REVIEW OF THE STEPS TO ESTABLISH A SHEEP AND GOAT COMMUNITY-BASED CONSERVATION AND BREEDING PROGRAM (CBCBP) IN ETHIOPIA

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ABSTRACT: This review paper presents the prominent steps to develop a set of principles for breeding criteria as a step wise application of Community Based Conservation and Breeding Program (CBCBP) in Ethiopia. Sheep and goats are an important commodity for smallholder farmers in Ethiopia and are considered a crucial source of cash income. They are sources of meat, milk, wool, hides, and manure. The 2021 national average sheep and goat populations in Ethiopia were 96.4 (range 95.3–97.7) million. Nine sheep and eight goat breeds are identified in the country. However, scientific breeding, conservation, and production activities are lagging. To maximize conservation and productivity of small ruminants in Ethiopia, stakeholders need to take action on limitations and leverage on available opportunities urgently. Thus, this paper provides a set of principles to guide the establishment of CBCBP to contribute to the sustainable production of sheep and goats in the country. Improving management includes increasing the efficiency of production, controlling the use of resources, and maintaining animal health and welfare. Selecting breeding stock requires assessing genetic parameters and economic value of traits to be included in the breeding program which uses a recorded data in the selection process. Moreover, facilitating marketing through the value chain can add value to the sustainability of the sector. Steps required for the successful implementation of sheep and goats conservation and improvement through participation of the community were also addressed.

Keywords: Breeding, Community based, Conservation, Goat, Production, Selection, Sheep

INTRODUCTION

In Ethiopia, indigenous sheep and goats play an important role in the lives of resource-poor farmers, providing a variety of tangible (income, meat, milk, skins, and manure) and intangible benefits (savings, insurance against emergencies, and cultural, and ceremonial values). These benefits vary depending on the culture, socio-economy, and agroecology, of the farmer. Thus, sheep and goats are an important asset for smallholder farmers in Ethiopia, providing much-needed resources for their households (Sherif and Alemayehu, 2018).

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Ethiopia has one of the largest populations of small ruminants in the world, with an estimated 42.9 million sheep and 52.5 million goats (CSA, 2021). This accounts for around 10% of Africa's and 4% of the world's small ruminant population (FAO, 2019). The small ruminant's population is large and rapidly growing contributing about 2% of the national annual GDP (Assefa et al., 2021). Nine sheep and eight goats were characterized and identified as breeds (Gizaw et al., 2007; Mekuriaw, 2016). Despite the presence of large number of indigenous sheep and goats in the country however, their economic value is far lower than it should be (Legese and Fadiga, 2014). This is due to the high kid mortality rates (up to 40%), a low offtake rate, and a limited range of production outputs with no signs of intensification (Jemberu et al., 2022).

To effectively conserve animal genetic resources, it is necessary to identify and document the breeds adequately (Assefa et al., 2021). Therefore, the objective of this review was to compile information on the sheep and goat production systems for establishing community base breeding and conservation programs (CBCBP). It also identifies the opportunities and limitations of research-based production and develop the basic steps of breeding and conservation criteria that would fulfill the gaps in the design of CBCBP. It is hoped that this review and its recommendations will help in improving the existing sheep and goat production systems and establishing more efficient CBCBP in different parts of the country. Such improved systems would help to increase the sustainability of livelihoods of the communities and reduce the environmental impacts of livestock production.

The research conducted in Ethiopia on small ruminant production and reproduction has been well-documented in various forms. To give a better understanding of the counry's small ruminant production and reproduction, a variety of different sources were used in this review which include policy documents, published guidelines, and working papers from agricultural research centers and institutes. Furthermore, to provide further insight into the work, supportive references were included from the research results of characterizations conducted in the country. Papers from organizations like CSA (Central Statistical Agency), ICARDA (International Center for Agricultural Research in the Dry Areas), ILRI (International

Livestock Research Institute), EIAR (Ethiopian Institute of Agricultural Research), EBI (Ethiopian Biodiversity Institute), and FAO (Food and Agriculture Organization of the United Nations) have been extensively used to gain a greater understanding of the data.

Sheep and goat production systems in Ethiopia

In Ethiopia, sheep and goat production systems are an important component of the country's agricultural sector, with livestock contributing more than 25 percent of the country's agricultural GDP, and being the major source of food and income for the majority of rural households (Alemu and Bantider, 2020). They are primarily used for meat, milk, and wool production, and also provide important services such as soil fertility improvement, and manure production for crop production (Admassie, 2019). The two major production systems are, the mixed crop-livestock production system and the pastoral and agro-pastoral production systems.

Mixed Crop-Livestock Production Systems (MCLPS)

Mixed Crop-Livestock Production System (MCLPS) is a type of agricultural system that integrates crop and livestock production activities. It involves the integration of multiple crops and livestock species, grown in a diversity of production systems, including intensive, semi-intensive, and extensive systems (Edwards et al., 2020). This type of integrated system attempts to optimize the use of available natural resources and maximize the economic and environmental benefits of agricultural production. MCLPSs can play a key role in promoting agricultural sustainability, by providing a productive and efficient use of resources, while also reducing the negative impacts that agricultural activities can have on the environment (MacMillan et al., 2018). Moreover, the integration of crops and livestock can also increase the efficiency of nutrient cycling, by improving the availability of nutrients for crop production, while at the same time reducing the need for external inputs, such as chemical fertilizers (Kumar et al., 2019). A crop-based mixed farming system is often found in highland agro-ecological zones where the altitude ranges between 1500 and 3000 meters above sea level (masl). This production system is favored by the favorable climate for farming crops and

raising livestock. Crop production is the main focus of this type of farming system, with livestock production playing a secondary role. Furthermore, the presence of livestock in a farming system can also help to break pest and disease cycles, thus helping to increase crop yields (Solomon et al., 2014).

Pastoral and Agro-Pastoral Production Systems

Pastoral and agro-pastoral production systems are common in Ethiopia. These production systems are based on the use of animals (livestock) as a source of food and income. The pastoral system involves keeping of cattle, sheep, goats, and camels, while the agro-pastoral system is a combination of animal husbandry and crop cultivation.

Pastoralists in Ethiopia usually move their herds from one area to another in search of water and grazing land. This is in contrast to agro-pastoralists, who tend to stay in one area and use animals to supplement their crop production. Livestock provides food, such as milk and meat, and is also an important source of income for many households. In addition, animal products, such as skins and hides, are used for trade.

The majority of small ruminants, including 40% of sheep and 40% of goats, are concentrated in pastoral and agro-pastoral areas (Asfaw and Jabbar, 2008). These production systems are often kept under extensive systems, which make them major sources of livestock products for the Ethiopian export market (Legese and Fadiga, 2014). The system can either be transhumant (the whole system moves periodically), or sedentary (the system has limited movement) (Solomon et al., 2008). This production system has a relatively low human pressure on natural resources and a higher land holding per household than in the mixed farming system.

Significance of Sheep and Goat Production in Ethiopia

The importance of sheep and goat production in Ethiopia lies in its environmental, social and economic contributions. Sheep and goat production can have a positive impact on the environment; by reducing reduce land degradation by providing a source of food and by providing fertilizer for the land (Lemma et al., 2018). Socially, sheep and goat production play a major role in the lives of many Ethiopians. It is an important part

of the traditional culture, an important source of nutrition and income and providing employment opportunities in rural areas (Mesfin et al., 2017). Economically sheep and goats contribute to income generation as well as to the country's GDP. It contributes 154,000 tons of meat, about 40% of fresh skins, and 92% of the value of semi-processed skin and hide export trade (Mourad et al., 2015). Ethiopia has the potential to export 700,000 sheep and 2 million goats annually as well as supply 1,078,000 sheep and 1,128,000 goats for the domestic market (Sheriff and Alemayehu, 2018).

The future growth in Ethiopian small ruminant meat production is likely to come from an increase in the number of slaughtered animals or slaughter volume. This is because the current dressing percentage of Ethiopian sheep and goats is very low, which has been reported to be 42.5% for sheep and between 42 and 45% for goats. Furthermore, this low dressing percentage of indigenous small ruminants has been found to occur mainly due to poor nutrition and husbandry practices, which have been further exacerbated by the effects of drought (Legese and Fadiga, 2014). The demand for animal products is expected to increase as a consequence of urbanization, population growth, and increased income (Westhoek et al., 2011). To fulfill the demand, designing and implementing appropriate genetic conservation and improvement programs that can boost productivity (Solomon, 2014). Community based conservation and breeding program of small ruminants is advantageous since the breeding flocks are located within the production environment and have potential genotype-environment interactions.

Limitations and Opportunities for Production

Despite the sector's importance, small ruminant production is faced with several challenges that limit its potential for development. Especially, animal genetic resource conservation and sustainable utilization programs have faced many limitations in the country. The major limitations include lack of adequate financial resources to support existing programs, lack of technical capacity and infrastructure to effectively implement such programs, lack of coordination between different stakeholders to implement successful conservation program, lack of legal and policy frameworks to protect animal genetic resources (Assefa et

al., 2021). According to Aklilu (2008) and Hassen and Tesfaye (2014), disease, lack of access to veterinary services, access to good breeding stock, lack of animal records, and an established marketing chain also limit the utilization of these resources. Inappropriate livestock development policies may also be another factor that contributes to the low productivity of small ruminants (Getachew et al., 2010; Gizaw et al., 2013; Aleme and Lemma, 2015; Jemberu et al., 2022).

To improve small ruminant's productivity, it is necessary to address all of these factors in a coordinated and effective manner. This can be achieved through the implementation of appropriate policies and interventions on nutrition, veterinary services, infrastructure, technology, financial services, genetics, selection, and livestock development.

Improvement of sheep and goats - selection versus cross-breeding

The selection of indigenous versus cross-bred animals for breeding purposes has been an ongoing debate. Indigenous breeds of sheep and goats have been selected over the years based on their hardiness and ability to survive in harsh conditions. These animals are considered to be well adapted to the climate and environment of Ethiopia and their meat is of high quality. On the other hand, cross-bred animals are known to have higher yields and have become increasingly popular in the country (Kebede and Bekele 2014). The Government of Ethiopia has provided subsidies to farmers for the purchase of high-yielding and disease-resistant animals and has also established a national animal identification and traceability system. Additionally, research into the genetic improvement of sheep and goats has been carried out to improve the quality of the animals (Alemu and Stevenson, 2017).

Village-based cooperative breeding programs have been established for Menz, Horro, and Bonga sheep breeds to improve their reproductive and growth performance (Gizawu et al., 2013). This program had a positive effect on the litter size, litter weight per ewe, and pre-weaning lamb mortality of the Doyogena sheep. The litter size at birth (LSB), litter size at weaning (LSW), total live weight at birth (TLWB), and total live weight at weaning (TLWW) of the Doyogena sheep managed under this program were 1.57±0.02

lambs, 1.50±0.02 lambs, 5.24 ±0.09 kg, and 24.14± 0.69 kg, respectively (Kebede et al., 2022). This indicated that the community-based breeding program had a positive influence on the reproductive and growth performance of the Doyogena sheep. The authors also noted that the ongoing selection program has increased the survival rate of lambs and proposed that the improvement of the environment in the flock and special care for multiple-born lambs and small lambs would lead to further lamb survival (Kebede et al., 2022). Village-based cooperative breeding programs are could thus be an effective way to improve the reproductive and growth performance of the Doyogena sheep, as well as improve the survival rate of lambs. For a long time, Ethiopia has attempted to improve goat production by crossing exotic breeds with local breeds, but the results were not satisfactory. A review on Boer goat's impacts in Ethiopia showed that that the growth rate of Boer goats and their crosses was lower than that of native breeds (Mustefa (2022). Furthermore, local goats had a higher conception, kidding, and abortion rate than Boer and its crosses. At the smallholder level, a sustainable genetic improvement without sacrificing diversity, such as within breed selection, is recommended since exotics had a high mortality rate and low survival rate compared to pure local breeds (Mustefa, 2022). Thus, community-based breeding programs that focus on breed selection may be used to improve goat production. To this end, the Ethiopian Biodiversity Institute (EBI) is collaborating with other research and higher learning institutes are implementing community-based conservation and breeding programs.

The selection requirement for the breeding program

Participatory identification of breeding objectives, animal identification, performance recording, and selection of the best animals based on recorded performance and farmer criteria, pooling small flocks, and arranging sire use and sharing systems are integral components of the breeding programs (Haile et al., 2018). These components are essential to ensure the success of any breeding program, as they enable farmers to select the animals with the highest genetic merit based on performance and their criteria. However, for resource-poor farmers, recording individual animal performance and their pedigree is often too complex to

apply, and as such, they rely on their criteria when selecting animals to be parents of the next generation. Pooling of small flocks and arranging sire use and sharing systems can also help resource-poor farmers to increase their access to superior genetics, as they can share the cost of their own sires and/or use sires from other flocks (Sherif and Alemayehu, 2018).

Selection criteria for smallholder farmers reflect their breeding activities and farming philosophies, and the criteria vary among different production systems and species (Roessler et al., 2008). The criteria are also different between sexes. For instance, for males, appearance (Getachew, 2008), body size (Zewudu et al., 2012), tail type, color, and height (Gizaw, 2008) are given due emphasis during selection. On the contrary, rams and bucks with black color, poor body condition, and small size are not preferred for breeding purposes, and male animals of such character are usually culled at a young age or sold or slaughtered at home (Gizaw, 2008; Zewudu et al., 2012). Similarly, in selecting ewes and does, appearance, coat color, and lamb survival (Getachew, 2008; Niggussie et al., 2013) and litter size and lamb growth (Gemeda et al., 2011) were reported as the most important selection criteria, yet those that are black-colored, old-aged, poor-conditioned, and have a long lambing interval are culled (Zewudu et al., 2012; Yenesew et al., 2013). This is because such features are deemed to be associated with low reproductive performance and poor productivity (Gemeda et al., 2011; Niggussie et al., 2013).

Despite variations in production systems and sex, selection criteria for small ruminants in Ethiopia are generally geared towards a single market-driven trait. For example, in crop-livestock mixed production systems, the primary focus is usually on a fast growth rate to produce sheep and goats that can fetch a higher market price (Zergaw et al., 2016; Haile et al., 2018).

Community-based conservation and breeding programs

The Community-based Breeding Program (CBCBP) is a village-based breeding activity planned, designed, and implemented by smallholder farmers, either individually or in cooperatives, to effect genetic improvement in their flocks and conserve indigenous genetic resources. Unlike conventional crossbreeding

and nucleus-based selection, CBCBP involves the local community at every stage (from planning to operation) and takes their indigenous knowledge of breeding practices and objectives into account (Gizaw et al., 2013; Mustefa, 2022). The CBCBP was designed as an alternative to the conventional crossbreeding and nucleus-based selection programs, which had failed to achieve the desired outcomes in terms of genetic improvement and conservation of indigenous genetic resources in Ethiopia (Gizaw et al., 2013).

To design an appropriate and feasible CBCBP, the basic steps involve the selection of the communities and breeds, analysis of the production system (including livelihood strategies), characterization (phenotypic and molecular) of the breeds, definition of the breeding objectives, and evaluation of the breeding programs (Haile et al., 2011; Wurzinger et al., 2011). Despite the attempts made as early as 2003, with Washera and later with Gumz sheep (Amhara region agricultural research institute (ARARI) research directory), the development of these CBBP has been unsuccessful due to a lack of proper knowledge among researchers on the new approach (Gizaw et al., 2013). Therefore, it is essential to understand the production system, the socio-economic factors, and the genetic resources of small ruminants prior to implementing CBCBP.

In this regard, EBI is working on the development of breeding programs that are based on the conservation of animal genetic resources. The main focus of the breeding program is to develop animal breeds that are adapted to local conditions and have genetic diversity that can withstand environmental changes (Mustefa, 2022). The breeding program is also designed to create breeds that can produce higher yields of milk, meat, and eggs, and to improve animal health and welfare (Getachew et al., 2016). To achieve this goal, EBI has created a network of community-based animal genetic resources conservation areas (CAGRCAs) in different regions of Ethiopia (Assefa et al., 2021). These CAGRCAs are managed by local communities and are used for breeding, raising, and protecting animal genetic resources. In addition, EBI has launched various capacity-building activities to promote the conservation of animal genetic resources. These activities include training local communities on animal breeding and management techniques, organizing seminars, workshops, and educational trips to increase awareness, and providing technical and financial support to

local communities that are involved in the conservation of animal genetic resources (Getachew et al., 2016). The Institute also guides communities on how to use animal genetic resources sustainably (Assefa et al., 2021).

Several community-based sheep breeding programs (CBCBP) have been implemented in Ethiopia by the national agricultural research centers (Bako, Bonga, Debre Berhan, and Worer) and some higher institutions in collaboration with ICARDA-ILRI (Gutu et al., 2015). The programs have been implemented in four sites (Horro, Bonga, Menz, and Afar), and detailed information has been provided by Gemeda (2011), Haile et al. (2011), and Mirkena (2011). The CBCBP programs have achieved some major successes, such as increased body weights at birth, increased number of births, a better market outlet, lambs with a bigger size, an attractive color that fetch a better market price, reduced mortality rates, better awareness about inbreeding and the need for breeding rams, and the formation of well-functioning cooperatives (Haile et al., 2011; Gizaw et al., 2013; Gutu et al., 2015).

Despite these efforts, the development of breeding programs in line with the conservation of animal genetic resources is still limited in the country. To address this issue, EBI is working on strengthening the legal and institutional framework for the conservation of animal genetic resources (Mustefa, 2022). The Institute has also developed programs to increase awareness and promote research activities in the area of animal genetic resources conservation and aims to further build the capacity of local communities to better protect and manage these resources (Getachew et al., 2016). The Institute is also working on establishing an animal genetic resource database that will enable researchers, breeders, and policymakers to gain access to accurate and up-to-date information on the characteristics and diversity of animal genetic resources (Assefa et al., 2021).

This would enable the institutes and research centers to maximize the genetic gains of the breeding programs through their research and community service endeavors (Getachew et al., 2016; Haile et al., 2018).

Moreover, policy documents and literature need to be consulted to provide further insight into the challenges and solutions related to the implementation of the CBCBP programs.

Criteria for establishing CBCBP in Ethiopia

Communities have a central role to play in biodiversity conservation, and a community-based breeding and conservation program is one way to ensure the protection of valuable species in a given area. This type of program involves the collaboration of local stakeholders in identifying, managing, and conserving threatened species, as well as developing a breeding program to increase the populations of those species. CBCBP is designed to be a low-input system in which smallholder farmers take a leading role and fully participate in developing and implementing the program (Gizaw et al., 2013; Haile et al., 2018; Assefa et al., 2021). The community must be given ownership of the program and benefits must be shared among members of other communities, as well as their traditional knowledge being utilized and upgraded. Additionally, clear and measurable output must be set (Meuller et al., 2015; Assefa et al., 2021).

The success of a community-based conservation and breeding program also depends working with local, regional, and national governments to provide resources and support for the program. It also requires the establishment of effective communication and coordination among stakeholders, including the community, local and regional governments, NGOs, universities, and research institutes, to ensure that the program is successful (Kamal et al., 2018).

This guideline was prepared based on the experience of community-based breeding programs that have been implemented in Ethiopia (Menz, Bonga, and Horro sheep breeding), Mexico (goat breeding), and Peru (llama breeding), the experience of Debre Berhan Agricultural Research Center in improving the Menz and Wollo sheep breeds, (Gizaw et al., 2013) and an in situ conservation of animal genetic resources by EBI. The major steps are: breed, site, and community selection, awareness creation for participants in the community, identification of breeding objectives, animal identification, data collection, and recording,

recruitment of enumerators from farmers' communities, animal selection and mating, sire use arrangement and organizing cooperatives and encouraging community ownership.

Breed, site, and community selection

When selecting a site and a community for a community-based breeding program, it is important to consider the environment, local resources, and the needs of the target population. A breeding program should be established in an area that has suitable environmental conditions to support the species of interest and is close to existing resources such as water and food sources, as well as veterinary and animal husbandry services. The site should be in a location that is easily accessible to the target community (population), so that the program can be properly monitored and managed. The target community should also have the capacity to be able to provide the necessary resources and support to sustain the breeding program.

A targeted breed for CBCBP needs to be selected based on the risk status and economic contribution of the breed to society, the contribution of the breed to the genetic diversity of the species, and previous characterization work on breeds to identify the targeted breed (Assefa et al., 2021). Once the breed has been defined, an appropriate site should be identified, considering the breeding tract of the breed. Local development agents and other stakeholders working on the breed should participate in site selection (Gizaw et al., 2013). The relative accessibility of the site to roads and markets, the presence of institutions supporting the community, the potential of the area for the conservation and improvement of the selected breed(s) need to be considered (Mueller et al., 2015). The breeders should be trained in the best practices of conservation and sustainable use of the breed and the techniques of artificial insemination and other reproductive technologies (Tiwari et al., 2018). Local institutions should be involved in the project, and the local government need to be consulted. It is important to ensure that the breeders are not only aware of the importance of genetic diversity but also that they understand the risks of inbreeding and the need to select animals with good reproductive performance (Kumar et al., 2019). It is also essential to prioritize the conservation and improvement of the breed to ensure its long-term sustainability (Rani et al., 2020).

Awareness creation for participants in the community

Awareness creation is a key element of any successful community-based breeding program. An effective program must ensure that the participants in the program, including farmers, extension workers, researchers, and other stakeholders, are aware of the objectives, activities, and outputs of the program. Awareness creation is an ongoing process that should be addressed at all stages of the program, from planning to implementation (Kumar and Rajaram, 2015).

At the initial planning stage, it is important to create awareness among the participants about the objectives, scope, and potential benefits of the program. This will help to ensure that all stakeholders are involved in the planning process and are aware of the activities and outputs of the program (Mbogga and Wambugu, 2019). Implementing community-based breeding programs, mainly, animal identification and performance recording, is a new concept for most Ethiopian livestock keepers. Initially, some farmers may refuse to collaborate in data collection and recording. Hence it is important to raise awareness about the importance of such activities to ensure the success of the breeding program.

Identification of breeding objectives

The first step in identifying breeding objectives is to understand the local production system. In Ethiopia, the majority of sheep and goats are kept under extensive management systems with limited inputs hence the production system relies heavily on natural resources, such as pasture and browse, and the animals have limited access to veterinary care and supplementary feed (Bantider et al., 2017). As a result, the productivity of sheep and goats is largely determined by their ability to survive and reproduce in the local environment. Thus, a major breeding objective for sheep and goats should be to select traits that enhance their ability to survive and thrive in the local environment. This could include selecting traits such as disease resistance, heat tolerance, and good foraging ability (Kassa et al., 2014).

Another important breeding objective for sheep and goats in Ethiopia is to select traits that increase the productivity of the animals. This could include selecting traits such as increased milk yield, increased

growth rate, and improved reproductive performance and as well as to maximize their profits (Tizazu et al., 2017; Eshete et al., 2018).

Finally, it is important to consider the socio-economic implications of breeding objectives. In Ethiopia, smallholder farmers are the main producers of sheep and goats, and their livelihoods are dependent on the success of their herds. Thus, it is important to select traits that enable the animals to perform effectively in the local environment, while also being economically viable for the farmers (Gebre et al., 2016). To determine the selection criteria of the farmers, a mix of approaches may be used, such as individual interviews, group discussions, and workshops. Additionally, the rankings of the live animals can be assessed, including the ranking of known and unknown animals to the farmers (Haile et al., 2011; Gizaw, 2013).

Animal identification, data collection, and recording

Animal identification, data collection, and recording are important aspects of animal husbandry. Animal identification includes the marking of individual animals, species-based identification, and breed-based identification. Data collection is the process of collecting, analyzing, and recording information about animals, such as age, sex, breed, health status, production, and performance. Recording is the process of registering and tracking information about animals and their environment. It includes tracking animal movements and interactions, recording animal health histories, and documenting the environmental conditions in which the animal is kept (Gebreyohanes et al., 2022).

Animal identification is used to track individual animals and can involve the use of tags, ear tags, tattoos, microchips, and even DNA. This helps to ensure that animals are properly accounted for and can be identified in the event of theft, disease, or injury. Species and breed identification can also be used to help in the selection of breeding stock and to ensure that animals are properly matched for health and performance. Data collection is used to track animal behavior, health, production, and performance. This information can then be used to make decisions about management, breeding, and health protocols (Fogarty,

2009). The recording is used to track changes in the environment, such as changes in temperature, humidity, and air quality. This information is then used to adjust management practices, such as feed, water, and shelter requirements.

Acquiring good records on the pedigree and performance of animals is a primary component of the breeding program. The accuracy of selection highly depends on performance and pedigree records. Linking genetic relationships with performances enables the estimation of the genetic worth or breeding value of animals for selected traits and allows ranking and selecting the best animals among the candidates to be used for the next generation. Ear tags are the most commonly used and preferred animal identification method. Ear tags are relatively cheap and easy to apply and should be identified by their dam and sire immediately at birth. However, some farmers might resist this; in this case, it is possible to postpone tagging of kids for a few days with proper identification and recording of the dam tag number, sire tag number, kid coat color, and unique identifiers (Haile et al., 2011).

To properly utilize these records, a good numbering system should be devised for decision-making and analysis purposes. As a general rule, a unique number should be given for each animal, and the number of offspring should be greater than the number of sires and dams. This is a prerequisite for software to estimate breeding value. To ensure accuracy and traceability, a reliable record system should be established and updated regularly. Proper record-keeping is essential for the progress and success of the breeding program. Collecting data is essential for successful genetic selection, as it forms the basis of the decision-making process. According to Getachew et al. (2010) and Haile et al. (2011), the data to be collected should be carefully chosen based on the identified selection criteria. Generally, the data should be kept as simple as possible to make it applicable to a farmer's situation. This could include birth weight, litter size at birth, weaning weight, six-month weight, doe post-partum weight, and linear body measurements to increase the growth of the breed. Mothering ability, reproductive performance, and traits related to adaptation should also be considered. Milk yield and lactation length should be assessed to increase milk yield. To make

genetic selection decisions, records for relatives of the current generation should be collected, including progeny of selected sires and dams, and the ancestors of the current generation. It is important to collect data for both sexes to estimate heritability and genetic correlations. To ensure the data is not biased, it should be collected by a trained and knowledgeable staff, and stored securely in an easily accessible manner. A good numbering system should also be devised for decision-making and analysis purposes. Following these guidelines will ensure that data collection is successful and can be used to make informed selection decisions.

Recruitment of enumerators from farmers' communities

Enumerator recruitment from farmers' communities is an important step in data collection. It allows researchers to access valuable information that can be used to inform policy decisions. Enumerators can provide insight into the current challenges and successes of the sector by conducting interviews with farmers, gathering data and monitoring changes over time (Tran et al., 2015). Enumerator recruitment can be a complex process, requiring a thorough understanding of the communities and their needs. Researchers should be aware of the cultural and language differences between the communities and make sure to recruit enumerators who can communicate fluently with the target population. Furthermore, researchers should make sure to provide adequate training to ensure that the enumerators have the necessary skills and knowledge to collect data reliably (Moghimi et al., 2019).

According to the EBI (2016a), enumerators are important for taking responsibility for animal identification, data collection, and technical follow-up of the breeding program. As a bridge connecting researchers and the community, enumerators need to have good conduct approved by the community, be honest, and be committed to serving the community. Routine (daily) monitoring and follow-up are required so that the enumerator can live and interact with the community respectfully. Furthermore, additional two to three hours of labor are also required to spend in data collection. This is important to ensure that the research is performed ethically and efficiently (EBI, 2016a).

Animal selection and mating

Performance records and pedigree information are key tools used to select the best animals to be parents of the next generation, which is essential for maintaining the best animals within the community (Gizaw et al., 2011; Mourad et al., 2015). This process of selection is necessary to ensure that the genetic merit of these animals is disseminated to the next generation. Furthermore, it is important to select and maintain the best animals at an early age to avoid prior sales (Mourad et al., 2015). The appropriate time and age of selection for the animals depend on the breed and market situation, and should be carefully taken into consideration (Gizaw et al., 2011). In addition, traditional flocks have uncontrolled and non-seasonal mating, which leads to kidding distributed throughout the year, yet there is still variation among seasons in the number of kids produced (Gizaw et al., 2011).

Selection of buck lambs should be conducted in batches while considering the market age of the breed, the marketing season associated with annual feasts, and the frequency of available candidates. Gizaw et al. (2007) and Mekuriaw (2016) recommend that sires should be ranked based on their estimated breeding value, and then farmers should make the final selection based on their phenotypic assessment. To achieve this, it is recommended to select buck kids immediately before major feasts (eg. New Year, Christmas, Ester, Ed-Al-Adha). This two-step selection process, selecting a larger number of candidates at an early age (immediately before market age) and then approving the selection among candidates at breeding age, allows for adjusting for known environmental variations (like age, management, dam parity, postpartum weight, etc.) and using farmers' criteria to select the best buck kids. Furthermore, sires that fail the breeding soundness test need to be rejected automatically.

Sire use arrangement

Participatory scheming of the system to maintain and use breeding sires is a crucial step for the community (Getachew et al., 2010). A successful breeding program requires a well-thought-out plan that considers both short-term and long-term goals. The first step is to identify the breeding goals of the community and select

sires that have the best genetic merit to meet these goals. This involves availing and ensuring the functionality of selected sires to serve all flocks of the community fairly. Buy-in from the community members is a key factor in the sustainability of the breeding program. To ensure success, the selected sires should produce offspring that fetch above-average income for their owners. To make this possible, a revolving fund from the project or the contribution of community members is required in the beginning to acquire selected sires and other inputs for the community (Getachew et al., 2010). Once the program is successfully launched, it should be monitored and evaluated regularly to ensure that it meets the desired goals. Small-holder flocks are usually too small to make a selection of sires within the flock, so the selection of sires is implemented at the community level to maximize genetic gain.

The farmers in the community should be allocated to different breeding groups based on their neighborhood and communal grazing land and these groups should be decided with the full participation of the community. As few sires as possible should be used without affecting the accessible breeding dams. If sires are needed for more than one generation, it is important to rotate the sires among the groups or family flocks within the community to reduce inbreeding (Getachew et al., 2010; Haile et al., 2011). Unselected sires should not be used when mating the breeding dams, instead, technologies like conditioning or fattening unselected sires should be imposed to add value to them. Additionally, agreements regarding the communal use of selected sires, rotation of sires among flocks, and generations, and the use of a revolving fund for best sire selection should be set in place with the full participation of the community (EBI, 2016b). Once the sires have been selected, they should be castrated and fattened for breeding before being sold at a good price. The money obtained from the auction of the culled breeding sires should be used to buy replacement buck lambs.

Organizing cooperatives and encouraging community ownership

Organizing cooperatives and encouraging community ownership can provide a unique and powerful model for communities to not only gain economic autonomy but also to promote democracy and social justice. Cooperatives are members-owned and democratically-run businesses, which pool resources and share

profits among members. Such organizations can provide a way for communities to gain autonomy and ownership over their economic destiny. For example, by pooling resources, communities can better access capital, build resilience, and gain control of their resources and assets. Additionally, cooperatives create jobs and can provide a way for communities to become more self-sufficient. According to the United Nations International Year of Cooperatives, "Cooperatives are a reminder to the international community that it is possible to pursue both economic viability and social responsibility." (United Nations, 2012). Furthermore, when communities can own and control the resources, it allows them to have a greater say in the decision-making process, further promoting democracy and social justice. (Weeks et al., 2017).

Organizing farmers into a well-functioning cooperative is important to facilitate in situ community-based conservation and breed improvement activities. Breeder cooperatives shall be organized based on the guidelines of cooperative formation (Solomon, 2014; Getachew et al., 2016; EBI et al., 2016). Assefa et al., 2021). A cooperative unit under the wereda (district livestock agency) or agricultural office, research centers, community providers, universities, cooperatives, NGOs and Ethiopian Biodiversity Institute or the district livestock agency, is responsible for organizing farmers. The cooperative is expected to be run by a committee selected with the full participation of the community, which will perform duties like facilitating data collection and recording, discussing with the community and those responsible for the formation of breeding groups, arranging and monitoring buck utilization and rotation among groups, facilitating input supply (like feed and drugs) for goat production, being a main actor during buck selection and the animal show, discussing with the community and assisting in the implementation of the culling of unselected bucks, facilitating the fattening and marketing of culled breeding bucks, searching the market for breeding bucks, and approving the sale of bucks for breeding purposes in collaboration with the enumerator, district experts, and researchers. The committee will also be responsible for controlling the finances and properties of the community (Getachew et al., 2016; Assefa et al., 2021). It is important to note that the success of the cooperative will depend on the level of participation and commitment of the members. Therefore, the

committee needs to ensure that the members are well informed about the benefits of the cooperative and that they are given the necessary training and support to build capacity and ensure that the cooperative functions effectively.

Monitoring and evaluation

The ultimate goal of the CBCBP is to achieve genetic improvement for selected traits while maintaining the genetic diversity of the breed. Monitoring and evaluation is hence a vital component of CBCBP. Through regular monitoring, corrective measures can be taken on time. Defining key indictors to measure the progress, in achieving the goals set by the program and assess the outputs' contribution to the outcome is critical (Haile et al., 2011).

CONCLUSION

Sheep and goat production in Ethiopia has a long history and practice, with the population of these animals increasing over time, albeit not at the same rate as the human population. While researchers have identified limitations to breeding and conservation activities in the country, the practical application of community-based conservation and breeding programs (CBCBP) is still very limited. Thus, concerned institutes and organizations, as well as researchers, must strive to fill gaps and carry out CBCBP initiatives to the best of their ability, taking into consideration the available potential and resources in the country. Participatory identification of the breeding objectives, animal identification, performance recording, and selection of the best animals based on recorded performance and farmer criteria, pooling small flocks, and arranging sire use and sharing systems are all essential components of these programs. To successfully establish CBCBP, the community must be fully involved in a bottom-up, socio-cultural approach, with clear benefits for the members of the community and the use and upgrading of indigenous knowledge. Additionally, the activities of CBCBP should include the selection of breed, site, and awareness creation, recruitment of enumerators from farmers, animal selection and mating, organization of cooperatives to encourage community ownership, and monitoring and evaluation.

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