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Improving livestock genetics to enhance animal welfare and production for African smallholder farmers

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Title:

The Centre for Tropical Livestock Genetics and Health (CTLGH) at the Royal (Dick) School of Veterinary Studies, University of Edinburgh: Improving livestock genetics to enhance animal welfare and production for African smallholder farmers.

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Text:

Animal production in low- and middle-income countries (LMICs), predominantly smallholder systems, faces considerable challenges. Low productivity, exposure to multiple pathogens, and climate-related abiotic stresses all cause major animal health and welfare issues. Unless addressed these challenges will continue to negate initiatives aiming for sustainable LMIC animal production. To address this, the Roslin Institute of the Royal (Dick) School of Veterinary Studies jointly established CTLGH with partners in Nairobi and Edinburgh (<https://wwwctlgh.org/>) to apply genetic improvement for improved animal productivity, health and welfare in LMICs.

CTLGH aims to apply to LMIC livestock production the advances in genetics, genomics, animal breeding and data science driving livestock genetic progress in advanced economies, in partnership with a global network of farmer-facing organisations. A priority has been improving genetics to enhance resilience to infection, thereby improving animal welfare and production. Research has targeted establishing the genetic basis of tolerance to key cattle and chicken diseases, and assessing the applicability of such traits to improvement through selective breeding or via gene editing.

Key CTLGH advances include tolerance to East Coast fever (ECF) and to ticks. ECF is caused by the protozoan *Theileria parva*, and annually kills ~1 million cattle in Eastern Africa. Research identified a lineage of cattle that were significantly less likely to die from an infection challenge that killed most susceptible counterparts. Analyses identified the genomic region containing DNA variants conferring this tolerance; this is now a tool for predicting cattle tolerance. Work continues to identify the causative variant, which would enable approaches like improved marker assisted selection or gene editing. For ticks, which are both pathogens and vectors of pathogens, CTLGH has united global efforts to identify the genetic basis of resilience, resulting in the identification of genomic regions that are amenable to breed improvement through genomic selection.

A further key need is field-applicable disease monitoring tools, ideally usable by veterinarians and farmers. CTLGH research has developed high-throughput diagnostic tools that capture the spectrum of pathogens infecting African and Asian cattle and chicken. This has focused on vector-borne pathogens and gastrointestinal helminths. These tools generate currently missing data on what the most important pathogens are, and provide a platform for developing truly field-applicable diagnostics.

To address ongoing biodiversity loss challenges, CTLGH has developed stem cell innovations coupled with advanced reproductive technologies, to enable preservation through biobanking

and resurrection of endangered poultry genetic resources. This safeguards poultry genetic resources, ensuring future breed improvement to address climate-related and other challenges that compromise adaptation, resilience, health and welfare in LMIC poultry production systems.

Therefore, since its establishment CTLGH has demonstrated the potential of novel strategies to mitigate the impact of disease through genetic improvement and informed breeding strategies. CTLGH continues to invest in genetic approaches to tackle animal health and welfare, focusing on the most important pathogens of LMIC ruminants, poultry and pigs. The integration of cutting-edge research with LMIC farmer-facing programmes is a critical route to achieving the planned impact of reducing disease burden, and enhancing animal welfare and production in this globally important sector.