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Review Article

"Exploring the Potential of Community-Based Sheep Breeding Programs: Harnessing Indigenous Knowledge for Resilient Livestock Development"

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Abstract

The genetic improvement of livestock is commonly perceived as a multifaceted endeavor that demands a high degree of organization and technical expertise. In developed countries, the state has traditionally provided support for animal breeding through large-scale national breeding programs. These programs involve the collection of data, which is then channelled to a central data processing center. Complex statistical methods are utilized to estimate "breeding values," and decisions regarding the use of male breeding animals are made centrally as part of these programs. In developing countries, the required supportive infra-structure is largely unavailable, and attempts to replicate approaches that have been successful in developed countries have met with little success [1]. Community-based breeding programs offer an appealing option for enhancing the genetic quality of small ruminants in low-input systems. In many developing countries, community-based breeding programs (CBBPs) have been proposed as viable alternatives to centralized, government-controlled breeding schemes for small ruminants. This paper presents valuable insights into the socioeconomic advantages that community-based breeding programs can offer to rural populations living in poverty.

Keywords: Community-Based Breeding; Small Livestock Farmers; Livestock; Low-Input System; Breeding Value; Sheep

Introduction

Sheep breeds in India play a significant role in generating cash income through the production of meat, milk, skin, and manure**.** In Many developing countries, centralized breeding schemes, predominantly managed and controlled by governments, were established and implemented.

These schemes typically involved a central station with limited or no participation from farmers. Governmental organizations were responsible for managing various aspects of the complex breeding process, including data recording, genetic evaluation, selection, Heterosis, and providing feedback to farmers. Despite their Good wills, these centralized schemes were unable to achieve sustainable genetic improvements, such as consistently supplying smallholders with an adequate number and quality of improved male animals. Additionally, they failed to actively involve end-users in the breeding process. It is noteworthy to mention that the top-down manner breeding programs mostly collapse once withdrawal of financial and technological support or changes in government priorities [2,3]. Hence, there is a need for a fresh approach, and one strategy that has garnered global attention is the community-based breeding approach. Programs that embrace this strategy consider and prioritize the needs, perspectives, decisions, and active involvement of farmers from the beginning stages of planning to the implementation phase. The success of such programs relies on giving due consideration to farmers' breeding objectives, infrastructure requirements, level of participation, and sense of ownership [4-6]. The community-based breeding program

(CBBP) has emerged as a more viable and sustainable approach for conserving and simultaneously genetically improving indigenous livestock within smallholder farming systems [6,7]. The concept of community-based breeding (CBB) has been employed as a tool in agricultural research since as early as 1970. Although not a new concept, CBB has proven to be an effective approach in various agricultural contexts [8]. CBBPs are based on bottom-up participatory approaches and typically relate with the farmers of low-input production systems within the certain geographical areas those having a common interest to work together for the improvement of their genetic resources [9,10]. A low input production system in sheep rearing refers to a management approach that minimizes external resources, interventions, and costs while maintaining the health and productivity of the sheep. It involves maximizing natural grazing, selecting resilient breeds, promoting pasture quality, emphasizing preventive health measures, providing simple shelter, and monitoring sheep performance. This sustainable approach reduces reliance on artificial inputs and promotes cost-effective practices. Community-based breeding (CBB) initiatives enhance the productivity and profitability of indigenous breeds or varieties while preserving their resilience and genetic integrity. These initiatives employ easily accessible interventions that effectively achieve these goals [11]. Community-based breeding programs (CBBPs) have demonstrated successful implementation in various regions. These programs have effectively utilized the indigenous genetic resources of smallholders in Latin American countries, specifically with sheep, goats, and llamas [12,13]. Similarly, successful CBBPs have been established for sheep and goats in Africa [14,15], as well as for goats and pigs in Asia [16,17].

Materials and Methods

Description of study area

To enhance the genetic improvement of sheep, breeding programs should be implemented across diverse locations that represent various agro-ecologies. These locations should encompass habitats for different indigenous sheep breeds. This approach allows for meaningful comparisons of results and facilitates the implementation of precise adjustments to the program. Successful improvements in livestock genetics through these breeding programs can lead to increased economic benefits for farmers.

Methodological frame work and management

A checklist can be developed, emphasizing current grazing and breeding management practices, desired breeding strategies (such as ram selection, sharing, rotation, and culling), grazing management, genetic correlation, and heritability of traits. This checklist can be served as a valuable guide for discussions and it will ensure comprehensive coverage of relevant topics. The essential steps for planning of CBBPs as proposed by FAO [18] are presented in figure 1.

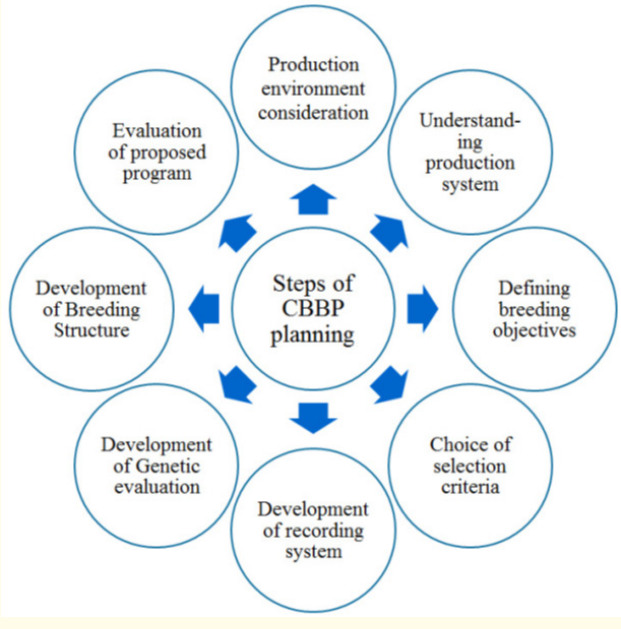

Figure 1: Illustrates the fundamental elements and principles for planning a community-based breeding program (CBBP), as provided by FAO in 2010.

The coefficient of covariance (COV) is a statistical measure that quantifies the relationship between two variables, specifically their joint variability. It is calculated by dividing the covariance of the variables by the product of their individual standard deviations. The COV is used to assess the relative strength and direction of the relationship between the variables [20]. We can see the importance of the coefficient of covariance as a tool for measuring the degree of association or dependence between variables. It can be particularly useful in analyzing data sets where variables are expected to be related or influence each other. Breeding methods are techniques used to produce offspring with desirable traits in plants and animals. These methods involve controlled mating and selection to enhance certain characteristics and improve the overall quality of the population [24]. These methods involve controlled mating and selection to enhance certain characteristics and improve the overall quality of the population. Here is a brief overview of some common breeding methods

- **Selective Breeding:** Selective breeding involves selecting and mating individuals with desired traits to create offspring with those traits. It has been used for centuries in agriculture to improve crop yield, disease resistance, and other agronomic traits.
- **Hybridization:** Hybridization is the crossing of two genetically distinct individuals or varieties to create offspring with desirable traits. Hybrids often exhibit improved vigor, yield, or other characteristics known as hybrid vigor or heterosis.
- **Inbreeding:** Inbreeding is the mating of individuals that are closely related, such as siblings or cousins. It is used to establish and maintain specific traits within a population, but it can also lead to the expression of deleterious recessive traits.
- **Line Breeding:** Line breeding involves mating individuals within a specific line or family that possess desirable traits. It is a form of selective breeding that aims to concentrate the genes of particular individuals while maintaining genetic diversity.
- **Cloning:** Cloning is a method of asexual reproduction that produces genetically identical copies of an organism. It is commonly used in plant breeding to propagate elite varieties with desirable traits.
- **Genetic Engineering:** Genetic engineering involves the direct manipulation of an organism's genes to introduce or enhance specific traits. It allows for the transfer of genes between unrelated species, providing a powerful tool for creating genetically modified organisms (GMOs) with desired traits [25-27].

Heterosis, also known as hybrid vigor, refers to the phenomenon in which the offspring of two different inbred lines or breeds exhibit improved traits compared to their parents. It is the result of the combination of favorable genetic traits from different parental lines [21]. When individuals from genetically diverse populations are crossed, their offspring can benefit from increased genetic variation, leading to improved performance in various traits such as growth rate, fertility, disease resistance, or productivity. The exact mechanisms underlying heterosis are not fully understood but are believed to involve the interaction of complementary or dominant alleles [22,23]. Heterosis is commonly exploited in agriculture, including livestock breeding, crop improvement, and plant breeding programs. By carefully selecting and crossing parental lines with desirable traits, breeders can produce hybrid offspring that exhibit enhanced performance and productivity compared to the parent lines. However, heterosis may vary across traits and populations, and not all hybrids exhibit significant hybrid vigor [22].

Data collection

To ensure effective monitoring and evaluation of the breeding program, the program team should establish key indicators to measure progress towards achieving the primary outputs of the program. Additionally, indicators should be defined to assess whether the program outputs are effectively contributing to the desired outcomes and impacts at the individual flock, household, and community levels. It is crucial to develop appropriate tools and procedures for monitoring these indicators, including well-defined timelines for each indicator. This approach will enable accurate tracking of program performance and facilitate informed decision-making throughout the program's implementation. Different data collection tools can be used. Data recording formats should be developed can be used to collect biological data from each household. Data analysed included birth weight, 6-month weight and litter size [19].

Conclusion

Community-based breeding programs are being suggested as a viable option for enhancing the genetic quality of livestock in developing countries. This innovative approach has shown promising results in a few locations, such as the implementation of such programs with dairy goats in Mexico, as well as with llamas and alpacas in Bolivia and Peru.

We can confirm that community-based management of animal genetic resources should consider the unique characteristics of each production circumstance and the specific community involved. Since the community-based breeding program is a relatively new approach, it is important to acknowledge that the current guidelines will need refinement and updates over time. As experience in community-based breeding accumulates and our tools for implementation improve, it will be necessary to continuously review and enhance the guidelines to ensure they remain relevant and effective in supporting successful community-based breeding programs.

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Declaration of Interest

The authors declare that they have no conflict of interest.

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