ANIMAL HUSBANDRY & VETERINARY SCIENCE | RESEARCH ARTICLE

Management system and breeding practices of indigenous goat types in selected districts of East Gojjam Zone, Amhara Region, Ethiopia

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Abstract: Understanding the management and breeding practices of indigenous livestock species kept under the traditional management system is very important to design and implement appropriate breeding and management interventions. This study described the goat management and breeding practices in East Gojjam Zone, Amhara Region, Ethiopia. A semi-structured questionnaire was prepared and administered to 202 randomly selected respondents and group discussions were held to triangulate the information. Qualitative and quantitative data were analyzed using the descriptive, and GLM procedures, respectively. In the area, crop-livestock farming was common (100%). The overall average goat flock size was 11.52 ± 9.09. The matured male-to-female goat ratio was 1:3.6. Goats were mainly raised for income (Index = 0.436). Hillside browsing was the first rated feed source in wet (I = 0.390) and dry (I = 0.394) seasons. Rivers were the major water sources in the dry (93.1%) and wet (92.1%) seasons. Most (98.5%) of the respondents reported that they practice buck castration. Most farmers reported the selection of breeding does (98.5%) and bucks (99%). Farmers rated body size as the first selection criteria to select breeding does (Index = 0.341) and bucks (Index = 0.344). About 84.7% of the respondents had their breeding buck(s). However, a natural uncontrolled mating

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PUBLIC INTEREST STATEMENT

In Ethiopia, goats are key assets for rural livelihoods with lots of advantages over large ruminants. Goats play substantial economic and cultural roles in the Ethiopian highlands, mixed crop-livestock, and lowland pastoral production systems. Keeping goats is convenient as financial assets to generate immediate cash requirements used to meet basic needs including, food, medicine, and school fees. Besides, goats have an important role in the social life of many Ethiopian people being used as gifts, dowry, in religious rituals, and rites of passage. In Ethiopia, goat production is constrained by many biological, environmental, and economic factors, and is subjected to low productivity. Knowledge of the goat management system, breeding practice, and compatibility of the breed genotype with the farmers’ breeding objectives are needed to enhance goat productivity. This research gives insight to readers into the management systems and breeding practices of indigenous goats in Ethiopia.
system (86.6%) was common. The overall mean age at first mating of male and female goats were 7.01 ± 1.55 and 6.69 ± 1.64 months, respectively. The overall mean age at first kidding, kidding interval, litter size at birth, and productive life of does were 13.02 ± 2.18 months, 6.47 ± 0.69 months, 2.15 ± 0.38 kids, and 6.93 ± 2.38 years, respectively. The uncontrolled breeding management and low male-to-female ratio in the flock would lead to inbreeding. Thus, designing and implementing an appropriate goat breeding strategy is worthwhile.

Subjects: Agriculture & Environmental Sciences; Environmental Management; Conservation - Environment Studies; Biodiversity & Conservation; Ecology - Environment Studies

Keywords: Breeding practice; East Gojjam Zone; indigenous goats; production system

1. Introduction
In Ethiopia, above 80% of the population gets their sustenance from agriculture, accounting for nearly 34.9% of the national GDP and 83.9% of total exports (NBE, 2018). Livestock is an integral part of agriculture, accounting for about 45% of agricultural production. To support livelihoods, nearly 70% of the population keeps livestock owing to small herds made of three cattle, three goats/sheep, and a few chickens (FOASTAT, 2019). Besides, providing meat, milk, cash, draft power, hauling services, insurance, and social capital to the population (Wodajo et al., 2020), the Ethiopian livestock contributes about 10% to the total export earnings, of which 69% is gained from live animals (cattle and small ruminant) exports (FOASTAT, 2019). Nationally, sheep and goats account for about 90% of the live animal meat and 92% of skin and hide export trade value (Wodajo et al., 2020).

The Ethiopian livestock herd comprises 52.5 million goats, 42.9 million sheep, 70 million cattle, 57 million poultry, 8.1 million camels, 2.1 million horses, 10.8 million donkeys, 0.38 million mules, and 6.99 million hives (CSA, 2021). The CSA (2021) report also showed that from the national goat population, the indigenous, hybrid, and exotic breeds covered about 99.9, 0.05, and 0.05 million heads, respectively, indicating that the indigenous goat breeds have the highest share. These livestock populations are distributed across various agro-ecological zones and managed under mixed crop-livestock, pastoral and agro-pastoral, landless urban and peri-urban, and commercial dairy and feedlot production systems (FOASTAT, 2019). Despite the presence of a diversified goat genetic pool, huge goat population in the country, and its tremendous economic contribution for rural households, the assistance of the sub-sector to the goat keeping households income and the national economy is relatively low (Haile et al., 2019) due to technical, economic, and institutional constraints (FOASTAT, 2019; Zewdie & Welday, 2015).

Genetic improvement is among the options employed for increasing goat productivity. But, it needs identification and description of the goat breeds, management systems, and compatibility of the breeds’ genotype with the farmers’ breeding objectives. Moreover, research outputs concerning breeding practices of the indigenous goats in Ethiopia are minimal (Aseged et al., 2021). To design a breeding program and to improve and conserve the indigenous goat types in their natural production environment, identification of the goat breeds, description of the management systems, knowing the breeding practice and farmers goat breeding objectives at a particular production environment are the first information to be addressed (FAO (Food and Agriculture Organization), 2011). Thus, this research aimed to describe the management system and breeding practices of the indigenous goats in East Gojjam Zone of the Amhara Region, Ethiopia.
2. Materials and methods

2.1. Description of the study areas
The study was conducted in three adjacent districts (Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts) purposively selected from East Gojjam Zone, Amhara region, Ethiopia (Figure 1). The study districts were selected based on accessibility, the potential of indigenous goats, the inclusiveness of all agro-ecologies, farmers’ participation in goat production, and the economic contribution of goats in the household income in the areas (Districts’ Agriculture development Offices (DADO), 2019). Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts lie between the coordinate points of 11° 00’ N and 12° 24’ N latitude and 34° 70’ E and 37° 35’ E longitude, respectively. Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts have an average annual rainfall of 1500, 1000, and 1100 mm in Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts, respectively. The average annual temperature in Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts are 16°C, 15°C, and 18.5°C, respectively. In all the study districts, lowland (the altitude is below 180 m.a.s.l.), midland (the altitude ranges between 1800 and 2400 m.a.s.l.), and highland (the altitude is above 2400 m.a.s.l.) agro-ecologies are found. But, Bibugn district has “Wurch” agro-ecology, which is characterized by mountain zone elevated above 3800 m a.s.l. (Districts’ Agriculture development Offices (DADO), 2019).

2.2. Sampling methods and sample size determination
A purposive multi-stage sampling technique was used to identify the study sites. Based on the information collected from preliminary field surveys and discussions with districts agriculture and rural development bureau experts, Peasant Associations (PA) development agents, and farmers living in the respective PA hierarchically, sample districts, PAss, and households from each PA were selected. Accordingly, three districts and nine PAs (three from each district) were purposively
selected considering the selection criteria mentioned in the study area description section. A systematic random sampling technique was used to identify households for the questionnaire interview. First, with the involvement of PAs’ development agents and community leaders, households who have goats and participate in goat production were identified from the selected PAs.

Table 1. Summary of the total number of sample households and PAs by districts

| District          | Total HHs in the District | No of Sampled PAs | No of HHs in the Sampled PAs | No of HHs Interviewed |
|------------------|---------------------------|------------------|-------------------------------|------------------------|
| Bibugn           | 14,521                    | 3                | 2,117                         | 57                     |
| Hulet Eju Enesie | 25,438                    | 3                | 2,482                         | 67                     |
| Goncha Siso Enesie | 198,405                  | 3                | 2,892                         | 78                     |
| Total            | 238,364                   | 9                | 7,491                         | 202                    |

PAs = Peasant Associations, No = Number, HHs = Households

Table 2. Demographic characteristics of the visited goat keeping households in east Gojam zone

| Variables                | Bibugn (57) | Goncha SisoEnesie (78) | Hulet Eju Enesie (67) | Overall (202) |
|--------------------------|-------------|-------------------------|-----------------------|---------------|
| Gender                   |             |                         |                       |               |
| Male                     | 55          | 77                      | 64                    | 196           |
| Female                   | 2           | 1                       | 3                     | 6             |
| χ²-value                 |             |                         | 1.35(Ns)              |               |
| Age                      |             |                         |                       |               |
| 20–30                    | 0           | 2                       | 4                     | 6             |
| 31–40                    | 14          | 28                      | 10                    | 52            |
| 41–50                    | 26          | 31                      | 40                    | 97            |
| 51–60                    | 13          | 17                      | 12                    | 42            |
| >60                      | 4           | 0                       | 1                     | 5             |
| χ²-value                 |             |                         | 20.4(**)              |               |
| Educational status       |             |                         |                       |               |
| Illiterate               | 27          | 59                      | 51                    | 137           |
| Read and write           | 21          | 13                      | 11                    | 45            |
| primary school           | 7           | 5                       | 4                     | 16            |
| Religious school         | 2           | 1                       | 1                     | 4             |
| χ²-value                 |             |                         | 15.3(∗)               |               |
| Marital status           |             |                         |                       |               |
| Single                   | 0           | 1                       | 0                     | 1             |
| Married                  | 57          | 77                      | 64                    | 198           |
| widowed                  | 0           | 0                       | 1                     | 1             |
| Divorced                 | 0           | 0                       | 2                     | 2             |
| χ²-value                 |             |                         | 7.7(Ns)               |               |

N = Number of households; χ² = Chi-square; Ns = Non significant; ** = P < 0.01; * = P < 0.05
Then starting from the first household, sample households were chosen using a fixed interval determined by dividing the number of households identified from each PA by the number of required households until the desired sample size was obtained. Households were taken proportionally from each PA after the total sample size was determined using Yemane’s (Yamane, 1967) sample size determination formula indicated hereunder (Table 1).

The formula used to determine sampled households for questionnaire interview was:

\[
n = \frac{N}{1+Ne^2}\\n = \text{required Sample size}\\N = \text{population size}\\e = \text{error margin (e = 0.07, was considered)}
\]

2.3. Data collection and analysis
A semi-structured questionnaire interview was used to generate data on the production system, goat breeding objectives, and breeding practices (FAO (Food and Agriculture Organization), 2012). To collect both qualitative and quantitative data, a total of 202 households were interviewed (Table 1). Qualitative data on household socio-economic characteristics (family size, age, and educational status), socio-economic and cultural importance of goats, management practices of goats comprising herding, housing, feeding and watering, selection and breeding aspects, available livestock feed resource and utilization methods, and data on other related issues were collected. In addition, quantitative data on economically important reproductive traits of indigenous goats including, age at puberty, age at first kidding, kidding interval, litter size, and average productive life of doses were collected. Focused group discussions with farmers were held in each district to triangulate information collected through questionnaires.

The data were checked for completeness and consistency and coded. All quantitative data were entered into the Microsoft office excel worksheet, 2019, whereas all coded qualitative data were entered and analyzed using SPSS, version 22 software application. Before the main data analysis, screening of outliers was employed. Chi-square test (\(\chi^2\) test), and F-test at (\(P < 0.05\)) were used to test the significance level. Quantitative data were analyzed using the general linear model (GLM) procedures of the Statistical Analysis System (SAS, 9.0; SAS, 2003) software application. ANOVA checked the significance of the effect of the independent variables on dependent variables, and if significance is declared, means were separated using Duncan’s multiple range mean separation method. Indexes were calculated for ranked variables (purposes of goat keeping, selection criteria of breeding flock, potential feed resources in wet and dry seasons, and common goat disease in the areas) to rank according to the producers’ perception using the formula: Index = \(\Sigma\) of [(\(n^*\) the number of households ranked first) + (\(n-1^*\) the number of households ranked second) + \(\ldots\) + (\(1^*\) the number of households ranked \(n^{th}\))] given for particular qualitative variables divided by \(\Sigma\) of [(\(n^{*}\)sum of households ranked first) + (\(n-1^{*}\) sum of households ranked second) + \(\ldots\) + (\(1^{*}\) sum of households ranked \(n^{th}\))] for all qualitative variables considered (Kosgey, 2004).

2.4. Ethical clearance
The semi-structured questionnaire and focused group discussion (FGD) checklists utilized to collect the data were reviewed for ethical clearance and approved by Dilla University Agricultural Productivity, Food Security, and Livelihood Research Team. Besides, participant households and members of FGD were informed about the objective of the study to obtain their agreement.
Table 3. Family size, and land and livestock holdings of the households in east Gojam zone of Amhara region

| Descriptors               | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) | P-value |
|---------------------------|-----------------|-----------------------------|---------------------------|-------------------|---------|
|                           | Mean ± SD       | Mean ± SD                   | Mean ± SD                 | Mean ± SD         |         |
| Family size               | 6.28 ± 1.64a    | 5.56 ± 1.76a                | 5.81 ± 1.74ab             | 5.85 ± 1.74       | *       |
| Grazing land (ha)         | 0.09 ± 0.13b    | 0.13 ± 0.16c                | 0.03 ± 0.09c              | 0.09 ± 0.13       | ***     |
| Cropping land (ha)        | 1.27 ± 0.56     | 1.32 ± 0.45                 | 1.16 ± 0.56               | 1.25 ± 0.52       | Ns      |
| Total land (ha)           | 1.35 ± 0.59ab   | 1.45 ± 0.49a                | 1.21 ± 0.63b              | 1.34 ± 0.57       | *       |
| Goats                     | 7.98 ± 6.26b    | 12.27 ± 7.88a               | 13.66 ± 11.39a            | 11.52 ± 9.09      | **      |
| Cattle                    | 4.35 ± 2.23b    | 5.28 ± 2.06a                | 5.66 ± 3.14a              | 5.14 ± 2.56       | *       |
| Sheep                     | 2.51 ± 3.42a    | 1.37 ± 2.95b                | 1.31 ± 2.10b              | 1.67 ± 2.88       | *       |
| Equine                    | 1.02 ± 0.77a    | 1.22 ± 0.82c                | 1.48 ± 0.86b              | 1.25 ± 0.83       | **      |
| Chicken                   | 6.89 ± 6.20ab   | 5.26 ± 6.15b                | 7.58 ± 5.80a              | 6.49 ± 6.10       | *       |
| Beehives                  | 1.47 ± 2.77a    | 0.82 ± 1.50b                | 0.70 ± 1.28b              | 0.97 ± 1.91       | *       |

a, b, c = means on the same row with different superscripts are significantly different (P < 0.05); N = Number of respondents; SD = Standard deviation; ha = Hectare; *** = P < 0.001; ** = P < 0.01; * = P < 0.05; Ns = Non significant (P > 0.05)

3. Results and discussion

3.1. Description of the production system

3.1.1. General household characteristics

Gender, age categories, educational status, and marital status of the interviewed households in the study areas are presented in Table 2. The proportion of male household heads in Bibugn (96.5%), Goncha Siso Enesie (98.7%), and Hulet Eju Enesie (95.5%) were higher than female household heads in all the study districts. This result slightly agreed with the report of Gatew (2014) and Tesema (2019), who noted that most (93.88%) and (93%) of the respondents were males in Bati area, and in Amhara Sayint, Habru, and Raya Kobo districts, respectively. The smallest proportion of female household heads in all the study districts may be due to males’ dominant role in undertaking outdoor goat management-related activities resulting in the highest probability of getting males with their animals. The majority of the interviewed household heads from all the studied areas were found in an age category of 41–50 years (48%), followed by 31–40 (25.7%) and 51–60 (20.8%) age categories.

The sample households’ average family size in the study districts were 6.28 ± 1.64 persons, 5.56 ± 1.76 persons, and 5.81 ± 1.74 persons in Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts, respectively (Table 3). The average family size in Bibugn district was significantly (P < 0.05) higher than that in Goncha Siso Enesie district. The overall average family size (5.85 ± 1.74 persons) in the present study was higher than the average household size in Ethiopia, which is 4.6 persons (3.5 persons in urban and 4.9 people in rural areas; CSA, 2016). However, the overall average family size in the present study was almost similar to the average family size in Raya Kobo (5.93 ± 1.59 persons) district (Tesema, 2019). In contrast, the overall average family size in the present study was lower than the average family size in Habru district (7.44 ± 4.15 persons; Tesema, 2019) and in Borena (8.07 ± 2.06 persons) and Siti (7.68 ± 0.26 persons) areas (Gatew, 2014). The variation in the average family size of the households from different areas may be due to the differences in the application of family planning.

The majority (67.8%) of the interviewed households were illiterate, whereas the remaining 22.3%, 7.9%, and 2% of the respondents could read and write and attended primary school and
Table 4. The sources of foundation goats, farming, and non-farming activities in east Gojjam zone of Amhara region

| Descriptors | Bibug N = 57 | Goncha Siso Enesie N = 78 | Hulet Eju Enesie N = 67 | Overall N = 202 |
|-------------|--------------|--------------------------|-------------------------|----------------|
| N (%)       | N (%)        | N (%)                    | N (%)                   | N (%)         |
| Gifted by families | 1(1.8) | 12(15.4) | 11(16.4) | 24(11.9) |
| Purchased from market | 53(93) | 65(83.3) | 54(80.6) | 172(85.1) |
| Obtained as loans | 3(5.3) | 1(1.3) | 2(3) | 6(3) |
| χ²-value | 9.25(Ns) |             |               |               |
| Farming activities |          |             |               |               |
| Only crop production | 0 | 0 | 0 | 0 |
| Only livestock rearing | 0 | 0 | 0 | 0 |
| Mixed crop-livestock farming | 57(100) | 78(100) | 67(100) | 202(100) |
| Engage on non-farm activities |          |             |               |               |
| Yes | 9(15.8) | 5(6.4) | 1(1.5) | 15(7.4) |
| No | 48(84.2) | 73(93.6) | 66(98.5) | 187(92.6) |
| χ²-value | 9.3(∗∗) |             |               |               |

N = Number of respondents; SD = Standard deviation; χ² = Chi square; Ns = Non-significant (P > 0.05); ∗∗ = P < 0.01

religious school, respectively. The result of the present study agreed with reports of different scholars (Gatew, 2014; Tesfahun, 2013; Zergaw, 2014), who stated that the majority of goat keepers in their respective study areas were illiterate. In contrast, the higher proportion of illiteracy in the present study did not agree with Tesema (2019), who reported that illiterate goat keepers were lower than the educated in Amhara Sayint, Habru, and Raya Kobo districts. The higher proportion of illiteracy in the area covered by this particular study may harm the application of intervention options to improve goat productivity in the area. Regarding the marital status of the interviewed households, most (98%) of the household heads were married.

3.1.2. Land and livestock holdings of the respondents

The average grazing land, cropping land, total landholding, livestock holding, and species composition owned by the respondents in all the study districts are presented in Table 3. The average total landholdings, including private grazing land of the sampled households in Bibug, Goncha Siso Enesie, and Hulet Eju Enesie districts, were 1.35 ± 0.59, 1.45 ± 0.49, and 1.21 ± 0.63 hectares, respectively. The average total landholding in Goncha Siso Enesie district was significantly (P < 0.05) higher than the average total landholding in Bibug and Hulet Eju Enesie districts. Similarly, the average grazing land in Goncha Siso Enesie (0.13 ± 0.16 hectare) district was significantly (P < 0.001) higher than the average grazing landholdings in Bibug (0.09 ± 0.13 hectare) and Hulet Eju Enesie (0.03 ± 0.09 hectare) districts. However, there was no significant difference between the study districts in terms of cropping landholdings. The result of the present study revealed that from the overall average total hectares of land (1.34 ± 0.57) owned by sampled households in all the study areas, a large part was covered by cropping land (1.25 ± 0.52) than grazing land (0.09 ± 0.13), which agreed with the report of Tesfahun (2013).

The use of a large hectare of land for crop production in the present study may be due to the application of crop-livestock farming as the dominant agricultural activity; hence, greater priority is given to crop production than livestock rearing for the livelihood of households in the area.

The study districts’ livestock holding and species composition comprise cattle, goats, sheep, equine, chicken, and beehives. From the total livestock species owned by the respondents in all the study districts, ruminant animals (goats, cattle, and sheep) were covered the highest species composition
while chicken and beehives were next to them. Equines took the smallest share of total livestock composition in all the study districts. There was a significant (P < 0.05) difference in the visited households’ livestock holding patterns among the studied districts. Respondents from Hule Eju Enesie and Goncha Siso Enesie had a more significant average number of goats, cattle, and equine than respondents from Bibugn; whereas, households from Bibugn district had a more significant average number of sheep and beehives than respondents from Hule Eju Enesie and Goncha Siso Enesie districts.

3.1.3. Farming and non-farming activities
A mixed crop-livestock production system is the dominant agriculture in the rural highlands of Ethiopia; however, one sub-sector has competed with the other in the use of land resources (Mekuria et al., 2020). Similarly, in the area, all respondents are engaged in mixed crop-livestock farming activities. There were no households engaged in only crop cultivation or livestock rearing (Table 4). The main crops cultivated are maize, teff, and barely in Bibugn, and maize, teff, wheat, peppercorn, and peanut/groundnut in Goncha Siso Enesie and Hule Eju Enesie districts. Whereas goats, cattle, sheep, poultry, and equines are the dominant livestock species reared in the area. In the area, livestock (cattle and equines) are the primary labour sources for crop production, and crop by-products are essential livestock feed resources. Besides crop-livestock farming, some (7.4%) respondents from all study districts practiced non-farm activities to generate additional household income (Table 4). Daily labourer, making handcraft, and miniature trading in the local market are among the non-farm activities implemented by the respondents.

3.1.4. Experience in goat keeping
The overall average goat farming experience (mean ± SD) of the study districts was 13.33 ± 7.91 years, which was lower than the Zergaw (2014), who noted the average goat farming experience in Meta-Robi and Konso districts was 19.42 ± 10.96 years. The average goat keeping experience of goat keepers in Bibugn, Goncha Siso Enesie, and Hule Eju Enesie districts were 15.37 ± 9.82, 12.58 ± 6.81, and 12.48 ± 7.05 years, respectively. There was no significant (P > 0.05) difference in goat farming experience between goat keepers from all the study districts.

The average starting goat numbers of the respondents were 2.28 ± 1.46, 2.53 ± 1.33, and 2.66 ± 1.34 for Bibugn, Goncha Siso Enesie, and Hule Eju Enesie districts, respectively. There was no significant (P > 0.05) difference among the study districts regarding starting goat numbers. Purchase from the local market, gifted by families, and obtained as loans were the commonly reported sources of the first goat(s) (Table 3). However, the majority of goat keepers (93%) in Bibugn, (83.3%) in Goncha Siso Enesie, and (80.6%) in Hule Eju Enesie obtained the first goat(s) through purchasing from the local market (Table 4), which may be an opportunity to introduce goats with new genetic makeup from the distant market into the areas.

3.1.5. Purpose of goat keeping
The ranks of the purpose of goat keeping in the area are presented in Table 5. Income sources through live animal sale, for the production of household meat, as a means of saving, skin and manure sources, and socio-cultural reasons (as a symbol of wealth) have been ranked as 1st, 2nd, 3rd, 4th, and 5th purposes goat keeping, respectively. However, the index values for each production purpose among the study districts were different. In the visited areas, income source(marketing) was rated as the 1st purpose of goat keeping with index values 0.424, 0.455, and 0.425 for Bibugn, Goncha Siso Enesie, and Hule Eju Enesie districts, respectively. In comparison, household meat production and a means of saving were the second and third goat production purposes. The present result is similar to the reports of different scholars in Ethiopia (Alemu, 2015; Gatew, 2014; Tesemo, 2019), who mentioned a source of cash income as the primary purpose of goat keeping. On the other hand, the present result disagreed with Tesfahun (2013) results’, who reported that the primary purpose of goat keeping in Benatsemay and Hamer districts was to identify pastoralists’ wealth status. The primary purpose of goat keeping was for the source of cash income in the present study may be due to the application of mixed crop-
Table 5. The purpose of keeping goats (ranks) in east Gojjam zone of Amhara region

| Purpose of keeping | Bibugn | Goncha Siso Enesie | Hulet Eju Enesie | Overall |
|-------------------|--------|--------------------|------------------|---------|
|                   | R₁     | R₂     | R₃     | Index | R₁     | R₂     | R₃     | Index | R₁     | R₂     | R₃     | Index | Index |
| Income sources    | 36     | 16     | 5      | 0.424 | 60     | 15     | 3      | 0.455 | 40     | 24     | 3      | 0.425 | 0.436 |
| Household meat    | 17     | 28     | 12     | 0.348 | 18     | 43     | 17     | 0.335 | 27     | 25     | 15     | 0.363 | 0.348 |
| Means of saving   | 4      | 13     | 25     | 0.184 | 0      | 20     | 37     | 0.164 | 0      | 18     | 26     | 0.154 | 0.167 |
| Skin and manure   | 0      | 0      | 15     | 0.044 | 0      | 0      | 21     | 0.044 | 0      | 0      | 23     | 0.057 | 0.049 |
| Socio-cultural reason | 0      | 0      | 0      | 0.00  | 0      | 0      | 0      | 0.00  | 0      | 0      | 0      | 0.00  | 0.00  |

Index = sum of (3 x number of households ranked first + 2 x number of households ranked second + 1 x number of households ranked third) given for each selection criteria divided by the sum of (3 x number of households ranked first + 2 x number of households ranked second + 1 x number of households ranked third) for all selection criteria in a study site; R₁, R₂, R₃ = Rank₁, Rank₂, and Rank₃, respectively.
livestock farming in the area, and as a result, farmers used goats to sell at the time of cash needed for the purchase of agricultural inputs, children's school fee, buying cloth and other household needs.

3.1.6. Goat flock structure

Knowledge of the flock structure of livestock species in a particular production environment is a prerequisite for maintaining the required male-to-female ratio for effective breeding management. Goat flock structure by their sex and age categories in the study area are presented in Table 6. From 2,336 goats reared by 202 households, female goats excluding suckling female kids and male goats excluding suckling male kids accounted for 53.9% and 29.9%, respectively. The remaining 15.8% was covered by suckling female and male kids. Percentages of male goats above weaning age (9.8%) for weaned males and (11.3%) for mature males >1 year were lower than the percentage of weaned females (12.8%) and adult females (41.1%). This result was similar to Asefa et al. (2015) report, who documented the percentage of male goats in the flock was 32.42%, and it decreases as their age increases in Bale Zone, Oromia region. The lower portion of males in the flock may be due to male goats being primarily selected for marketing by the farmers when cash was needed and slaughtered during festivals and ceremonial occasions, while females were allowed to breed in the flock till the end of their production life. In this particular study, the ratio of male goats (weaned males and matured males>1 year) and matured male goats with their female counterparts were 1:2.6 and 1:3.6, respectively. This result was similar to the findings of Tesfahun (2013) (1:3) and Zergaw (2014) (1:3) reported for mature males to matured females ratio in the lowlands of South Omo Zone and Konso and Meta-Robi districts, respectively. But, higher male-to-female ratios were reported for Bale Zone (1:8.4; Asefa et al., 2015) and pastoralists (1:11.23) in Abo'ala district of the Afar region (Gebre et al., 2020). The low male-to-female ratio recorded in the present study may aggravate the inbreeding level that resulted in the loss of genetic diversity and hybrid-vigor within the flock.

3.1.7. Labour sources and herding

Labour sources for goat herding practice, ways of goat herding, and herding goats for grazing purposes are presented in Table 7. The majority of the respondents (90.1%) reported that family members are their sources of labour to herd their goats. The remaining (9.9%) respondents herd their goats together with their neighbours in round sequences one after the other. All age and sex groups of goats, except suckling kids less than a month, were herded together in the area. Other researchers from different parts of Ethiopia reported similar goat herding practices (Gatew, 2014; Tesfahun, 2013; Zergaw, 2014). Only 39.1% of respondents herd their goats separately from other livestock species (Figure 2).
Table 7. Labour source and goat herding practice in east Gojjam zone of Amhara region

| Descriptors                      | Bibugn | Goncha Siso Enesie | Hulet Eju Enesie | Overall | $\chi^2$-value |
|----------------------------------|--------|--------------------|------------------|---------|----------------|
| Labour sources                   |        |                    |                  |         | 5.32 (Ns)      |
| Family members                   | 47     | 82.5               | 72               | 92.3    | 63             | 94            | 182           | 90.1            |
| Working with others              | 10     | 17.5               | 6                | 7.7     | 4              | 6             | 20             | 9.9             |
| Ways of goat herding             |        |                    |                  |         | 5.32 (Ns)      |
| Goats of a HH run as a flock     | 47     | 82.5               | 72               | 92.3    | 63             | 94            | 182           | 90.1            |
| Goats of >1HH run as a flock     | 10     | 17.5               | 6                | 7.7     | 4              | 6             | 20             | 9.9             |
| Herding goat for grazing         |        |                    |                  |         | 57.62 (***     |
| Herding goats separately         | 15     | 26.3               | 20               | 25.6    | 44             | 65.7          | 79             | 39.1            |
| Herding goats with sheep         | 19     | 33.3               | 5                | 6.4     | 4              | 6.0           | 28             | 13.9            |
| Herding goats with cattle        | 3      | 5.3                | 19               | 24.4    | 4              | 6.0           | 26             | 12.9            |
| All are herded together          | 20     | 35.1               | 34               | 43.6    | 15             | 22.4          | 69             | 34.2            |

HH = Household; N = Number of respondents; $\chi^2$ = Chi square; Ns = Non significant (P > 0.05)
3.1.8. Feed resources and feeding management

The quantity and quality of feeds and the nutritional status of goats determine their reproductive and productive potential since it hinders the full expression of the genetic potential of an individual (Joshi et al., 2018). Zewdie and Welday (2015), noted that the feed resource bases for goat production in Ethiopia are natural grazing lands and crop residues that vary highly with seasons. The index values of hillside browsing for Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts in the dry season were 0.398, 0.385, and 0.403, while the corresponding index values in the wet season were 0.383, 0.391, and 0.388, respectively. It was the primary feed resource for goats in both dry and wet seasons in the area (Table 8). The present result differed from Tesfahun (2013) and Alemu (2015) findings, who reported natural pasture was the primary feed resource for goats in the dry and wet seasons. Communal grazing lands and crop-aftermath were the 2nd and 3rd rated feed resources in Bibugn and Hulet Eju Enesie districts, while in Goncha Siso Enesie district, crop-aftermath was the 2nd rated feed resource in the dry season. In comparison, communal and private grazing lands were the 2nd and 3rd ranked feed resources in all the study districts during the wet season. This result is similar to Asefa et al. (2015) finding, who reported natural pasture was the primary feed resource during the wet season in Bale Zone. Although the index values were lower, goat keepers in the area used non-conventional feeds (brewery by-products and kitchen leftovers) and agricultural by-products (especially by-products from peanut/ground net crop) as goats’ feed.

Most (86.1%) respondents in the study area have faced seasonal feed shortages, from which the majority of them have faced the feed-related challenge in the dry season (79.3%) while...
### Table 8. The ranks of feed resources in wet and dry seasons in east Gojjam zone of Amhara region

| Seasons            | Bibuyn | Gancha Siso Enesie | Hulet Eju Enesie | Overall |
|--------------------|--------|--------------------|------------------|---------|
|                    | R₁     | R₂     | R₃     | Index | R₁     | R₂     | R₃     | Index | R₁     | R₂     | R₃     | Index | Index |
| **Dry season**     |        |        |        |       |        |        |        |       |        |        |        |       |       |
| Hillside browsing  | 32     | 15     | 10     | 0.398 | 42     | 18     | 18     | 0.385 | 37     | 21     | 9      | 0.403 | 0.394 |
| Communal grazing   | 19     | 14     | 24     | 0.319 | 16     | 12     | 35     | 0.229 | 15     | 20     | 32     | 0.291 | 0.275 |
| Crop aftermath      | 4      | 24     | 12     | 0.211 | 11     | 34     | 14     | 0.246 | 10     | 23     | 11     | 0.216 | 0.226 |
| Private grazing     | 1      | 4      | 3      | 0.041 | 9      | 4      | 1      | 0.077 | 5      | 2      | 3      | 0.055 | 0.059 |
| Non convensional   | 1      | 0      | 8      | 0.032 | 0      | 0      | 7      | 0.015 | 0      | 0      | 5      | 0.012 | 0.019 |
| Agricultural by-products | 0 | 0     | 0      | 0.00  | 0      | 10     | 3      | 0.049 | 0      | 1      | 7      | 0.022 | 0.026 |
| **Wet season**     |        |        |        |       |        |        |        |       |        |        |        |       |       |
| Hillside browsing  | 27     | 20     | 10     | 0.383 | 43     | 18     | 17     | 0.391 | 35     | 23     | 9      | 0.388 | 0.390 |
| Communal grazing   | 24     | 16     | 17     | 0.354 | 24     | 19     | 35     | 0.311 | 18     | 22     | 27     | 0.313 | 0.323 |
| Crop aftermath      | 0      | 0      | 0      | 0.00  | 0      | 0      | 0      | 0.00  | 0      | 0      | 0      | 0.00  | 0.00  |
| Private grazing     | 5      | 17     | 26     | 0.208 | 3      | 38     | 19     | 0.223 | 9      | 20     | 15     | 0.221 | 0.215 |
| Non convensional   | 1      | 5      | 6      | 0.056 | 8      | 3      | 3      | 0.071 | 5      | 2      | 8      | 0.073 | 0.065 |
| Agricultural by-products | 0 | 0     | 0      | 0.00  | 0      | 0      | 2      | 0.004 | 0      | 0      | 8      | 0.004 | 0.008 |

Index = \( \text{sum}(3 \times \text{number of households ranked first} + 2 \times \text{number of households ranked second} + \text{number of households ranked third}) \) given for each selection criteria divided by the sum of \( \text{sum}(3 \times \text{number of households ranked first} + 2 \times \text{number of households ranked second} + \text{number of households ranked third}) \) for all selection criteria in a study site; \( R₁, R₂, R₃ = \text{Rank}_1, \text{Rank}_2, \text{and Rank}_3 \).
Table 9. Feeding practices and management of goats in east Gojjam zone of Amhara region

| Descriptors (N (%)) | Bibugn (57) | Goncha Siso Enesie (78) | Hulet Eju Enesie (67) | Overall (202) | χ²-value |
|--------------------|-------------|--------------------------|-----------------------|---------------|----------|
| **Seasonal feed shortage** |             |                         |                       |               | 2.04 (Ns) |
| Yes                | 48(84.2)    | 65(83.3)                 | 61(91)                | 174 (86.1)    |          |
| No                 | 9(15.8)     | 13(16.7)                 | 6(9)                  | 28 (13.9)     |          |
| **Season of feed shortage** |             |                         |                       |               | 1.9 (Ns) |
| Wet season         | 8(16.7)     | 17(26.2)                 | 11(18.0)              | 36 (20.7)     |          |
| Dry season         | 40(83.3)    | 48(73.8)                 | 50(82)                | 138(79.3)     |          |
| **Withstanding Measures** |             |                         |                       |               | 14.2 (**) |
| Feed conservation  | 0           | 13(20)                   | 4(6.6)                | 17(9.8)       |          |
| Reduce flock size  | 5(10.4)     | 8(12.3)                  | 7(11.5)               | 20(11.5)      |          |
| Give supplementary feeds | 43(89.6) | 44(67.7)                 | 50(82)                | 137(78.7)     |          |
| **Provide supplementary feeds** |             |                         |                       |               |          |
| Yes                | 57(100)     | 78(100)                  | 67(100)               | 202(100)      |          |
| No                 | 0           | 0                        | 0                     | 0             |          |
| **Goats’ commonly supplement** |             |                         |                       |               | 12.37(*) |
| Pregnant does      | 0           | 0                        | 0                     | 0             |          |
| Lactating does     | 8(14)       | 20(25.6)                 | 9(13.4)               | 37(18.3)      |          |
| Breeding bucks     | 0           | 0                        | 0                     | 0             |          |
| Growing kids       | 0           | 0                        | 0                     | 0             |          |
| Castrated male goats | 10(17.5) | 14(17.9)                 | 7(10.4)               | 31(15.3)      |          |
| For the whole flock | 7(12.3)   | 18(23.1)                 | 15(22.4)              | 40(19.8)      |          |
| Castrated males and lactating does | 32(56.1) | 26(33.3)                 | 36(53.7)              | 94(46.5)      |          |
| **Time of provision** |             |                         |                       |               | 19.51(**) |
| Morning            | 0 (0.00)    | 5(6.4)                   | 7(10.4)               | 12(5.9)       |          |
| Evening            | 51(89.5)    | 45(57.7)                 | 41(61.2)              | 137(67.8)     |          |
| Both morning and evening | 6(10.5) | 28(35.9)                 | 19(28.4)              | 53(26.2)      |          |
| **Feeding method of un-weaned kids** |             |                         |                       |               |          |
| Unrestricted suckling | 57(100)  | 78(100)                  | 68(100)               | 202(100)      |          |
| Restricted suckling | 0        | 0                        | 0                     | 0             |          |
| **The practice of forced weaning** |             |                         |                       |               |          |

(Continued)
others (20.7%) were in the wet season (Table 9). The result was similar to (Tesfahun, 2013) and (Asefa et al., 2015) findings, who mentioned that feed shortage in dry seasons of the year caused by erratic rainfall, was a critical challenge for goat keepers in South Omo and Bale Zones. But, the present result was contradicted Tsegaye (2009) finding, who reported feed shortage was not a limiting factor for goat production in Metema area. Seasonal feed shortage in the study areas may be due to the application of intensive crop production, and the presence of stock exclusion areas for soil and water conservation activities resulted in the shrinkage of communal lands for livestock stocking. In the area, farmers have supplemented goats using homemade grains and cut tree branches (78.7%), reduced flock size (11.5%), and used conserved feed (9.8%) at times of feed shortage. Besides, in the area, goats were supplemented to enhance productivity.

### 3.1.9. Watering management

Table 10 shows water sources for goats in the dry and the wet seasons of the year in the area. Most (93.1%) of respondents were reported river water was the primary water source for goats, followed by spring (5.9%) and underground water (1%) in the dry season. Similarly, the most frequently reported water source in wet seasons was river water (92.1%), followed by spring water (7.9%). This finding was similar to other researchers’ work in Ethiopia (Alemu, 2015; Gatew, 2014; Zergaw, 2014). However, it disagreed with Asefa et al. (2015) report, which stated that spring water followed by borehole water was the primary water source for goats. The overall average hour (mean ± SD) traveled by goat keepers from home to the nearest watering point was 0.39 ± 0.24 hours. The average traveling hour by respondents from Bibugn district (0.29 ± 0.24 hour) was significantly (P < 0.01) lower than Hulet Eju Enesie (0.43 ± 0.25 hour) and Goncha Siso Enesie (0.42 ± 0.20 hour) districts.

### 3.1.10. Goat houses and housing systems

A properly constructed house is required to protect goats from extreme environmental weather conditions, diseases, predators, and theft and make management easier (Asefa et al., 2015). The type of goat houses varies with the environmental temperature and type of production. In the area, three types of goat housing systems, i.e. separate housing (81.7%), housing with other animals (14.4%), and housing within the human house (4%), were identified (Table 11). Goat houses were mainly built from iron sheet (roof) and wood (wall) (89.1%) and grass (roof) and wood (wall) (10.1%). Mixed goat housing may create a conducive environment for infectious diseases transmission from animals to animals and zoonotic disease from animals to humans and vice versa. In Bibugn district, goat keepers have constructed the floor of goat houses 1 cm above the ground and covered it with a Bamboo plant (Figure 3 (a, and b) for adequate drainage of urine and manure away from the laying area. Different scholars from Ethiopia had reported similar results (Asefa et al., 2015; Tesfahun, 2013; Zergaw, 2014),

### 3.1.11. Castration practice

Castration is part of small ruminant management practices mainly applied to non-breeding males and males not slaughtered at a younger age for controlled breeding and production of the fattened carcass (Abebe & Yami, 2008). Ideally, castration should be implemented in less than three weeks, but it is not the case in Ethiopia. Results concerning buck castration practice in the

### Table 10: Watering system

| Descriptors (N (%)) | Bibugn (57) | Goncha Siso Enesie (78) | Hulet Eju Enesie (67) | Overall (202) | χ²-value |
|---------------------|------------|--------------------------|-----------------------|---------------|-----------|
| Yes                 | 0          | 0                        | 0                     | 0             |           |
| No                  | 57(100)    | 78(100)                  | 67(100)               | 202(100)      |           |

N = Number of respondents; χ² = Chi square; ** = P < 0.01; * = P < 0.05; NS = Non-significant (P > 0.05)
study area are presented in Table 12. In the study area, the majority (98.5%) of goat keepers have reported castration of male goats, which is similar to the findings of (Tesfahun, 2013) and (Gatew, 2014) who reported that the majority of goat keepers in South Omo Zone, and Siti and Bati areas practice buck castration. In contrast to this, (Asefa et al., 2015) and (Gebreselassie, 2015) noted that due to the marketing of male goats at an early age, low market acceptance of castrated bucks, and the presence of cultural influences in the areas, castration was not common in Bale Zone (85.3) and Lare and Jikawo districts of Nuer Zone (85.55%).

The majority (54.3%) of goat keepers have used the traditional castration method that is carried out by experienced individuals in the community using smooth wood, stone, or blunt-sided iron. However, modern (24.1%) and combinations of both modern and traditional (21.6%) castration methods have been applied to castrate male goats. The majority (71.4%) of the respondents were castrating their goat in the wet season (at the start or end of the main rainy season) when feed availability is relatively better. While the remaining (28.6%) castrate goats in the dry season since they thought that wounds created by the castration process would not dry sooner if goats were castrated in wet seasons. Fattening, fattening and controlling unwanted mating, fattening and avoiding goatee smell, and fattening and ease of management were the reported reasons for buck castration. However, fattening and preventing goatee smell (56.8%) was covered the highest proportion, followed by fattening (38.7%). Similarly, fattening was mentioned as the primary reason for buck castration by Arab and Oromo goat keepers (Sheriff et al., 2020).

The overall mean castration age of bucks in the study area (2.05 ± 0.24 years) was significantly (P < 0.05) lower for bucks in Bibugn district (2.00 ± 0.22 years) than for bucks in Goncha Siso Enesie (2.05 ± 0.26 years) and Hulet Eju Enesie (2.10 ± 0.24 years) districts. The present result was nearly comparable previous reports (Gatew, 2014; Zergaw, 2014; Gebre et al., 2020), who noted the average castration age of goats in Borena, Konso, and Aba’ala areas were 2.2 ± 0.11, 2.4 ± 0.8, and 2.3 ± 1.9 years, respectively. But, it was lower than the report by Gatew (2014), who recorded an average castration age of 3.17 ± 0.09 years for the Siti area.

3.1.12. Breeding management
3.1.12.1. Selection of breeding flock. Selection, allowing individuals with desirable traits to be parents of the next generation, is usually done within cohorts within a flock, among animals of the same age that have been raised together (Abegaz & Awgichew, 2008). In the visited area, almost all goat keepers reported selection of breeding does (98.5%) and bucks (99%) to establish the breeding flock. However, there were also goat keepers who reported selection of either sex (Table 13). The present result is similar to Alebel et al.(2020) report, which stated that goat keepers

| Sources       | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) | χ²-value |
|---------------|-----------------|-----------------------------|---------------------------|-------------------|----------|
| Dry season    |                 |                             |                           |                   | 12.9(*)  |
| Rivers        | 49(86)          | 75(96.2)                    | 64(95.5)                  | 188(93.1)         |          |
| Spring        | 8(14)           | 1(1.3)                      | 3(4.5)                    | 12(5.9)           |          |
| Underground   | 0               | 2(2.6)                      | 0                         | 2(1)              |          |
| Wet Season    |                 |                             |                           |                   | 4.72(Ns) |
| Rivers        | 49(86)          | 75(96.2)                    | 62(92.5)                  | 186(92.1)         |          |
| Spring        | 8(14)           | 3(3.8)                      | 5(7.5)                    | 16(7.9)           |          |

N = Number of respondents; χ² = Chi square; * = P < 0.05; Ns = Non-significant (P > 0.05)
in Mandura district, Metekel Zone practice selection of both does and bucks. The average selection age (mean ± SD) of males and females were (5.00 ± 2.88; 4.88 ± 2.78 months) in Bibugn, (4.88 ± 2.23; 4.56 ± 1.86 months) in Goncha Siso Enesie, and (4.61 ± 1.63; 4.49 ± 1.64 months) in Hulet Eju Enesie districts. The overall selection ages (mean ± SD) for males and females were 4.83 ± 2.26 months and 4.63 ± 2.10 months, respectively. Females were selected at an early age than males, which is likely to be correlated with the early sexual maturity of females than males. There was no significant (P > 0.05) difference among the study districts in the selection age of male and female goats.

3.1.12.2. Breeding does selection criteria. Careful selection of breeding females in small ruminant production enhances the flocks’ productivity, thereby increasing farm profitability. Small ruminants can be selected based on performance records and/or visual appraisal, of which selection based on records (objective selection) is better than selection by physical appraisal (subjective selection). However, selection based on a visual appraisal conducted by looking at the appearance, conformation, and presence or absence of defects in the animal is vital in areas where record-keeping is not practical (Abegaz & Awgichew, 2008). The same was true in areas covered by this particular
study. Goat keepers were practiced the selection of breeding females by physical observation based on their trait preferences (Table 14). Body size (growth), hair coat color, and pigment, and conformation characteristics were rated as 1st, 2nd, and 3rd selection criteria of breeding does with index values of 0.353, 0.225, and 0.205, respectively. Female goats with a good growth rate (large), white coat-colour, and red-pigmented tail line, muzzle, and inner ears, and are structurally correct, are selected as breeding does.

Reproduction abilities, adaptation, udder and teat traits, horn traits, tail traits, and ear traits were also considered selection criteria to select breeding does in the area. Good reproducibility (early maturity, multiple births, short kidding interval, and longer productive life), a healthy udder hanging above the hocks, healthy teats, straight horns pointing backward, and wide and long tail and ears are preferred traits to select breeding does. Similar results were reported for Arab and Oromo goat keepers in Assosa Zone, Benishangul Gumuz Region (Sheriff et al., 2020), and goat keepers in Aba’ala, Afar Region (Gebre et al., 2020).

3.1.12.3. Breeding bucks selection criteria. In small ruminant production, breeding bucks should also be selected to optimize the overall flock productivity since it determines the overall pregnancy rate in the flock and shares 50% of the genetic makeup of kids born. Body size (growth), conformation, coat color, and pigment were the 1st, 2nd, and 3rd rated breeding buck selection criteria, respectively (Table 15). Accordingly, male goats with better growth rate, good conformation (structurally correct), and white coat colour (Bibugn district) white, red and white and red mixed colour (Goncha Siso Enesie and Hulet Eju Enesie districts) were selected as breeding bucks than their contemporaries. Besides, goat keepers from Bibugn district were concerned for horn traits, cannon bone perimeter, tail traits, ear traits, adaptation traits, and libido and mating ability of bucks to select breeding bucks. In contrast, goat keepers in Goncha Siso Enesie and Hulet Eju Enesie districts focus more on horn traits, adaptation traits, libido and mating ability, cannon bone perimeter, and tail and ear traits of bucks. Hence, in the area covered by this study, a buck with straight horns pointing backward, fat cannon bone perimeter, wide and long tail and ears, environmentally adaptive, having better libido, and effectively mate with the opposite sex are preferable to be a breeding buck.
Table 12. Buck castration and castration practices in east Gojam zone of Amhara region

| Parameters                        | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) | χ² -value |
|----------------------------------|-----------------|-----------------------------|---------------------------|-------------------|----------|
| N (%)                            | N (%)           | N (%)                       | N (%)                     |                   |          |
| Castration practice              |                 |                             |                           |                   | 2.6(Ns) |
| Yes                              | 55(96.5)        | 77(98.7)                    | 67(100)                   | 199(98.5)         |          |
| No                               | 2(3.5)          | 1(1.3)                      | 0                         | 3(1.5)            |          |
| Castration methods               |                 |                             |                           |                   | 25.9(***)|
| Traditional                      | 39(70.9)        | 48(62.3)                    | 21(31.3)                  | 108(54.3)        |          |
| Modern                           | 11(20)          | 11(14.3)                    | 26(38.8)                  | 48(24.1)          |          |
| Both                             | 5(9.1)          | 18(23.4)                    | 20(29.9)                  | 43(21.6)          |          |
| Season of castration             |                 |                             |                           |                   | 30.1(***)|
| Wet season                       | 54(98.2)        | 52(67.5)                    | 36(53.7)                  | 142(71.4)        |          |
| Dry season                       | 1(1.8)          | 25(32.5)                    | 31(46.3)                  | 57(28.6)          |          |
| Reasons of castration            |                 |                             |                           |                   | 18.9 (**)|
| Fattening                        | 30(54.5)        | 26(33.8)                    | 21(31.3)                  | 77(38.7)          |          |
| Fattening and control unwanted   | 2(3.6)          | 2(2.6)                      | 0                         | 4(2)              |          |
| Fattening and avoid goatess smell| 23(41.8)        | 44(57.1)                    | 46(68.7)                  | 113(56.8)         |          |
| Fattening and ease of            |                 |                             |                           |                   |          |
| management                        | 0               | 5(6.5)                      | 0                         | 5(2.5)            |          |
| Avoid goatess smell              | 0               | 0                           | 0                         | 0                 |          |

N = Number of respondents; χ² = Chi square; *** = P < 0.001; ** = P < 0.01; * = P < 0.05; Ns = Non significant (P > 0.05)

Generally, goat keepers in the study area were focused more on body size, conformation, and colour traits to select breeding does and bucks. This may be due to goats with these characteristics being preferred by goat producers in the area and creating great bargaining power to the seller and the ability to fetch a better price in the market. The present result was similar to previous reports (Gatew, 2014; Gebre et al., 2020; Sheriff et al., 2020; Zergaw, 2014).

3.1.12.4. Possession of breeding buck(s) and mating system. The majority (84.7%) of the visited goat keepers had breeding buck(s) to breed does in the flock. However, few (15.3%) were used breeding bucks available in the neighborhood (8.9%) and at grazing fields (6.4%) to breed does (Table 16). This result was similar to Tesfahun (2013) and Gatew (2014) reports, who noted that most goat keepers from the South Omo Zone and Borena and Siti areas had breeding bucks. Goat keepers in the area have kept bucks for multiple purposes, of which the majority (72.8%) were kept bucks for the aim of mating and fattening. Selected bucks are first used for mating, then they were castrated and fattened either for marketing or home consumption. Only 13.4% of goat keepers in the area were reported natural, controlled mating while the majority (86.6%) were used natural, uncontrolled mating. Herding male and female goats on similar grazing/browsing fields (84%), lack of awareness on controlled breeding (0.6%), and combination of the two (15.4%) were the
Table 13. Selection practices of breeding does and bucks in east Gojjam zone of Amhara region

| Selection practices | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) |
|---------------------|----------------|---------------------------|--------------------------|------------------|
| Does                | N   | %              | N   | %            | N   | %            | N   | %    |
| Yes                 | 55  | 96.5           | 78  | 100          | 66  | 98.5         | 199 | 98.5 |
| No                  | 2   | 3.5            | 0   | 0            | 1   | 1.5          | 3   | 1.5  |
| χ²-value            |     |                |     |              |     |              | 2.77(Ns)|      |
| Bucks               |     |                |     |              |     |              | 5.14(Ns)|      |
| Yes                 | 55  | 96.5           | 78  | 100          | 67  | 100          | 200 | 99   |
| No                  | 2   | 3.5            | 0   | 0            | 0   | 0            | 2   | 1    |

N = Number of respondents; χ² = Chi-square Ns = Non significant (P > 0.05)

reported reasons for uncontrolled mating. From these herding of both sexes together for grazing/browsing was covered the highest. This result is similar to the reports of other researchers in Ethiopia (Gatew, 2014; Gebreselassie, 2015; Tesfahun, 2013; Zergaw, 2014), who reported the natural, uncontrolled goat mating system is the most frequently used goat breeding system in the traditional goat production system. In the area, goat mating was seasonally restricted (93.1%), and in most cases, it was occurred in the short rainy seasons (autumn and spring) (75.2%), while some will mate in summer (17.8%; Table 16). Seasonal feed shortage, especially in winter, was the reported reason for the seasonal variation of goat mating. Similarly, Abebe (2008) noted that in the Ethiopian highlands, most conception in sheep and goats occurs during or following the short rain (spring) season.

3.1.12.5. Culling and replacement of breeding flock. Culling, removing un-productive goat(s) from the flock, is an important management practice to enhance flock productivity. The reason and method of culling are varied with goat production systems (Abebe & Yami, 2008). All visited goat keepers in the study area practice culling of unproductive goats, of which 84.7% of the goat keepers apply culling to reduce management costs. While 15.3% of goat keepers were practice culling for genetic improvement. Old goats (60.9%) and kids attained marketing age (39.1%) were the priority age class of goats most frequently culled. Selling (33.7%), slaughtering (6.9%), and selling and slaughtering (59.4%) were the commonly mentioned methods of culling. Born from own flock, own flock and purchasing, and purchasing from local market and neighbourhood were the main sources of goats to replace the breeding flock (Table 17).

3.1.13. Reproductive performances of indigenous goats

The recorded reproductive performances of indigenous goat types are presented in Table 18. The average ages of sexual maturity for male and female goats were 7.01 ± 1.55 and 6.69 ± 1.64 months, respectively. The result indicated that females are more sexually mature early than their male counterparts. The average age at first mating (AFM) of male goats in Bibugn district was significantly (P < 0.001) longer than the AFM of male goats in Goncha Siso Enesie and Hulet Eju Enesie districts. However, there was no significant (P > 0.05) difference in average age at first mating for female goats among the visited areas. The obtained result in this study for male goats was similar to the report of (Sheriff et al., 2020), who recorded 7.0 ± 1.0 months average age at sexual maturity of Arab goats. In contrast, it was shorter as compared to the values reported for local goats (11.1 ± 1.5 months) from northwest Amhara (Alemayehu & Kebede, 2017) and Maefur goats (9.52 ± 0.60 months; Gebreyowhens & Kumar, 2018). The obtained value for female goats was shorter than the values for Maefur goats (12.7 ± 2.1 months; Gebreyowhens & Kumar, 2018), Begait goats (7.15 ± 1.04 months; Abraham et al., 2019), Arab goats (7.9 ± 0.9 months), and Oromo goats (8.3 ± 0.7 months; Sheriff et al.,
Table 14. The breeding doe selection criteria (rank) in east Gojjam zone of Amhara region

| Selection Criteria's | Bibugn | Ganda Siso Ensie | Hulet Eju Ensie | Overall |
|----------------------|--------|-----------------|----------------|---------|
|                      | R1     | R2          | R3          | Index   | R1     | R2          | R3          | Index   | Index   |
| Body size (growth)   | 30     | 12          | 7           | 0.353    | 31     | 13          | 21          | 0.299    | 34      | 22          | 6           | 0.378    | 0.341    |
| Colour and pigments  | 9      | 21          | 8           | 0.225    | 19     | 18          | 12          | 0.224    | 8       | 17          | 15          | 0.181    | 0.210    |
| Conformation         | 11     | 9           | 19          | 0.205    | 15     | 31          | 13          | 0.256    | 13      | 14          | 17          | 0.209    | 0.226    |
| Reproductive traits  | 7      | 9           | 3           | 0.123    | 13     | 1           | 7           | 0.103    | 12      | 4           | 1           | 0.112    | 0.111    |
| Horn traits          | 0      | 0           | 7           | 0.020    | 0      | 0           | 14          | 0.050    | 0       | 0           | 11          | 0.027    | 0.026    |
| Tail and ear traits  | 0      | 0           | 4           | 0.012    | 0      | 0           | 3           | 0.006    | 0       | 0           | 7           | 0.017    | 0.012    |
| Adaptation           | 0      | 4           | 5           | 0.038    | 0      | 15          | 3           | 0.071    | 0       | 10          | 6           | 0.065    | 0.059    |
| Udder and teat traits| 0      | 2           | 4           | 0.023    | 0      | 0           | 5           | 0.011    | 0       | 0           | 4           | 0.010    | 0.014    |

Index = sum of (3 x number of households ranked first + 2 x number of households ranked second + 1 x number of households ranked third) given for each selection criteria divided by the sum of (3 x number of households ranked first + 2 x number of households ranked second + 1 x number of households ranked third) for all selection criteria in a study site; R₁, R₂, R₃ = Rank₁, Rank₂, and Rank₃, respectively.
Table 15. The breeding buck selection criteria (rank) in east Gojjam zone of Amhara region

| Selection Criteria’s                  | Bibugn | Gancha Siso Enesie | Hulet Eju Enesie | Overall |
|---------------------------------------|--------|--------------------|------------------|---------|
|                                       | $R_1$  | $R_2$  | $R_3$ | Index | $R_1$  | $R_2$  | $R_3$ | Index | $R_1$  | $R_2$  | $R_3$ | Index | Index |
| Body size (growth)                    | 21     | 13     | 16    | 0.307 | 42     | 14     | 20    | 0.372 | 29     | 22     | 7     | 0.343 | 0.344 |
| Colour and pigments                  | 12     | 14     | 7     | 0.208 | 11     | 26     | 16    | 0.216 | 16     | 14     | 11    | 0.216 | 0.214 |
| Conformation                          | 24     | 11     | 5     | 0.289 | 18     | 21     | 19    | 0.246 | 18     | 17     | 20    | 0.268 | 0.266 |
| Libido and mating                     | 0      | 1      | 2     | 0.012 | 1      | 2      | 5     | 0.026 | 0      | 1      | 6     | 0.020 | 0.020 |
| Horn traits                           | 0      | 18     | 4     | 0.117 | 6      | 5      | 8     | 0.077 | 4      | 3      | 9     | 0.067 | 0.085 |
| Tail and ear taints                   | 0      | 0      | 8     | 0.023 | 0      | 0      | 5     | 0.011 | 0      | 0      | 3     | 0.007 | 0.013 |
| Adaptation                            | 0      | 0      | 6     | 0.018 | 0      | 8      | 1     | 0.036 | 0      | 10     | 5     | 0.062 | 0.039 |
| Cannon perimeter                      | 0      | 0      | 9     | 0.026 | 0      | 2      | 4     | 0.017 | 0      | 0      | 6     | 0.015 | 0.019 |

Index = sum of ($3 \times$ number of households ranked first + $2 \times$ number of households ranked second + $1 \times$ number of households ranked third) given for each selection criteria divided by the sum of ($3 \times$ number of households ranked first + $2 \times$ number of households ranked second + $1 \times$ number of households ranked third) for all selection criteria in a study site; $R_1$, $R_2$, $R_3$ = Rank 1, Rank 2, and Rank 3, respectively.
The shorter age at first sexual maturity of goats in the present study may be due to genetics and management differences.

The average age at first kidding (AFK) in this study was 13.02 ± 2.18 months. The recorded value for Bibugn district (14.75 ± 2.83 months) was statistically (P < 0.001) longer than the recorded values for Hulet Eju Enesie (12.34 ± 1.15 months) and Goncha Siso Enesie (12.33 ± 1.53 months) districts. However, there was no significant (P > 0.05) difference in AFK of goats in Hulet Eju Enesie and Goncha Siso Enesie districts. The obtained result in the present study was almost comparable with the AFK of local goats (13.12 ± 0.10 months; Hussein, 2018) and Central Highland goats.
(13.59 ± 1.35 months; Taye et al., 2013), recorded under extensive management conditions. However, the present result was shorter than the AFK of Maefur goats (21.1 ± 2.0 months; Gebreyowhens & Kumar, 2018), Begait goats (14.30 ± 1.21 months; Abraham et al., 2019), and Oromo goats (14.9 ± 2.4 months; Sheriff et al., 2020). In contrast, the present result was longer than the value recorded for local goats (12.34 ± 0.25 months) from northwestern Amhara reported under extensive management conditions (Alemayehu & Kebede, 2017).

In the present study, indigenous goats’ average kidding interval (KI) was 6.47 ± 0.69 months which is nearly similar to the kidding interval of central highland goats (6.6 ± 1.37 months) recorded under the extensive management condition (Zergaw, 2014). But, the present result was shorter than the values recorded for Abergelle goats (12.07 ± 2.73 months; Jembere et al., 2019), Oromo goats (7.8 ± 1.1 months; Sheriff et al., 2020), and Begait goat (8.09 ± 0.09 months; Abraham et al., 2019), recorded under extensive management condition. The differences in kidding interval

| Descriptors                             | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) | χ²-value |
|-----------------------------------------|-----------------|------------------------------|---------------------------|--------------------|----------|
| Culling unproductive goats             |                 |                              |                           |                    | 35.2 (***)|
| Yes                                     | 57(100)         | 78(100)                      | 67(100)                   | 202(100)           |          |
| Reason of culling                       |                 |                              |                           |                    |          |
| Genetic improvement                     | 22(38.6)        | 8(10.3)                      | 1(1.5)                    | 31(15.3)           |          |
| Avoid management cost                   | 35(61.4)        | 70(89.7)                     | 66(98.5)                  | 171(84.7)          |          |
| Method of culling                       |                 |                              |                           |                    | 7.3(Ns)  |
| Selling                                 | 19(33.3)        | 27(34.6)                     | 22(32.8)                  | 68(33.7)           |          |
| Slaughtering                            | 0               | 9(11.5)                      | 5(7.5)                    | 14(6.9)            |          |
| Selling and slaughtering                | 38(66.7)        | 42(53.8)                     | 40(59.7)                  | 120(59.4)          |          |
| Culling age                             |                 |                              |                           |                    | 0.14(Ns) |
| Kids (marketing age)                   | 23(40.4)        | 31(39.7)                     | 25(37.3)                  | 79(39.1)           |          |
| Old goats                               | 34(59.6)        | 47(60.3)                     | 42(62.7)                  | 123(60.9)          |          |
| Sources for flock replacement           |                 |                              |                           |                    | 28.3(***)|
| Born from own flock                     | 36 (63.2)       | 25(32.1)                     | 38(56.7)                  | 99(49)             |          |
| Purchase from neighborhood              | 2(3.5)          | 10(12.8)                     | 5(7.5)                    | 17(8.4)            |          |
| Purchase from local market              | 4(7)            | 11(14.1)                     | 16(23.9)                  | 31(15.3)           |          |
| From own flock and purchased            | 15(26.3)        | 32(41)                       | 8(11.9)                   | 55(27.2)           |          |

N = Numbers of respondents; χ² = Chi square; *** = P < 0.001; Ns = Non significant (P > 0.05)
among Ethiopian indigenous goat types may be due to breed, location, and management differences, which enhance the possibilities of re-conception after parturition.

Litter size at birth (LSB) in the present study was 2.15 ± 0.38 kids per kidding doe. This result is comparable with the values for Sidama goats (2.07 ± 0.13 kids) reported by (Assefa, 2007). However, the preset result was higher than the litter sizes of Central Highland goats (1.16 ± 0.04 kids; Taye et al., 2013), Begait goats (1.52 ± 0.02 kids; Abraham et al., 2019), and Abergele goats (1.00 ± 0.170 kids; Jembere et al., 2019), recorded under extensive management conditions. The higher litter size obtained in this study may be due to genetics, management differences, and farmers’ selection practices that give due attention to prolificacy as a selection criterion of breeding does. In this study, the overall average productive life of does (PLD) was 6.93 ± 2.38 years. This result was longer than the productive age of Woyto Guji goats (4.72 ± 0.08 years; Tesfahun, 2013) and shorter as compared with the values of local goats (8.24 ± 0.33 years; Alemayehu & Kebede, 2017). The variation in average dos productive life may be due to the variable culling age of goats by goat keepers across locations and production systems.

### 3.1.14. Common goat diseases and health management

In Ethiopia, small ruminant production in general and communal goat production, in particular, are highly constrained by diseases and parasite incidences (Sissay et al., 2006). Sheep (goat) pox, *peste des petits ruminants* (PPR), fascioliasis, pasteurellosis, and respiratory diseases are the common goat diseases in Ethiopia (Abegaz, 2014). Interviewed households from all the study areas have ranked the economically important goat diseases and parasites in the study areas (Table 19). Anthrax, goat pox, ovine pasteurellosis, ectoparasites (lice, fleas and tick), contagious ecthyma, and brucellosis were ranked in the visited site as 1st, 2nd, 3rd, 4th, and 5th respectively. Farmers in the study areas have identified a particular disease based on the observed clinical signs on the infected goats.

### Table 18. The reproductive performances of indigenous goat types in east Gojam zone of Amhara region

| Reproductive parameters | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) | P-value |
|-------------------------|-----------------|-----------------------------|--------------------------|------------------|---------|
| Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | |
| AFM for males (months) | 7.67 ± 2.17\(^a\) | 6.97 ± 1.15\(^b\) | 6.51 ± 1.09\(^b\) | 7.01 ± 1.55 | *** |
| AFM for females (months) | 6.82 ± 1.59 | 6.74 ± 1.72 | 6.52 ± 1.58 | 6.69 ± 1.64 | Ns |
| AFK (months) | 14.75 ± 2.83\(^a\) | 12.33 ± 1.53\(^b\) | 12.34 ± 1.15\(^b\) | 13.02 ± 2.18 | *** |
| KI (months) | 6.44 ± 0.76 | 6.55 ± 0.68 | 6.39 ± 0.65 | 6.47 ± 0.69 | Ns |
| LSB (kids) | 2.14 ± 0.44 | 2.12 ± 0.32 | 2.19 ± 0.40 | 2.15 ± 0.38 | Ns |
| PLD (Years) | 8.05 ± 2.71\(^a\) | 6.83 ± 1.82\(^b\) | 6.09 ± 2.33\(^b\) | 6.93 ± 2.38 | *** |

a, b, c = means on the same row with different superscripts are significantly different (P < 0.05); AFM = Age at First Matting; AFK = Age at Frist Kidding; KI = Kidding Interval; LSB = Litter Size at Birth; PLD = Productive life of Does; N = Number of respondents; SD = Standard deviation; *** = P < 0.001; Ns = Non significant (P > 0.05)
Table 19. The importance (rank) goat diseases in east Gojjam zone of Amhara region

| Local name | Common name | Gbogn | Gocho Sis So Enesie | Yithel Sisio Enesie | Overall |
|------------|-------------|-------|---------------------|--------------------|---------|
|            |             | R1    | R2                  | R3                  | Index   |
| Tembes     | Anthrax     | 11    | 19                  | 7                   | 0.404   |
|            |             |       |                     |                     |         |
|             |             | 17    | 35                  | 6                   | 0.399   |
|            |             |       |                     |                     |         |
|             |             | 35    | 21                  | 11                  | 0.398   |
| Fentata     | Goat pox    | 5     | 26                  | 17                  | 0.246   |
|             |             |       |                     |                     |         |
|             |             | 10    | 33                  | 27                  | 0.260   |
|            |             |       |                     |                     |         |
|             |             | 13    | 31                  | 17                  | 0.268   |
| Mechie      | O. pasteurellosis | 10 | 5              | 23                  | 0.184   |
|             |             |       |                     |                     |         |
|             |             | 23    | 6                   | 39                  | 0.256   |
|            |             |       |                     |                     |         |
|             |             | 17    | 9                   | 31                  | 0.240   |
|             |             |       |                     |                     | 0.233   |
| Wureja     | Brucellosis | 0     | 1                   | 5                   | 0.020   |
|             |             |       |                     |                     |         |
|             |             | 0     | 3                   | 4                   | 0.021   |
|            |             |       |                     |                     |         |
|             |             | 0     | 1                   | 2                   | 0.009   |
|             |             |       |                     |                     | 0.017   |
| Dermen     | Ecto-parasities | 9   | 5                   | 2                   | 0.114   |
|             |             |       |                     |                     |         |
|             |             | 4     | 1                   | 1                   | 0.032   |
|            |             |       |                     |                     |         |
|             |             | 1     | 2                   | 5                   | 0.020   |
| Qitegn     | Contagious E | 2    | 1                   | 3                   | 0.032   |
|             |             |       |                     |                     |         |
|             |             | 4     | 0                   | 1                   | 0.028   |
|            |             |       |                     |                     |         |
|             |             | 1     | 3                   | 1                   | 0.035   |
|             |             |       |                     |                     | 0.028   |

Index = sum of (3 x number of households ranked first + 2 x number of households ranked second +1 x number of households ranked third) given for each selection criteria divided by the sum of (3 x number of households ranked first + 2 x number of households ranked second + 1 x number of households ranked third) for all selection criteria in a study site; R1, R2, R3 = Rank1, Rank2, and Rank3, respectively; O. = Ovine; E. = ecthyma
Table 20. Veterinary services and treatment of sick goats in east Gojam zone of Amhara region

| Descriptors                          | Bibugn (N = 57) | Goncha Siso Enesie (N = 78) | Hulet Eju Enesie (N = 67) | Overall (N = 202) | χ²-Value |
|-------------------------------------|-----------------|------------------------------|---------------------------|--------------------|----------|
|                                     | N (%)           | N (%)                        | N (%)                     | N (%)              |          |
| Highly affected age class           |                 |                              |                           |                    | 24.27(***)|
| Kids                                | 47(82.5)        | 43 (55.1)                    | 26 (38.8)                 | 116 (57.4)         |          |
| Mature goats                        | 0               | 0                            | 0                         | 0                  |          |
| Old goats                           | 0               | 0                            | 0                         | 0                  |          |
| All age groups                      | 10(17.5)        | 35 (44.9)                    | 41 (61.2)                 | 86 (42.6)          |          |
| Vet. clinics in the areas           |                 |                              |                           |                    |          |
| Yes                                 | 57(100)         | 78(100)                      | 67(100)                   | 202(100)           |          |
| No                                  | 0               | 0                            | 0                         | 0                  |          |
| Traditional treatments              |                 |                              |                           |                    | 7.50(*)  |
| Yes                                 | 17(29.8)        | 25(32.1)                     | 9(13.4)                   | 51(25.2)           |          |
| No                                  | 40(70.2)        | 53(67.9)                     | 58(86.6)                  | 151(74.8)          |          |
| Hrs. (Home to Vet. Clinics)        | Mean ± SD       | Mean ± SD                    | Mean ± SD                 | Mean ± SD          | P-Value  |
|                                     | 1.01 ± 0.38<sup>a</sup> | 1.32 ± 0.49<sup>b</sup> | 1.06 ± 0.37<sup>c</sup> | 1.15 ± 0.44<sup>c</sup> | ***      |

<sup>a, b, c =</sup> means on the same row with different superscripts are significantly different (P < 0.05); N = Number of observations; χ² = Chi square SD = Standard deviation; *** = P < 0.001; * = P < 0.05

More than half (57.4%) of the interviewed households were reported that newborn kids were the most frequently affected age class (Table 20). Sabapara and Deshpande (2010) observed that from different age classes of Surti goats managed under field conditions, the mortality rate was the highest in 0 to 3 months age group followed by 3 to 12 months age was least among the adult group. In the area, goat keepers were ought to travel 1.15 ± 0.44 hours to reach the nearest veterinary clinic. The average traveling hour in Goncha Siso Enesie district (1.32 ± 0.49 hours) is significantly (P > 0.001) higher than in Hulet Eju Enesie (1.06 ± 0.37 hours) and Bibugn (1.01 ± 0.38 hours) districts (Table 20). This indicated that even though the government established veterinary clinics commonly located at the center of each peasant association, farmers ought to travel long distances may be impossible if the animal is very sick. Some (25.2%) of goat keepers were applied traditional treatments to treat goat diseases. Fumigate with parts of selected herbs (the vegetative part of “Aregressa” and root of “Keberecho”) for ovine pasteurellosis (“Mechie”), fumigate by dried animal dung (dung from monkey and cattle), and herbs (“Keberecho” root) for respiratory disease (“Kuro”), washing by salt solution, smearing by food salt (“Dekuse”) with hot “Injera”, and fumigate by herb root (“Gumero”) for contagious echyma (“Qitegn/ Gúmero”) were among the reported traditional treatments used by the respondents in the study areas.

4. Conclusion
The study revealed that illiteracy is high, and the mixed crop-livestock production system is the dominant agricultural system. Goats have the highest proportion of all livestock species kept in the area and are mainly raised for income generation. Hillside browsing and river water are the main feed and water sources of goats, respectively. Goats are housed in separate houses built from iron sheets and wood. Farmers use more subjective than objective criteria to select breeding does and bucks, which contradicts the ideal criteria for improved performances. Although most farmers have breeding buck(s), in the area, natural, uncontrolled goat mating is common. Goats in the study areas have better reproductive
performances that give opportunities for further improvement of the breed. However, uncontrolled mating, absence of flock mixing, replacing breeding does and bucks from own flock, and low male-to-female ratio in the flock will enhance the inbreeding level within the flock, and result in inbreeding depression. Thus, providing training for goat keepers concerning the purposes of avoiding those issues is needed.

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