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# Review on the Success and Challenges of Community-Based Sheep Breeding Programs in Bale Zone: The Case of Indigenous Breeds

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## ABSTRACT

The review reveals significant successes in the genetic improvement of growth traits, including measurable increases in birth and weaning weights and enhanced reproductive performance, such as increased twinning rates. Institutionally, the formation of functional Breeders' Cooperatives has empowered local communities, fostering ownership of genetic resources and increasing household income by 20-25% through the sale of certified breeding rams. However, several constraints remain, including inaccurate pedigree recording in communal grazing systems, seasonal feed scarcity, and weak market linkages that fail to provide premium prices for genetically superior animals. Furthermore, the transition of these programs from donor-funded projects to self-sustaining community enterprises remains a critical challenge. While CBBPs have demonstrated clear potential to enhance the livelihoods of farmers and conserve the Arsi-Bale breed, their future success depends on stronger institutional support, digitalization of pedigree data, and better integration with health and nutrition services.

**Keywords:** Arsi-Bale Sheep, Community-Based Breeding (CBBP), Genetic Improvement, Indigenous Breeds, Smallholder livelihoods, Breeders' Cooperatives.

## INTRODUCTION

### Background and Global Perspective

Small ruminants, particularly sheep, are vital assets for the livelihoods of millions of smallholder farmers and pastoralists in sub-Saharan Africa. They provide immediate cash income, high-quality protein, and serve as a living bank against environmental shocks. However, historical attempts to improve sheep productivity through centralized, "top-down" breeding programs often involving exotic breed introductions have largely failed in developing countries due to a lack of environmental adaptation and high management costs [1,2].

### The Shift to Community-Based Breeding (CBBP)

To address these failures, Community-Based Breeding Programs (CBBPs) were introduced as a participatory alternative. Unlike ranch-based systems, CBBPs focus on indigenous breeds within their natural production environments, prioritizing farmer participation in defining

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breeding objectives and selecting superior sires [3,4]. In Ethiopia, CBBPs have been piloted to conserve genetic diversity while improving economically important traits like growth rate and resilience [5].

### The Significance of the Bale Zone

The Bale Zone of the Oromia Regional State is a premier livestock hub in Ethiopia. Its diverse agro-ecology, ranging from Afro-alpine highlands to semi-arid mid-and-lowlands, supports a massive population of the Arsi-Bale sheep breed. This breed is renowned for its hardiness, prolificacy, and ability to thrive on poor-quality forage in challenging environments [6]. Given this potential, various CBBPs have been implemented in areas like Sinana, Agarfa, and Dinsho to transform traditional sheep farming into a more productive and market-oriented system [7].

### Problem Statement and Objectives

Despite over a decade of CBBP implementation in the Bale Zone, there is a lack of synthesized evidence regarding their overall impact. While some reports indicate significant gains in weaning weight and twinning rates, other studies highlight persistent challenges such as weak market linkages, feed shortages, and the difficulty of maintaining accurate pedigree records in communal grazing systems [8,9].

Therefore, this review is designed to:

1. Evaluate the genetic and institutional successes recorded in Bale Zone CBBPs.
2. Identify the technical and socio-economic constraints hindering the sustainability of these programs.
3. Provide recommendations for integrating indigenous knowledge with modern selection tools to benefit local sheep-rearing communities.

## METHODOLOGY OF THE REVIEW

### Search Strategy and Data Sources

To ensure a comprehensive collection of relevant information, a systematic search was conducted across multiple electronic databases and institutional repositories. Primary sources included Google Scholar, PubMed, Science Direct, and Research Gate. Additionally, "gray literature" such as technical reports from the International Livestock Research Institute (ILRI), ICARDA, and the Ethiopian Institute of Agricultural Research (EIAR) was consulted. Local data were also sought from the Sinana Agricultural Research Centre (SARC) and Bale Zone Agriculture and Natural Resource Bureaus.

### Inclusion and Exclusion Criteria

To maintain the quality and relevance of the review, specific criteria were applied:

- Inclusion: Peer-reviewed articles, MSc/PhD theses, and official project reports published between 2008 and 2025. Focus was placed on studies involving Arsi-Bale sheep, Community-Based Breeding Programs (CBBP), and livestock production systems in the Bale Zone and surrounding Oromia highlands.
- Exclusion: Studies focusing solely on exotic breeds without connection to local systems, or papers lacking empirical data on breeding outcomes, were excluded.

### Data Extraction and Synthesis

The retrieved documents were first screened by title and abstract. Relevant papers were then fully reviewed to extract key performance indicators, including:

- Genetic parameters: (Birth weight, weaning weight, and pre-weaning growth rates).
- Institutional outcomes: (Formation of cooperatives, sire exchange mechanisms).
- Challenges: (Socio-economic constraints, feed availability, and technical gaps).

The findings were synthesized qualitatively to describe trends and quantitatively where data allowed for comparisons of performance before and after the implementation of CBBPs in the region.

## SUCCESSES OF CBBP IN BALE ZONE

### Genetic Progress in Growth Traits

The primary success of CBBPs in the Bale Zone is the measurable improvement in the growth performance of the Arsi-Bale sheep. Through systematic selection of top-performing rams based on phenotypic traits, significant gains have been recorded:

- Weight Gain: Studies indicate that lambs born within CBBP flocks show an increase in birth weight (approx. 0.41 kg improvement) and weaning weight compared to baseline values [1,10].
- Six-Month Weight: There is a statistically significant improvement in six-month weight (averaging a 7.58% increase), which is a crucial metric for market readiness [11,12].

### Reproductive Performance Improvement

Selection within the community has also positively impacted the reproductive efficiency of indigenous ewes:

- Litter Size: There has been a notable increase in litter size (approx. 0.25 lambs per lambing), meaning more twins are being born in participating flocks [10,12].
- Lambing Interval: The average time between lambing has been reduced by approximately 11.36% (about 21 days),

allowing farmers to produce more lamb crops over a shorter period [11].

**Institutional Success: Breeders' Cooperatives**

One of the most sustainable outcomes in the Bale Zone (specifically in districts like Agarfa and Sinana) is the legal establishment of Sheep Breeders' Cooperatives:

- Ownership: Farmers have moved from being passive recipients of technology to active managers of their genetic resources.
- Financial Gains: Members of these cooperatives have reported an average income increase of 20% to 25% due to the sale of certified "breeding rams" which fetch higher prices than meat-purpose animals [13,14].
- Sire Exchange: Successful implementation of ram rotation/exchange systems between villages has helped minimize the risk of inbreeding within communal flocks.

**Conservation of Indigenous Genetic Resources**

Unlike past crossbreeding attempts with exotic breeds (like the Merino), CBBPs in Bale have focused on the Arsi-Bale breed's natural resilience:

- Climate Resilience: The programs have successfully improved productivity without losing the breed's natural resistance to local diseases and its ability to thrive on poor-quality forage in the Afro-alpine highlands [15].
- Gene Pool Maintenance: By discouraging indiscriminate crossbreeding, CBBPs have acted as an "in-situ" conservation tool for Ethiopia's valuable sheep biodiversity.

**Table 1.** Summary of Success Metrics

| Performance Indicator | Baseline (Pre-CBBP) | Current Trend (Post-CBBP) |
|---|---|---|
| 6-Month Weight | Lower/Variable | ~7.58% Increase |
| Litter Size (Twins) | Low | Significant Improvement |
| Farmer Income | Traditional Market | 20-25% Increase |
| Breed Purity | At risk of dilution | Conserved & Improved |

## CHALLENGES AND CONSTRAINTS OF CBBP IN BALE ZONE

Despite the documented successes, the long-term sustainability and scaling-up of Community-Based Breeding Programs (CBBPs) in the Bale Zone face several multi-dimensional bottlenecks. These can be categorized into technical, environmental, and socio-economic constraints.

**Technical and Infrastructural Constraints**

- Inaccurate Pedigree Recording: In the communal grazing systems of Bale, maintaining accurate parentage records is a significant challenge. Without controlled mating, identifying the exact sire of a lamb becomes difficult, which reduces the accuracy of genetic evaluations and selection indexes [1,8].
- Lack of Field Equipment: Many breeding cooperatives in districts like Agarfa and Sinana suffer from a shortage of essential tools such as digital weighing scales, ear tags, and data management software. Relying on manual record-keeping often leads to data loss or entry errors [2].
- Genetic Dilution and Uncontrolled Mating: The presence of "unimproved" rams from neighbouring non-participating flocks often leads to unplanned mating during communal grazing, slowing down the rate of genetic gain [5].

**Biological and Environmental Pressures**

- Feed Scarcity and Seasonality: The Bale highlands and midlands experience significant fluctuations in forage quality and quantity. During the dry season, the lack of quality feed prevents sheep from expressing their full genetic potential for growth, often leading to weight loss and reduced fertility [16].
- Disease Prevalence and Mortality: High lamb mortality rates due to internal parasites and respiratory infections (such as PPR) remain a threat. These health issues can wipe out years of selective breeding progress within a single season if veterinary services are not well-integrated [17].

**Socio-Economic and Institutional Barriers**

- Weak Market Linkages: A major frustration for farmers is the lack of a "premium price" for improved breeding rams. When the market does not distinguish between a genetically superior ram and a meat-purpose ram, farmers lose the incentive to follow strict breeding protocols [14].
- Sustainability and "Project-Dependency": Many CBBPs in Ethiopia are initiated by international organizations (e.g., ICARDA, ILRI). Once project funding ends, local agricultural bureaus often struggle to provide the necessary technical follow-up and financial support to keep the cooperatives active [18].
- High Dropout Rates: Some members of the cooperatives may exit the program due to the slow nature of genetic improvement, preferring immediate cash returns over the long-term benefits of a structured breeding program.

**Table 2.** Summary of Constraints at a Glance

| Category | Specific Challenge | Impact on the Program |
|---|---|---|
| Technical | Poor record-keeping & pedigree errors | Lowers genetic gain accuracy |
| Environmental | Seasonal feed shortage & disease | Increases mortality and slows growth |
| Economic | Lack of premium markets for rams | Discourages farmer participation |
| Institutional | Dependency on external project funding | Threatens long-term sustainability |

## CONCLUSION AND RECOMMENDATIONS

### CONCLUSION

The review demonstrates that Community-Based Breeding Programs (CBBPs) in the Bale Zone have successfully transformed the traditional sheep-rearing system into a more structured, productive, and participatory model. The evidence shows significant improvements in the phenotypic traits of Arsi-Bale sheep, particularly in birth weight, weaning weight, and twinning rates. Beyond genetic gains, the establishment of Breeders' Cooperatives has empowered smallholder farmers by fostering ownership of their genetic resources and increasing household income through the sale of certified breeding rams.

However, the sustainability of these gains is currently threatened by technical gaps in record-keeping, seasonal feed scarcity, and the lack of a structured premium market for genetically superior animals. Without addressing these "project-dependency" issues and integrating animal health and nutrition with breeding, the long-term impact on the Bale Zone's livestock sector may remain limited.

### RECOMMENDATIONS

To ensure the continued success and scaling-up of CBBPs in the region, the following measures are recommended:

- Digitization of Pedigree Data: Local agricultural offices should transition from manual paper-based records to mobile-based data collection apps to reduce pedigree errors and improve the accuracy of genetic evaluations.
- Strengthening Market Linkages: Policy makers should facilitate "Certified Breeding Ram Markets" where cooperatives can sell their selected animals at a premium price, distinct from the local meat market.
- Integrated Intervention: Breeding programs should not operate in isolation. They must be coupled with improved forage development (e.g., planting adaptable grasses like Phalaris or legumes) and regular vaccination programs to reduce lamb mortality.
- Institutionalizing the Program: Regional governments (Oromia Agriculture Bureau) must integrate CBBPs into their regular budget and extension systems rather than relying solely on time-bound international projects.
- Capacity Building: Continuous training for lead farmers and cooperative managers on modern selection criteria and financial management is essential for post-project independence.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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