Optimization of community-based breeding programs

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Summary

Any breeding program undergoes numerous stages of improvement and adjustment and is never completely flawless from the beginning. Initial selection in the community-based breeding programs (CBBPs) were made only based on phenotypic performance, disregarding the relationships between individuals. Following the accumulation of pedigree and performance data, the BLUP animal model has now been employed. Significant genetic gain for selection qualities were achieved in Ethiopian sheep CBBPs. However, there are still ways to maximize genetic advancement and overall advantages of the breeding programs. A method to maximize the current CBBPs was studied, which included increasing selection intensity and sire use strategy, index-based selection, enhancing breeding females' reproductive productivity, and connecting CBBPs with the production unit. The researchers attended planning and training sessions regarding CBBP optimization. The researchers later returned to their respective villages and implemented CBBP optimization as appropriate.

Improve selection intensity and sire use strategy

According to Haile et al. (2020), the evaluation of the community-based breeding program in Menz, Horro, and Bonga sheep resulted in annual genetic gains for the selection trait (six-month weight) of 0.11, 0.21, and 0.18 kg, respectively. These gains are equivalent to 0.8%, 1.1%, and 1.0% of the average value of six-months weight. Even if this is commendable and constructive development, genetic research can yet be improved. There could be several issues causing lower progress. First, in most sheep and goat CBBPs, fewer individuals are available for selection than anticipated.

Menz, for instance, has the potential to have 7 times as many candidate males available at selection time (282 instead of 40) (Mueller et al., 2019). Less number of candidates at selection time occurred because of fast-growing animals being sold at a young age for immediate financial needs. Some farmers may also prefer not to bring their animals to the selection site in favor of selling them on the market after fattening because they anticipate a lower price for breeding rams or they may think that their animal might not win selection as fewer replacement rams are needed. Second, whereas a male to female ratio of 1:25 is predicted, Bonga and Menz rams produced only 8.5 and 5.7 lambs per year, respectively. For Bonga and Menz sheep, the ram service year was 1.6 and 2.2 years, respectively, and the association between lamb weight at six months and the quantity of lambs born per sire was 0.49 for Menz sheep and 0.06 for Bonga sheep. This finding, in particular for Bonga sheep, indicated that rams with high EBV had a lower likelihood of remaining in the flock for an extended period of time.

Planning and Training session was organized for the researchers at the beginning of 2022 with the aim of optimizing the on-going CBBPs. The key messages during the training included:

1. Avoid the use of non-selected rams while increasing selection intensity by employing as few rams as possible in the CBBP. In Menz for example, it is normal practice to keep non-selected animals until they are two years old with the intention of castrating and fattening them. The problem was discussed at the training with

researchers, who then returned to the community to impart this knowledge. Farmers then consent to isolate non-selected animals until castration age. Another strategy involved showing the advantages of castration and fattening at a young age, and then many farmers expressed interest in adopting this approach.

2. Rather than using solely young candidates, the replacement of rams should be based on predicted breeding values across all ages. Ram selection across all age groups has already begun in the Bonga, Menz, and Doyogena CBBPs. This should increase the likelihood of the top rams having more progeny.
3. During the training, the experiences of Bonga sheep CBBPs that the cooperative used their capital to purchase younger animals, were explained and discussed. This strategy has already been adopted and implemented by cooperatives in Menz and Doyogena. Retaining about 20% of lambs selected on three months weight in the first stage is enough to achieve 80% of maximum selection differential in six-months wight (Mueller et al., 2021).
4. To establish genetic connections across CBBPs and use the best and preferred sires across CBBPs on a larger scale, sire rotation among CBBPs has been started in Bonga.
5. To promote optimization in the current CBBPs, links between the CBBPs and the production unit surrounding them are essential. While a strong market is being developed for their breeding sires, CBBP participants are being urged to advance their CBBPs. Menz, Wollo, Washera, Bonga, and Horro sheep CBBPs as well as Konso goat CBBPs extensively use the dissemination of improved genetics through dispersing improved sires to the production unit. Artificial insemination was performed on the Menz, Doyogena, Bonga, and Konso CBBPs to support this.

Figure 1. Best breeding sires in Menz CBBP

Selection on total merit index

In the CBBP, selection is often based on growth performance and only considers male animals. Although it is challenging to include reproduction traits because of data management and analytic issues as well as the minimal genetic diversity in reproduction traits, including such traits like liter size, lambing interval, and mothering competence could potentially boost the total benefit. For the Bonga sheep and Abergelle goat, we devised an index selection considering their economic relevance (Mueller et al. 2021). Sire for meat sheep programs should be selected based on own early live weight and their dam's number of lamb born. For goats, where milk is important, buck should be selected based on index that considers own early live weight and dam's mean milk production record.

Many CBBPs have collected reproduction information, but the information has never been used to make selection decisions. One of the key causes is that data administration and analysis call for higher level skills. The organization of advanced training on 1. handling and getting ready raw data for reproduction performance analysis 2. How to combine information on reproduction and growth performance (lambing interval and dam liter size)

using a repeatability model has substantially helped trainees in their data management and analysis. The trainees were instructed on how to determine age at first lambing, lambing interval, and liter size using various EXCEL functions and R scripts. To execute the genetic analysis, wombat parameter files were also provided and explained to them. After that, an example file was given to them, so they worked on preparing and analyzing reproduction data.

After the training, researchers analyzed their reproduction data and prepared a manuscript for publications. Some researchers began taking reproduction performance into account while making their selections. Additionally, researchers received training on how to calculate the economic value of various traits. The training manual prepared for the purpose served to train the researcher (Mueller et al., 2021). The training also covered breeding value estimation based on uncertaint sire and across age selection of sires for replacement.

Improving reproduction efficiency

Having enough high-quality breeding sires in the flock, using improved management techniques like proper feeding of breeding ram and dams, culling ewes with low reproductive performances due to old age or other factors, and keeping the best breeding females in the flock are all expected to increase reproductive success. Even among the most advanced CBBPs today, there are still ewes with subpar performance. For instance, in the advanced Bonga sheep CBBPs, 10% of the ewes had undesirable coat color, morphology and low reproductive performance (Figure 2). This figure is higher in the recent CBBPs.

Farmers, enumerators, and development agents were trained on how to identify and remove non-productive breeding females from their flocks. The removal of infertile females from the flock is done using ultrasonography. Farmers in Menz CBBP agreed to cull sheep with more than seven parities because their performance was anticipated to deteriorate at this stage. Furthermore, because undesirable coat color and morphological traits are linked to market value and breed traits, farmers agree to cull sheep with these traits.

Figure 2. Top Bonga ewes (left) and worst ewes (right) selected by the community within their flock. Photo: ICARDA.

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