Irradiated animal vaccines keep Ethiopia's animals healthy, helping exports and food security

By Miklos Gaspar

Cattle are an important part of Ethiopia's economy.
(Photo: M. Gaspar/IAEA)

Ethiopia exports over one million cattle per year, a number which would not be possible without nuclear techniques. To prevent epidemics, all livestock destined for export, as well as domestic consumption, need to be vaccinated against animal diseases. In Ethiopia, vaccines are developed and produced at the National Veterinary Institute (NVI). These vaccines are developed to fight evolving pathogens and then produced for use both domestically and in neighbouring countries. The IAEA, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), supports both stages of the process.

"Livestock exports are vital to our economy, and the contribution of the NVI to the livestock sector is immeasurable," said Wondemagegn Tufa, a Director at Ethiopia's Ministry of Agriculture in charge of ensuring export procedures for cattle. The Ministry buys vaccines from the NVI and then distributes them among farmers, including pastoralists in the eastern part of the country whose animals are most at risk of exposure to disease, given that they roam across a large area and mingle with wild animals.

With 60 million cattle, Ethiopia has the largest livestock population in Africa and the fifth largest in the world, according to the World Bank. The livestock sector accounts for around one-fifth of the country's economy and close to 10% of its exports.

To keep up with both increasing demand from farmers and the changing regulations of importing countries, the NVI has increased its vaccine production from 93 million doses to 260 million doses per year over the last decade. This has also enabled the export of vaccines to neighbouring countries, including those vaccines that prevent *peste des petits ruminants*, a viral disease of goats and sheep, the eradication of which is a major goal of the African Union.

Vaccines and how they work

The availability of and access to effective vaccines is vital for controlling and preventing the spread of many animal diseases, some of which can also spread to humans. Vaccines work the same way in animals as they do in humans, by activating an immunological response that helps the body prepare to fight off a future disease. However, some vaccinations use live microorganisms, like viruses, which could lead to an eruption of the disease. Radiation can help to address this by inactivating a microorganism so that it cannot infect the vaccinated animal. At the same time, radiation does not affect the microorganism's structure, so the immune system can still recognize it, allowing the animal to develop a protection mechanism. The irradiation of vaccines also ensures that the vaccines do not contain any contamination.

Using irradiation technology to develop vaccines is safer for the animals because it does not require additional chemicals or other compounds that are traditionally used for deactivating viruses. "These irradiated vaccines are of a higher quality because they better preserve the structure of the microorganism, which results in a broader immune protective response," said Charles Lamien, an Animal Health Officer at the Joint FAO/IAEA Division of Nuclear Techniques for Food and Agriculture.

Through its technical cooperation programme and in partnership with the FAO, the IAEA supports the NVI in staff training and in the supply of consumables and equipment. All technical staff in the NVI's Research and Development Department have benefitted from training by the FAO and IAEA. "Whether through short courses or longer fellowships, they have all been exposed to cutting edge science," said Martha Yami, Director General of the NVI.

Vaccine development

The IAEA played a pivotal role in establishing the NVI's molecular laboratory, where new strains of viruses are characterized so that vaccines can be adjusted to provide protection against them, Yami said.

This characterization of the viruses' deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) is carried out using nuclear-derived molecular techniques, which can reveal the differences between strains. This technology is used to compare the wild virus from an outbreak with the vaccine itself, and, if they are closely related, the vaccine will provide the required protection. If they are not, the vaccine needs to be modified.

The IAEA now relies on the NVI's experts to train scientists from across Africa in the use of various nuclear techniques in animal health, Lamien said. "Animals, and with them the diseases they carry, cross borders," he said. "Therefore, a continent-wide approach is required to fight these diseases."

Beyond dollars and cents

The impact of this work is visible across Ethiopia, where cattle roam on hillsides, pastures and roads. Many of the country's 12 million farming households depend on cattle and therefore benefit from nuclear technology, whether they know it or not.

"The importance of cattle and their health is more than just economic," said Tufa. "Cattle are a way of life for pastoralists. They are central to the culture and function as a storage of wealth and as insurance to use in times of hardship." Improving the health and well-being of these animals and increasing their productivity is a key development objective of the Government, he added.

A scientist at the National Veterinary Institute researching the genetic make-up of a virus.
(Photo: M. Gaspar/IAEA)