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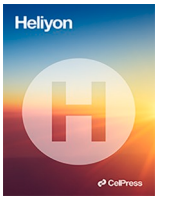

Review article

Review on current status of Bonga, Afar, Menz, and Horro sheep breeds genetic improvement: Breeding program and progress

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ABSTRACT

This working paper reviews the research and development in genetic improvement and breeding strategies of Bonga, Menz, Afar and Horro sheep in Ethiopia. This review aims to provide structured information regarding the Ethiopian indigenous sheep breeds (Bonga, Afar, Menz, and Horro) breeding programs and its progress. Genetic diversity is an essential element for genetic improvement, preserving populations, evaluation and adapting to variable environmental situations. Sustainable breeding techniques and sensible use of indigenous breed have been developed as result of recent research approaches to the conservation of sheep genetic resources. However, there is still growing interest of the government and of farmers in different breeding program to improve indigenous sheep breeds. There is no comprehensive study showing the performance of indigenous sheep breeds (Bonga, Afar, Menz, and Horro) genetic improvement under different breeding program and its progress, both biological and economic, to substantiate the argument on the benefit of different breeding programs for smallholders farmers. Programs for the sheep breeds Menz, Afar, Horro, and Bonga have now been developed at the community level. The idea behind the nucleus breeding program is to develop elite breeding animals by gathering the finest male and female breeding participants from the population in one central location. The first stage in creating a breeding program is defining the breeding goals. Planning breeding programs requires a thorough grasp of the farmers' (beneficiaries') breeding goals and production objectives. Therefore, this review makes it evident that numerous instruments and techniques, including choice experiments, participatory rural assessment procedures, and rating animals from flocks, have been used to define and ascertain the breeding aim of Afar, Horro, Bonga and Menz sheep breeds in Ethiopia.

1. Introduction

Small ruminants, particularly native breed kinds, play a significant role to the livelihood of considerable part of human population in the tropics from socio-economic aspects [1,2,3]. Thus combined trails with emphasis on administration and genetic progress to improve animal outputs are of deceive significance [4,5]. Economic and biological efficiency of sheep production enterprises generally improves by increasing productivity and reproductive performance of ewes [6,7,8,9,10].

According to estimates, there are about 31.30 million Ethiopian sheep in the country [11]. Despite the country's enormous sheep population, the smallholder production system's present farm productivity is below the global average [12,13]. Moreover, the study of

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breeds, using molecular technique is very important and useful for characterizing [2,8]. Conservation of genetic diversity in animal species requires the proper performance of conversation superiorities and sustainable handling plans that should be based on universal information on population structures, including genetic diversity resources among and between breeds [6,14]. Genetic diversity is an essential element for genetic improvement, preserving populations, evaluation and adapting to variable environmental situations [15,16]. On other hands, determination of gene polymorphism is important in farm animal breeding [1,17] in order to define genotypes of animal and their associations with productive, reproductive and economic traits [18,19,20].

The current evolutionary and genetic improvement of Bonga, Afar, Menz and Horro sheep are explained by the evulation of dominant agricultural systems and productions. Following the development of breeding techniques and genetic advancements in sheep sector, a genetics research agenda took place at various community and government research centers. Due to the need to preserve the original genetic diversity, it is recommended to continue with the native breeds in the improvement work [21]. An assessment of farmers' traditional breeding practice showed that genetic improvement is not achievable through the individual effort of farmers and pastoralists [22]. Without a national animal genetic improvement program, genetic progress is difficult to achieve and monitor. Lack of effective, sustainable parentage program for indigenous types in developing country like Ethiopia is one reason that similar types lose their competitive benefit due to changing product system and external condition [23,24].

A variety of techniques have been suggested to address the problem of overcoming genetic improvement problem of indigenous sheep breed in Ethiopia Moreover, research on this issue had produced general overview on genetic improvement and different methods of improving genetic gains have been explored. The community-based program, nucleusbased selection, and cross-breeding program were implemented as ways to improve the breed of sheep [23,25,26]. The cross-breeding initiative seeks to boost the productivity of native sheep breed by allowing them to mate with exotic sheep breeds.

Community-based breeding programs (CBBPs) have gained popularity recently as the most effective method for smallholder farmers and pastoralists in developing nations like Ethiopia to improve genetic makeup of native breeds [27]. Studies have shown that community-based breeding programs can effectively promote genetic diversity and improve the quality of life for smallholder groups [28]. For Ethiopia Bonga and Menz sheep, CBBPs have been used since 2009 to increase growth rates [27]. For the in-situ conservation of indigenous animal genetic resources, community-based breeding initiatives created with the active involvement of indigenous breeders are appropriate [29]. Hence, a community-based program is maintained in order to stop the national extinction of native breeds and to diversify the genetic resource of livestock at farm level. According to Ref. [30], the ranking of breeds serves as a foundation for Ethiopian sheep conservation initiatives and adds to a regional or worldwide conservation plan.

At various Agriculture research centers, crossbreeding between native breeds has also been conducted as an alternative to using exotic genotypes to raise the performance levels of native sheep breeds [31,27]. The nucleus scheme could be used to conserve genetic resources by enhancing and properly utilizing and disseminating improved genetic materials, which would enable the preservation and enhancement of native sheep breeds [32]. Evaluation of the alternative plan is necessary for the community-level smallholder sheep breeding to be optimized in order to forecast the genetic gain, fincial return and operational viability during implementation [25].

Developing suitable breeding and use strategies requires an understanding of the genetic resources for adaptable sheep. Government and farmers are still becoming more interested in various breeding programs to improve native sheep breeds. However, there is no comprehensive study showing the performance of indigenous sheep breeds (Bonga, Afar, Menz, and Horro) genetic improvement under different breeding program and its progress, both biological and economic, to substantiate the argument on the benefit of different breeding programs for smallholders farmers. The genetic improvement of indigenous sheep breed has been recognized as potential problem in Ethiopia that deserves serious attention. Therefore, this review aims to provide structured information regarding the Ethiopian indigenous sheep breeds (Bonga, Afar, Menz, and Horro) breeding programs and its progress. This type review is currently a trends, in addition to offering comprehensive documentation of breeding program, progress and its evaluation in Bonga, Afar, Menz, and Horro) breeds. This review confirms that genetic improvement of Bonga, Afar, Menz and Horro sheep breed presents problem that go beyond breeding strategies, discuss specific and general solutions and concludes that specific genetic improvement strategies that are needed today and future improvement.

1.1. Characterization of the production system and the areas

The primary focus of the production system's characterization was determining the role and various applications of livestock within the system, as well as the economic assessment of production, breeding and ram management techniques, and the channels of distribution that are accessible for live animals and their byproducts [27]. Since sheep are thought to be environmentally, socially, and economically unsustainable, it is crucial to characterize the production system and the environment in which they are kept in developing nations like Ethiopia in order to increase sheep productivity and genetic resources [23]. The production systems classified as pastoral, subalpine sheep-barley, cereal crop-livestock, and perennial crop-livestock have been the subject of the majority of studies carried out in four sheep farming communities [33,34]. The way that production is described can change depending on the ecological circumstances, desired qualities, breeding practices, and grazing management [35]. Assuming that secondary sources already provide some general information about the production system, the breeding program's characterization of production systems should focus on other aspects, such as: Livestock's role in the system, importance, and utilization of livestock products, current breeding techniques and economic appraisal of production (production costs and returns from sales [36]. Customized management and breeding interventions are designed based on an environment and production system description.

Crop-livestock integrated systems may offer chances to record the ecological relationships between various land use systems, thereby increasing the efficiency of agricultural ecosystems in terms of nutrient cycling, protecting the environment and natural

resources, boosting biodiversity, and improving soil quality [37]. Since profits from large livestock production may be obtained at very low costs, large livestock production is an efficient and flexible way to utilize rangelands. Pastoralists' usage of land is influenced by the relatively low inherent productivity caused by warmth, height, or aridity—or occasionally a combination of all three [38]. The primary feed sources utilized in the region for livestock feeding are natural pastures, which are primarily made up of grasses, forbs, and browses [39].

1.2. Characterization of breed resources

Characterization of breed resources Sheep breeds are initially identified through phenotypic characterization, which includes both quantitative and qualitative features, and genomic characterization, which includes mitochondrial DNA, micro- and mini-satellite markers, restriction fragment length polymorphism, and biochemical polymorphism [27]. Important components of assessing breed resources include eliciting community opinions about sheep and categorizing the population in terms of breed type, adaptive characteristic, and productive qualities [33]. For genetic improvement initiatives to be successful and for enhanced technologies to be implemented, it is essential to comprehend and describe the physical characteristics of the target breed [40]. A description of the production environment is crucial to understanding the relative fitness of adaptive traits, such as longevity, fertility, maternal ability, resistance to prevalent diseases, and unique qualities of the final products. The genetic variation for indigenous (Bonga, Afar, Menz and Horro) sheep may be attributed by a geographical situation of a country and their distribution is paralleled with diverse ecology therefore Bonga, Afar, Menz and Horro sheep have characterized and their names are also designated from their commonest niche areas. The details of reviewed data of indigenous (Bonga, Afar, Menz and Horro) sheep production and productivity traits were collected and depicted containing their parallel reference sources in Table 1. It is also important to understand the genetic makeup of the breed and how the production environment may affect animal productivity [41,23].

Menz sheep are native to Ethiopia's highlandlands and are prized for the meat and wool they produce [30]. The coarse wool is commonly used to weave traditional blankets, known as "Zitet" or "banna" and carpet. For many farmers, especially women, this is their second source of income [30]. The Bonga sheep breed has been rated as good based on characteristics such as growth rate, meat quality, fattening potential, twining rate and temperament [43]. Sheep of the Bonga and Horro breeds are known for having large tails and are prized for their ability to produce large amounts of meat [44]. The Ethiopia Bonga is grouped into the fat-tailed sheep subgroup of east Africa [45]. Horro sheep is fat-tailed and the tail commonly hangs below the hocks [46]. The special advantage of horro sheep breed were considered to be fast growth rate, maternal ability, twinning and early lambing. Integrated crop-livestock systems (ICLS) are production systems that integrate crop and livestock enterprises both temporally and spatially [47]. Afar sheep are native to Ethiopia's pastoral areas and were first raised in pastoral production systems for domestic milk use and as a source of money from live animal savings [39,37].

1.3. Community breeding objective definition

Breeding goals for farmers and pastoralists differ slightly throughout production systems and agro-ecology, whereas those of sheep keepers are determined by their varied and many production goals [48]. From the perspective of why sheep are kept, farmers' and pastoralists' breeding objectives can be identified, and they undoubtedly alter over time in response to the shifting needs of animal producers as well as consumer and societal demands. The four communities' subalpine sheep-barley, pastoral, perennial crop-livestock, and cereal livestock production systems have established the breeding objectives for the Menz, Bonga, Horro, and Afar breeds. These goals were founded on the understanding that farmers in the subalpine sheep-barley system prioritized improving the growth rates and body conformation of Menz sheep in order to increase the animal's market value. The goal of these objectives was to meet the needs of farmers in the subalpine sheep-barley system for Menz sheep, who prioritize improving the animal's growth rates and body conformation to increase its market value. This also applies to farmers in the perennial crop-livestock system for the Bonga breed and the cereal livestock system for the Horro breed [33].

To define and determine the breeding objective of sheep in Ethiopia, various tools and methods have been employed, such as choice experiments, participatory rural appraisal approaches, and ranking animals from flocks [49,29,50,51,52,30]. In order to define the goals for various sheep breeds' breeding program, a participatory approach has been implemented recently [52]. Breeding objectives for the Menz, Horro, and Bonga sheep breeds have been defined through the application of the participatory assessment approach in production system involving cereal-livestock, perennial crop-livestock, and subalpinesheep-barley [44]. According to Ref. [49], choice trails are helpful instruments for defining and identifying smallholder farmers' preferred traits and selection criteria for native sheep [53]. describes an experiment on the ranking of own flock sheep with the aim of identifying the breeding objectives for sheep. The

Table 1
Chaterization of breeding resource of Ethiopian indigenous sheep breeds (Bonga, Afar, Menz, and Horro).

Breeds	Tail type/shape	Production system	Body size	Major use	Litter size	Population 000	Sources
Menz	Short fat tailed	Mixed crop-livestock	Small	Meat, Wool	1.0	971.4	[30,33,35]
Horro	Long fat tailed	Mixed crop-livestock	Large	Meat	1.6	3409.3	[42,30,33]
Bonga	Long fat tailed	Mixed crop-livestock	Large	Meat	1.4	517.5	[42,30,33]
Afar	Fat-rumped	Pastoral	Medium	Milk, meat	1.3	681.9	[30,33,35].

*Shows respectively reported data.

experiment involves assessing the animals based on their performance in reproduction and production. The studies reviewed in this paper indicate that Ethiopia livestock breeding objectives are not as clearly defined when using choice experiment methodologies, based on the opinions of farmer and pastoralist. Each pastoralist and farmer explains why they have chosen to rank the ram and ewes in a particular order. Each farmer's reasons have been ranked according to the importance of the tangible and intangible benefits of sheep, with the first, second, and third reasons being roughly valued similarly [54,42]. [32] Established that the breeding objective for sheep production should be to improve growth rate and yearling survival to reach a weight of 30 kg. The main goals of Afar pastoralists' breeding program are increased milk and meat production [33]. The way the breeding program defined its breeding target differed depending on the region ([44]. Because sheep can increase their reproductive rate by reducing age at first lambing (AFL), increasing the number of lambs per lambing, reducing the number of days between lambings, and reducing lamb mortality, economically significant reproductive performance traits identified by the community are crucial to the production of sheep [55]. According to research done on the economic values of two native sheep breeds' key characteristics, the Horro breed outperformed the Menz sheep breed in terms of litter size. This was because of the higher twinning rate, which led to more money being made from the sale of fattened lambs and herd replacement animals [51]. The Bonga sheep breed's age lambing interval increased from 245 $\pm$ 2.10 days to 269 $\pm$ 5.7 days between 2015 and 2018, according to research on traits study of the lambing interval [55].

1.4. Genetic improvement strategies

Enhancing livestock productivity through genetic modification is a potent technique [13]. To increase the genetic resources of sheep, Ethiopia has adopted and used a variety of breeding techniques in the last few years [23,56,26]. Sheep productivity can be raised by selecting the most productive animal for the next mating and by improving management practices [57]. Since the programs have just recently been started, realized genetic gains have not yet been measured [58]. Ethiopia employed a variety of breeding techniques, such as cross breeding, nucleus-based selection, and community based programs, to boost the output of indigenous breeds. In order to improve the quality of sheep, Ethiopia breeding programs will prioritize the selection of traits such as fertility, growth, and survival within and between breeds [32]. In 2010, efforts to choose the best-performing young ram from the community flock for use later on constituted a large portion of the work in genetic development of sheep in Ethiopia's Horro, Bonga, and Menze breeds. A major part of the work in sheep genetic improvement in Ethiopia's Horro, Bonga, and Menze breeds in 2010 involved selecting the besting performing young ram from the community flock for future use [56]. From the perspective of the farmer, local sheep breeding methods that take into account the society's desired traits and production goals are 93.13% satisfying and crucial for preserving the variety of phenotypic appearances of local sheep in the event of future genetic advancement [59]. Reducing the impact of environmental sources could lead to improvements in the production qualities and ultimately productivity at the flock level [60]. Researches began to focus on improving the genetic potential of native sheep breeds in 1977.

However, the broad and traditional sheep production systems maintained by smallholders with low resources remained unaffected by attempt to cross-breed local sheep breeds with imported exotic breeds in different parts of nation [29]. In 1944, 1967, and 1980, Ethiopia received exotic breeds of sheep from Italy, Kenya, Isreal, and the republic of south Africa, including Merino, Dorper, Romney, Corriedale, Hampshire, and Rambouillet sheep [61,32]. Following importation, many government ranches and agricultural research centers have evaluated and multiplied crossbreeds with varying levels of exotic blood. Subsequently, superior crossbreed rams have been dispersed around the nation to interbreed with native sheep [62].

1.4.1. Central nucleus-based breeding programs

In 1970, Ethiopia initiated an Ethiopian Institute of Agricultural Research (EIAR) breeding program [33]. The central schemes have attempted to collected data, assess genetics, choose animals, disperse animals that have undergone genetic improvement, and interact with farmers. However, the schemes have not been able to provide smallholders with continuous genetic improvements or a sufficient quantity and quality of improved breeding males for continuous breeding [56]. A examination of the successes and failures of small ruminant breeding programs indicated that the foundation animals for a nucleus-breeding unit would need to be a combination of excellent animals with the highest genetic merit from multiple sources [63]. Project based on the central nucleus-based breeding programs have not produced satisfactory results despite decades of research because of technical constraints like unplanned and threatened to dilute the sheep genetic diversity in the country [56]. Even though they are more challenging to implement in developing countries, open nucleus schemes perform better than closed nucleus schemes in terms of genetic and economic efficiencies because of higher predicted mean genetic value of nucleus replacements [52]. Central nucleus program were more efficient than community-based program [64]. According to Ref. [25] the study on the optimization of alternative breeding schemes for the genetic improvement of common Tigray highland sheep revealed that the central nucleus scheme was more effective in gaining genetic gain than the village-based scheme. In order to assess the genetic potential and reaction of regional breeds to selection, as well as to build an elite nucleus flock as a source of enhanced rams, the program began closed nucleus breeding in research facilities [33]. According to Gumuz [65], compared to village-based schemes, the central nucleus plan produced the maximum genetic gain and cost efficiency across all breeding objectives. The central nucleus program was created in 2009 to maximize genetic benefits [22], with an emphasis on giving the village farmer the best rams for breeding from the central nucleus. In his review of the goals and methods of breeding small-holder sheep production in Ethiopia [12], pointed out that one tactic for improving the genetic makeup of Ethiopian sheep is open-nucleus breeding, which permits the inflow of highly qualified breeding animals from lower-tier flocks for pure breeding to nucleus flocks on ranches [32]. suggested that breeding programs based on open nucleus flocks using government ranches at the top of a three-tier system of flocks be used for crossbreeding and genetic conservation of indigenous breeds, as well as for breeding values based on the breeding goal traits.

Table 2 shows central nucleus breeding scheme could result in reasonable genetic progresses in Horro and Menz breeds but Afar breeds showed some discontinue until reinitiated. The sheep breeding structure in Afar, Horro, and Menz can be best described as a one tier structure, with researcher, farmer and pastoralists as breeder and producer. The ongoing Menz sheep nucleus selection program appears to be moderately efficient, with realized responses per generation in LW of 55.6% of the predicted responses being achieved in some years, although there are fluctuations in responses due to variation in selection intensities over the years [66].

1.4.2. Community-based breeding strategies

Most technologies have been adopted for the Bonga, Afar, Menz and Horro breeds and consequently are more favorably applied in close collaboration with farmer and pastoralists and breeders for genetic improvement. Community-based breeding programs (CBBPs) are interactive livestock breeding initiatives that facilitate communication between farmers and researchers in order to uphold livestock breeding improvement initiatives that prioritize the goal of farmers [54,64]. In order to achieve long-term genetic gain and ensure the CBB's sustainability, institutionalization in a relevant manner is crucial [44]. A practicable design for village breeding needs to build upon and accommodate some of the farmers' traditional practices and introduce improved practices in consultation with the community [22]. CBBPs have a significant effect on each community's standard of living [28].

Numerous studies have examined the point of community-based breeding [22], as genetic improvement cannot be accomplished by smallholder farmers working alone. Instead, smallholder farmers must form cooperative village breeding groups in order to carry out successful genetic improvement program. The willingness and commitment of farmers to participate in the program and the existence of permanently established institutions and organizations that support it provide the opportunity and sustainable institutional support for recipients to build sustainable CBBP principles [68]. [64] describe these programs as "typically related to farmers having common interest to improve and share their genetic resources with low-input systems within certain areas of community" [68]. conclude that CBBP promotes and enables smallholder access to small ruminant forage resources by protecting existing community pastures, improving pasture productivity and conserving crop residues and crop by-products. Since on-station feeding and management of sheep is not always the case, breeding program based on CBBPs have shown higher growth performance than on-station conditions for lambs because owners take better care of feed, and manage their animals than in the traditional smallholders system [34]. Based on the CBBP's breeding program [44], found that 95.8% of the body size of newborn lambs in their flock of sheep shown improvements in performance, farmers' market participation, and sheep meat consumption. In the CBBP, selection based only on sire has resulted in significant and positive genetic improvement in the SMWT trait, demonstrating the effectiveness of selection for improving body weight traits in Menz and Bonga sheep [27]. Reproductive performance data for lambing interval, first lambing, annual reproductive rate, and litter size under CBBP have been used to estimate genetic changes. The results show that there has been a positive change in lambing interval, which has decreased from 302 $\pm$ 11.6 days in 2012 to 272 $\pm$ 5.5 days in 2017 [59]. According to Ref. [69], BLUP selection under the within-village-based approach resulted in faster genetic advancement than mass selection. Based on genetic analysis, the following indices of improvement were found: 0.56, 0.15, 0.11, 0.08, 0.08, and 0.01 for growth, twining rate, lamb survival, age at first lambing, and coat color [59].

Although in different places, CBBP has been implemented in Ethiopia since 2009. The Bonga Community-Based Breeding Program (CBBP) was started in 2009 with the aim of increasing the income and productivity of small-scale sheep producers in two villages [13]. As of right now, there are sixteen CBBP. Five of the sixteen CBBPs— Abeta, Buta, Dacha, Dirbedo, and Shosha—were founded in 2012, and the remaining fourteen were introduced in 2014 [59]. In order to mobilize farmers, the Bonga Agricultural Research Center is ramping up its efforts, with assistance from the Cooperative Promotion Office ([44]. According to Ref. [50], the CBBP had several difficulties establishing community-based initiatives that would be sustainable. According to Zewdu, the challenges faced by CBBP include a very small flock size with only a few breeding males, unstructured breeding seasons, uncontrolled mating, the rarity of animals being separated based on sex, communal grazing during the wet season, and free roaming during the dry season [59]. also showed specific constraints faced by Bonga CBBP participants. According to his research, the main obstacles for the participants were insufficient development of human resources (lack of training), low customers and desire to buy larger breeds and lack of animal health assistance.

Horro community based breeding program (CBBP) is launched in 2009 [34]. At the location where two sheep producers' cooperatives were founded and actively participated in the selection and shared use of rams, a community-based breeding program has been in operation since 2009 [13]. Details about ongoing initiatives have been emphasized by him, including the connection between CBBP and fattening programs for culled rams, the detection of reproductive diseases in male breeding, the identification of cases involving lamb mortality, the determination of the prevalence of major diseases in sheep, the identification of prolificacy genes in the sheep breed, the expansion of breeders' cooperatives based on the tenet that "no ewe should be mated with unselected ram," and the creation of fodder in farmer groups. But Horro is very different; neither are the breeding groups there officially registered, nor do the members follow the agreements that were established at the start of the program [44]. Based on reports of various scholars (Table 3), Community based breeding program have designed for Bonga, Afar, Menz and Horro breed with total breeding flock of 795, 420, 2000

Table 2
Ethiopia's central nucleus-based breeding scheme. Adapted from [67]:

Breed	Selection standards	Institution	Current status
Afar	Post weaning weight	Werer agricultural research center	Initial program discontinued reinitiated
Horro	Yearling weight	Bako agricultural research center	Continued
Menz	Yearling weight	Debri Birahan Agriculture research center	Continued

and 802 ewes to benefit from the existing sheep production practices. Showing result in Table 3, a one tier breeding structure have adopted, that is selection have implemented in the whole indigenous (Bonga, Afar, Menz and Horro) sheep.

1.4.3. Cross breeding

Cross breeding can be implemented to improve genetic potential of local breeds by crossing with selected local breeds. Community-based sheep crossbreeding has been implemented since 1998 in three villages of Wollo, Menz and Chacha districts in Ethiopia in the framework of a project run by Debre Berhan Agricultural Research Center (DBARC) Sheep crossbreeding programs in Ethiopia have of necessity been designed with a 2- tier breeding structure. According to Ref. [71], Bonga x Menz cross breed grew faster and were heavier at yearling than 50% WM and pure MM lambs. Since 2012, various regions of Ethiopia have begun to distribute improved Bonga sire from community-based Bonga sheep breeding in order to achieve genetic improvement [31]. The term "upgrading" refers to the practice of repeatedly backcrossing the female progeny of crossbreed males. Ethiopia crossbreeding programs have been difficult to design and as result, their impact has been minimal [33].

1.5. Monitoring & evaluation

To facilitate the process, a stepwise evaluation procedure has been developed; with a progression of stages from primary assessment domains include monitoring of implementation output, assessing the impact of their association on farmers' livelihoods and the environment, and evaluating the CBBP's implementation [72]. The assessment of program execution centers on organizational concerns through an analysis of efficient functioning and technical issues through an examination of actions carried out at pertinent stages of the breeding program. The planning of a breeding program and program evaluation are impacted by participant socioeconomic status, cultural practices, and the environment [44]. Another important aspect to evaluate is number of farmers recruited in the CBBP, increased market demand for breeding animals and the establishment of a formally or informally recognized farmers' breeding association may be used as indicators to assess program outreach, its acceptability and how farmers are willing to take upon themselves the breeding work [72].

2. Conclusion

This review makes it evident that a great deal of research and development work has been done in order to create an appropriate breeding program to improve the genetic makeup of Bonga, Afar, Menz, and Horro sheep breeds. Defining the breeding aim is the first step in assessing the effectiveness of various breeding methods. To establish the breeding objectives of the Bonga, Afar, Menz, and Horro sheep breeds, a variety of instruments and techniques have been used. Numerous instruments and techniques, including choice experiments, participatory rural assessment procedures, and rating animals from flocks, have been used to define and ascertain the breeding aim of sheep in Ethiopia. It would be beneficial to create efficient breeding techniques that increase the output of native breeds in order to have sustainable breed advancements and breed conservation. These and related studies provide thorough descriptions of breed-specific data that serve as a foundation for the creation of practical sheep development plans.

The literature in this report defines overall problems and offers some solution. However, research is needed to more clearly categorize difficulties caused by disseminating effectively improved local breeds to cross with chosen local breeds in order to boost genetic potential, the relationship between the research and development wings of the nucleus breeding to strengthen.

3. Suggestion

More research must be done on the creation of breeding programs that are appropriate for smallholders' farmers' circumstances and their advancement. Future studies ought to concentrate on producing breeding animals that satisfy the demand s of commercial farmers, transforming village programs into more structured ones, establishing a connection between village breeding scheme and nucleus breeding programs, and devising strategies for transforming village schemes into village ram breeding nucleus centers that provide a source of enhancing breeding. Conservation measure should encourage genetic improvement initiatives to boost the market competitiveness of native populations with lower productivity and production zone stratification to prevent random crossbreeding.

Table 3
Community based breeding program and expected gain.

Trait	Breed	Number of Animal (head)	Breeding Scheme/Expected genetic gain	Sources of References
Milk yield	Afar	420 breeding ewes	Single tier community based breeding program; on-station	[43,36,70]
Body size	Horro	802 sheep underwent measurements to determine	Single tier community based breeding program	[43,33,36]
Lambing interval Body size Wool yield	Menz	(2000 ewe per village)	Single tier community based breeding program; on-station	[43,22,36,70]
Body size (Meat production)	Bonga	795 sheep were measured to characterize	Single tier community based breeding program Bonga ranch used as testing station to candidate rams	[43,33,36]

*Shows respectively reported data that include both published and unpublished data.

Data availability statement

The corresponding author can provide the dataset used to support the study's finding upon reasonable request. Data sharing is not applicable for this article as no datasets were generated or analyzed during the current study.

Additional information

No additional information is available for this paper.

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Declaration of competing interest

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