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# Research Article
# Management Practices and Lactation Performance of Crossbred Dairy Cows in Adigrat Town, Eastern Tigray Zone, Northern Ethiopia

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## Abstract

**Background and Objective:** The crossbreeding program was introduced in different parts of Ethiopia to improve the milk production performance of local dairy cattle breeds. This study was conducted in Adigrat to assess management practices as well as the lactation performance of crossbred dairy cows. **Materials and Methods:** Purposive and random sampling techniques were used to identify study sites and dairy farmers, respectively. A semi-structured questionnaire and key-informant interviews were employed for data collection. Data were analyzed by using Excel software (Microsoft Office 2010). **Results:** The overall family size of studied dairy farmers was 4.2±1.2 persons. The dairy farmers had over ten years of experience in dairy farming. Animals were fed on natural pasture, grass hay, crop residues, cactus pear (*Opuntia ficus-indica*) and residues from local breweries. The local government was the main provider of veterinary services. Lactating cows were supplemented with mineral salt and concentrates. Based on face-to-face interviews, the mean daily milk yield (DMY) was 11.2±1.8 liters, with a mean lactation length (LL) of 9.3±2.1 months. **Conclusion:** The study indicated that implementing genetic improvement programs could help optimize milk production performance in crossbred dairy cows. However, challenges such as feed shortages and costs, limited pasture land, poor artificial insemination (AI) and veterinary services and inadequate space for proper housing remain significant concerns. Therefore, appropriate intervention measures should be considered to address these challenges.

Key words: Dairy farmers, crossbred dairy cows, milk production, dairy products, feed shortages

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

The dairy sector in Ethiopia contributes to Ethiopians livelihoods by providing vigorous sources of food and income[1], which accounts for 13.7% of overall agricultural output and 39.4% of total livestock production[2]. In all parts of Ethiopia, collected fresh milk is used as a source of food in the form of fresh milk and traditionally processed dairy products. Dairy products that are commonly used in the country are fermented milk, defatted sour milk, buttermilk, cheese, butter and ghee[3,4]. Overall, fresh milk and dairy products are marketed in small towns plus marketplaces. Cattle contribute the largest share of the total national annual milk output, followed by camels, goats and sheep. Presently, the demand for milk and dairy products is increasing in the country[1]. Indeed, the demand for milk and dairy products is expected to increase exponentially in developing countries[5]. Therefore, the high demand for milk and dairy products can be comprehended mainly by increasing the number of high-producing and tropically adapted dairy cattle, the number of commercial dairy herds and productivity per cow.

By crossing *B. indicus* with *B. taurus*, the amount of milk production in the tropical countries has been increased[6,7] as the performance of crossbred is superior to that of their parents as a result of the heterosis effect[8]. Ethiopian modern dairy development activities date back to the 1940s[9], soon after the end of the Second World War[4]. Since then, crossing local cattle with exotic dairy cattle breeds of superior genetic merit has been anticipated as the most effective and fastest way of improving the productivity of local dairy cattle[10,11]. As a result, numerous efforts have been made to develop the dairy sector using artificial insemination (AI) or shared crossbred bull service or by distributing crossbred F1 heifers to smallholder dairy producers in urban areas and to those rural smallholder farmers.

To ensure their success, nevertheless, crossbreeding programs need to be monitored regularly by evaluating the lactation performance of the crossbred dairy cows under the prevailing management and environmental conditions. The primary objective of the current study was, therefore, to evaluate the management practices and lactation performance of crossbred dairy cows in Adigrat Town, the Eastern Tigray Zone of Ethiopia.

## MATERIALS AND METHODS

**Description of the study area:** The study was conducted in Adigrat town (Fig. 1). It is around 900 km North of Addis Ababa, the capital of Ethiopia and the diplomatic center of Africa. Adigrat town is the administrative center of the Eastern Tigray Zone. It is believed that the town is the second largest

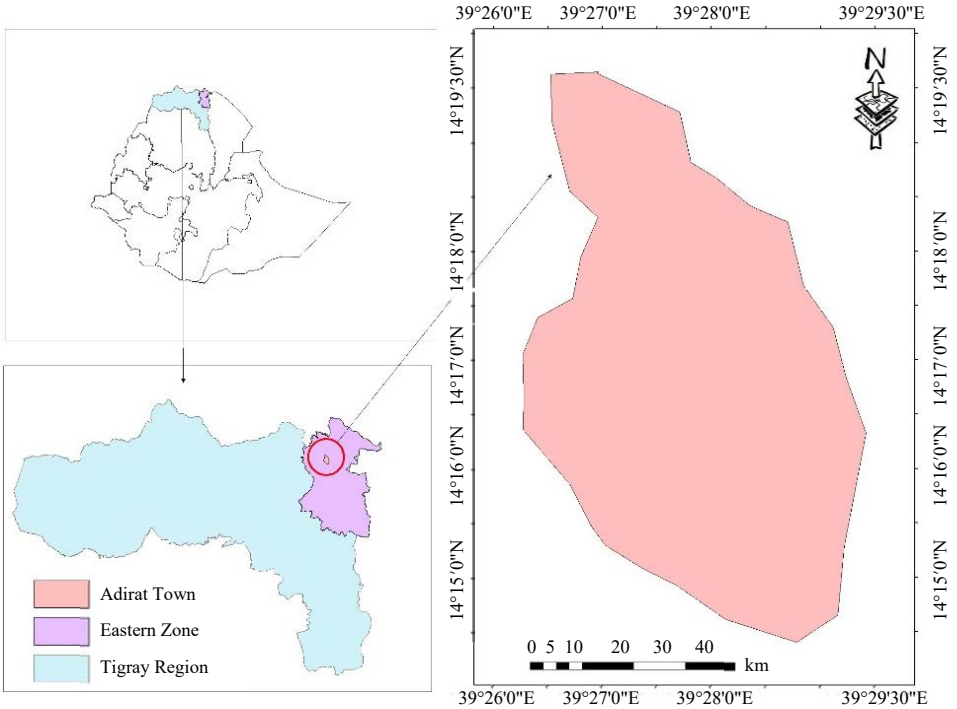


Fig. 1: Map of the study area

town in the Tigray regional state, next to Mekelle city. Geographically, Adigrat town is positioned at 14°20' North Latitude and 39°29' East Longitude. The altitude ranges from 1500-2500 m.a.s.L. The study area has a cold semi-arid climate. The overall climate throughout the year is mild and dry. Annual rainfall ranges between 400 and 600 mm, with most of the rain falling during the rainy season (between June and September). Annual minimum and maximum temperatures are 15 and 20°C, respectively[12-14].

**Sampling procedures and sample size determination:** Dairy farms found in the town were recognized with the help of Adigrat town Micro and Small Enterprises. Following the identification of the dairy farmers, both purposive and random sampling techniques were used. Adigrat town is subdivided into six *kebelles* (the smallest administrative unit). Of the six *kebelles*, four *kebelles* (01, 02, 03 and 06) were used as study sites based on milk production and possession of crossbred dairy cattle. A random sampling method was used to select dairy farmers. A total of 180 respondents (45 from each *kebelle*) were visited and interviewed.

**Data collection procedures:** Semi-structured questionnaires were developed, pre-tested and administered to farm owners found in the town. In addition to the primary data generated through face-to-face interviews, data were collected through consultation of key informants. The questionnaire included open-ended questions on household demographic characteristics, dairy cows holding, daily milk yield, milking times, lactation length and milk processing practices. Data collection was conducted across dairy farmers from February to July, 2024. Each dairy farmer was visited at least once during the study period.

**Statistical analysis:** Data collected from dairy producers were cleaned and entered into an Excel spreadsheet. Statistical analysis were performed by using Excel software (Microsoft Office, 2010).

## RESULTS

**Demographic characteristics of the dairy farmers:** Table 1 shows a detailed summary of the demographic characteristics of the study sample. The majority of 165 (91.7%) were males and 15 (8.3%) were females. The mean age of all the sampled dairy farmers is 48.1±3.4 years. The mean household size observed in the present study is 4.2±1.2 people. It was also observed that about 98.3% of all the respondents reported they were married at the time of the survey. A small percentage reported being divorced (1.1%) and widowed (0.6%). Results indicated that (3.3%) of the respondents were illiterate, (11.7%) were able to read and write, (42.8%) attained elementary school, while a small number of the sampled household heads, (29.4%), (12.8%), attained high school and obtained diploma and above, respectively.

**Experience of the dairy farmers:** Dairy farming experience affects the farm management and decision-making process. The experience of the studied dairy farmers was assessed by the number of years that a farmer has been practicing dairy farming. The results from Table 2 indicated that most of the farmers had practiced dairy farming for between 10-20 years (46.1%), followed by 20-30 years (32.8%), 1-10 (14.4%) years and 30-40 years (6.7%). The minimum period that the studied farmers have reared dairy cows was 7 years, while the maximum period was 35 years.

**Dairy animal management practices in the study area:** Animal feeds represent the major input in dairy production. Common feed resources in the study area included natural pasture, grass hay, crop residue, mainly barley straw, cactus pear (*Opuntia ficus-indica*), locally available non-conventional feeds for example, *Atella* and oilseed cakes such as noug, cottonseed and sesame cakes. The study revealed that dairy farmers in the area purchased feeds from the local market. Stall feeding was the main feeding system.

Dairy farmers keep their cattle in separate houses. The purposes of housing dairy cattle in the area are to protect them from theft and extreme weather conditions during the dry and wet seasons. The study also revealed that calves were housed separately from the dams except when calves were needed to stimulate milk let-down. Tape water was the major source of water and AI was the most common method for dairy cattle breeding. The respondents practiced regular vaccination of their animals. The study indicated a high level of awareness in dairy animal owners.

However, availability and costs of feeds, poor AI and veterinary services, pasture land shortage and limited space for proper housing are the major challenges identified in the study area.

**Dairy cows holding, milking practices and milk production purposes:** As shown in Table 3, 94.4% of the dairy farmers reared 3-5 cows, while 3.9% reared 6-10 cows and 1.7% reared 10 or more. Results of the study also revealed that milking is

Table 1: Demographic characteristics of the responding households

| | Kebelle | | | | |
|---|---|---|---|---|---|
| Demographic factor | 01 (n = 45) | 02 (n = 45) | 03 (n = 45) | 06 (n = 45) | Overall (n =180) |
| Sex | | | | | |
| Male | 42 (93.3) | 41 (91.1) | 42 (93.3) | 40 (89.9) | 165 (91.7) |
| Female | 3 (6.7) | 4 (8.9) | 3 (6.7) | 5 (11.1) | 15 (8.3) |
| Age (Mean ±SD) | 49.1±3.9 | 48.5±2.6 | 48.7±4.1 | 49.5±3.4 | 48.8±3.6 |
| Family size (Mean ±SD) | 4.3±1.3 | 4.2±1.1 | 4.1±0.8 | 4.1±1.4 | 4.2±1.2 |
| Marital status | | | | | |
| Married | 44 (97.8) | 44 (97.8) | 44 (97.8) | 45 (100) | 177 (98.3) |
| Divorced | 1 (2.2) | 1 (2.2) | 0 (0) | 0 (0) | 2 (1.1) |
| Widowed | 0 (0) | 0 (0) | 1 (2.2) | 0 (0) | 1 (0.6) |
| Single | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Education level | | | | | |
| Illiterate | 2 (4.4) | 3 (6.7) | 1 (2.2) | 0 (0) | 6 (3.3) |
| Read and write | 7 (15.6) | 5 (11.1) | 4 (8.9) | 5 (11.1) | 21 (11.7) |
| Elementary school | 19 (42.2) | 20 (44.4) | 18 (40.0) | 20 (44.4) | 77 (42.8) |
| High school | 11 (24.4) | 13 (28.9) | 15 (33.3) | 14 (31.1) | 53 (29.4) |
| Diploma and above | 6 (13.3) | 4 (8.9) | 7 (15.6) | 6 (13.3) | 23 (12.8) |

N: Number of respondents; numbers in parentheses represent the percentage from respondents and numbers outside of parentheses represent number of respondents and SD: Standard deviation

Table 2: Dairy farmers experience in dairy farming in the area

| | Kebelle | | | | |
|---|---|---|---|---|---|
| Respondent's experience in dairying (year) | 01 (n = 45) | 02 (n = 45) | 03 (n = 45) | 06 (n = 45) | Overall (n =180) |
| 1-10 | 7 (15.6) | 6 (13.3) | 8 (17.8) | 5 (11.1) | 26 (14.4) |
| 10-20 | 19 (42.2) | 22 (48.9) | 20 (44.4) | 22 (48.9) | 83 (46.1) |
| 20-30 | 15 (33.3) | 14 (31.1) | 15 (33.3) | 15 (33.3) | 59 (32.8) |
| 30-40 | 4 (8.9) | 3 (6.7) | 2 (4.4) | 3 (6.7) | 12 (6.7) |

N: Number of respondents; numbers in parentheses represent the percentage from respondents and numbers outside of parentheses represent number of respondents

Table 3: Crossbred dairy cows holding, milking practices and purpose of milk production in the area

| | Kebelle | | | | |
|---|---|---|---|---|---|
| Variable | 01 (n=45) | 02 (n=45) | 03 (n=45) | 06 (n=45) | Overall (n=180) |
| Number of cows/household | | | | | |
| 3-5 | 40 (88.9) | 44 (97.8) | 43 (95.6) | 43 (95.6) | 170 (94.4) |
| 6-10 | 3 (6.7) | 1 (2.2) | 1 (2.2) | 2 (4.4) | 7 (3.9) |
| >10 | 2 (4.4) | 0 (0.0) | 1 (2.2) | 0 (0.0) | 3 (1.7) |
| Milking practice | | | | | |
| Hand milking | 45 (100) | 45 (100) | 45 (100) | 45 (100) | 180 (100) |
| Machine milking | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Milking frequency ($day^{-1}$) | | | | | |
| Once | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Twice | 45 (100) | 45 (100) | 45 (100) | 45 (100) | 45 (100) |
| Thrice | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| DMY (mean ±SD, liters) | 11.5±2.7 | 10.8±1.3 | 11.3±2.1 | 10.9±1.8 | 11.2±1.8 |
| LL (mean ±SD, months) | 9.5±2.2 | 9.3±2.4 | 9.1±2.0 | 9.4±2.2 | 9.3±2.1 |
| Purposes of milk production | | | | | |
| For marketing | 44 (97.8) | 43 (100) | 44 (97.8) | 44 (97.8) | 175 (97.2) |
| For consumption | 1 (2.2) | 1 (2.2) | 0 (0) | 1 (2.2) | 3 (1.7) |
| For processing | 0 (0) | 1 (2.2) | 1 (2.2) | 0 (0) | 2 (1.1) |

N: Number of respondents; numbers in parentheses represent the percentage from respondents and numbers outside of parentheses represent number of respondents, DMY: Daily milk yield, LL: Lactation length and SD: Standard deviation

done by hand (100%) with the milking frequency of twice a day about eleven hours apart. Most of the time (98.0%), milking is the responsibility of women and by men (2.0%) in rare cases. The mean daily milk yield was 11.2±1.8 liters/head/day. The studied dairy farmers used warm water and detergents to wash their hands, milk-handling containers and udders before milking. The milkers dip their fingers in the milking vessels and moisten the teats

of cows to facilitate milking. All the dairy farmers who were studied reported that they wash their milk containers before and after milking. The estimated mean lactation length was 9.3±2.1 months. Nearly ninety-seven percent of the respondents produced fresh milk for sale, while 1.7 and 1.1% of the households used it for consumption and processing at the household level, respectively.

**Processing dairy products in the study area:** Traditional milk processing is the only milk processing method practiced in the study area. The common dairy products produced are fresh whole milk, traditional fermented (sour) milk, butter, buttermilk, ghee and traditional fermented cottage cheese. Naturally fermented sour milk is used as a raw material for the processing and production of various traditional dairy products indicated above and hence is rarely consumed. Dairy products processing, selling as well as other household activities are permanently the responsibility of women. Butter is used for sale, for cooking and for cosmetic purposes, mainly by ladies and by children very rarely. The interviewed household heads reported that buttermilk is used for direct consumption, sale and for the production of defatted sour milk as well as fermented cottage cheese.

## DISCUSSION

In the present study, the highest percentages of households were male-headed, which suggests that higher proportions of males were engaged in urban dairy farming than females. The large proportion of male farmers is essential for the transfer and adopting of technologies as men are regularly decision makers in most African countries[15]. For that reason, attention must be given to female' participation in dairy farming for work, employment and income generation. The age of the respondents revealed that urban dairy production in the area is more practiced by adult people than young people and this in turn, indicates that young people are less involved in urban dairy farming, which might be due to different reasons such as financial and experience-related problems. The overall mean family size of the responding dairy farmers is moderate. The mean family size in this study was closer to the figures reported earlier in Raya Kobo District[16] and Western Tigray Abraham[17], but lower than the results of Fita *et al.*[18].

Education plays a significant role in development as it affects household income, new technology adoption and its better understanding, livestock management practices, as well as livelihood of the owners[17-19]. This shows educational background of livestock owners may have crucial importance in determining the type of development and extension service approaches. Results of the study indicated that the majority of the sampled dairy farmers were literate, which ranges from reading and writing up to diploma and above. Hence, this is a good opportunity for advancing dairy production in the area, which is mainly based on the traditional production system currently.

Experience in dairy farming is an important issue, which is measured by the number of years the farmer has been involved in activities of participation in dairy farming. Honestly, an experienced farmer will most likely identify the relative advantage of new and improved technologies over the old. Results of the current study showed that the majority of the sampled dairy farmers were traditionally experienced in dairying for a long period. Above 94 percent of the interviewed dairy farmers own 3-5 lactating cows. Based on own observations and interview results of the respondents, major sources of animal feed in the study area included pasture, grass hay, crop residues, cactus pear (*Opuntia ficus-indica*), oil seed cakes and locally available non-conventional feeds. In line with the present study, hay, grazing, crop residue, oil seed cakes and byproducts of local breweries, for example, *Atella,* were the major sources of feed in central Tigray Zone[19]. The interviewed dairy farmers totally relied on hand milking. Hand milking is commonly used in various parts of the world where farmers do not have access to technology for machine milking. The obtained daily milk yield (DMY) is similar to the mean daily milk yield of 10.8±2.4 and 11.6±3.1 l/d per cow for crossbred dairy cows in Akaki and Bishoftu towns, respectively[20]. The lactation length of this study is shorter than the ideal lactation length of 305 days, which was defined by Foley *et al.*[21]. Dairy farming in the area is constrained by feed availability and cost, poor AI and veterinary services, shortage of pasture land and limited spaces for proper housing.

## CONCLUSION

The study indicated that crossbred dairy cows are crucial to enhancing dairy production. Dairy farmers in the area dominantly use the stall-feeding system. However, dairy farmers should be capacitated on dairy animal management to obtain good quality, safety and healthy dairy products. The study also recommends that dairy farmers in the study area be trained in the use of modern technologies such as a milking machine. Besides, dairy farming in the area should be considered by responsible bodies.

## SIGNIFICANCE STATEMENT

This study discovered that the crossbreeding program can be beneficial for dairy production improvement in the study area. The lactation performance of tropical dairy cattle can be further improved by genetic selection as well as by improving management practices. Hence, the results of this study will help the researchers to uncover the critical areas of crossbreeding programs in dairy production enhancement under various management practices in the tropical countries that many researchers were not able to explore.

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