# Sheep Production System and Farmers' Perception towards Dorper Crossbred Lambs in Eastern Amhara, Ethiopia

**Mesfin Lakew[1*], Zeleke Tessema[2], Belay Deribe[2]**

[1]*Amhara Agricultural Research Institute, P.O. Box 527, Bahir Dar, Ethiopia*
[2]*Sirinka Agricultural Research Center, P.O. Box 74, Woldia, Ethiopia*

**Abstract**
The study was conducted to assess the production system and farmers' perceptions of Dorper crossbreds in Eastern Amhara, Ethiopia. Data on the sheep production system and farmers' perceptions were collected using participatory rural appraisal in Kalu and Gubalafto districts. According to this survey, the average landholding in Kalu and Gubalafto districts was 0.75 and 0.55ha per household, respectively. The average number of sheep per household in Kalu (0.64TLU) was higher than in Gubalafto (0.42TLU). In the districts, sheep were virtually kept under low-input, traditional management systems; sheep production was entirely dependent on local sheep, and pure breeding was common. However, following the introduction of the Dorper sheep, few farmers were found to participate in crossbreeding activities. The primary goal of keeping sheep in Kalu and Gubalafto was to generate income with indexes of 0.31 and 0.32, respectively, followed by social security with the same index (0.24). In Kalu and Gubalafto, in approximately 77.3 and 68% of cases, respectively, children were found to be involved in sheepherding. In the Kalu district, feed scarcity and disease ranked first and second, respectively, with indexes of 0.40 and 0.27. In Gubalafto, feed scarcity ranked first with the same index (0.40), and still, the disease ranked second with a lower index (0.23). Because of their fast growth, all farmers expressed a strong desire to keep Dorper crossbreds. Farmers also reported that the 25% Dorper crossbreds had a high market demand and price due to their larger body size. In conclusion, to use Dorper sheep properly and increase the profitability of sheep producers, effective ram dissemination and breeding strategies need to be designed by considering the current production system and the farmers' needs.

**Keywords**: Crossbreeding, Dorper crossbred, Gubalafto, Kalu, Perception.

## 1. Introduction

Agriculture has long been the primary source of income for the Amhara region people and the region's economic backbone. Some parts of the region, however, are not yet self-sufficient in food. The majority of areas in the eastern Amhara region are particularly mentioned in this regard. In these food-deficient areas, crop production activity is unreliable and encounters several challenges, the most severe of which are inadequate and erratic rainfall, frost, rugged terrain, and land degradation [1]. Livestock production, therefore, is regarded as a primary income source and means of livelihood for these areas. Sheep production, in particular, plays a significant role in ensuring food security due to their high reproductive rate and low initial capital requirements making sheep production suitable for low-income farmers and landless youth and women [2-4].

The Amhara region has the highest sheep population in the country, with 10.39 million headcounts, estimating about 26.05% of Ethiopia's total sheep population of 39.89 million heads [5]. The food-deficient eastern parts of the region have the highest concentration of sheep. Although this vast resource contributes to the regional economy, its productivity is lower than expected [6]. The

* Corresponding author: Mesfin Lakew, meslamess@gmail.com

main problems mentioned frequently are a lack of feed in terms of quantity and quality, the occurrence of diseases, the presence of traditional production systems, which led to improper management practices, and the inadequacy of improved sheep breeds [4].

As a result, improving the local sheep breeds and rearing a small number of highly productive animals is crucial to cope with these enormous challenges. Despite the availability of drought-prone sheep breeds that have good traits to cope with the high feed and water shortage conditions, farmers have not benefited much from these breeds beyond counting their heads. Hence, improving the local sheep breeds in farmers' possession is very important to obtain crossbreds that can adapt and produce a high carcass yield [7]. As a result, local sheep must be crossed with exotic sheep breeds to reverse this situation [8]. Hence, improved sheep production is the best alternative and most feasible development strategy for improving community livelihoods and combating poverty in food-insecure and drought-prone areas.

In this regard, recently, attempts have been made to introduce highly productive and efficient meat-producing sheep breeds known as Dorper, which are suitable for the lowland areas of Eastern Amhara. For this program to become a reality, the Ethiopian Sheep and Goat Productivity Improvement Program (ESGPIP), with the financial support of the United States Agency for International Development (USAID), was in charge of importing the improved genotype to accomplish the crossbreeding program.

To realize this crossbreeding program in the area, the Sirinka Agricultural Research Center established a Breeding, Evaluation, and Distribution (BED) site. A community-based breeding program was then designed and implemented to ensure the long-term use of this genotype. The centre distributed the 50% Dorper x local crossbred sires to local sheep producers to cross local sheep with Dorper sheep. Hence, to utilize this new genotype effectively, it is necessary to understand the current production system and producers' preferences for crossbred lambs. There are, however, no reports about the current sheep production system in the areas and farmers' attitudes toward these crossbred lambs. Therefore, this study was conducted to assess the smallholder sheep production system of the project area and producers' preferences for Dorper x local crossbred lambs.

## 2. Materials and methods

### *Description of the study area*

The survey was conducted in Gubalafto and Kalu districts of the North and South Wollo Administration Zones of the Amhara National Regional State, respectively. Gubalafto district is located 520 kilometres northeast of Addis Ababa, the country's capital, and 360 kilometres east of Bahir Dar, the region's capital, at 12°0′0″ N latitude and 39°20′0″ E longitude. The district has an altitude ranging from 1300 to 3900 meters above sea level. This district, on average, receives 700 to 1200 mm of rainfall per annum. The mean minimum and maximum temperatures are also 12 and 25°C, respectively.

Kalu district, on the other hand, is located 365 kilometres northeast of Addis Ababa and 495 kilometres east of Bahir Dar, with coordinates of 11°0′0″ N latitude and 39°50′0″ E longitude. It has an altitude ranging from 800 to 1,750 meters above sea level. On average, the district receives 750 to 900 mm of rainfall per year. It also has a mean minimum and maximum annual temperatures ranging from 12.5 to 18.15°C.

In general, both the study districts have a bimodal rainfall pattern, with the main rainy season "Meher" being extended from June to September and providing about 70% of the total rainfall of the area. On the other hand, the short rainy season "Belg" extends from February to April. Livestock production is primarily traditional and subsistence-oriented, with a low level of management input for feeding, breeding, and disease control. The two zones have approximately 2.49 million sheep, accounting for about 24% of the region's total sheep population [5].

Farmers in the areas practiced a mixed farming system in which crops and livestock coexisted, with the products and by-products of one serving as an input for the other. Natural pasture grazing is the primary source of feed for livestock. Crop residues, non-arable land vegetation, and crop aftermaths are all potential feed resources in the areas. The vast majority of grazing areas were communally owned and situated on the upper slopes of hills and bottomlands that flooded

seasonally. Hay preparation for dry season feeding is a common practice in the area.

***Description of the breeds***

The local sheep in the study area are locally named "Tumelie." Sheep farmers believe the local sheep are a cross between Wollo and Afar sheep. Solomon [9] classified this sheep population as Afar sheep, but Sisay [10] recently reclassified it as rift valley sheep. The latter author described the local sheep as having a well-developed shield-shaped fat-tail that curves upward at the tip, small in size, covered with short and coarse hair, commonly plain white, light-brown and red in coat colour, and a polled and straight head with pads of fat on both sides of the nose and short ears.

The Dorper sheep were developed in the harsh, dry regions of South Africa from a Dorset Horn ram and a Blackhead Persian ewe [11]. This meat-type sheep with a large body frame is recognized as a tough, adaptable breed that thrives in harsh environments [12]. Dorper sheep were known for their hardiness, adaptability, good mothering ability, high fertility, high sexual libido, good carcass quality, and attractive physical appearance [13].

***Data collection and source***

The participatory rural appraisal (PRA) method was employed to collect data on the sheep production system in the study area and farmers' perceptions of the newly introduced Dorper crossbred sheep. Household surveys with semi-structured interviews, observations, key informant interviews, and focus group discussions were part of the data collection tools. The household survey and focus group discussion with farmers who keep local and Dorper crossbred sheep in the crossbreeding program's target districts (Gubalafto and Kalu) were conducted using a semi-structured questionnaire and checklist. As a result, 25 farmers from Gubalafto and 22 from the Kalu districts participated in the study. Key informants like the district office of agriculture and Kebele livestock experts participated in the discussion. Secondary data was obtained from each district's reports and other official documents.

***Data Management and Analysis***

Data collected through questionnaire were described by descriptive statistics using the Statistical Package for Social Sciences [14]. The analysed data were presented and summarized using tables, percentages, and frequency distributions. Indices were calculated for all ranking data using the following formula: Index = Σ[3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for each reason divided by Σ[3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all reasons, where indices represent weighted averages of all rankings for a particular reason.

## 3. Results and discussion

***Agricultural production system***

Farmers in the study area produced both crops and livestock, with the products and by-products of one serving as input for the other. Several studies [15-18] reported similar production systems. In these areas, the crop production subsystem is both rain-fed and irrigated with an oxen-drawn plough. Farmers rely on their draught oxen to plough their land, sow seeds, remove weeds, and even thresh the harvest. As a result, the crop production subsystem has intimately connected with the livestock sector. The livestock production subsystem is sedentary and traditional, with low-level management for feeding, breeding, and disease control.

***Landholding and distribution***

The landholding and land use per household in the study areas are shown in Table 1. The year-to-year increase in the population size in the study districts has shrunk the average landholding per household. According to discussions with farmers, the minimum amount of land held was none at all, while the maximum amount was 1.5 ha. The smallest landholding size was found in the Gubalafto district, while the maximum holding (1.5 ha) was in the Kalu. Farmers in Kalu had larger farm plots on average than those in the Gubalafto district.

According to the survey results, the average landholding per household in Kalu and Gubalafto districts was 0.75 and 0.55 ha, respectively. In Kalu, the distribution of landholding showed that 36.4 percent and 95.5 percent of farmers owned less than 0.5 and 1 ha, respectively. The overall landholding per household is significantly lower than that found by Sisay [19] in the northern Gondar areas and Getachew [20] in the central

highlands of Ethiopia. Cereals dominated rain-fed crop production in the study area, with sorghum, teff, and chickpeas being the most important crops grown. Vegetable production in Kalu and sugarcane plantations in Gubalafto districts dominated the irrigation-based production system.

**Table 1.** Distribution of landholding in the study areas

| | Kalu (N=22) | | Gubalafto (N=25) | |
|---|---|---|---|---|
| | Mean (ha) | Farmers owning (%) | Mean (ha) | Farmers owning (%) |
| Landholding | 0.75 | - | 0.55 | - |
| Land size | | | | |
| 0.00 - 0.49 | | 36.4 | | 44.0 |
| 0.50 - 0.99 | | 59.1 | | 56.0 |
| 1.0 - 1.50 | | 4.5 | | |

*N = number of farmers*

### *Livestock holding and composition*

Livestock composition and the number of livestock holdings in the two districts are indicated in Table 2. In the current study, cattle, small ruminants, and equines were the dominant livestock species in the study areas. The total TLU (4.14) recorded for Kalu was higher than the TLU (3.75) recorded for Gubalafto. This difference could be due to the presence of relatively larger communal grazing lands in the Kalu district compared to Gubalafto. The current result, however, was found to be significantly lower than the findings of Asaminew [21] in a research work conducted in Bahir Dar Zuria (10.32) and Aderajew [22] in Kutaber district (5.21) of the South Wollo Zone. In the study districts, sheep were reared at a subsistence level, with a higher number in Kalu (0.64±0.22) than in Gubalafto (0.42±0.17). However, it was lower than Sisay's [19] findings in a study conducted in the North Gondar Zone.

**Table 2.** Livestock composition and holding per household in the study areas

| | Kalu (N = 30) | Gubalafto (N = 25) |
|---|---|---|
| Livestock species | Mean±SE | Mean±SE |
| Livestock (TLU) | 4.1±0.16 | 3.8±0.12 |
| Cattle (TLU) | 2.5±0.62 | 2.3±0.52 |
| Sheep (TLU) | 0.6±0.22 | 0.4±0.17 |
| Goats (TLU) | 0.28±0.11 | 0.18±0.08 |
| Donkeys (TLU) | 0.52±0.19 | 0.58±0.22 |
| Horse (TLU) | 0.08±0.01 | 0.11±0.01 |
| Mules (TLU) | 0.14±0.01 | 0.19±0.02 |
| Poultry (No.) | 2.6 | 2.4 |

*TLU = Tropical Livestock Units, N = number of farmers, SE = standard error*

### *Purposes of keeping sheep*

Table 3 shows the ranking of sheep production purposes in the Kalu and Gubalafto districts. The primary goal of keeping sheep in both study districts was to generate income, followed by social security. When crop harvesting was insufficient in the area, sheep were the first animals to be sold to purchase food grain and other family needs. Many authors reported similar reasons for keeping sheep in their findings, which confirmed this result [23, 19, 16, 24].

**Table 3.** Purposes of keeping sheep ranked according to the importance

| | Rank | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Site and purposes | 1st | 2nd | 3rd | 4th | 5th | 6th | Index | Rank |
| **Kalu District** | | | | | | | | |
| Meat | - | 1 | 15 | 3 | - | - | 0.18 | 3 |
| Replacement stock | - | 2 | 3 | 13 | - | - | 0.14 | 4 |
| Income generation | 22 | - | - | - | - | - | 0.31 | 1 |
| Social security | - | 19 | 2 | - | - | - | 0.24 | 2 |
| Social prestige | - | - | - | 3 | 13 | 1 | 0.09 | 5 |
| Skin | - | - | - | - | 1 | 14 | 0.04 | 6 |
| **Gubalafto District** | | | | | | | | |
| Meat | - | 1 | 5 | 13 | - | - | 0.13 | 4 |
| Replacement stock | - | 2 | 19 | 1 | - | - | 0.19 | 3 |
| Income generation | 25 | - | - | - | - | - | 0.32 | 1 |
| Social security | - | 22 | 1 | - | - | - | 0.24 | 2 |
| Social prestige | - | - | - | 8 | 8 | 1 | 0.09 | 5 |
| Skin | - | - | - | - | 4 | 10 | 0.04 | 6 |

*1st, 2nd, 3rd, 4th, 5th, and 6th = number of households ranked first, second, third, fourth, fifth, and sixth.*

Sheep are reared for meat consumption, particularly during festivals and religious celebrations. Farmers slaughtered sheep for domestic and guest consumption, and their skin also served as a source of income. Sheep are also reared for social status as well as for their enormous economic value. The findings of this survey were consistent with those of other studies [25].

In the study districts, sheep were kept not only by wealthy people but also by resource-limited farmers who could not raise large ruminants. Poor farmers who could not keep sheep benefited from a practice known as "Yerbi," which allowed them to rear the sheep of wealthier farmers and share the new-born lambs equally. When wealthier farmers fail to meet management requirements, such as herding and housing, for their large flocks of sheep, they are forced to give their sheep to poor farmers.

***Breeding practice and labour***

In the study areas, pure breeding within local breeds was the most common sheep breeding system, and several sheep producers practiced an uncontrolled mating system, though only a few farmers involved in this crossbreeding program have started to cross their ewes with Dorper crossbred sires. Dorper crossbred rams have recently been introduced in both Kalu and Gubalafto districts.

As a result, the farmers who participated in the crossbreeding program practiced a controlled mating system. To avoid unwanted mating in their flocks, all farmers involved in the program castrated their local rams. Furthermore, farmers castrate lambs with a 25% Dorper inheritance to prevent further breeding. As the key informants mentioned, this practice allowed producers to earn more money when they sold castrated lambs at a young age. In line with this finding, several authors, including [26,18], have reported that ram castration is commonly practiced for breeding purposes in many areas.

Table 4 showed the responsibilities of family members in the two districts, with everyone in the family having a different role to play in the overall sheep management practices. Males did the majority of the feeding and transporting of sheep to market places. In the districts, each family member has a different role to play in sheep production. In Kalu and Gubalafto, in approximately 77.3 and 68 percent of cases, respectively, children were found to be involved in sheepherding. Children in the Kalu and Gubalafto districts also did watering in approximately 68.2 and 60 percent of cases, respectively. The current study agreed with Getachew's [20] and Sisay's [19], who reported similar results in the central highlands of Ethiopia and the North Gondar zone, respectively.

Caring for a sick animal was the responsibility of the husband and woman. Many domestic activities are regarded as solely the responsibility of women in many parts of the country. Similarly, in these study areas, women do barn cleaning and other household tasks. Furthermore, women were in charge of meeting the family's daily needs by selling animal products. If a family does not have children, a hired labourer cares for the sheep.

**Table 4.** Share of responsibilities among family members in sheep management

| | Kalu (N=22) | | | | Gubalafto (N= 25) | | | |
|---|---|---|---|---|---|---|---|---|
| Activity | Husband (%) | Wife (%) | Children (%) | Hired labour (%) | Husband (%) | Wife (%) | Children (%) | Hired labour (%) |
| Feeding | 68.2 | 13.6 | 9.1 | 9.1 | 36 | 16 | 44 | 4 |
| Watering | 4.5 | 18.2 | 68.2 | 9.1 | 8 | 20 | 60 | 12 |
| Herding | - | 4.5 | 77.3 | 18.2 | 4 | 12 | 68 | 16 |
| Barn cleaning | - | 86.4 | 4.5 | 9.1 | - | 88 | 8 | 4 |
| Caring diseased | 54.6 | 36.3 | 9.1 | - | 20 | 64 | 12 | 4 |
| Sheep selling | 90.9 | 9.1 | - | - | 84 | 16 | - | - |

*N = number of participants*

***Feeds and feeding practices***

According to the present survey results, the type of available feed resources in the study area includes native pasture, crop residue, crop aftermath, hay, and industrial by-products, especially in the Kalu district and sugarcane tops in the Gubalafto district. However, the availability of these feed resources varies depending on the seasons. Mostly, crop

residue was available after crop harvesting, though its amount was inadequate to feed lactating, pregnant ewes, and young lambs during the long dry season of the area. During the dry season, farmers living in the surrounding towns have been purchased industrial by-products as supplementary feed for fattening animals and lactating ewes. Hay preparation is a common practice for many farmers in both districts, especially during October and November. Other researchers agreed with the current result, reporting similar feeding practices in various parts of the country [16, 18, 19, 27].

In general, not all farmers have enough land, even for crop production. As a result, private grazing land was not available in the area, resulting in critical feed shortages during the dry season and sheepherding to be practiced in mountainous or marginal areas, unsuitable for crop production.

***Watering and housing***

All farmers in the study area watered their sheep once a day. The primary sources of water were rivers, springs, and water from the pipeline. Sheep took between 10 and 30 minutes to reach water points in both of the districts. According to the information obtained from the group discussion, water infestation by parasites is a major limiting factor for livestock production. Mostly, river water was infested with leech, a small blood-sucking worm that attached itself to the soft palate of the host in the oral cavity, causing body condition loss.

Most sheep owners in the study areas keep their sheep in a separate barn built inside or near the family house, while cattle are kept in a fence in the backyard during the dry season. Sisay [19] reported similar sheep housing management practices in the north Gondar area, Tesfaye [16] in the Menz area, and Shigdaf [18] in the Northwestern Amhara Region. Economic status and security were the two main factors that practically determined the construction of separate sheep barns in the study areas. In general, the farmers involved in the Dorper crossbreeding program were constructing barns from locally available materials such as wood and mud for pregnant ewes, lactating, and young lambs.

***Sheep health system***

According to the district's office of agriculture data, Pasteureollosis, sheep pox, and anthrax were the most common diseases in the study areas. Anthrax was a highly prevalent disease in the Kalu district. External parasites such as ticks, lice, and mites were also common in the study areas. The prevalence of major diseases is reasonably associated with the season, which includes feed availability and drought. Internal parasitic diseases, such as Fasciola, are more prevalent at the end of the rainy season. Furthermore, there was a critical shortage of grazing land in these areas, mostly limited to hillsides. As a result, there was a high concentration of animals in limited grazing areas, which resulted in high parasite and disease challenges.

Sheep producers in the study areas (Kalu and Gubalafto) use modern and traditional veterinary services, depending on the availability and severity of the disease. During the discussion with interviewees, they emphasized the insufficiency of available veterinary services to provide the required health services for Dorper crossbred lambs, which might require better care and frequent follow-up. Furthermore, the veterinarian-to-livestock population ratio, as well as the wide range of animal diseases in the area, were found to be insufficient for providing adequate health services. As a result, farmers consider ethno-botanical veterinary medicine as an essential means of treating diseased animals in areas far from modern services and when veterinary services are unavailable. Similarly, poor veterinary service delivery, shortage of veterinarians, and inadequate drug supplies were also reported by Shigdaf [18] as the main constraints in the north-western part of the Amhara region, contributing to sheep deaths.

***Sheep marketing***

In the study areas, the market price of sheep varied with time and place. Sheep were sold at a high market price in the wide market places of neighbouring towns during the months of religious festivals and ceremonies. The most attractive selling months were December, April, and the end of August. Meat demand was high during these months, resulting in a higher price for sheep [16]. The problem here is that the sheep must travel long distances to get into such markets or back home when the animals cannot be sold, which causes body condition losses.

During the discussion, farmers described the market price dropping around the middle of September and October when they needed money to pay school fees, buy school supplies for their children, and pay their land taxes. They are also

sold at a lower market price in May and June when they need additional cash to purchase fertilizer and improved seed. Many studies [16, 17, 28] reported similar marketing conditions.

***Sheep production constraints***

The ranking of sheep production constraints in the study areas is presented below in Table 5. In both districts, several restrictions were reported to be limiting sheep productivity, among which feed shortages remain the most important ones in both Kalu and Gubalafto districts, with equal severity. In the Kalu district, farmers ranked feed shortages and sheep disease as the first and second constraints, respectively, with an index of 0.40 and 0.27. Feed shortages, however, were reported as the first constraint with the same index (0.40) in Gubalafto, while disease ranked as the second limiting factor with a lower index (0.23). Shortage of capital to expand sheep production and lack of improved genotype were the third and fourth constraints in Kalu, with indexes of 0.14 and 0.11, respectively, whereas, in Gubalafto district, lack of genotype ranked third with an index of 0.17 and shortage of capital ranked fourth with an index of 0.13. According to the findings of studies conducted in the Menz and Afar areas, the main constraints for sheep production include lack of feed, disease, a lack of money, and improved genotype [16]. In line with this result, Markos [4] and Shigdaf [18] also reported feed shortages, health problems, labour shortages, and the occurrence of drought as main constraints for sheep production.

In the study districts, grazing lands became shrunken as farmlands have become increasingly widened. As a result, feed shortages have become the most pressing problem across the study districts. During the dry season, from May to June, the feed shortages remained much worse. Crop residue, the other feed source, was inadequate to feed all animals during this season. At this time, farmers have put their oxen and lactating cows first, causing severe feed shortages for the rest of the animals. Sheep, in particular, were found the most threatened farm animals in the current production system due to their dependence on grazing alone. In addition, because of the feed shortages during the long dry season, sheep became susceptible to diseases.

Judith [29] also indicated that the land available for natural grazing and browsing is rapidly decreasing due to the increasing human population and the high demand for cropland in the Amhara region. The high number of animals competing for grazing areas, unreliable rainfall, increasing human population, small landholding size, and decreasing land productivity are significant threats to livestock production [30].

**Table 5**. Ranking of sheep production constraints in the study areas

| Site and Constraints | Rank | | | | Index | Rank |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | | |
| **Kalu District** | | | | | | |
| Feed shortage | 22 | - | - | - | 0.40 | 1 |
| Water shortage | - | - | - | 2 | 0.01 | 6 |
| Lack of improved genotype | - | 5 | 4 | 2 | 0.11 | 4 |
| Disease prevalence | - | 13 | 6 | 9 | 0.27 | 2 |
| Shortage of capital | - | 2 | 9 | 7 | 0.14 | 3 |
| Inadequate market | - | 2 | 3 | 2 | 0.06 | 5 |
| **Gubalafto District** | | | | | | |
| Feed shortage | 25 | - | - | - | 0.40 | 1 |
| Water shortage | - | - | 1 | 3 | 0.02 | 6 |
| Lack of improved genotype | - | 3 | 14 | 5 | 0.17 | 3 |
| Disease prevalence | - | 16 | 4 | 2 | 0.23 | 2 |
| Shortage of capital | - | 5 | 3 | 11 | 0.13 | 4 |
| Inadequate market | - | 1 | 3 | 4 | 0.05 | 5 |

Sheep producers criticized local sheep breeds for their low productivity, which they saw as a significant limiting factor in the profitability of sheep production. Farmers also explained that the slow growth rate, small size, high lamb mortality, and poor mothering ability of local sheep breed ewes have been discouraging, pressuring them to demand other breeds that outperform the local sheep breed. Several studies supported the farmer's point of view. Slow growth rate, resulting

in a low market weight of indigenous sheep, has been identified as a significant limiting factor on sheep profitability in the Ethiopian highlands [31]. As a result, farmers should raise improved breeds that are specialized for meat production. Dorper sheep, for example, are in high demand in project areas. However, the cost of such a breed is prohibitive, and supply is insufficient to meet demand.

***Farmers' perception on local and Dorper crossbred sheep***

The study districts were dominated by local sheep breeds known as Tumelie sheep, though only a few farmers involved in the current Dorper crossbreeding program produced the 25% crossbred lambs using the 50% Dorper crossbred ram as a terminal sire. Farmers who took part in this crossbreeding activity became well acquainted with the advantages of crossbred lambs and local sheep breeds in terms of growth potential, appearance, and disease tolerance ability. Farmers have unique preferences because they are intimately acquainted with their respective local environments, conditions, problems, and priorities [32]. According to the farmers' response, the advantages of local sheep breeds over Dorper crossbreds were disease tolerance, the ability to thrive in feed shortages, and having a broad fat tail. The slow growth rate and small body size of the local sheep breeds were perceived as disadvantages.

***Growth potential***

Almost all farmers who reared the 50% crossbred sires observed good body conformation and large body size compared with the local sheep rams. Even the crossbred lambs having 25% Dorper inheritance also showed a remarkable fast growth rate and good body conformation compared with the local sheep breed lambs. In line with this result, Awassi crossbred lambs showed higher growth performance than Menz sheep [33]. Because of their rapid growth, crossbred lambs were in high demand at an early age, with a high market price compared to local sheep.

***Coat colour preference***

Farmers and sheep buyers in the study areas are more concerned with coat colour and pattern. Accordingly, almost all farmers prefer white, red, and brown, and their mixtures in that order. Farmers were most interested in crossbreds that were white with blackheads. Sheep buyers at market places preferred this coat colour as well. According to Solomon et al. [34], farmers in east Wellega and West Shewa preferred white and brown coloured sheep. Almost no sheep producers or buyers choose a black coat colour. In addition to the production traits, farmers consider the coat colour of their sheep when making decisions [35].

***Disease and feed shortage tolerance***

Farmers prefer local sheep breeds since they can thrive in the presence of feed shortages and adapt to the harsh environment of the areas. Local sheep breeds, farmers claim, are more disease-resistant than crossbreds. According to information obtained from district experts, the Dorper crossbred lambs showed good adaptation potential with a lower death rate. The failures of previous crossbreeding programs, on the other hand, could commonly be attributed to the low survival rate of the exotic genotype under such conditions [33]. Crossbred lambs, however, require more attention to their health care and better housing management and require regular monitoring compared to local sheep, especially during the rainy seasons.

Almost all farmers explained that the crossbreds performed well in body condition when fed properly. However, if they do not receive enough feed, they become inactive. As a result, preparing and storing enough hay for the area's long dry season is critical. Because of good feed availability, the crossbreds performed better in the wet season than in the long dry season. Generally, farmers reported that the crossbreds had higher feed requirements than the locals did.

***Tail condition***

Buyers have not preferred crossbreds with 50% Dorper bloodline due to their docked tails. The tails of crossbred lambs with a 25% Dorper inheritance, on the other hand, are longer. This condition shows that the 25% crossbreds would have a higher market preference than the 50% crossbreds. According to Tesfaye et al. [36], a big fat tail gets a higher market price. Sheep with big fat tails are also in high demand during the holidays [18], and the community often views slaughtering such sheep as a sign of wealth. Similarly, Awassi crossbreds are popular in the

community because they meet the market demand for tails [37].

***Dorper crossbred sheep marketing***

This Dorper crossbreeding program aimed to produce crossbred lambs with a 25% Dorper inheritance using a 50% Dorper crossbred ram as a terminal sire. Almost all farmers in both districts admire the 25% crossbreds for their fast growth, good body conformation, and phenotypic similarity to the local sheep breeds. During the focus group discussion, farmers mentioned that crossbred lambs with 25% Dorper inheritance had high market demand and prices for their excellent body conformation, which attracted the attention of sheep buyers. During the discussion, key informants emphasized that farmers have been able to produce lambs that are in high demand in the local market at a high market price. This condition shows that the current crossbreeding program has benefited participating farmers.

Sheep are generally traded using eyeball pricing in the study areas, where the price is determined by individual bargaining power. Moreover, seasons, occurrences of religious and cultural festivals influence sheep prices. Sheep supplies in the study areas reach their peak during festivals and ceremonies. The severity of the long dry season, around May and June, and farmers pressing needs for cash also influenced its supply. Tesfaye [16] reported similar seasonal effects on sheep marketing conditions. Sheep prices are also affected by the sheep's characteristics, such as weight, sex, age, body condition, and coat colour [38].

Farmers observed that producing crossbred sheep with 25% Dorper inheritance was more profitable due to their high market demand, better price, phenotypic preference, and low feed requirement. However, as farmers become more involved and gain experience in producing higher blood levels in crossbred lambs, there may be a demand gap between producers and the nature of the crossbreds and others. Because of the complex nature of the study areas, the current survey indicates that there is a need for researchers to determine the appropriate blood level by taking into account the existing on-farm conditions and based on the farmers' interest at this early stage of the program.

***Farmers' perspective on the crossbreeding program approaches***

The study areas are among those in the region with a food-insecure society. Farmers struggle in a dynamic and complex environment with risky and conventional agriculture. Rainfall is erratic and rare. In such conditions, the community living in the area fights to make a living by relying on limited and deteriorating production methods. Farmers have never been reluctant to adopt new ideas and methodologies that are profitable, stable, and compatible with the natural, socio-cultural, and economic conditions under which they work. The key argument is that farmers need dependable and harmonious technology to improve their lives.

With so many issues and so much population pressure, the farming community has placed its entire trust in the limited natural resources of land and water. However, their large livestock population is critical to their livelihood. As a result, increasing the productivity of these vast livestock resources through new technologies would play a crucial role in reducing the farming community's reliance on limited land resources through traditional methods. With this fact in mind and the farming community's tendency towards technology adoption, the current sheep productivity improvement program has a good chance of succeeding. For example, among previous sheep genetic improvement efforts in the country, the Awassi sheep breeding program achieved its goal. This success can confirm the technological adoption nature of the farming communities in the study areas, even if it mainly depends on the type of new technology. Farmers' preferences and breed adaptability were critical factors in achieving this successful outcome.

Farmers' perspectives and issues that require immediate attention from researchers in the current crossbreeding program were addressed during the focus group discussion. Farmers are thus dissatisfied with individual-based ram distribution methods. When following this dissemination approach, farmers continued to herd their flocks separately from the other sheep flocks found in the villages to avoid unwanted mating. Therefore, the ram dissemination approach should be revised and advised to be group-based. In doing so, all participants in the program need to agree to cull and castrate their local sheep rams. A previous study on the Awassi sheep crossbreeding

program found that using privately owned and individual-based rams was ineffective [33].
Farmers have also criticized the breeding ram exchange approaches used in this crossbreeding program. Farmers suggest two possible solutions to these issues. First, breeding rams should be exchanged between established groups and collected after providing adequate services to avoid unwanted mating and inbreeding. Second, farmers emphasized the importance of establishing market links between potential buyers and the continuous replacement of breeding rams from the BED site.

## 4. Conclusions

Sheep are the major ruminant animals produced in the study districts. Farmers raise sheep for several reasons, including income, meat consumption, replacement stock, and social security. The main constraints to sheep production are feed shortages and disease. The sheep production system is traditional as well, with low-level management. As a result, the Dorper sheep crossbreeding program was started to increase the productivity of local sheep breeds in the area. From the present survey results, the 50% Dorper crossbred rams can be used as a terminal sire to produce crossbreds with a 25% blood level. The 25% crossbred lambs gained high acceptance and demand in the local market at a high price from producers and buyers because of their fast growth and phenotypic resemblance to local sheep. Thus, Dorper sheep can be considered one of the suitable breeds to increase the meat yield of the study area.

## Recommendations

Based on current findings, the following points are recommended for further consideration:
• Researchers must devise an effective breeding ram dissemination strategy by taking into account the existing sheep production system and the interests of producers.
• Priority should be given to the establishment of a market link between producers and buyers.
• The institutional linkage between the livestock resources development agency and research centres has to be strengthened to ensure proper and long-term ram distribution, data recording, feedback on the status of crossbreds, and training and livestock extension services provision.

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