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Farming practices and breeding objectives identification of farmer in north shoa and south wello zones of Amhara region

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ABSTRACT

The study aims at assessing the production systems and identifying the traits preferred by farmers in the study areas to establish community-based breeding and sustainable utilization programs. The study was conducted in the four purposively selected districts of North Shoa and South Wello zones of Amhara region (Merehabete, Wereillu, Moretena Jiru and Mojaena Wedera). A total of 120(30 farmers from each district) purposively selected farmers participated in their own flock ranking experiment. Furthermore, 216 (i.e., 54 farmers from each district) *were interviewed about their goat production systems and trait preferences to be improved. The chi-square test was used to analyze qualitative data, and analysis of variance was used to analyze quantitative data generated by the survey. For the rank data, indexes were calculated using Microsoft Excel 2010. Income was the main objective of goat rearing in all the study areas. Doe has a larger proportion than other flock structures in all the study areas. Mostly, the age of castration was above one year in all the study areas. The breeding buck selection criteria were growth, shape, size, and color. Body size, litter size, and mothering ability were identified as important traits in all study areas. Early selling of fast-buck kids is practiced in all study areas for their immediate cash. This results in the use of poor-performing bucks for breeding and may result in negative selection. To address such issues, it is critical to create and implement a community-based breeding program that takes into account body size, litter size, mothering capacity, puberty age, and longevity.*

1. Introduction

In Ethiopia mixed, pastoral, and agropastoral goat production systems are common [1]. In the highland agro-ecological zones, where livestock production is secondary to crop production, the mixed crop-livestock production system is common. Due to shrinking grazing spaces per household, limited feed availability, and land degradation, the system has very small flock sizes [2,3]. In different agro-ecological and production systems, goats contribute as sources of income, saving accounts, providing food, improving crop production and soil fertility, fuel, social functions, and employment [4]. Though, goats have great contribution for the livelihoods of the community in Ethiopia mainly in traditional production systems, the identification of breeding traits and designing of appropriate breeding programs are less applicable. However, farmers have the trend to select their breeding buck and doe even if their selection criteria differ based on agroecologies, flock size, housing type, and culture of the communities [5]. Because production systems and

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production objectives are determined by agroecology and commonly differ in terms of stress factors (water shortage, disease, parasites, and temperature extremes), and because the target production system must be well understood and characterized to set up a breeding program [6].

Even though efforts have been made to identify farming practices and breeding objectives to enhance their productivity in different areas of the country, the studies were not exhaustive and did not cover the potential goat production areas in the North Shoa, South Wollo and adjacent areas of the Amhara region. The reason may be because of its remoteness and the difficulties of accessing transportation due to its challenging topography. However, the places have the potential for goat production since there are more gorge areas and marginal land available, which is not suitable for crop cultivation but can be useful for goat production because goats prefer such areas by nature. Moreover, goats play an important role in the community's livelihood as well as other tangible and intangible benefits for farmers in these areas. To convert these opportunities into economic benefits and to carry out any improvement program, the identification of production systems and breeding objective traits is required. Therefore, the objective of this study is to generate baseline data for designing and conducting community-based breeding program.

2. Materials and methods

2.1. Study areas description

The research was conducted in the South Wello Zone, Wereillu district, and the North Shoa Zone (Mojaena Wedera, Merehabete, and Moretena Jiru districts) as presented in Fig. 1. Preliminary information about the study area was collected prior to actual work. The study areas were selected based on their representativeness, goat population potential and distribution, road availability, and goat contribution to farmers. The study site consisted of two villages per district, each representing a goat population within the district, and all villages were located in the same agroecology, i.e., 1500–2300 m.a.s.l., with temperatures ranging from 17 to 21 °C. and annual rainfall averaging 800-1400 mm.

2.2. Sampling strategy and sample size determination

Experienced farmers for goat production and study areas were selected based on a purposive sampling strategy. The households that participated in the interview were determined by Ref. [7] formula; (1.96)2 (0.85) *(0.15)/0.052 = 196. On it, adding up to 10% (196*10% = 216) of the sample size was considered to increase accuracy. Based on this, interviews with the households of Wereillu (54), Mojaena Wedera (54), Merehabete (54), and Moretena Jiru (54) were conducted. Based on a prepared checklist, in each district, a focused group discussion was held (15 focused group participants per district) regarding farming practices, trait preferences of farmers, etc. a total of 120 farmers involved in their own flock ranking experiment (about 30 individuals from each district were assign using the purposive sampling strategy) [3].

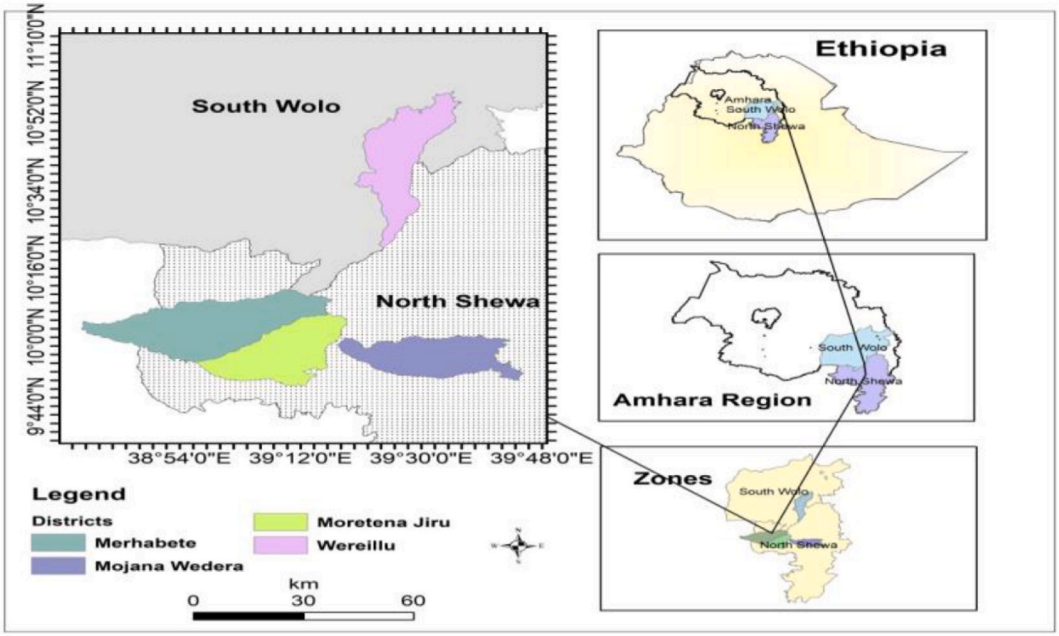

Figure: 1. Study areas map.

2.3. Data collection

Qualitative and quantitative data for the assessment of farming practices and trait preferences were collected following [8] guidelines and the Ethiopian Biodiversity Institute adoption of the Ethiopian situation [9]. Secondary data for the study was gathered from the respective livestock offices. A focused group discussion was held with experienced farmers and experts (selection was on specialized knowledge and unique perspectives on the topic). Farmers' trait preferences were gathered using their own flock ranking experiment in conjunction with personal interviews. An own flock ranking experiment, conducted on female goats and buck ranking, was canceled due to a lack of an adequate number of similarly aged bucks. Farmers were asked to choose the 1st best, 2nd best, 3rd best, and worst goats from their flock. All the reasons for giving rank were asked for and recorded.

2.4. Data management and analysis

The effect of study kebele in each district was less as the results were merged. All qualitative data were subjected to a Chi-square test, with district serving as the main effect. Quantitative data is entered, cleaned, and analyzed using SPSS ver. 20. A significance test was implemented at 5% of the level of error and the separation of significance levels was conducted by using Tukey multiple range tests. The flock ranking experiment data were summarized by counting each trait within each rank group with the SPSS frequency counting method and then subjected to a chi-square test. Indices were calculated using: Index = [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular variables, divided by [3 for rank 1 + 2 for rank 2 + 1 for rank 3] using Microsoft Excel 2010. Focused group discussions were guided by a set of open-ended questions and summarized at the end of each question.

3. Results and discussion

3.1. Ranking importance of livestock

Five species of livestock were commonly used in the study area by farmers. The contribution ranks of goats (0.41) and cattle (0.38) was better than that of other species of livestock species along the study areas (Table 1). This may be related to cattle being used mainly for conducting crop farming, but goats are used for purchasing different household expenses like children's education fees, fertilizer fees and sources, land tax fees, home consumption, etc., and that makes for a higher rank of use. The result is in agreement with the [10] report on the ranking of livestock species in small households; the goat was first, followed by cattle and sheep, respectively, in tropical countries.

3.2. Flock structure of goats

Table 2 shows the goat flock structure in the study areas. The comparative ratio of bucks to does is 3–5. The average number of does was better than the other flock groups of goats. The higher proportion of breeding does seen in these study areas could indicate a practice of keeping does for breeding purposes and producing more kids. This provides an opportunity for conducting community-based breeding programs by excluding negative selection, since it enhances the selection intensity and effectiveness of selective breeding. Bucks, on the other hand, had a lower proportion than their female counterparts. This could be the result of males being removed for sale or domestic consumption [11]. The average number of does and bucks per household in all districts was lower than reported by Ref. [12].

Conversely, all flock structures were similar to those reported by Ref. [13], in a mixed production system; [14], in which 47% of the flocks were does and 19% bucks; and FARM-Africa [15], in which 71.3% were female and 22.2% bucks. However, focus group participants indicated that the trend of goat population size per household indicates a decreasing trend in the study area due to most of the communal rangeland that is used for keeping goats previously has entered in to the area enclosure for natural resource conservation purposes. Moreover, as the landholding of farmers limited, the rearing of more goats may be a problem and a threat to the breeding program.

Table 1
Importance of livestock species (index).

Livestock Species	Districts				
	Wereillu	Mojaena Werdera	Merehabete	Moretena Jiru	Overall Index
Cattle	0.32	0.35	0.37	0.47	0.38
Sheep	0.15	0.17	0.01	0.02	0.09
Goat	0.47	0.37	0.42	0.36	0.41
Chicken	0.00	0.05	0.12	0.05	0.06
Donkey	0.06	0.06	0.08	0.10	0.07

Table 2
Flock Structure of Goats per household (Mean ± S. D).

Districts	Female kids	Male kids	Goatling	Buckling	Doe	Buck	Wether
Wereillu	2.54 ± 1.6	3.50 ± 2.5	3.10 ± 1.6	2.24 ± 1	8.90 ± 4.5	4.60 ± 1.7	4.46 ± 3.2
Mojaena Wedera	2.36 ± 1.3	2.52 ± 1	2.43 ± 0.9	1.71 ± .7	3.86 ± 3	2.07 ± 1.6	2.60 ± 2
Merehabete	2.67 ± 0.8	2.03 ± 0.7	3.07 ± 0.9	2.40 ± 1.3	4.80 ± 1.3	2.60 ± 0.9	2.17 ± 1
Moretena Jiru	4.20 ± 1.3	2.90 ± 1.4	3.20 ± 1.4	1.70 ± 0.5	4.30 ± 1.9	3.20 ± 1.6	1.70 ± 0.5
Overall	2.81 ± 1.3	2.48 ± 1.5	3.00 ± 1.2	2.10 ± 1	5.33 ± 3.2	2.96 ± 1.6	2.63 ± 2

3.3. Objective of goat production

Table 3 indicates the objective of goat production. The sources of income, meat production, and savings account were determined by the rank of goat production objectively in all districts of the study areas. Goat production is used as an income source, especially by farmers who have a limited area of land for crop production and in situations where farmers have land with difficult topography for crop production but suitable for goat production. Similarly, farmers kept goats for the purpose of household consumption, particularly during holidays and different cultural ceremonies. On the other hand, goat keepers live far from these areas where banks are available, and farmers rear goats so that they may get economic returns in times of need. The findings are comparable to those of [11,16,17,and 10], but different from the study of [18].

3.4. Housing, feeding and watering of goats

The housing system, feeding practices, and watering of goats are presented in Table 4. In spite of the differences in design, materials used to build, and size of houses, the majority of farmers keep their goats in purposely built houses during the night in both the summer 184 (89.3%) and the dry 151 (73.7%) seasons. The finding is in line with husbandry practice of farmers in north western lowlands of Ethiopia [19], but unlike with the report of [20]. Keeping goats in grazing areas and free grazing systems were the main feeding practices of goats in all study districts, and the finding is similar to that of [21]. In addition to the feed, they obtain from goats themselves, farmers give supplementary feed two times per day to bridge the pain of feed shortages, as 176 (85.4%) of respondents described. Grass, legumes, crop residue, and food leftovers were the most prevalent feed supplements [21].

During the summer, 172 (83.9%) of respondents agree that their water source would be less than one km, whereas 158 (77.1%) of respondents agree that their water source would be less than one km during the dry season. This might be because goats travel a long distance for browsing and grazing from their homes, and water sources are closest to the grazing area during both seasons. Getting water within a radius of less than one km is an opportunity for breed improvement, as water scarcity is a problem for goat production in particular, and livestock production in general in other parts of the country. The finding is in agreement with the western lowland and Abergelle goat breeds of Ethiopia [3], but unlike that of the Begait goat population in western Tigray in the northern part of Ethiopia [22].

3.5. Age of goat castration

Castration of goats was popular in the study areas, with the goal of improving docility and increasing meat quality and/or quantity. The age of castration was more than 12 months in Mojaena, Werdera, and Merehabete districts. While in Wereillu, 45% of respondents castrated between the ages of 6 and 12 months, with the remaining 55% casting for more than 12 months, and in Moretena Jiru, 94% of respondents confirmed that the age of goat castration was more than 12 months, with the remaining 6% casting between the ages of 6 and 12 months. Most of the time, the age of castration was above one year in all the study areas. Ideally, castration should be done at less than three weeks of age, but in the study areas, farmers believed that early castration causes stunted growth, which leads to a lack of desired muscling and conformation, resulting in a poor market price, and the finding is in line with [23]. The age of castration was similar to that in Ref. [11]; the average castration age of Arabian goats was 1.9 ± 0.6 years and 2.2 ± 1.1 years for Oromo goats in northwestern Ethiopia; in Ref. [24], the age of castration of goats was greater than 19 months in south-western Ethiopia.

Table 3
Objective of goat production (index).

Attributes	Districts				
	Wereillu	Mojaena wedera	Merehabete	Moretena Jiru	Overall index
Meat	0.34	0.24	0.36	0.26	0.30
Income	0.51	0.50	0.47	0.45	0.48
Saving	0.05	0.23	0.03	0.25	0.14
Fertilizer	0.01	0.03	0.12	0.04	0.05
Skin	0.09	0.00	0.03	0.00	0.03

Table 4
Housing, feeding and watering of goats (%).

Attributes		Districts						
		Wereillu	Mojaena Wedera	Merehabete	Moretena Jiru	Overall	X^2	P. value
Housing of goat during summer	Purposively constructed house	90.2	98.1	78.8	90.2	89.3	36.2	0.001
	with other animals	9.8	1.9	1.9	9.8	5.8		
	Purposively constructed house and with another animal	0	0	19.2	0	4.9		
Housing of goat during dry season	Purposively constructed house	88.2	98.1	33.3	74.5	73.7	65.18	0.002
	with other animals	11.8	1.9	64.7	25.5	25.9		
	Purposively constructed house and with another animal	0	0	2	0	0.5		
Have you given supplementary feed	Yes	64.7	94.2	86.5	96.1	85.4	25.54	0.001
	No	35.3	5.8	13.5	3.9	14.6		
Distance of water (summer)	Less than 1 km	96.1	82.7	64.7	92.2	83.9	22.14	
	1–5 km	3.9	17.3	35.3	7.8	16.1		0.001
Distance of water (dry season)	<1 km	94.1	82.7	35.3	96.1	77.1	70.12	
	1–5 km	5.9	17.3	64.7	3.9	22.9		

3.6. Goat culling criteria

The goat culling criteria are presented in Table 5. The result shows farmers have different culling criteria and make the index value small. Largely, the priority culling criteria were production decline and growth rate, with index values of 0.28 and 0.2, respectively. When the size of the kids born decreases and miscarriage occurs as a result of decreased production (kid birth), culling of unproductive goats is usual in the study areas to overcome this issue. In particular, shape/appearance and growth were the primary and secondary priority culling criteria in the Merehabete district, respectively. During the focus group discussion, participants confirmed that females with no triangular shape and males with no rectangular shape were culled from their flock. Generally, the culling criteria of farmers in the study area are in close accordance with [16,17,25]

3.7. Breeding buck selection criteria

Growth, shape, size, and color were the breeding buck selection criteria, with overall index values of 0.33, 0.29, 0.19, and 0.17, respectively, as presented in Table 6. A buck that has fast growth and that is born from a doe that has good pedigree information (through the recalling method) can be selected as a replacement. Similarly, a buck with a rectangular shape or appearance can be selected as a replacement in Amharic; they are called "Wenda wend". Furthermore, red, red-white, white-red, and black coat colors (Mojaena Wedera district) were the most preferred coat colors for selecting their buckling as a replacement. Though farmers are aware of how to select breeding bucks and know the traits for selecting bucks, putting these criteria into practice is difficult, as focused group discussion participants indicated. The main challenge is selling good male goats, which have a high market value since the price can be better or higher. Yet, such circumstances hinder genetic improvement or lead to negative selection. The selection criteria for bucks were aligned with [11,16,21]. Doe selection was not common, and all females were used as replacements unless defects were observed and they were sold for income generation. Farmers practice uncontrolled mating in the study areas. The finding is similar to that of [26] farmers in Metekel Zone, Ethiopia, practice uncontrolled mating.

4. Weaning age and litter size of goats

Table 7 shows the weaning age and litter size of goats. According to this, 75.1% of goat owners in the study area agree that the weaning age was 3–4 months. However, there was variability in weaning age in the goat populations of Merehabete compared with other study area goat populations. This could be connected to different management factors as well as genetic factors. The finding is in

Table 5
Goat culling criteria (index).

Traits	Districts				
	Wereillu	Mojaena Wedera	Merehabete	Moretena Jiru	Overall index
Size	0.18	0.09	0.02	0.10	0.09
Shape	0.04	0.04	0.20	0.18	0.12
Color	0.01	0.06	0.19	0.00	0.07
Health	0.05	0.05	0.16	0.04	0.08
Growth	0.19	0.31	0.20	0.08	0.20
Age	0.04	0.16	0.14	0.30	0.17
Decreasing of production	0.49	0.29	0.09	0.30	0.28

Table 6
Buck selection criteria (index).

Traits	Districts				
	Wereillu	Mojaena Wedera	Merehabete	Moretena Jiru	Overall index
Size	0.11	0.25	0.04	0.36	0.19
Shape	0.39	0.16	0.35	0.28	0.29
Color	0.14	0.18	0.28	0.08	0.17
Docility	0.00	0.01	0.01	0.04	0.02
Growth	0.36	0.40	0.31	0.24	0.33

Table 7
Weaning age and litter size of goats (%).

Traits	Districts						X^2	P. value
		Wereillu	Mojaena Wedera	Merehabete	Moretena Jiru	Overall		
Weaning age	<3 month	0.0	3.8	0.0	0.0	1.0	31.5	0.001
	3–4month	58.8	67.3	100	74.5	75.1		
	5–6month	41.2	28.8	0.0	25.5	23.9		
Litter size	Single	9.6	42.3	21.6	33.3	29.3	8.4	0.04
	Twining	80.4	57.7	78.4	66.7	70.7		

close accordance with [27–29]. A majority of respondents (70.7%) stated that twining was common. The present study is in agreement with [30] findings and inconsistent with [31].

4.1. Breeding objective trait preference identification

Interviews were held in conjunction with their own flock ranking experiment in order to identify breeding objective traits, and the findings are reported in Tables 8 and 9, respectively. In general, the two methods of breeding objective trait identification information can be summarized as follows: body size, litter size, and mothering ability, the priority of farmers' interests in accordance with its order for the districts of Wereillu, Mojaena Wedera, and Moretena Jiru. However, in the Merehabete district, body size, age at puberty, mothering ability, litter size, and longevity were frequently reported traits that farmers found to be improving. However, including all these traits in the breeding program design might be difficult to manage, and the program may become too complex. Therefore, considering traits that can be summarized in a manageable form can be used. For example, mothering ability can encompass litter size and a variety of traits such as genetics, nourishment, and adaption. Therefore, incorporating such traits into an improvement program can also include other positively correlated traits. Generally, the interests of farmers are in some agreement [32,29,16,14,and33]] with different priority orders of interest in different parts of the country.

5. Conclusion

All of the study districts' goat populations are dominated by does, which presents an opportunity to obtain additional replacements for carrying out community-based breeding. Also, the comparable buck-to-doe ratio of 3–5 presents an excellent chance for running a community-based breeding program. In the research areas, a source of income (0.48), meat production (0.3), and to get economic returns in times of need (0.14) are the goat keepers' top priorities. In the research area, castration of goats older than 12 months is normal with the aim of enhancing docility and meat quality and quantity. Farmers in the study locations typically use their own bucks without selection as well as those from neighbors' and other grazing areas, which promote inbreeding and non-selective breeding. The primary criteria for culling goats in the research areas are low productivity (0.28), poor growth (0.2), and elderly age (0.17). More than 70% of the goat population is engaged in twining. In the region, weaning often happens between the ages of 3 and 4 months. Mothering ability, body size, puberty age, and longevity can be summed up as the farmers' breeding goals in the research locations. Generally, these baseline researches investigate important information on production system and identification of breeding objective of the farmer.

Author contribution statement

Teklewold Belayhun Getachew, MSc: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Tesfaye Getachew Mengistu, PhD; Amine Mustefa NurUhusen, MSc: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Aweke Engdawork Gebrekidan, DVM: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Seble Sinke Tesema, BSc: Contributed reagents, materials, analysis tools or data.

Table 8
Breeding objective trait preference identification summary based on Questioner.

Traits	Districts				
	Wereillu	Mojaena Wedera	Merehabete	Moretena Jiru	Overall index
Size/growth	0.41	0.43	0.14	0.49	0.360
Age at puberty	0.00	0.00	0.23	0.10	0.080
Age at first kidding	0.11	0.11	0.19	0.20	0.153
Litter size	0.29	0.24	0.05	0.17	0.190
Kidding interval	0.01	0.07	0.19	0.04	0.080
Longevity	0.13	0.06	0.18	0.00	0.093
Color	0.02	0.08	0.02	0.00	0.031
Shape	0.03	0.01	0.00	0.00	0.013

Table 9
Breeding objective trait preference (from own flock ranking experiment).

Traits	Districts F (%)					
	Moretena Jiru	Merehabete	Mojaena Wedera	Wereillu	Overall	X^2 (P- value)
Litter size	60(52.2)	46(35.9)	40(32.3)	103(58.5)	249(45.9)	27.5(0.00)
Body size	83(72.2)	80(62.5)	101(81.4)	109(62)	373(68.7)	24.1(0.00)
Color	46(40)	34(26.6)	39(31.5)	33(18.8)	152(28)	16.5(0.01)
MA	45(39.1)	47(36.7)	44(35.5)	94(53.4)	230(42.4)	13.4(0.04)
KI	15(13)	19(14.8)	18(14.5)	24(13.6)	76(14)	0.2(0.98)
Longevity	13(11.3)	18(14.1)	18(14.5)	16(9.1)	65(12)	2.7(0.44)
A@P	5(4.3)	10(7.8)	2(1.6)	4(2.3)	21(3.9)	8.3(0.40)
Body growth	3(2.6)	6(4.7)	4(3.2)	10(5.7)	23(4.2)	2.0(0.60)
BC	5(4.3)	5(3.9)	9(7.3)	29(16.5)	48(8.8)	23.5(0.01)

F = frequency, MA = mothering ability, KI = kidding interval, A@P = age at puberty, BC = body condition.

Aberra Melesse Ayenew, Professor: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Data availability statement

Data will be made available on request.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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