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LIVESTOCK GENETICS | FIELD SOLUTIONS FOR ARTIFICIAL INSEMINATION OF SHEEP AND GOATS IN LOW INPUT SYSTEMS

KEY MESSAGES

- Artificial Insemination (AI) and related biotechnologies (estrus synchronization and semen evaluation) are the main universal methods to disseminate improved genetics in livestock species.
- AI technologies can be adjusted to various levels of infrastructure, semen technology, techniques and field organization.
- AI using fresh semen, collected in the field and relying on basic infrastructure, is a promising technology for wider delivery of improved genetics (selected rams in community-based breeding programs) under low input systems.
- AI facilitates a wider reach to farmers in communities, expands breeding programs and facilitates access to genetic gain.
- When AI is associated with the use of certified sires, it reduces transmission of infectious reproductive diseases.

INTRODUCTION

In countries with tropical conditions, such as Ethiopia, small ruminants are reared in both crop-livestock farming and pastoral production systems. Despite the importance of this activity as a source of income and employment, herd management is generally poor, breeding is uncontrolled, infertile animals are kept in the herd (affecting flock fertility) and crossbreeding is commonplace, which increases the loss of pure-bred genotypes.

Community-based breeding programs (CBBPs) have proven to be well-adapted for the genetic improvement of Ethiopian sheep and goat genetic resources. To scale their impact, however, requires a complementary reproductive program wherein artificial insemination (AI) plays a central role.

The development of low-cost, low-infrastructure AI protocols in support of the sheep and goat breeding programs was one innovation that resulted in the development of the Ethiopia small ruminant reproductive platform which seeks to establish links between relevant national institutions (research centers, universities, national AI centers and private veterinarians) and exchange knowledge between the different project target areas. The reproductive platform works across breeds, sites and represents a dynamic space for supporting the scaling of CBBPs.



Photo LLR/Apollo Habtamu

Community-based breeding programs in Ethiopia are raising the quality of flocks by selecting the best rams for breeding. AI offers the possibility of making wider and more effective use of superior rams.



Photo ICARDA/Tesfaye Getachew

Young herders await the turn of their animals at the joint artificial insemination campaign held by ICARDA and the United States Department of Agriculture in Konso, Ethiopia, in 2021.

THE INNOVATION

Universally, AI is the most viable option for a wider and more effective use of superior sires, and helps to improve the mean genetic level in the community flocks and to reduce the dissemination of sexually transmitted diseases. This innovation is the development of AI protocols that are adapted to low-input systems where central AI centers or labs do not exist and where basic commodities are lacking (e.g. electricity, running water and cold chain facilities for distributing fresh cooled semen).

The main pillars of this innovative AI scheme for low input systems were:

- To overcome the absence of infrastructure while not resorting to heavy investments which cannot be duplicated, ICARDA and its national partners co-invested in low-cost, low-infrastructure, mobile AI labs in all the sites and all the regions. Reliable, mobile electro generators were used to cover for the lack of electricity.
- The selection of the AI rams and bucks is based not only on their estimated breeding values and general condition-which includes body size and examination and palpation of the reproductive organs-but also on the semen evaluation. In fact, the fertility of males, including the ability to produce

normal spermatozoa and to mate, has a great influence on herd performance and livestock productivity. The AI rams were also vaccinated against the most prevalent diseases in order to reduce the transmission of diseases.

- Use of fixed-time AI. Females are estrus synchronized and alternative protocols based on the use of prostaglandins were tested and gave satisfactory results. The conventional progestogen-eCG-based treatments remain expensive and are not available in many countries. These types of treatments also do cause vaginal problems, reduce fertility, have negative effects on sperm transport and viability and negative implications of progestogen residues in milk. On the other hand, prostaglandin-based protocols yield clean estrus, are easy to use, cheaper and are adapted to breeds under inter-tropical and equatorial African condition. Several prostaglandin analogues are locally available.
- The fixed time AI protocol relies on the use of fresh, non-cooled semen that is collected, assessed, processed and subsequently packed and used. Average time lag between collection and deposition should not exceed 30 minutes. Such a scheme requires a novel organization of the workflow in comparison to the conventional way in which semen is centrally produced and then distributed to the AI sites.



Photo ICARDA/Tesfaye Getachew

Technicians at the artificial insemination campaign in Konso, Ethiopia, test semen for viability.



Photo ICARDA

Pictured here: cervical insemination of sheep. The AI approach developed for Ethiopia has low infrastructure needs, is applicable to both sheep and goat breeds and most regional research centers in the country have the basic equipment needed to undertake the work.

THE DRIVERS

- **AI as a reproductive tool contributes to food security and improvement of genetic resources.** It contributes to increased productivity, leading to better incomes that can impact food security and reduce hunger and malnutrition. In market-oriented flocks (export market), the use of fixed-time AI combined with estrus synchronization is a reliable tool to help time the appropriate birth season with market demand.
- **The use of reproductive biotechnology tools combined with selection programs can assist a faster genetic progress.**
- **The use of new technologies and the active participation of farmers and private practitioners in this program** may contribute to job creation for youth.

PROGRESS AND IMPACTS

- In twelve districts in Ethiopia, including in Menz, Horro, Bonga, Doyogena, Konso and Abergelle, **6,000 households** benefited from, or were exposed to, services provided by reproductive platforms.
- **Technical guidelines** for adapted reproductive biotechnologies of sheep and goats are drafted and are ready for dissemination.
- To **ensure the process is simple, cheap and accessible**, sheep and goat synchronization protocols rely on the use of prostaglandins, which have now been registered in Ethiopia and are available on the market. Using a simple protocol of two injections of a prostaglandin analogue (Enzaprost), 11 days apart, increases fertility up to 89% in natural mating conditions and up to 60.8% using AI, and allows fixed time AI. The champion synchronization protocol costs USD 1.30 vs. USD 8.50 when using the conventional protocol.
- The AI program achieved **conception rates of up to 50-60%** in large field trials, as well as improvements in overall fertility in target flocks and increased number of offspring produced by the CBBP flocks as a result of better management practices.
- The approach developed in Ethiopia **has low infrastructure needs**, is applicable to both sheep and goats and most regional research centers in the country have the basic equipment needed to undertake the work.
- The **process of certification of rams** is now part of the routine work of the official services of the Ministry of Agriculture because the use of elite rams in the AI program prompted the need for prior certification.
- The **network of laboratories**—representing a co-investment between ICARDA and its Ethiopian partners and supported by an important capacity development and training program—is **unique in Africa**. It offers scheduled natural mating plans, estrus synchronization, fixed-time AI and pregnancy diagnosis. It also optimizes fertility through focused management interventions.
- **Scaling of the program** is underway in Ethiopia and the program was piloted in other countries in Africa such as Tanzania and Sudan.

BUILDING LOCAL CAPACITY FOR EXPERTISE AND AUTONOMY

In addition to the co-investment in infrastructure, ICARDA has extensively invested in human capacity development with 300 staff (44 females) benefitting from short-term trainings and six staff from degree level trainings (one PhD and five Msc). This effort contributed to having seven expert teams in seven sites performing at least four different reproductive interventions and services. This in-house capacity was successfully tested under the COVID-19 pandemic when all sites maintained their field activities by relying solely on these locally trained staff. Moreover, it was possible to expand to new communities/villages and new staff were recruited to implement all the segments leading to AI after receiving training and knowledge from the initially trained groups.



Photo: ILRI/Apollo Habtamu

Improved sheep and goats have the potential to be more productive, providing not only better livelihoods for livestock farmers but also better and more meat and milk.

CRITICAL FACTORS OF SUCCESS

Based on the experience and lessons learned from the implementation of the reproductive platform in Ethiopia, critical factors for success were identified as follows:

- **Investment** in some specific equipment is needed, such as a spectrophotometers and insemination gun. Most regional research centers in the country should have the **basic equipment** including a microscope and a water bath.
- **Capacity development** of the different actors in the animal husbandry sector is essential.
- **Synchronization products** available in the market should be simple, cheap and accessible.
- The approach developed in Ethiopia is **valid for both sheep and goats**, though when scaling up and out into other regions, implementers must **consider and adapt the approach** to the local environments, breed requirements and objectives of the communities.

IMPLICATIONS AND RECOMMENDATIONS

- To ensure impact, reproductive platforms need to be scaled up and this should be a priority for the regional and federal governments
- Transforming subsistence sheep and goat production into market-oriented businesses is crucial. The private sector, including farmer cooperatives, veterinary drug suppliers, feed processors and traders, could play a role in the provision of inputs and services to support breeding programmes and

the related reproductive technologies. However, government incentives are needed to attract the private sector to invest in this area including tax exemption on inputs for specific period, access to credit facilities and access to land.

- Linkages should also be sought with large investment projects focused on interventions in the sheep and goat improvement sector.

Related publications and references

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Partners



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Cover photo: Access to better breeds of sheep and goats in Ethiopia are providing greater livelihood opportunities for small ruminant farmers like Alemitu Shigato-pictured here with one of her ewes in Bonga, Ethiopia.