African researchers use gene editing and other tools to breed heartier livestock

Livestock researchers in Africa are looking to genome editing and other new technologies to identify genes that could help them tame the spread of a parasite that spreads sleeping sickness in animals and humans.

In addition to work aimed at eradicating African trypanosomiasis, scientists at the International Livestock Research Institute (ILRI) in Nairobi are using gene editing to introduce such desirable traits as heat tolerance and disease resistance into cattle and chickens, said Prof. Steve Kemp, program leader in livestock genetics at ILRI. However, he said the effort is still at the preliminary research stage.

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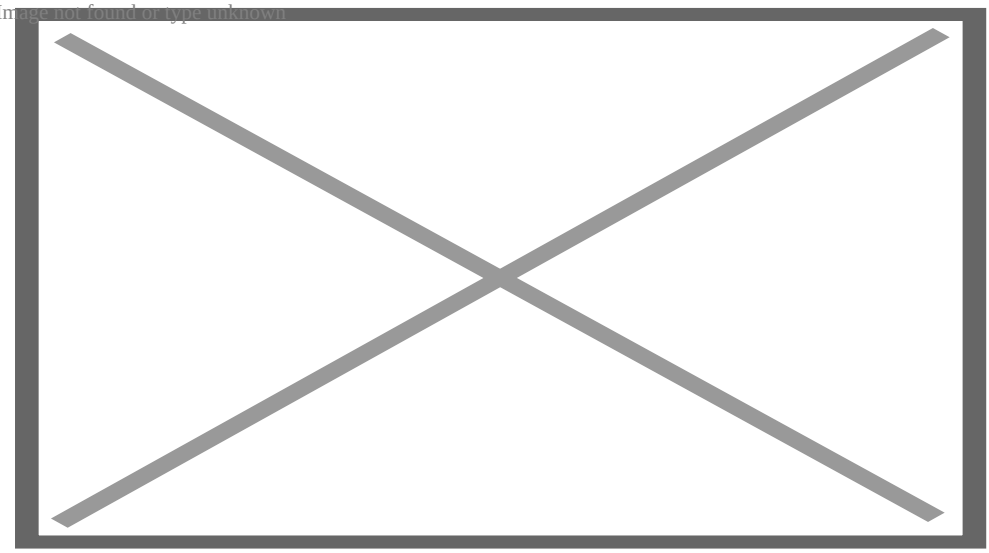

Steve Kemp. Credit: ILRI

African animal trypanosomiasis is a parasitic disease that causes serious livestock losses due to anemia and lower reproduction rates, according to the Center for Food Security and Public Health. Losses in cattle are especially prominent, though other animals, including dogs, can also be affected. Untreated cases can be fatal, and the mortality rate is high in some outbreaks.

“Eradicating African animal trypanosomiasis is extremely important as we estimate that Africa loses US$1 billion annually due to human and livestock diseases,” Kemp said.

The people keeping livestock have experienced huge losses due to animal diseases, said Abdikadir Mohamed, chief executive officer of the Kenya Livestock Marketing Council (KLMC). “This leads to people getting poorer. Some sickly animals are rejected during market days, yet they come from far to sell the livestock. There is also a security threat as herders go back with their livestock. We need to stop these persistent diseases by available technologies.”

This past July, the World Bank released a report titled Meat, milk and more: Policy innovations to shepherd inclusive and sustainable livestock systems in Africa, which found that African producers will be

unable to satisfy the growing demand for livestock products and may need to import about 20 percent of their animal-source foods, such as milk, beef and poultry, by 2050 if the continent does not employ policy innovations to spearhead inclusive and sustainable livestock systems.

Constraints to livestock production in Africa are complex and vary from place to place. For instance, feed availability and genetic quality are important, but so are diseases and adaptation to heat and drought. All of these factors interact with and influence profitability, which in turn depends on many external factors, especially access to market, Kemp told the Alliance for Science.

However, genetic improvement is one consistent thread that researchers are pursuing, although it is not done through the use of just one tool, Kemp explained. Researchers are working with farmers and breeders to improve access to appropriate genetics and help farmers to identify bulls and cows that will be profitable for particular farms.

“Genome editing is a longer-term study to look at ways of addressing particularly severe constraints, such as major diseases,” he said. “If successful, this will then be rolled into a multi-faceted improvement program that includes feed, AI [artificial insemination] availability, management and market development.”

“However, establishing trust is key to regulatory progress and the eventual adoption and understanding of genome edited livestock,” Kemp added.

ILRI’s application to use gene editing to confer resistance to African trypanosomiasis in an indigenous goat species (*Capra hircus*) was approved by Kenya’s National Biosafety Authority (NBA) after a thorough risk assessment that determined the risk management measures put in place were acceptable, according to Prof. Dorrington Ogoyi, the agency’s chief executive officer.

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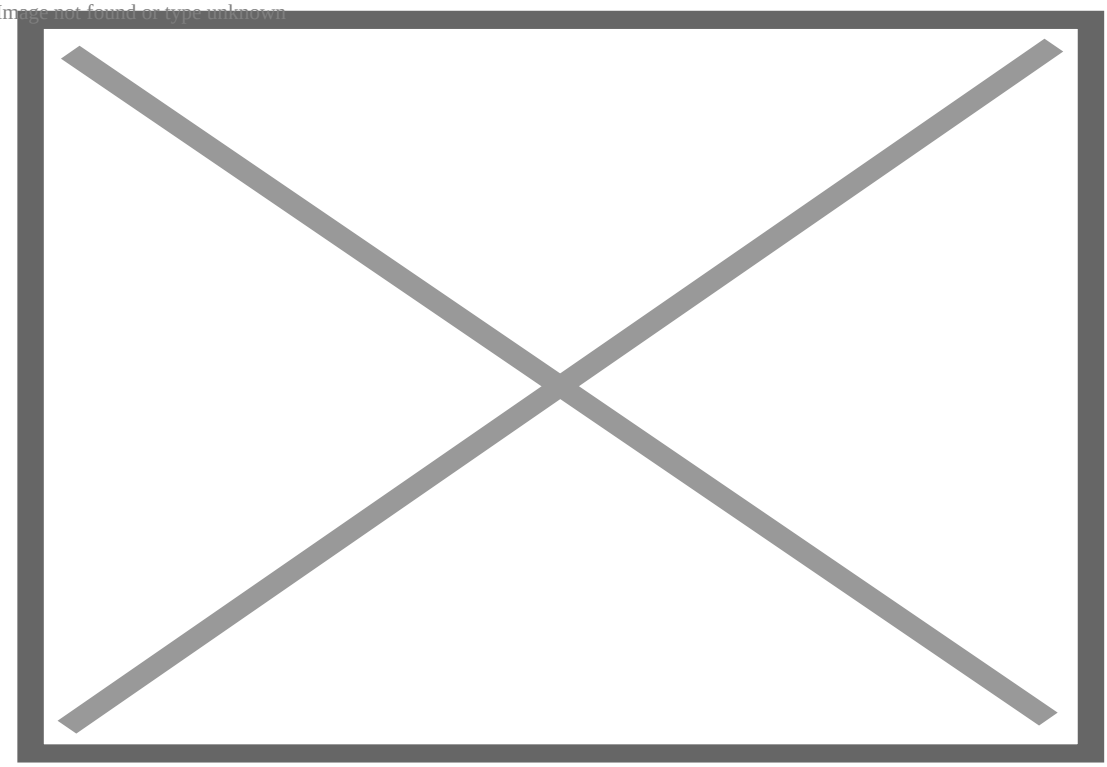

Capra hircus. Credit: Scott Bauer

Even if the research proves successful, it will be a logistical challenge to introduce improved livestock genetics to farmers with small herds given that farms are typically scattered across arid and semi-arid areas where artificial insemination currently is not working very well.

But ILRI scientists are also using genome editing to research technologies that might facilitate distribution of improved genetics, such as using surrogate sires to support genetic improvement in smallholder settings, Kemp said.

“You can make thousands of recipients from one elite and they will pass on sperm from the donor to small herds,” he explained. “Indigenous germline ablated bucks carry the sperm of ‘elite’ bucks. Instead of having one elite buck, we would have thousands. This provides a transformative step to disseminate ‘elite’ semen without changing the existing infrastructure.”

Ever since agriculture emerged, nature or people have worked with diversity to modify phenotypes both within and across species, Kemp said. Therefore, agricultural improvements are driven by diversity. “There has been no systematic search for the genomic basis of adaptation. Because until now, we have had no validation tools and no delivery tools. But new genome editing tools could change the landscape.”

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Scientists are using other advanced biotechnology applications to help smallholder farmers conserve poultry systems in Kenya and Tanzania. Kemp said. They are rolling out an improved transfer of genetics that focuses on indigenous varieties of chickens, ducks, geese and pigeons that are highly adaptive to low diets and tolerant of diseases.

“It would be a tragedy if they were lost. Therefore, as we improve the smallholder production system, we back up the existing diversity. This is done through the biobanking technique that cultures chicken primordial germ cells.’’

That project is being implemented through collaboration with African Union-based gene banks and the African Union Inter-African Bureau for Animal Resources (AU-IBAR).

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