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Dairy Cattle Breeding Practices and Farmers Trait Preferences in Sidama Zone, Southern Ethiopia

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Abstract
The study was aimed to assess indigenous dairy cattle breeding practices and major trait preferences in selecting better dairy cows in Sidama zone. A total of 120 households from high land and midland area were randomly selected for household survey. Data was analyzed using SPSS version 20. The average cattle holding per household was a significant ($P<0.05$) difference among the study sites. Higher number of cattle per household was obtained from highland (2.71±1.23) site. The average number of cows per household was significantly ($P<0.01$) higher in highland (6.73±3.93 than midland (3.23±1.6). The main breeding objective of cattle was income generation, saving and meat purpose. Uncontrolled/natural mating (69%) was dominated, but AI existed (13.5%) in small frequencies in both study sites. Majority of respondents do not own their own breeding bulls but rely on bulls owned by their neighbors. Animal productivity was preferred by most of the participants of the study due to better expression of the dairy traits. Among these, the major dairy traits were milk, fertility of animals, growth rate and low feeding behavior with the indices value of 0.3, 0.27, 0.21 and 0.1, respectively. The major problems for dairy cattle productively were feed shortage, diseases, and repeat breeder cows. In conclusion, dairy cattle productivity was limited by constraints namely uncontrolled breeding system, shortage of feed, and higher prevalence of repeat breeder cows. Therefore, to improve the productivity of dairy cattle, breeding practices use through artificial insemination would be the best recommended practice in the study areas and beyond.

Keywords: Dairy Cattle, Breeding Practice, Herd Composition, Trait Preference, Mating Type

Introduction

In Ethiopia cattle production is the major component of the livestock sector and owning to the large population of 70 million, of which about 56% are females and 44% are males. Dairy cows are estimated to be around 10.8% and dominated by local breeds and only 2.6 % are cross-bred and exotic from the total cattle population (CSA, 2021) [5]. The distribution of local cattle populations across the different agro-ecologies of the country provide various options for tangible (milk, meat, hide and draft power) and non-tangible (social prestige and savings) use of livestock products to the smallholder farmers and pastoral communities (CSA, 2019). However, the productivity of the local cattle is low due to their genetic makeup, low level of inputs, and traditional husbandry practice besides environmental stress (Tegegne *et al*., 2010) [23].

Indigenous cattle populations are a valuable genetic resource, because of their adaptation to harsh climatic conditions, their ability to better utilize poor quality feed resources and their tolerance to a diseases and soundly fit with farmers farming condition, which they have acquired through natural selection (Tadesse *et al.,* 2014) [22]. However, the productivity of local cattle are low due to absence of genetic improvement intervention, low level of inputs, traditional husbandry practices as well as environmental stress (Tegegne *et al*., 2010 [23], cited in Zewidu *et al*., 2018). On average indigenous cattle milk production is 1.48 liters per cow per day (CSA, 2021) [5].

In cattle breeding, most of the dairy owners in the highland, midland and the lowland areas of the country used natural mating system and some farmers used along with artificial insemination (Bedada *et al*., 2021) [4]. Some of the farmers also preferred seasons for mating for their dairy cattle. They mate their cows in such a way that the calving falls during the wet season to take the advantage of abundant feed supply which promotes better milk production and hence a better chance of survival of calves

(Bedada *et al*., 2021) [4]. Trait preference for selection of animals are various across the different agro-ecologies, communities, and production system (Roessler *et al*., 2008) [18].

However, the most economically important traits in livestock breeding can be influenced by differences in their production systems. Therefore, in order to meet this demand, improving the potential milk production status of dairy cattle through selection and breeding of cows by trait preference of the dairy owners and breeding practices among production systems. Therefore, the main objective of this study were to assess dairy cattle breeding practice, and identify major trait preference for selection of dairy cattle particularly used by smallholder farmers.

Materials and Methods

Description of the study areas

The study was conducted in highland and midland agro-ecologies of Sidama Zone of Southern Region. Geographically, Sidama zone is situated between the coordinates of $5^0$45' and $6^0$45' N latitude and $38^0$39' and $38^0$29' E longitude with altitude ranging from 1100 to 3500 meter above sea level (m asl). Rainfall pattern of the zone is bimodal type with small rainfall during the months of February to April followed by the main rainy season from July to September. Sidama zone consists of 19 districts with total area coverage of about 10,000 km^2. It has a diverse agro ecology classified as highlands, midlands and semi-dry lowlands covering 30%, 60% and 10% respectively. The zone endowed with different livestock resources such as cattle, small ruminants, equines, poultry and honey bee.

Sampling techniques and data collection procedures

Both primary and secondary data were collected from primary and secondary data sources. Questionnaire survey was used for the primary data collection. A total of 120 households were selected randomly to administer a questionnaire. The questionnaire was designed to explore general information about breeding practice, purpose of keeping cattle and trait preference for selection of dairy cattle. A total of eight group discussions were employed to fill any emerging information gap in each site. The discussions on how farmers select and breed cows for milk production, and what criteria they apply.

Data analysis

Data collected via questionnaire survey was processed in Microsoft Excel and Statistical Package for Social Science Version 20.0 (SPSS). Qualitative data from survey was analysed using descriptive statistics such as percentage, average, frequency and standard deviation and qualitative data was analyzed using non-parametric tests. The variation between groups was considered significant when the P value was less than 0.05. Purpose of keeping cattle, trait preferences and constraints of cattle productivity were analyzed using index method of ranking analyses (Musa *et al*., 2006) [17].

$$\text{Rankingindex} = \frac{Rn * C1 + Rn - 1 * C_2 \ldots + R_1 * CN}{\sum Rn * C_1 + Rn - 1 * C_2 \ldots + R_1 * CN}$$

Where,

R_n=the last rank (if the last rank is 5, then R_{n-1} = 4), R_1 = 1

$C_{1 \ldots N}$ = percent of respondents ranked first to last

Result and Discussion

Socio-economics characteristics

The majority (94.7%) of the respondents in both study areas were male headed Table 1. The study revealed that majority of household was male headed. The mean age of the respondent was 42.5 years which is comparable with the value 42.5 reported by Abegaz *et al*. (2013) [1] for Metema (42.5) and Abergelle (42.0) districts of Amhara Region. Majority of respondents were literate (69.9%), whereas 31.1% are Illiterate. The relatively higher proportion of literate household heads for dairy cattle owners would be a good opportunity to implement any improvement as it might be easier for them to record performance of dairy cattle. Haile and Tesfahun (2022) [10] findings support the importance of education on agricultural technology practices and efficient resources use.

Table 1: Socio-economic and demographic characteristics of the households (N=120)

Parameters	Highland	Midland	Overall mean
Family size (mean±SD)	8.2±2.8[a]	7.2±2.3[b]	7.5±2.5
Male	4.4±2.0	3.7±1.6	4±1.8
Female	3.7±1.8	3.5±1.7	3.4±1.8
Age of household (mean±SD)	45±12.4[a]	40.3±10.6[b]	42.5±11.3
Educational level (%)			
Illiterate	26.7	33.3	31.1
1-6	23.3	25	24.4
7-8	28.3	20.8	23.3
9-12	21.7	20.8	21.1

[a-b] means with different subscript letters across agro-ecology are significantly different (P<0.05), SD= standard deviation, N= number of respondents.

Herd Composition

The average herd compositions are summarized in Table 2. The result indicates that herd size was a significant (P< 0.05) difference among the study agro-ecologies. The mean herd size of the current study was significantly lower than that reported by Mekonen *et al*. (2012) [16] as 11.7± 0.55 in western Oromia, but it was slightly lower than from Gebissa (2014) [7] as 2.4+1.6 in Borana zone. The differences in the herd size may be attributed to shortage of gazing land and large share of farm lands which are voted for agronomic crops. Cows take the leading numbers in the herd composition, but it was a significantly (P<0.001) varied among the study agro-ecologies. The number of bulls, heifers and calves were also significantly (P< 0.05) higher in highland study area. The higher numbers of cows and young animals among the herd composition are in line with the result of Haile and Tesfahun (2022) [10] as they reported that farmers possess more cows among the herd composition. The higher proportion of cows and young animals in the herd endeavors large crops of calves for rapid herd growth and enhance cattle productivity of the country (Gebissa, 2014) [7].

Table 2: Cattle herd composition and average herd size of the sampled households (N=120)

Herd composition	Highland	Midland	Overall (Mean ± SE)
Overall	2.71±1.23[a]	1.42±1.2[b]	1.83±1.42
Cow	6.73±3.93	3.23±1.6	4.41±3.09***
Ox	0.28±0.49	0.55±0.63	0.46±0.60
Bull	0.75±0.6	0.32±0.42	0.46±0.52
Heifer	2.92±1.4	1.5±1.1	1.99±1.4**
Calves	2.62±1.33	1.41±0.95	1.8±1.23**

Note: a & b indicate herd size difference across agro- ecology; *** & ** indicate herd size difference across herd composition are significant at P < 0.01, P < 0.05, respectively, SD= standard deviation, N= number of respondents

Breeding objectives of cattle

Selecting multiple traits of animals are always part of breeding objectives, assuming that farmers purposely selecting breeding animals based their performance in relative to their parent generation (Haile and Tesfahun, 2022) [10]. The breeding objective of dairy cattle as ranked by the respondents in the study area is presented in Table 3. The result indicated that the first and second ranked farmers' dairy cattle breeding objectives were obtaining milk production and income source. The finding of the current study is in accordance with resulted reported by Banerejee *et al*. (2014) [3] and Hailemariam *et al*. (2022) [11] the purpose of keeping cattle in Ethiopia is mostly for milk production and income generation. More milk production also means better-fed calves that will have better pre- and post-weaning survival rates. An increase in milk yield will bring additional income from the sale of butter. In addition to increasing milk production and income source, keeping cattle are used for social asset and traction. Cattle are raised as an asset, which will eventually be used for the fulfilling obligatory needs of the family and also for strengthening of social value (Banerjee *et al.,* 2014) [3].

Table 3: Ranking of livestock rearing functions of respondents in highland and midland

Parameter	Highland					Midland				
	1st	2nd	3rd	4th	Index	1st	2nd	3rd	4th	Index
Milk yield	73.3	26.7	0	0	0.37	68.3	31.7	0	0	0.37
Income source	26.7	73.3	0	0	0.33	31.7	65	3.3	0	0.32
Social value	0	0	88.7	11.3	0.19	0	3.3	76	20.7	0.18
Traction	0	0	11.3	88.7	0.11	0	0	20.7	79.3	0.13

Index=the sum of (4 times first order + 3 times second order +2 times third order + 1 times fourth order) for individual variables divided by the sum of (4 times first order + 3 times second order +2 times third order + 1 times fourth order) for all variable

Dairy cattle breeding practices and source of bulls

Genetic improvement of cattle is the key element in the production of milk and milk products that determines the potential of dairy cattle (Ayza *et al.,* 2013) [2]. However, the results of the current finding indicated that natural mating system is dominated, but AI existed in small frequencies in both study agro-ecologies (Table 4). The findings are in line with those reported by (Mekonen *et al*. (2012) [16], Tegegne *et al*. (2013) [24] in most rural area of Ethiopia predominantly random breeding is a major problem for genetic improvement of the cattle. This may be attributed to the fact that many of the mating takes place in the grazing land which is shrinking over the years. Contrary to this study those with reported by Gebremedin *et al*. (2015) [9] in Central Tigray and Haile and Tesfatseion (2022) [10] in Gedeo zone AI practice is more common. However, access to AI service in the current study was higher than those reported by Ayza *et al*. (2013) [2] in Boditti, South Ethiopia. The reason for the limited use of AI service in study area could be due to lack of awareness in genetic improvement, timely access AI service, higher number of services required per conception resulting in poor reproduction in the herd. Studies by Malik *et al.* (2012) [15] indicate that cows mated naturally conceive earlier than those mated using AI because bulls have a natural advantage of stimulating estrus activity and detecting estrus in cows.

Source of breeding bulls are presented in Table 4. As the result shown majority of farmers in the study area did not have their own breeding bulls. Similar result also reported by Tegegne (2013) [24] in the rural lowland areas of Metema, majority of farmers breed their cow with any available bull in the village. This is because most of the farmers do not own breeding bulls and they use bulls from neighbors or use open mating in the communal grazing.

Table 4: Prevalent mating system and source of bull in the study area (N= 120)

Parameter	Agro-Ecology		
	Highland	Midland	Average
Mating system	%	%	%
AI	15	12	13.5
Natural and AI	17	18	17.5
Natural	68	70	69
Source of bull			
Own	36.7	24.2	32.2
From neighbors	63.3	75.8	67.8

Note: N= Number of households, AI= Artificial insemination

Trait preferences

The ranking of preferential traits for selecting breeding cattle as perceived by farmers was summarized in Table 5. Selection criteria's for dairy cattle were parallel across all the agro-ecologies. The major preferred traits as reported the sample respondents were milk yield, being regular breeder/fertility, higher rate of growth, and low feeding behavior of animals. The finding is similar with those reported by (Misganaw *et al*., 2014 [14], Destalem *et al*., 2015 and Tesfatsion, 2022) cattle producers from different parts of Ethiopia select dairy cows based on their dairy potential, regular reproduction performance, optimum growth and other important traits being desired by the dairy farmers. Some of the adaptive/ temperament, disease tolerance and coat color traits were also mentioned as selection criteria in the study sites. The adaptive traits are need to be taken into account in selection of their livestock, especially when the farmers have to face vagaries of nature and have to depend on ethno veterinary medicines for treating the sick animals (Kocho and Geta, 2011) [12].

Table 5: Ranking farmers trait preference and selection criteria for dairy cattle

Parameter	Highland						Midland					
	1st	2nd	3rd	4th	5th	Index	1st	2nd	3rd	4th	5th	Index
Milk yield	73.3	23.3	0	3.3	0	0.31	71.7	11.7	15	1.7	0	0.3
Fertility	21.7	58.3	18.3	0	1.7	0.27	16.7	81.6	0	0	0	0.27
Growth rate	0	16.7	76.7	3.3	3.3	0.2	11.7	5	68.3	13.3	0	0.21
Feeding behavior	5	0	1.7	55.3	1.7	0.1	0	0	3.3	63.3	18.3	0.1
Temperament	0	0	1.7	16.7	23.3	0.04	0	3.3	13.3	1.7	50	0.04
Coat color	0	1.7	1.7	18.3	18.3	0.05	0	0	0	0	3.3	0.02
Disease resistance	0	0	0	3.1	51.7	0.03	0	0	0	20	28.3	0.06

Index=the sum of (5 times first order + 4 times second order +3 times third order + 2 times fourth order + 1 times fifth order) for individual variables divided by the sum of (5 times first order + 4 times second order +3 times third order + 2 times fourth order + 1 times fifth order)

Constraints of dairy cattle production

The major constraints of cattle production are presented in Table 6. Irrespective of the study agro-ecologies feed shortage, prevalence of repeat breeder, diseases prevalence and shortage of veterinary service are the major problems affecting livestock productivity. Feed shortage was the primary constraints that hinder cattle productivities in both study agro-ecologies. Similar studies reported by Seid (2014) [19] in Burji district of Southern region and Belay *et al*. (2012) in Dandi district of Oromia region feed shortage is the major problem in livestock production. Shahaji *et al*. (2021) [20] reported that poor nutrition increases the susceptibility of cows to health problem and physiological stress which results in lower production, longer calving interval and poor fertility.

Prevalence of repeat breeder was the second constraints of reproduction performance of dairy cows and heifers in the study sites. Repeat breeders are those cow or heifer that requires three or more AI services to conceive without any clinical affection of the reproductive tracts and usually return to estrus at regular intervals (Sood *et al.*, 2015) [21]. This condition markedly reproductive performance due to the increased number of inseminations and loner calving intervals, thereby increasing culling rate and replacement costs in dairy cows (Garcia-Ispierto, 2007) [6]. In Addis Ababa Abattoir enterprise, 235 female cattle that came for slaughtering, which accounted for 39.1% were reproductive problems and 28% were repeat breeding (Gebrekidan *et al.,* 2009) [8].

Disease prevelace of the current study was in line with the report of Seid (2014) [19] animl health problem mentioned as a constraint for livestock productivity in Burji woreda of Southern Region. The most significant diseases indicated by respondants in study area were liver flucke, pasturolosis, mastites, lumpyskin, blackleg, pneumonia, pasteurellosis and tick. Veterinary service shortage of the current study was similar that reported by Kumare (2014) the high cost for the medicine and low productivity of the animals discourages farmers in Tigray region. During discussion farmers reported that long distance to the health centers, high cost of private medicine and lack of timely availability of veterinary supplies are the main challenges. According to Tegegne *et al*. (2013) [24] the main problems of access to animal health services in rural areas are distance from animal health centers, lack of skilled health technicians and lack of timely availability of veterinary supplies.

Table 6: Major constraints of dairy cattle productivity in the highland and midland area

Constraints	Highland					Midland				
	1st	2nd	3rd	4th	Index	1st	2nd	3rd	4th	Index
Feed shortage	73.3	26.7	0	0	0.37	50	26.7	15	8.3	0.33
Repeat breeder	26.7	73.3	0	0	0.33	40	50	10	0	0.32
Disease prevalence	0	0	88.7	11.3	0.19	10	10	35	45	0.19
Veterinary service	0	0	11.3	88.7	0.11	0	13.3	40	46.7	0.16

Index=the sum of (4 times first order + 3 times second order +2 times third order + 1 times fourth order) for individual variables divided by the sum of (4 times first order + 3 times second order +2 times third order + 1 times fourth order) for all variables.

Conclusion and Recommendations

The average holding cattle per household was significantly different among the highland and midland study sites. The major breeding objectives of cattle in each study site were milk production, income source, and saving of animals. This entails that cattle play multi-functional roles in improving livelihoods of households. The major farmer's dairy cattle selection criteria were high dairy potential, higher fertility rate, and optimum growth rate and low feeding behavior of animals. The productivity of dairy cattle in the study site is influenced by natural uncontrolled type mating, limited feed availability, prevalence of repeated breeder cows and poor veterinary services. Moreover, farmers do not own their desirable breeding bull for females during heat period. Designing of appropriate breeding system with the full participation of the farmers is the best option to improve the existing breeding practice, management systems and their selection preferences of dairy farmers. Trait preference is a key factor to livestock productivity and has a significant impact on the reproductive performance of animals. By considering farmers indigenous knowledge on animal management, trait preferences, setting breeding objectives and finally designing appropriate mating system with full participation of farmers is of great importance to improve dairy cattle productivity. In conclusion: to improve livestock productivity farmers should be trained in animal nutrition, health care and management system to develop their skills.

It is recommended to consider the preferred traits of farmers for the improvement and sustainability of dairy cattle breeding. Avoid uncontrolled natural mating system by improving controlled and artificial insemination service through strong extension service.

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