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LIVESTOCK GENETICS | ULTRASOUND TO DIAGNOSE PREGNANCY AND REPRODUCTIVE DISORDERS IN SHEEP AND GOATS

KEY MESSAGES

- Ultrasound-based solutions fit into the broader concept of clean, green management of sheep and goats' reproduction, and the solutions are effective in managing reproduction.
- Ultrasound-based solutions are available as easy-use, high resolution, portable machines; with prices decreasing they are more accessible to suit even the most extensive, low input systems.
- In addition to screening for pregnant females and determining litter size, ultrasound-based solutions can be used to:
 - Check on repeat breeders
 - Check on females with recent reproductive pathologies
 - Remove pregnant females prior to synchronization and artificial insemination (AI)
 - Prevent slaughter of pregnant females

CONTEXT AND PROBLEM

Ethiopia has one of the largest livestock populations in Africa. Livestock hold a high cultural value within communities and not only provides a source of food (meat and milk) and income generation including through the sale of milk, wool and manure, but also acts as insurance for farmers against crop failure. Despite the growing demand for animal products, the productivity of livestock (sheep and goats) is considered low. This is due to a depressed fertility rate under a crop-livestock farming system, poor management of animal's health and seasonal fluctuations of feed resources. Reproduction is critical for the attainment of profitability, and reproductive parameters such as fertility, lambing rate, prolificacy are very important for a successful animal production program. Reproductive failure leads to lower economic opportunities for the farmer. Other major reproductive-related problems that are economically important for smallholders include infertility, delayed puberty and first conception, extended postpartum anestrus and postnatal mortality.

With the increased availability of portable ultrasound machines—which are easy-to-use, high resolution and have a high reliability of diagnosis as early as 30 days of

pregnancy—pregnancy diagnosis was adopted as a low-tech tool to improve livestock productivity in extensive and low input systems.

THE INNOVATION

Pregnancy diagnosis through a transabdominal ultrasound scan is a practical and efficient approach for monitoring pregnancy and fetal growth in small ruminants. The main criteria for positive diagnosis of pregnancy in sheep is the visualization of an anechoic cross section of the uterine lumen (embryonic vesicle), embryo fetus or placentomes in the amniotic fluid. The fetus appears as an echogenic structure inside a non-echogenic structure.

This early identification of pregnancy is a method to improve flock fertility and a tool for identification of efficacy of AI or synchronization protocols. The ultrasound also allows detection of some uterine pathologies and abnormalities. Management decisions are closely related to the pregnancy status of an animal and farmers are able to (i) adjust nutrition levels for fetal demands and mammary growth; (ii) better manage the vaccination schedule and administration of drugs; and (iii) prepare the lambing environment. Transabdominal ultrasound diagnosis in sheep ranges from 25 to 110 days of gestation and the optimum time for detecting pregnancy is from 45 to 90 days of gestation.

Animals should not be given food and water for 12 hours prior to scanning. After preparing the ultrasound scanner equipment with a 3.5 MHz probe, animals are lightly restrained against a railing in a standing position ready for examination. Scanning is performed in the inguinal region of the animal and ultrasound coupling gel is applied each time to the probe to develop good contact and to remove air between the probe and the skin.

When pregnancy is diagnosed early, reproduction performance is improved by decreasing the interval between successive pregnancies and by coupling a non-pregnancy diagnosis with an appropriate strategy to rapidly rebreed the animal (e.g. nutritional boost and hormone therapy). Pregnancy diagnosis allows a determination of the number of fetuses and enables separation of animals carrying twins or triplets to ensure they get additional nutrients. Finally, early pregnancy diagnosis allows an estimation of fetal age, monitoring of fetal growth and diagnosis of pregnancy disorders that are all key considerations to prepare for the lambing environment.

The information generated by pregnancy diagnosis can be crucial to take timely decisions with regards to:

- Opportunity for re-mating
- Screening against non-fertile females and females that are reproductively problematic by spotting them for culling
- Planning conditions for birth
- Discarding pregnant females prior to synchronization and AI, particularly when the synchronization protocols rely on the use of prostaglandin analogues
- Preventing the slaughter of pregnant females which may be common under some circumstances



Photo ICARDA

Pregnancy diagnosis of goats in Tanzania, using ultrasound equipment similar to the ones adopted in Ethiopia.



Photo ICARDA

A small ruminant fetus with the head and a front leg clearly visible, taken at 50-60 days of gestation.



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ICARDA's pregnancy diagnosis team.

THE DRIVERS OF THE INNOVATION

- Barren or non-productive females negatively impact the environment because they contribute to overgrazing and produce more greenhouse gas per unit of production. Pregnancy diagnosis responds to the challenge of fitter reproduction and a less preponderant environmental "hoofprint".
- Ultrasound-based solutions do not contravene environmental priorities and allow an increase of reproductive efficiency while using clean, green, non-invasive and non-hormonal practices.
- Control over reproductive events is the first step to match demanding physiological stages with feed abundance. It helps farmers plan to maximize females giving birth, and growth of newborn lambs and kids, during the best seasons in terms of natural feed supply and meteorological conditions. Routine ultrasound pregnancy diagnosis - together with other tools and technologies - will contribute achieving this objective.
- The use of new technologies may be appealing for young private veterinarians to broaden their business spectrum and adopt modern tools and technologies.

PROGRESS SO FAR AND IMPACTS

- Pregnancy diagnosis tools are used in many regions in Ethiopia.
- A field guide for transabdominal pregnancy diagnosis in sheep and goats has been developed.
- A core team, with advanced field expertise in sheep and goat pregnancy diagnosis, is operational in all CBBP sites in Ethiopia.
- In 2014, ICARDA started screening the international market for cost-effective, user-friendly ultrasound machines and purchased machines.

- Between 2014 and 2015, ultrasound-based solutions for the management of reproduction and reproductive disorders in sheep and goats were initiated in three sites (Menz, Bonga, Doyogena), and then expanded to eight CBBP sheep and goats sites.
- ICARDA expanded this program to include Awassi sheep in agro-pastoral systems of Jordan, Karakul sheep in Aral Sea, Angora goats in Fergana Valley and Sudan Desert sheep in Sudan.
- Core teams of national technical staff (veterinarians and animal production specialists) were trained on machine use, interpretation of ultrasound images, data enhancement in Ethiopia and the reliability of the diagnosis now exceeds 95%.
- Well trained veterinarians and livestock technicians are able to handle a large number of animals (over 200 females in a single day)
- The outcomes of the diagnosis are shared and discussed with farmers to advise on culling of unproductive animals or to develop supplementation strategies to match requirements of animals (barren animals, single fetus bearing females and multi-bearing females).

CRITICAL FACTORS OF SUCCESS

Based on the experience of the use of pregnancy diagnosis tools in Ethiopia, critical factors for the success were identified:

- **Knowledge and skills** are the main resources required. Expertise and equipment is needed to help rapid development and adoption of the technology for animal farming that will result in improved fetus age estimation and viability.
- An **initial cash investment** is needed to buy the machine.
- The technology is most **suited for private veterinarians** who can develop ultrasound service provision, in addition to other health services, for a small fee.

IMPLICATIONS AND RECOMMENDATIONS

- The development of ultrasound-based service for pregnancy diagnosis should gradually be taken up by private veterinarians.
- Investment is not huge and therefore funding remains within the scope of existing mechanisms of microfinance.
- ICARDA and its research partners will invest in sensitization campaigns backed by local enumerators who are trusted by the farmers and have easy access to their production data.
- ICARDA will continue its mission to increase the technical capability of the research staff and to expand the trainings to private veterinarians willing to expand their business towards units for pregnancy diagnosis.



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Twin lambs in in Doyogena.

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Partners

The SmaRT-Ethiopia project is led by ICARDA in close collaboration with ILRI, Ethiopian NARS and other international partners.



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Cover caption: Widespread use of portable ultrasound machines—which are easy-to-use, high resolution and have a high reliability of diagnosis as early as 30 days of pregnancy—can help communities adopt better breeding practices and optimize the reproductive value of their animals.