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BREEDING PRACTICES AND TRAITS PREFERENCE IN DAIRY CATTLE IN GEDEO AGROFORESTRY OF ETHIOPIA

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ABSTRACT: The study was conducted to identify breeding practices and traits preferences of the dairy cattle producers in the southern part of Ethiopia. Representative sample households were selected by SRS (Simple Random Sampling) techniques. A cross-sectional survey with a structured questionnaire was used to collect the data on the purpose of keeping dairy cattle, herd composition, source of dairy cattle, trait preference, and breeding practices performed by the farmers. The data were analyzed using statistical software SPSS 27, and chi-square was used to compare categorical variables. The herd composition of the Bule district is significantly different from the rest of the districts in the mean number of calves, heifers, and bulls. The Yirgachefe district significantly differs in the mean number of cows compared to other districts. The breed preference of most farmers (81.67%) is cross-bred bulls (Jersey and Holstein Frisian). There are not enough bulls on the farms; only 21.7% of them have a breeding bull, and the primary sources of bulls in the study community are the grazing areas and the neighbors. Respondents preferred artificial insemination (96.1%) to natural mating. Milk yield, appearance, and genotype were important traits in selecting a dam, whereas genotype, appearance, and fast growth rate were the most preferred traits in sire ranking. The farmers' breeding objectives were to improve milk production and increase cash income. Therefore, establishing a village-based mating program for the genetic improvement of dairy cattle in the study area is recommended to overcome the shortage of bulls.

Keywords: Artificial Insemination, Breeding, Genetic improvement, Selection criteria, Sire.

INTRODUCTION

Ethiopia has enormous potential for cattle in Africa and keeps about 70 million cattle population. More than half (56%) of female cattle, and the remaining 44% are male cattle. Dairy cows are estimated to be around 10.8% and dominated by local breeds and only 2.6 % are cross-bred and the exotic from the total cattle population. On average, milk production is 1.48 liters per cow per day (CSA, 2021).

The dairy sector is critical to Sub-Saharan Africa's (SSA) socioeconomic situation, particularly in Ethiopia, by providing food security and revenue generation, especially for small households (Lemaire et al., 2019; Wangu et al., 2021). Despite its importance to farmers and the economy as a whole, the cattle sector has been neglected and underutilized (Mekonnen et al., 2012)

Breeding practices of dairy farmers differ in agroecology (highland, midland and the lowland) areas of Ethiopia (Bedada et al., 2021). Trait preferences of farmers usually vary across communities, production systems, and agroecological zones (Roessler et al., 2008; Duguma et al., 2010; Zewdu et al., 2018; Aman et al., 2021). This has resulted from economically important traits influenced by livestock keepers' production environment.

The study area is found in Shashemene Dilla milkshed and, its contribution in terms of milk production to the community is high, comprehensive baseline data about breeding practices and selection criteria were not found. To enhance the productivity of the dairy sector and design dairy production improvement strategies or interventions, knowing the dairy farmers' trait preferences and breeding practices is vital (Gebremichae et al., 2015; Zewdu et al., 2018). In this regard, farmers' trait preferences and breeding practices of dairy cows are essential to study that have not been investigated in the study area. Therefore, the current study was initiated to fill this research gap by investigate the farmers' trait preferences and breeding practices of dairy cattle production in the Gedeo agroforestry production system.

MATERIALS AND METHODS

Study area description

The study was conducted in selected districts of Gedeo Zone and Abaya District of West Guji and geographically located between 5^{0}50' 19" to 6^{0}35' 56"N latitude and 37^0 50' 47" to 38^0 26'17" E longitudes (Figure 1). The selected districts from Gedeo zone were Bule, Gedeb and Yirgachefe. The elevation varies between 1450 and 3200 m.a.s.l. It is

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normal to get bimodal rainfall from March to May and August to October. The annual rainfall fluctuates between 1200 and 1800mm. The temperature is between 18 ^{0}c and 25^{0}c. The Gedeo zone is made up of 26 percent Dega (highland), 65 percent Woina Dega (middle), and 9 percent Kola (lowland) agroecologically. Abaya, the other selected district, is found in West Guji Zone in Oromiya Region. Agro-ecologically, it comprises two main agro-ecologies, namely Kolla/lowland (70 Percent) and Woina Dega/midland (30 Percent). The altitude ranges from 1200 to 2060 m.a.s.l. The temperature is between 16 ^{0}c and 28 ^{0}c. The average annual rainfall of the district is 105.5 mm, which commences in May and extends to the end of October (Mebrate et al., 2021).

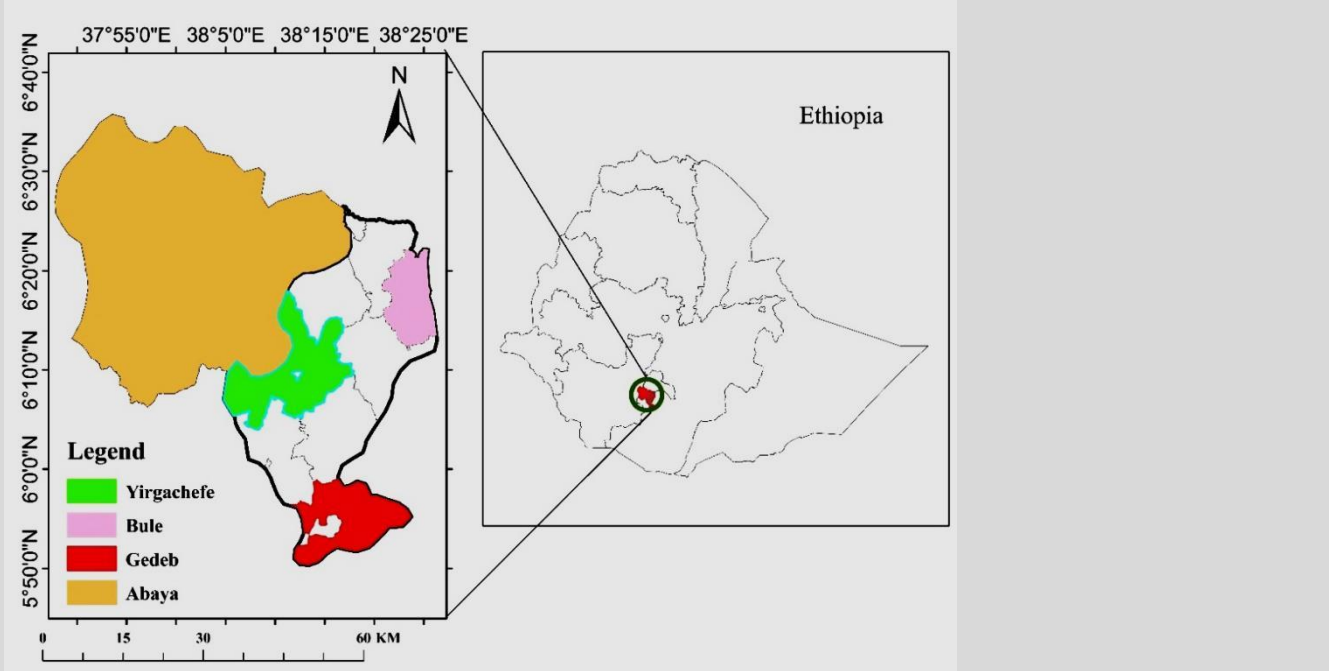

Figure 1 - Study area location map

Sampling procedures and sample size determination

A cross-sectional study design was used for the study. The study districts were purposively selected as they have a high potential for dairy cattle production with the consultation of Gedeo Zone and Abaya district livestock officers. Four potential districts (Yirgachefe, Gedeb, Bule and Abaya) were selected. Target households were selected from three kebeles (small administrative units) for each district using the same criteria that the districts were selected. Finally, the interviewed individuals were selected using simple random sampling (SRS) procedures. The sample size was determined by the formula (1) of Arsham, (2005) for the survey study.

$$N = \frac{0.25}{(SE)^2} \quad \text{..... (1)}$$

Where; N=population size and SE= standard error. Accordingly, 3.73 % of standard error with 95% CI (confidence interval), hence, the total sample households become 180.

Methods of data collection

A survey was undertaken to collect data from 180 dairy farmers in the four districts. Structured questioners were designed. Before the commencement of the actual study, a pretest was conducted to ensure the respondents understood and answered the questions correctly. The questioner used to collect general household information, herd composition, sources, and breeding practices. Secondary data was gathered from the agriculture offices in the zone and districts.

Data analysis

The collected data were summarized on Microsoft excel 2021, and using SPSS 26 (statistical package for social science) was used to analyze descriptive statistics. A chi-square ($\chi 2$) test was calculated using SAS (Statistical Analysis System) version 9.4 to see if the proportions of the different categorical variables were significantly different or not at $P \leq 0.05$. Indices were calculated to provide an overall ranking of keeping dairy cattle and the traits used for choosing sires and dams according to the formula of the index (2) developed by Kosgey et al. (2008).

$$\text{Index} = \frac{[(N*F1)+((N-1)*F2)+\cdots+(1*Fn)]}{\sum[(N*F1)+((N-1*F2)+\cdots+(1*Fn)]} \quad (2)$$

Where N maximum level of rank, F1 frequency of the 1st rank, F2 frequency of the 2nd rank, and Fn frequency of the last rank. The herd compositions of the respondent were analyzed using the GLM (general linear model) procedure of SAS 9.4. Mean comparisons were carried out using Duncan's multiple range tests, and the significant differences were declared when $P < 0.05$. The appropriate statistical model (3) used was:

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$$Yij = \mu + \mathrm{Ti} + \mathrm{eij} \quad (3)$$

Where Y_{ij}: Observed value of the herd composition, μ: Overall mean, T_i: Effect of i^{th} location (i = Abaya, Bule, Gedeb and Yirgachefe) and e_{ij}: Residual random error.

Ethical approval

The study is a survey type and did not involve humans or animals as subjects in the research. All the data collection instruments (household survey questionnaires) were reviewed for ethical clearance and approved by the Dilla University College of Agriculture and Natural Resources ethics committee.

RESULTS AND DISCUSSION

General household characteristics

General household characteristics are presented in Table 1. The differences in sex, education, and age are significant at p<0.05 using the chi-square test. In all districts, males outnumber females, with Bule (93.3%), Gedeb (82.2%), Abaya (82.2%), and Yirgachefe (80.0%). In Adama, Gurage Zone, and North Shoa, 73.5%, 81.1%, and 90.4% of the respondents were men, according to Sharew (2018), Tesfaye and Wondossen (2019), and Yohanis and Tilahun (2021) respectively.

Nearly 3/4th of the interviewed household heads from all the studied areas were found in an age category of 30-59 years. The result (Table 1) showed that the farmers still practice dairy farming when their age increases. Similarly, Yohanis and Tilahun, (2021) and Hailemariam et al. (2022) also reported similar findings in Adama and Dilla Zuriya.

The majority (85.5%) of the interviewed households were literate. The result of the present study agreed with reports of Melku, (2016), and Sharew et al. (2022). The literacy of respondents gives a better chance to apply agricultural technologies to agricultural practices and makes it easy the acceptance new technologies and efficient resources use. Assemu et al. (2013) and Gatew et al. (2018) findings support the importance of education on agricultural technology practices.

Table 1 - Household characteristics of the respondent

Descriptions		Yirgachefe N (%)	Bule N (%)	Gedeb N (%)	Abaya N (%)	Over all %	χ2	P-value
Sex	Male	36(80.0)	42(93.3)	37(82.2)	37(82.2)	84.4	85.42***	0.0001
	Female	9(20.0)	3(6.7)	8(17.8)	8(17.8)	15.6		
Education background	Illiterate	3(6.7)	11(24.4)	7(15.6)	5(11.1)	14.4	76.94***	0.0001
	Read& write	6(13.3)	6(13.3)	9(20.0)	8(17.8)	16.1		
	1-6 class	18(40.0)	19(42.2)	21(46.7)	20(44.4)	43.3		
	7-12 class	13(28.9)	9(20.0)	6(13.3)	12(26.7)	22.2		
	≥Diploma	5(11.1)	-	2(4.4)	-	3.9		
Age	20-29	5(11.1)	2(4.4)	-	1(2.2)	4.4	75.67***	0.0001
	30-39	12(26.7)	9(20.0)	6(13.3)	6(13.3)	18.3		
	40-49	15(33.3)	18(40.0)	25(55.6)	19(42.2)	42.8		
	50-59	6(13.3)	9(20.0)	11(24.4)	15(33.3)	22.8		
	≥60	7(15.6)	7(15.6)	3(6.7)	4(8.9)	11.7		

χ2 = Chi-square; *= significant if p< 0.05; ***= p < 0.001

Table 2 - Herd composition in the study area

Herd composition	Yirgachefe (Mean ±SE)	Gedeb (Mean ±SE)	Bule (Mean ±SE)	Abaya (Mean ±SE)	Overall (Mean ±SE)	P-value
Calves	1.82±0.21 ^{b}	1.45±0.10 ^{b}	2.67±0.21 ^{a}	1.69±0.13 ^{b}	1.96±0.09	0.0001***
Heifers	1.29±0.11 ^{b}	1.43±0.11 ^{b}	2.57±0.26 ^{a}	1.16±0.08 ^{b}	1.68±0.10	0.0001***
Oxen	1.00±0.00 ^{b}	1.64±0.17 ^{ab}	2.20±0.55 ^{a}	1.50±0.11 ^{ab}	1.65±0.13	0.0001***
Bulls	1.00±0.00 ^{a}	1.14±0.14 ^{a}	1.50 ±0.11 ^{a}	1.00±0.00 ^{a}	1.36±0.08	0.1444 ^{ns}
Cows	1.34±0.14 ^{b}	2.42±0.18 ^{a}	2.39±0.27 ^{a}	2.20 ±0.13 ^{a}	2.13±0.09	0.0004***

^{a,b} Means within a row with different superscripts differ significantly (P<0.05); ***= p < 0.001; NS = not significant; SE = Standard Error

Dairy cattle herd compositions

The average herd composition in the area is summarized in Table 2. On average (2.13±0.09), cows take the leading number in the herd composition. These results agree with those (Bereda et al., 2014; Tesfaye and Wondossen, 2019; Hailemariam et al., 2022) in Gurage Zone and Dilla Zuriya and Enemor districts and Hadiya respectively. The average

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number of calves and heifers Bule district significantly differs ($p<0.05$) from the remaining districts. The mean cow number in Yirgachefe district significantly differs ($p<0.05$) from the remaining three districts. There is no significant difference among bulls keeping potential across the districts in the present study. The number of bulls kept by the respondents was small compared to other herd compositions. This might be because the area is known for its agroforestry practices, and farming is less practiced than other farming systems. The lower average number of bulls could be attributed to a significant land constraint on providing sufficient feed for their animals (Bereda et al., 2014).

Breeding objectives

Choosing multiple traits for which animals are specifically bred is always a part of breeding objectives, assuming that farmers have consciously decided to improve the next generation of animals genetically. The cost of production and revenue from product sales associated with a genetic alteration in the target attribute is likely to impact the breeding objectives (Sölkner et al., 2008 and Godadaw et al., 2014). The purpose of dairy cattle keeping as ranked by the respondents in the study area is depicted in Figure 2. The first two important breeding objective stated by the sampled farmers in all study districts was obtaining better milk yield and income sources. Overall, these findings are in accordance with results reported by Endashaw et al. (2012); Banerjee et al. (2014), Debir, (2016), Woldeyohannes, (2018), and Hailemariam et al. (2022); the purpose of keeping cattle is for milk production and income source. The milk production assumption is related to increased profit with increased yield per cow per day. In addition, more milk supply also indicates better-fed calves with greater pre-and post-weaning survival rates (Godadaw et al., 2014).

The farmers reared dairy cattle as the following important functions are farming/draft power and manure. There is no special breed for a specific trait in the country, whereas cattle are used as a multipurpose role for the livestock keepers in the tropics. Adebabay (2009) also studied in Amhara Region and Bainesagn (2015) in West Shoa stated multipurpose role of cattle is common in the country.

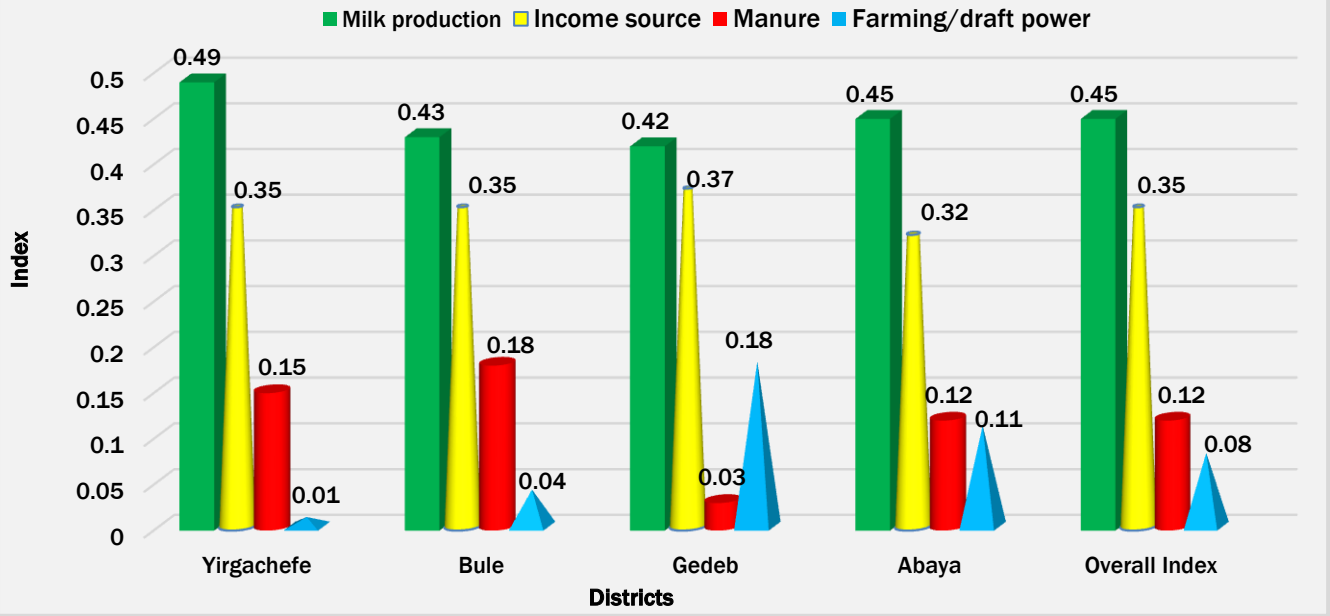

Figure 2 - Breeding objectives

Breeding practices

The breeding practices of the study districts are illustrated in Table 3. The breeding practices reported in the study area are mostly (96.1%) Artificial Insemination (AI), and natural mating was very rare. The present study confirms the findings of Destalem (2015) in the Central Zone of Tigray, AI was preferred by two-thirds of the respondent. There is a trend toward replacing natural mating with AI. The majority (81.67%) of the respondents' breed preferences were cross-bred (Jersey and HF cross) than the indigenous breeds. At the same time Hailu and Abate, (2016) also reported in North Gondar that 82.5% of the dairy farmers prefer cross-breeding.

According to individual farmer interviews, obtaining the desired type of breeding bulls has also become increasingly difficult in the area. Less than a quarter (21.7%) of the respondents have a breeding bull. This might be related to the management cost of bulls. These results agree with (Godadaw et al., 2014; Lakew et al., 2019; Duguma, 2020) findings that farmers don't have breeding bulls in different parts of the country. To overcome the problem, farmers have an additional bull source for mating. The farmers obtained breeding bulls from their neighbors and grazing areas. So, most (81.1%) farmers primarily rely on bulls from neighbors and grazing areas. The results of this study are in keeping with previous observational (Godadaw et al., 2014; Ayeneshet et al., 2017; Lakew et al., 2019), which report 55% to 81.9% of the farmers depend on mating with neighbors, grazing area in North Amhara, North Gondar, and North Shoa Zone of the country.

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Sources of dairy cattle

Sources of dairy cattle are represented in Table 4. There are different sources for dairy cattle replacement in the study area like own herd, buying, a gifts from families. Except for Gedeb, the highest percentage of the source of dairy cattle is buying, whereas in Gedeb own herd replacement is the highest percentage than the others. The buying and own herd covers 88.83% of replacement stock in the study area. Similarly, Godadaw et al. (2014) and Gebremichael et al. (2015) and reported that purchase is the highest source for foundation stock in Dembia district and Tigray highlands, respectively. Sharew (2018) also stated that owning herd replacement is the second source of foundation stock in North Shoa.

Trait preference for selection of dairy cattle

The ranking of traits for selecting breeding males and females as perceived by farmers was summarized in Table 5. The index value showed that milk yield was ranked first in the selection of breeding females with an index value of 0.3, 0.36, 0.4 & 0.21 in Yirgachefe, Bule Gedeb and Abaya districts, respectively. In accordance with the present result, previous studies by Takele (2005), Godadaw et al.(2014), Ftiwi and Tamir (2015), Girma et al. (2016), and Belay and Zeleke (2021) have demonstrated that milk yield is the primary interest of the livestock keeper in a different part of the country.

In Yirgachefe and Bule, appearance was the second most important trait in the selection of breeding females, whilst genotypes were in Gedeb and Abaya. Similarly, Ftiwi and Tamir (2015) stated that physical appearance is one of the preferred traits in the selection of breeding animals. The farmers focus on body shape, udder size and teat position as primary interests when looking at the appearance of the animals. In general, cattle owners' selection criteria are related to production traits in a different part of the country. It is assumed that large animals produce high milk yields and reach market weight sooner.

Traits like genotype, appearance, fast growth and disease resistance were the most preferred traits by the farmers in the area study areas in selecting breeding bulls (Table 5). According to Mekonnen et al. (2012) in Western Oromia, Bayou et al. (2014) in Benchi Maji, Mezgebe et al. (2017) in Northern Ethiopia and Aman et al. (2021) in mid rift valley of Oromia found, most farmers practiced selection based on appearance. Coat color and temperament were given relatively little emphasis in selecting breeding bulls. Temperament was the list preferred trait in west Tigray and the Aneded district of East Gojam (Ftiwi and Tamir, 2015; Zewdu et al., 2018).

Table 3 - Breeding practices in the study districts

Breed preference		Yirgachefe N (%)	Bule N (%)	Gedeb N (%)	Abaya N (%)	Overall (%)
Local		7(15.56)	16(35.56)	1(2.22)	9(20)	18.33
Jersey cross		17(37.78)	-	6(13.33)	13(28.89)	20.00
HF cross		21(46.67)	29(64.44)	38(84.44)	23(51.11)	61.67
Mating preference	AI	43(95.6)	40(88.9)	45(100)	45(100)	96.1
	Natural mating	2(4.4)	5(11.1)	-	-	3.9
Own breeding bull	Yes	5(11.1)	19(42.2)	7(15.6)	8(17.8)	21.7
	No	40(89.9)	26(57.8)	38(84.4)	37(82.2)	78.3
Breeds of bull	Local	3(60)	14(73.7)	5(71.4)	8(100)	76.9
	Cross	2(40)	4(21.1)	1(14.3)	-	17.2
	Both	-	1(5.3)	1(14.3)	-	5.1
Sources of bull for mating	Neighbor	22(48.9)	19(42.2)	30(66.7)	21(46.7)	51.1
	Grazing area	19(42.2)	7(15.6)	10(22.2)	18(40)	30
	Own herd	4(8.9)	19(42.2)	5(11.1)	6(13.3)	18.9

NB: HF-Holstein Frisian; AI-Artificial Insemination

Table 4 - Sources of dairy cattle

Sources	Yirgachefe N (%)	Bule N (%)	Gedeb N (%)	Abaya N (%)	Over all %
Buying	31(68.90)	26(57.80)	10(22.20)	40(88.90)	59.40%
Gift	1(2.20)	-	1(2.20)	4(8.90)	3.30%
Own herd	5(11.10)	19(42.20)	27(60.00)	1(2.20)	28.90%
Buying and own herd	8(17.80)	-	4(8.90)	-	6.70%
Buying and gift	-	-	3(6.70)	-	1.70%

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Table 5- Selection criteria of dam and sire

	Traits preferences	Yirgachefe	Bule	Gedeb	Abaya	Overall Index
Dam	Appearance	0.17	0.19	0.08	0.19	0.16
	Milk yield	0.30	0.36	0.40	0.21	0.31
	Fast Growth	0.08	0.13	0.09	0.17	0.12
	Genotype	0.16	0.19	0.19	0.19	0.18
	Temperament	0.12	0.01	0.01	0.00	0.04
	Coat color	0.01	0.03	0.03	0.01	0.02
	Disease Resistant	0.11	0.01	0.10	0.07	0.07
	Record history	0.05	0.08	0.10	0.16	0.10
	Total	1.00	1.00	1.00	1.00	1.00
Sire	Appearance	0.08	0.42	0.14	0.19	0.21
	Libido	0.10	0.07	0.11	0.18	0.11
	Genotype	0.44	0.30	0.38	0.20	0.33
	Fast Growth	0.12	0.11	0.15	0.30	0.17
	Temperament	0.02	0.01	0.05	0.02	0.02
	Coat color	0.00	0.07	0.02	0.06	0.04
	Disease resistant	0.24	0.02	0.15	0.05	0.12
	Total	1.00	1.00	1.00	1.00	1.00

CONCLUSION

Dairy cattle production plays a significant role in food security. Artificial insemination was preferred over natural mating. The grazing area and the neighbors are the sources of bulls for natural mating. The breeding objectives in each district were better milk yield, income source, and traction/draft power. According to the index value, the most preferred traits in dam selection were milk yield, appearance, and genotype. The three most useful sire selection criteria were genotype, appearance, and fast growth rate. In conclusion, farmers should use a village-based mating system since bulls are a shortage. In addition, the local administrators should think about establishing more AI centers to bring genetic improvement programs in short.

DECLARATIONS

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Authors' contribution
Both of authors contribute equally for this work.

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Conflict of Interests
The authors have not declared any conflict of interests.

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