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# ZOO-TECHNICAL PERFORMANCE OF INDIGENOUS DAIRY COWS UNDER SMALL HOLDER FARMERS MANAGEMENT SYSTEM IN HAWELLA-TULLA DISTRICT, ETHIOPIA

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*Supporting Information*

**ABSTRACT**: Ethiopia's dairy production system is predominantly extensive, with poor cattle performance constrained by a variety of factors such as poor genetics, low reproductive performance, and poor quality of feed, among others. So far, little work aimed at increasing dairy production has been undertaken. The objective of the study was to characterize the zoo-technical performance of indigenous dairy cows under small holder farmer management system. The study was undertaken in Hawella-Tulla district, Sidama Region; Sothern Ethiopia from November 2020 to March 2021. From three peasant associations (PA), 180 smallholder dairy farmers who owned local cows were selected using a simple random selection technique. Data were collected using a structured questionnaire. The majority of farmers (75%) practiced in mixed crop-livestock farming primarily produce milk for income generation. Farmers hold an average of 1.95±0.063 local lactating cows. The productive performance of the indigenous cow mean of daily milk yield was 1.53±0.09 liters and 6.5±0.89 months of lactation length. The mean age at first service (AFS) was 38.5±2.71 months, Age at first calving (AFC) was 45.3±2.82 months, calving interval (CI) was 20.08±0.9 months, and number of services per conception (NSPC) was 2.5±0.63. It can be concluded that the zoo-technical performance of local cows was very low. Therefore, planned technical and institutional intervention to improve the feeding system, provide better health management, genetic improvement of local breeds through crossbreeding and synchronization should be carried out for the betterment performance of local cows.

RESEARCH ARTICLE

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## INTRODUCTION

Dairy production is an essential part of livestock farming in Ethiopia (Getabalew et al., 2019). Dairying, however, has not been completely utilized and stimulated (Sintayehu et al., 2008; Minten et al., 2020). Moreover, due to a lack of infrastructure and market links, commercialized smallholder dairy production is not effectively practiced, with only around 15% of the output reaching the market. As a result, the dairy sector's contribution to the country's agricultural economy remains lower than it could be (FAO, 2017).

Ethiopia's milk production is growing slowly. The annual milk production growth rate of 1.2 percent lags behind the expected yearly human population growth of 3%. About 97 % of annual milk production of the countries is produced under the smallholder milk production system, which is dominated by local breeds with low production levels (Getabalew et al., 2019). The Zoo technical performance of the herd or animal is a key indicator of the sustainability of a dairy farming system. In this regard, the performance record of local cows is essential for designing breeding as well as management strategies in dairy sector (Abrha et al., 2020). Zoo technical features such as age at first service, calving interval, number of services per conception, average milk yield per day, and calving interval determine cow reproductive and productive efficiency (Neto et al., 2018). It is further noted that these traits are critical in terms of the economics of dairy management (Abrha et al., 2020).

The Hawella-Tulla district is one of the potential dairy cattle production areas, which is dominated by indigenous dairy cows. Despite this, the performance of dairy cows has not been scientifically documented. So far, little research has been conducted to identify the overall productive and reproductive performances of indigenous dairy cows managed by smallholder farmers. So, an understanding of Zoo-technical performance of indigenous cows under smallholder farmer's management system provides guidance as to which of the possible new technologies are appropriate and worth pursuing in order to increase productivity in indigenous dairy cows. Thus, studying the zoo-technical performances of local cows is crucial in order to generate baseline data that livestock owners, extension agents, and researchers can use to develop improvement and development strategies for local cow productivity. On the basis of this, the current study investigated the zoo-technical performance of indigenous cows in the Hawella–Tulla district under a smallholder management system.



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## MATERIALS AND METHODS

### Description of the study area

This research was carried out in the Hawella-Tulla district of Sidama Regional State, which is 10 kilometers from Hawassa City and 285 km south of Addis Ababa. Geographically, it is located between 6.45 degree and 38.7 degree longitude east, and between 6.33 degree and 6.62 degree latitude north. The district is one of the eight districts in the Hawassa city administration. The district has a total population of 138,979. The average annual rainfall is 1124 mm. The average altitude is 1710 meters, with a maximum temperature of 32 degrees Celsius and a minimum temperature of 28 degrees Celsius. Maize is the dominant crop grown in the area. Cattles are the most common livestock in the area (Teklemariam and Cochrane, 2021).

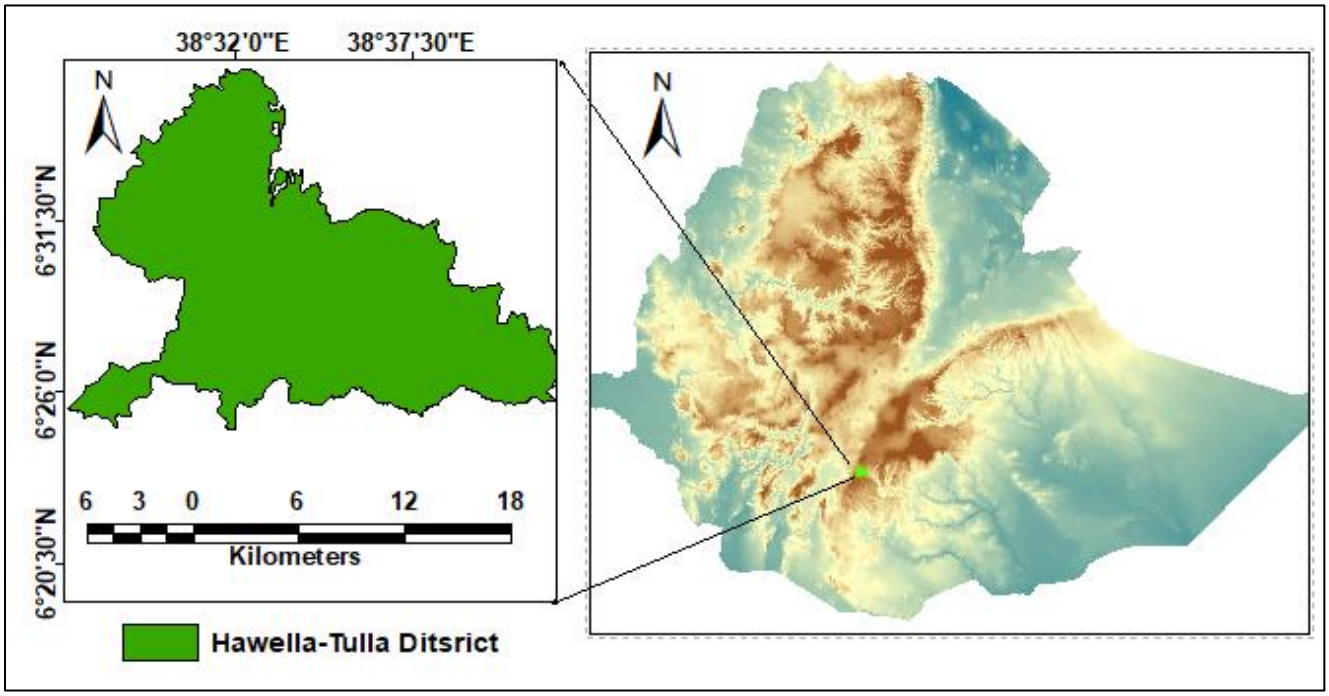


**Figure 1** - Location map of Hawella-Tulla District

### Sampling procedures/ techniques

The survey was conducted during the months of November 2020 to March 2021. A reconnaissance survey instrument was developed and conducted in order to select specific dairy farmers and to get a general picture of the study sites. A two-stage purposive and random sampling technique was implemented to select research units. First, after taking information on the production potentials of all kebeles from the district, three kebeles (peasant associations) were selected purposively based on their potential in dairy cattle production and minimum holding of at least one local cow. Second, a total of 180 smallholder dairy farmers from three kebeles were selected using a simple random selection technique and the sample size determination formula 1 presented by Yamane (1965).

$$n=\frac{N}{1+N(e)^2} \quad \text{.....1}$$

Where, n is the sample size, N is the population size and e is the level of precession. The total dairy cattle producers in the district were 301 and 4.75% precision was used

$$n=\frac{301}{1+301(0.475)^2} = 179.2 \text{.....2}$$

As a result, an approximation was employed, and the total number of small holder dairy producers used was 180.

### Sources and methods of data collection

A cross-sectional survey was undertaken on 180 purposely selected smallholder dairy farmers from three potential kebeles (Cheffe, Dato and Tulla). Primary data was collected through a pretested structured questionnaire. Secondary data were collected from documents of district's livestock and fisheries office and other related articles.

### Data analysis

The data was encoded and cleared using Microsoft Office Excel 2019 and descriptive statics were generated after analysis using SPSS (statistical package for social science, version 26). Percentages, means tables, and standard error



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were used to illustrate the summarized results. A person chi-square test was calculated using a statistical analysis system to see whether or not the proportions of the variables differed significantly.

### Ethical clearance

The data collection tool (field survey questionnaire) were assessed and approved by Dilla University's College of Agriculture and Natural Resources Furthermore, all of the surveyed smallholder farmers in this study provided informed consent.

## RESULTS AND DISCUSSION

### Characterization of production system

The significant difference in characterization and purpose of production system of respondents was tested at 5% probability. According to the respondents, 75% practiced mixed crop-livestock farming, indicating a significant difference ($P<0.05$) in the percentage of farmers that practiced mixed production compared livestock production (Table 1). The findings are comparable to those of Asrat et al. (2016) in Wolaita Sodo Town, Southern Ethiopia. This implies Crop cultivation and cattle production are complementary activities for the majority of the respondents. Cereal crop based system (Maize) is the major system under the mixed crop-livestock production system in the Hawella-Tulla district. A significant number of smallholder dairy farmers (58.3%) were producing milk primarily for income generation. Getabalew et al. (2019) also mentioned milk production as income generation/sale purpose in small scale dairy production system.

### Characterization of local cattle herd compositions

The average herd composition of the assessed small holder dairy farms in the district is summarized in Table 2. Farmers hold an average of 1.95±0.063 local lactating cows. In Dilla-Zuriya district, Hailemariam et al. (2022) mentioned that smallholder farmers hold of 2.92 ± 1.18 local cows. The study identifies that even though indigenous cow are low milk producer, and they were the major source of milk in the study area. According to Hailemariam et al. (2022), keeping the most cows may be beneficial due to their various functional uses in milk production, replacement stock, and manure. Farmers, on the other hand, rarely kept local bulls. This lower average of bulls in the current study could be attributable to a major land limitation on providing adequate feed for their animals.

### Zoo-technical performance of local cows

#### *Daily milk yield and lactation length*

The mean daily milk yield (DMY) of local cow under small holder farmer management system was 1.53±0.09 liters. The DMY recorded in this study was comparable with the report by Yetera et al. (2018) who reported 1.51± 0.08 liters in selected parts of Sidama Zone, but lower than that reported Abdurehman Musa and Yusuf Mummed (2020) which was 1.94 ±0.154 liters in West Hararghe, Oromiya Regional State and 1.8±0.045 liters in Dawero zone by Hussein (2018).

The difference in daily milk yield could be explained by feed availability, animal health management, agro-ecological zones difference, and variations in farmers' practices of keeping selected local cows. In terms of nutrition, for example, the research conducted by Mekuriaw et al. (2020) in Fogera local cow showed that the milk yield in the cows fed Brachiaria hybrid grass hay was almost double (52.97%) that of the natural pasture hay diet. These results suggest that better feeding and fodder incorporation could increase milk yield in indigenous dairy cows.

The lactation length (LL) is a crucial production trait since it affects total milk yield (Vijayakumar et al., 2017; Demeke, 2020). The lactation length found in the Hawella-Tulla district was 6.5±0.89 months. The current study's mean LL of local cow under farmer's management was lower than the reports of Kibru et al. (2015), Abrha et al. (2020), Adane and Ayalew (2020), and Demeke (2020) in Central Tigray, Chuko, Gondar, Angot District respectively. The LL in this study was also lower than the national average of seven months (Mekuriaw and Harris, 2021). This indicates that cows in the current study area had shorter lactation periods. This could be due to feed as well as other management issues such as breed improvement practices. As a result, addressing these issues will improve the cow's LL. For example, a study by Ayalew and Asefa (2013) indicated that better feeding conditions and cross breeding improved the lactation length of crossbred Holstein Friesian–local cows to 11.13 ± 4.84 months compared to the local cow LL of 9.13 ± 2.6 months. Most Ethiopian local cows have a short lactation period, indicating that they have been kept for an extended length of time without generating any output (milk or calf), instead relying on feed and other production costs.

### Reproductive performance of local cows

#### *Age at first service (AFS)*

The mean age at first service (AFS) was found to be 38.5 ± 2.71 months (Table-3). The current finding is lower than AFS of 44.1±5.9 months reported by Belay (2016) and 42.61±2.82 by Yetera et al. (2018) for local dairy cows in Sidama Zone, Southern Ethiopia. In Siltie Zone, Tolasa (2021) mentioned lower AFS (37.5± 13.5). This variance could be attributable to various factors such as feed availability and access to concentrate feed, artificial insemination availability, and dairy husbandry practices. Farmers remarked that the likely cause of the delayed first service is slow heifer growth, which is largely influenced by feed and animal health management.



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***Age at first calving (AFC)***

Age at first calving , or the time it takes a female calf to achieve puberty and reproduce for the first time, is a significant element in the expense of rearing replacements in dairy herds (Atashi et al., 2021). Local cows in Hawella-Tulla district had a mean age at first calving of 45.3±2.82, which was comparable to the AFC of 45.13±2.31 in Angot District reported by Demeke (2020). It was, however, greater than the mean age at first calving (AFC) in Central Tigray, which was 43.3±2.7 months by Abrha et al. (2020) and lower than the AFC of 52.30±2.73 months reported by Yetera et al. (2018). These variations could be linked to a shortage of feed sources, as environmental factors, notably nutrition, can affect heifer growth and maturity, as well as the normal development of reproductive organs in order for them to perform their functions. Farmers noted that a cow's nutritional state has a huge impact on AFC.

***Calving interval***

The calving interval is the period time between two consecutive parturitions (Atashi et al., 2021). The mean calving interval (CI) in this study was 20.08±0.9 months, which was greater than the CI of 16.02±0.29 months reported in West Hararghe, Oromiya Regional State by Abdurehman Musa and Yusuf Mummed (2020) and with CI of 19.93 ±0.18 by Kibru et al. (2015). However, the current finding was comparable with the CI of 20.08±0.90 by Yetera et al. (2018) and lower than CI of 23.6±4.4 by Belay (2016). The variation could be linked to feed shortages, the calving season, health care, and a lack of fodder availability in indigenous dairy cows documented across the country. Farmers in the study area believe that silent estrus and a lack of adequate heat detection are important reasons in the delayed CI of local cows.

***Number of services per conception (NSPC)***

In the Hawella-Tula district, the average number of services per conception of indigenous cows was 2.5±0.63. The mean NSPC is greater than the NSPC of 1.81 for indigenous cows in Silte zone (Tolasa, 2021). Furthermore in smallholder farm situations in and around Maksegnit Town NSPC of 2 was reported by Alemayehu and Moges (2014) and 1.8 by Belay (2016) in Sidama zone. According to Kumar et al. (2014), indigenous cows in Gondar had a considerably higher NSPC (2.2±0.2) than HF crossbreds (1.5±0.3) under a small holder management system. According to Mukasa-Mugerwa (1989), a number of services per conception greater than two should be considered poor. Poor reproductive management, a lack of effective heat detection, and a lack of timely insemination could all be contributing factors to the study area's high NSPC. NSPC depends on the breeding system used. It is higher under uncontrolled natural breeding than artificial insemination. Moreover Silent estrus also increases the NSPC of local cows in the study area.

**Table 1-** Characterization production system dairy in Hawella-Tulla district

| Description | | Cheffe N (%) | Dato N (%) | Tullo N (%) | Overall % | X2 | P-value |
|---|---|---|---|---|---|---|---|
| Production system | Livestock production | 12(20) | 18(30) | 15(25) | 25 | 37.545* | 0.0001 |
| | Mixed crop-livestock farming | 48(80) | 42(70) | 45(75) | 75 | | |
| Purpose of milk production | Income generation/sale | 18(30) | 48(80) | 39(65) | 58.3 | 18.045* | 0.001 |
| | Home consumption | 12(20) | 3(5) | 6(10) | 11.7 | | |
| | Both | 30(50) | 9(15) | 15(25) | 30 | | |

χ2 =Chi-square; * = significant if p < 0.05 level of significance.

**Table 2 -** Local cattle herd structure in Hawella-Tulla District

| Local cattle herd structure | Mean ± SE |
|---|---|
| Lactating cows | 1.95±0.063 |
| Dry cows | 1±0.001 |
| Heifer | 1.17±0.167 |
| Calves | 1.06±0.062 |
| Bull | 0.25±0.02 |

**Table 3-** Zoo- technical performance of local cows in Hawella-Tulla District

| Parameters | Mean ±SE |
|---|---|
| Daily milk yield (liters) | 1.53±0.09 |
| Lactation length (month) | 6.5±0.89 |
| Age at first service (month) | 38.5±2.71 |
| Age at first calving (month) | 45.3±2.82 |
| Calving interval (month) | 20.08±0.9 |
| No. of service per conception | 2.5±0.63 |



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## CONCLUSION

Smallholder dairy farmers in Hawella-Tulla district produce milk under a mixed crop-livestock production system primarily for income generation. Local cows managed by small-holder farmers had low daily milk yields, short lactation lengths, lengthy calving intervals, and a large number of services per consumption. Based on the current survey results, it can be stated that the zoo-technical performance of local cows was very poor. This requires coordinated technical and institutional interventions to improve the feeding system, provide improved health management, genetic development of indigenous breeds through cross breeding, and estrus synchronization. Smallholders in the study areas should be encouraged to improve and expand their crossbred dairy cattle production.

## DECLARATIONS

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**Authors' contribution**
I contribute with idea generation, data collecting, and analysis, as well as manuscript writing.

**Conflict of interests**
The author declares no conflict of interest.

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