liters) to produce a kilogram of butter reported by Asaminew (2007) was less than the overall mean amount in the present study. The difference might be due to the proportion of crossbred and indigenous Zebu-type milking cows.

There were different reasons for processing milk into various processed products (Table 6). However, differences were observed among the studied sites for the reasons of processing of milk. For instance, most sampled households in Sebatamit rural *kebele* processed milk to produce diversified processed milk products mainly for household consumption and the surplus was for sale. However, sample households mainly in Bahir Dar City and to a lesser extent in Tis Abay processed milk due to the lack of regular milk market during fasting periods of the year. Orthodox Church followers comprise about 40% of the Ethiopian population where majority of them abstain from consuming milk and other animal products for about 200 days in a year.

Table 5. Average volume of fermented milk (liters) churned at a time and fermentation time across three study sites in Amhara region, Ethiopia

Variables	Study sites			Overall Mean (S:E)
	BDT Mean (S.D)	SRK Mean (S.D)	TARK Mean (S.D)	
Amount of fermented milk churned at a time	10.1 (5.67)	5.7 (2.88)	6.6 (3.29)	6.73 (.31)
Amount of fresh milk to produce a kg of butter	24.3 (2.90)	21.1 (3.18)	20.2 (2.7)	21.2 (0.26)
Milk fermentation time for churning (days)	4.5 (1.28)	4..0 (1.3)	4.1 (0.85)	4.1 (0.09)

Note: BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*; SD: Standard deviation, S:E: Standard errors

Table 6. Role of family members in milk processing practices across three study sites in Amhara region, Ethiopia

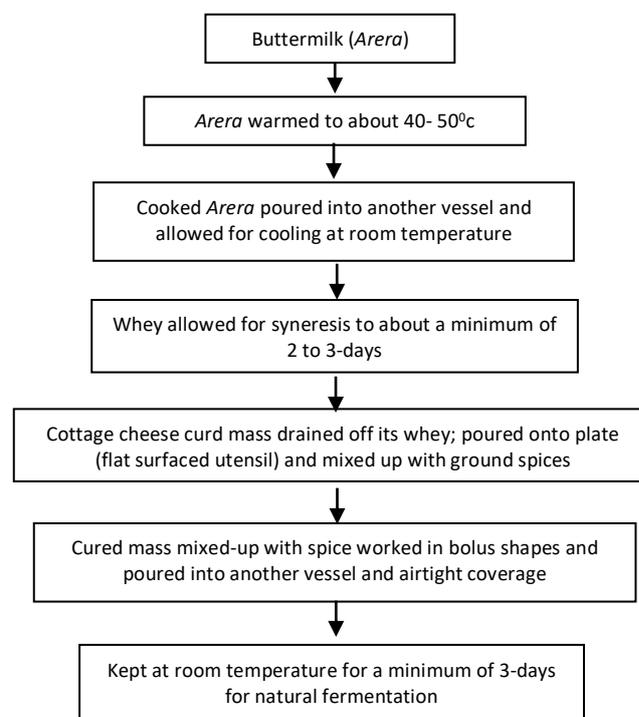
Variables	Study sites		
	BDT (n=45)	SRK (n=65)	TARK (n=70)
Do a household process milk (%)			
Yes	51	100	97.2
Household member involved in milk processing %			
Children less than 15-years	11.3	8	6
Female adults	64.2	67	78.3
Male adults	22.6	25	15.7
Hired labor	1.9	-	-
Reasons for milk processing (%)			
To extend product shelf life	-	30.8	41.4
Diversify processed products for consumption and/or market	2.2	69.2	45.5
Lack of regular market for milk	48.8	-	11.3
No churning practice	49	-	2.8
Time occasion for larger volume of milk to process (%)			
Long fasting period	48.8	4.5	11.2
<i>Kiremt</i> (rainy season)	2.2	84.5	78.8
Dry season	-	11.	7.2

Note: N: number of respondents, BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*

Accordingly, the majority of sample households in Sebatamit and Tis Abay rural *kebeles* reported processing larger proportion of milk in the rainy season (Table 6). In general, this could be seen in connection to better supply of feeds both quality and quantity-wise in the rainy season. Collecting and preserving feed resources in the rainy season need to be the focus of extension service delivery to improve dry season's animal feeding for increasing milk production.

The majority of sample households in Sebatamit and Tis Abay rural *kebeles* reported processing milk into various processed products and further the majority of them process larger proportion of milk during the rainy season as opposed to sampling households in Bahir Dar City (Table 6). These, together with other factors, might have created enormous workload on female adults of the former two study sites than in Bahir Dar City. With this respect, generally considering benefits of milk market linkage in the area established through cooperatives, seeks for addressing the limiting factor to enhance milk production and selling at household level, which ultimately improves benefit of producers from milk selling as well as reducing the workload of female adults.

The traditional method of milk processing was employed using gourd and clay pot for churning to produce butter, but the method was reported to be labor-intensive and time-consuming. The majority of the sample households employed the traditional method of churning and further processing as well-practiced to produce other processed milk products. Generally, in respect to this, the further processed milk products in this study included cottage cheese, ghee, and *metata ayib*, where the production of *metata ayib* was reported to depend mainly on the volume of milk available for processing. Dairy producers in the study area produced traditional hard curd mass of products known locally as *metata ayib*. They are poured in a clay pot or pan and are heated similar to cottage cheese until a distinct curd mass is formed. The clay pot is then put away from the fire to facilitate cooling and by the time the curd whey mixture is transferred to another smoked clay pot or gourd and kept at room temperature. The procedure followed by producers in the manufacturing of this product is depicted in Figure 2.

**Figure 2.** Flow diagrams for *Metata ayib* making in the study area

In general, the practice and procedures for making the product in the study area are indigenous knowledge developed for preservation and extending product's shelf life. Hence, it deserves further investigation and research on the chemical composition of ingredients, reaction to the process, chemical composition and food quality of the product.

Milk and milk products consumption of households in the studied area

The overall daily milk consumption was 0.4 liters per household, and this was relatively high (0.5 liters) in Bahir Dar City and low in Sebatamit rural *kebele* (0.2 liters) (Table 7). Similarly, Lemma et al. (2004) reported almost similar average daily milk consumption at household level for East Shoa Zone of Oromia. In this study, the lower average amount of milk daily produced per household and the majority of the sample households at Sebatamit rural *kebele* processed milk might have attributed to the lower average amount of milk daily consumed. Generally, in the study area, children were prioritized in most of the cases (78.9%) for milk consumption of milk, which might be due to its nutritional value importance to young children.

Characterizing dairy marketing system in the study area

Producers' involvement in milk and milk product marketing

This study revealed that higher proportion of households in Bahir Dar City followed by Tis Abay rural *kebele* supply milk for market than Sebatamit rural *kebele* (Table 8). In addition, the majority and about two-fifths of the sample households in Bahir Dar City and Tis Abay rural *kebele*, respectively reported for milk produced is to market. Tis Abay is a small rural town with regular and frequent public transport access; this together with other factors could possibly create opportunity for the involvement of different milk marketing agents in the area. Thus, consequently, the sample households in Bahir Dar City and Tis Abay rural *kebele* might have been encouraged for delivering milk to other sale outlets as opposed to households in Sebatamit rural *kebele*.

The average volume of milk daily supplied per household was highest in Bahir Dar City (9.7 liters) and lowest in Tis Abay rural *kebele* (2.3 liters) (Table 8). The majority of the sample households in Sebatamit (100%) and Tis Abay (80%) were involved in butter marketing as opposed to sampling households in Bahir Dar City (Table 9). Nevertheless, cooperatives established milk market linkage within each of the respective study sites. Majority of the sample households in Tis Abay and Sebatamit rural *kebeles* reported for milk processing to produce diversified milk processed products for family consumption and the surplus was for sale. This, together with other factors might have attributed to the majority of the sample households selling butter. On the contrary, some households (44%) in Bahir Dar City might have processed unsold milk during the long fasting periods, mainly used for family consumption.

Table 7. Milk consumption of households across three study sites in Amhara region, Ethiopia as reported by respondents

Parameters	Study sites			Overall (n=180)
	BDT (n=45)	SRK (n=65)	TARK (n=70)	
Milk consumption (L/day/HH)	0.58	0.2	0.4	0.4 (0.32)
Consumption priority (%)				
Children	64.5	80.0	87.1	78.9
Husband	18.4	3.1	1.4	6.2
Sick and elders	2.2	9.2	1.4	4.4
No distinction	13.7	4.6	5.8	7.2
No consumption of whole milk	2.2	3.1	4.3	3.3
Total, %	100	100	100	100

Note: BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*, HH: Household, n: Number of respondents

Table 8. Milk selling practice of producers across three study sites in Amhara region, Ethiopia

Variables	Study sites			Overall (n=180)
	BDT (n=45)	SRK (n=65)	TARK (n=70)	
Households sold milk (%)				
Cooperative	15.6	13.8	12.8	13.9
Other sale outlets*	82.2	-	28.6	31.7
Farmgate	35.6	-	20	-
Customers' gate	15.5	-	7.14	-
Both types	28.9	-	-	-
Own farm shop	2.2	-	-	-
Average unit price paid/L of milk (Eth. Birr)				
Dairy cooperative	3.75	3.5	2.1	3.0
Other sale outlets	4.00	-	2.35	3.4
Travel time (minutes) to reach milk collection center	25	42.38	38	36.38
Average daily milk sold (L/household)	9.7	5.6	2.3	6.6
Households faced with milk rejection (%)	13.3	1.54	12.9	-

Note: n: Number of respondents, BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*, *= Means farm gate, customers' gate (delivery system) and own farm shop milk sale outlets

Milk collection, processing, and marketing in the dairy cooperatives

Milk collection

Milk was collected once daily in the morning time in Abay Zuria and Tis Abay cooperatives, however, Bahir Dar City cooperative received milk twice a day, i.e., morning and late afternoon time. On arrival at the collection center, the milk was observed for general appearance, adulteration or skimming off using lactometer readings and buying based on volume. The overall mean volume of milk (liters) collected monthly at the cooperative was 12321.6 (± 107.45) liters. Highly significant difference was ($P \leq 0.01$) observed between the cooperatives and seasons considered on the average volume of milk received monthly.

Table 9. Processed milk product selling practices of producers across three study sites in Amhara region, Ethiopia

Variables	Study site		
	BDT (n = 45)	SRK (n = 65)	TARK (n = 70)
Butter selling			
Households used sale outlets (%)			
Open market	-	100	77.1
Farm gate	2.2	-	2.9
Farm shop	2.2	-	-
Households' used market place (%)	-	-	-
Urban market	4.4	100	-
Local market	-	-	80
Buyers type of the product (%)			
Consumers	4.4	81.6	21.6
Mobile traders	-	16.9	57
Institution	-	1.5	1.4
Households sold other processed milk products (%)			
Ghee	2.2	13.9	11.4
Metata Ayib	-	6.1	4.2
Sour milk (<i>ergo</i>)	2.2	-	-

Note: N: Number of respondents, BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*

The variance analysis revealed the monthly volume of milk collected in the dry season was significantly ($P \leq 0.01$) higher than in the rainy season's monthly volume of milk collected at Bahir Dar City cooperative (Table 10). The majority of the sample households were restricted from consumption of milk during the long fasting periods of Orthodox Church followers. The overall mean monthly milk collection per cooperative of the present study (12321.6 liters) was much higher as compared to the report

by Solomon (2006) for *Dejen woreda* (4217.56 liters). Result of variance analysis has shown that location of the dairy cooperative had significant ($P \leq 0.05$) effect on the monthly average unit price of milk paid. The overall mean monthly average unit price of milk paid per cooperative was 2.75 birr, being the highest in Bahir Dar City (2.9 birrs) and lowest in Abay Zuria cooperative (2.55 birr). Even if there was not marked difference in the average unit price of milk paid both for cooperative and season, relatively higher average unit price of milk paid in the rainy season as compared to that of dry season in both cooperatives. This might partly be due to the long fasting periods within the dry season, at which time the majority of Orthodox Church followers abstain from consuming milk and other livestock products. This consequently could affect consumers' number and further reduction of the product price.

Processing

Various processed milk products, i.e. cream, skim milk, sour skim milk, cottage cheese, butter, and occasionally sour milk were the major milk processed products produced in the cooperatives in the study areas. The cooperatives with the technological innovation introduced since their inception time, carried out milk separation and cream churning using centrifugal separator and hand-driven churner, respectively during the study period. In addition, aluminum milk cans and plastic containers were used for handling milk and milk processed products and a pan was used for heating and making cottage type cheese. The various processed milk products produced at the cooperatives were butter, fresh skim milk, sour skim milk, and milk as well as cottage type cheese.

Table 10. Mean (\pm S:E) volume of milk collected monthly and unit price (Eth.birr) paid in the studied cooperatives

Variables ¹	Monthly milk volume (lts) collected ²		Price (birr) paid per liter of milk ³	
	N	Mean (\pm S:E)	N	Mean (\pm S:E)
Bahir Dar City cooperative	18	21234.9 ^b (151.94)	18	2.9 ^a (0.16)
Abay Zuria cooperative	18	3409.4 ^a (151.94)	18	2.55 ^a (0.16)
Overall mean ⁴	36	12321.6 (107.45)	36	2.75 (0.08)
Season				NS.
Dry season (DS)		13193.9 ^b (151.94)		2.65 (0.16)
Rainy season (RS)		11450.4 ^a (151.94)		2.85 (0.16)
C.V		3.68%		17.12%
Season effect on levels of location				
Interaction of location & season		2237.7 (214.84) ⁵		NS
Bahir Dar City cooperative *DS	9	23225.5. ^b (214.84)		
Bahir Dar City cooperative *RS	9	19244.7 ^a (214.84)		
Abay Zuria cooperative *DS	9	3162.3 ^a (214.84)		
Abay Zuria cooperative *RS	9	3656.6 ^a (214.84)		

Note: ¹ Column means with different superscript letters are significantly different, ^{2, 3}: Comparison among respective variable means is along column wise, ⁴, Overall mean volume of milk monthly collected, Average unit price (Eth. Birr) of milk paid, ⁵ Mean monthly milk volume of the interaction effects, Significant at $P \leq 0.01$, Significant at $P \leq 0.05$, NS= Not significant, S:E: Standard errors, C.V: Coefficient of variation, N: Number of observations, DS: Dry season, RS: Rainy season

Marketing of milk and milk processed products at cooperatives

In Bahir Dar City cooperative sold the highest (88%), followed by Tis Abay cooperative (67%) and *Abay Zuria* cooperative less than 1% of their own total volume of milk collected (Table 11). The location of Bahir Dar City cooperative in the town could possibly attribute to its larger volume of milk sold, as it is generally higher demand for milk and milk products in the urban center. Fresh defatted milk/ skim milk and semi-skim milk sold overall amounted to 11280.1 liters (70.6%) with the highest was at *Abay Zuria* (97.5%) followed by Tis Abay (82.5%) and lowest at Bahir Dar City cooperative (0.08%). In this respect, revenue from processed milk products and whole milk accounted for 9.9 and 90.1, 99 and 0.98 and 36.7 and 63.3%, respectively of total revenue obtained for Bahir Dar City, *Abay Zuria* and Tis Abay cooperatives. Larger proportion of defatted milk/ skim milk sold in its fresh state at *Abay Zuria* and Tis Abay cooperatives together with other factors might have attributed for the greater revenue fetched from processed milk products.

Average gross revenue obtained per liter of whole milk processed for investigated has shown that highest (4.13 birr) and (3.73 birrs) were generated at Tis Abay and *Abay Zuria* cooperatives, respectively than at Bahir Dar City cooperative (1.88 birrs), (Table 11). The difference could partly be linked with the types of processed milk products sold, average sale unit price received, disposal of unsold processed products, and the efficiency of processing. In line with this, generally fresh skim milk was exceptionally sold at *Abay Zuria* and Tis Abay cooperatives, which accounted for about 46 and 18.4%, respectively of the total revenue generated in the respective cooperative.

Marketing chains and channels of dairy products

Market channels of dairy products

Dairy products' marketing channels in the current studied area (Figure 3) involved various intermediates, for instance, producer-sellers, mobile traders, individual retailers, institutions (hotels, cafeterias, organizations) and cooperatives. In regards, whole milk in the study area passed from producers through cooperatives, different traders and institutions to reach final consumers in Bahir Dar city. In the present study area sour milk, sour skim milk and cottage type cheese (*ayib*) had the shortest channels and were commonly marketed by dairy cooperatives directly to the immediate consumers. Similarly, ghee and *metata ayib* had also the shortest channels but were marketed occasionally by producers directly to consumers. Whereas marketing of butter got the longest market channel passed through intermediaries between producers and/ or cooperatives and consumers.

Market chains of dairy products

The general picture for dairy product market chain of the present study is summarized in Figure 4 below. As indicated in Figure 4, for the marketing chain of dairy commodities, marketing agents involved include producer-sellers, mobile traders, retailers (hotels, cafes and other

organizations), dairy cooperatives and individual retailers both outside and inside of the study area.

Constraints and opportunities of dairy marketing in the study area

Constraints

Feed shortage, lack of improved dairy breed, limited market access, lack of producers' awareness and unreliable milk market were among the major constraints limiting marketable milk supply as reported by sampled households (Table 12).

Table 11. Revenue generated from marketing operation of the three cooperatives studied

Description	Cooperatives		
	Bahir Dar City	<i>Abay Zuria</i>	Tis Abay
Total revenue	112808.40	32246.00	53171.80
Revenue from whole milk	102219.4	316.00	33644.4
Revenue from processed milk products	10589	31930	19527.4
Butter	8226.50	17081.00	8413.00
Fresh skim milk	10.50	14821.00	9787.80
Sour skim milk	-	-	1326.60
Sour milk	177.50	-	-
Cottage type cheese	2174.50	28.00	-
Average gross revenue/ lit milk processed	1.88	3.73	4.13

1. Whole milk

- i. Producer → Dairy cooperatives → Retailers (mobile traders, Hotels, Cafes, Organization.) → Consumers
- ii. Producer → Dairy cooperatives → Local processor → Consumers
- iii. Producer → Dairy cooperatives → Consumers
- iv. Producers → Retailers → Consumers
- v. Producers → Consumers

2. Skim milk

- i. Dairy cooperatives → Individual trader → Hotel → Consumers
- ii. Dairy cooperatives → Retailers → Consumers.
- iii. Dairy cooperatives → Consumers.

3. Sour milk: Producer → Consumers

4. Sour skim milk: Dairy cooperative → Consumers

5. Cottage type cheese (*ayib*): Dairy cooperatives → Consumers

6. Ghee: Producers → Consumers

7. Butter.

- i. Producers → Individual traders → Hotels → Consumers.
- ii. Producers → Retailers → Consumers.
- iii. Producers → Consumers.
- iv. Dairy cooperatives → Mobile traders → Consumers.
- v. Dairy cooperatives → Consumers.

Figure 3. Marketing channels of each dairy product in the study area

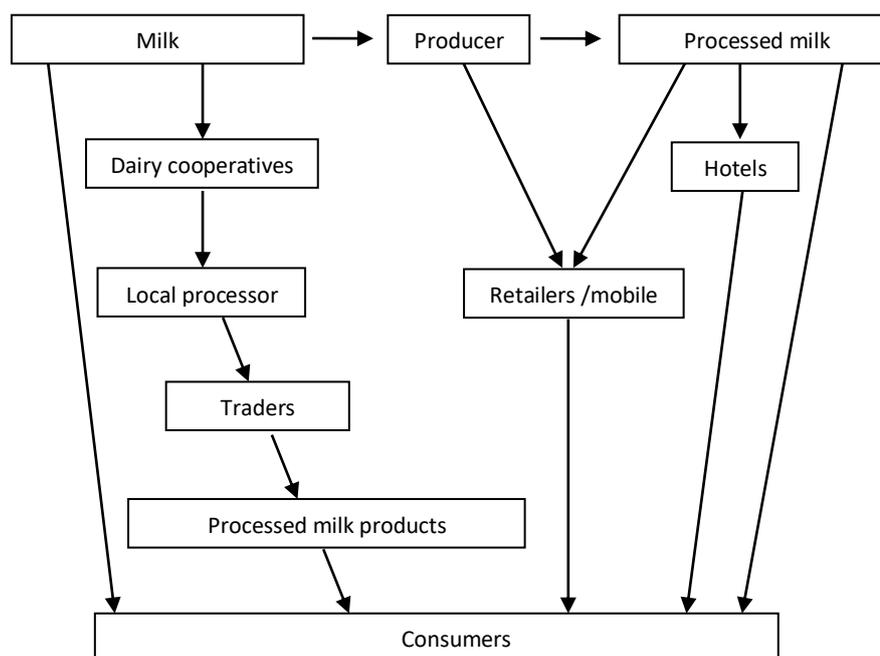


Figure 4 Market chains of dairy products in the study area

Table 12. Average proportion of producers by determinant factors for marketable milk supply

Determinant factors	Study sites			Overall (n=180)
	BDT (n=45)	SRK (n=65)	TARK (n=70)	
	%	%	%	
Market access	28.9	41.5	64.3	47.2
Feed shortage	77.8	73.8	92.7	82.2
Lack improved breed	46.7	86.2	57.1	64.4
Lack of producer's awareness	13.3	63.1	30.0	37.8
Unreliable milk market	57.8	29.3	28.6	36.1
Low and unattractive milk price	40.0	40.0	20.0	32.2

Note: BDT: Bahir Dar City, SRK: Sebatamit rural *kebele*, TARK: Tis Abay rural *kebele*, n: Number of observations

Table 13. Opportunities and advantages of dairy cooperatives in the study area as reported by respondents (%)

Variables	Study sites			Overall (n=180)
	BDT (n=45)	SRK (n=65)	TARK (n=70)	
Creation of milk market outlet	15.4	67.7	18.6	35.6
Increased milk production	8.8	13.8	20	15
Better income	15.4	13.8	15.7	15
Access for market information	15.6	6.2	21.4	14.4
Awareness created on breed improvement	66.7	100	85.7	91.1

Note: BDT= Bahir Dar City, SRK= Sebatamit rural *kebele*, TARK= Tis Abay rural *kebele*, n= Number of observation

In respect to improve dairy breed type, for instance, crossbred cows accounted for 10.7% of the total cattle in the study area as mentioned earlier. In addition, the existing breed improvement work through artificial insemination could not able to address the producers due to the limited number of technicians, low area coverage of the service and even the low frequency of supervision. Furthermore, lack of market for processed milk products, breakage of dairy equipment such as cream separator, milk thermometer and lactometer, were reported to be the most important factors limiting milk collection, processing and marketing activities of cooperatives.

Opportunities

In the present study area, the sampled households noticed that the emergence of milk collection centers in the nearby villages provide advantages and opportunities among which increased milk production, milk market outlet creation, income generation, access to market information and create awareness on breed improvement for producers were reported to be the major opportunities (Table 13).

Conclusion and recommendation

To conclude, the contribution of milk production as income source, household consumption, employment creation and supporting crop production was substantially important in the study area. Generally, the handling practice of milk in the area was substandard. In the area, lower amount of milk daily produced and limited milk selling outlets restricted producers from milk selling. Furthermore, the absence of regular milk market access, as well as market outlet risks, could compound the problem of producers' milk selling in the area. Despite cooperatives in

the area creating milk market linkage, limited number of producers involved in the organization and amount of milk delivery will influence sustainable development of dairy cooperatives and benefits of producers from market opportunity. The amount of milk consumed daily at household level seemed to depend mainly on the average volume of milk daily produced as well as targets of milk produced as milk for selling and milk exclusively for processing. The marketing of butter passed through long channels, followed by marketing of milk passed through three channels. In general, various marketing agents were identified in the exchange function between producers and the final consumers, which included producers, cooperatives, individual traders and institutions (hotels, cafes, small food houses, government organizations). Generally, the absence of formal market information available to all involved market actors could possibly affect producers' market value as well as product supply to market. Feed shortage, lack of improved dairy type breed, lack of awareness on market-orientation and unreliable milk market were the major constraints reported limiting marketable milk supply of producers.

To recommend, concrete efforts should be coordinated and integrated in a planned strategy focusing on the domain of milk potential area to stimulate and strengthen sound development of dairy cooperatives as well as more market-oriented dairy producers. Governmental organizations and other related partners should focus to promote market-oriented dairying in the area; making access to finance, credit, artificial insemination, and veterinary services, leading for marketable milk production as well as build capacity of dairy cooperatives on milk collection, processing, and marketing. This, in turn, will strengthen and ensure supply of milk to cooperatives, facilitate for better processing operation, minimize wastage and losses of products, thus generally benefiting producers from the market opportunity of dairying in the area. Seasonal milk supply market problems at the dairy cooperatives and the market outlet risks for the producers' milk in the area need to be critically addressed. Accordingly, provision of opportunities for capacity building of cooperative committee members on managing and operating business-oriented dairy cooperatives should be in place by concerned parties mainly by extension team and department of cooperative promotion. Regular training on milk reception, processing, handling and marketing should also be given to hired workers and further setting standards of processing efficiency and field supervision have to be emphasized by the department of extension. The larger proportion of indigenous Zebu-type cows dominantly constituting the dairy herd cows and lower daily milk off-take observed in the studied area restricted producers to sell milk. Concerned governmental organizations should focus on addressing the issue, which will motivate market participation of producers to benefit from the opportunity of dairying in the area. Designing an appropriate breeding strategy should have to be given attention along with planned monitoring and evaluation of the progress in the focus area using AI service as one means. Feed supply shortage has to be addressed through designing and

implementing sustainable forage development strategy compatible to the farming system supported with a planned monitoring and evaluation scheme. In addition, improving feed value of the available feed resources is the most crucial for livestock feeding that needs due attention.

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