Corporate Report

2016–2017

International Livestock Research Institute

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ILRI would also like to thank all those who contributed to the realization of this report.

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better lives through livestock

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ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa

Contents

Goat lives and livelihoods in Mayurbhanj, Odisha, India (photo credit: ILRI/Susan MacMillan)

Foreword

Rapidly rising demand for milk, meat and eggs in low- and middle-income countries is opening up big new opportunities to establish and grow businesses and create jobs. This demand is being driven by rapid population growth, higher incomes and urbanization. With a view to ending poverty, protecting the planet and ensuring prosperity for all, in 2015, the international community adopted the United Nations Sustainable Development Goals (SDGs). Helping to ensure that hundreds of millions of poor small-scale livestock farmers, processors and marketers, many of whom are women, benefit from these opportunities will be crucial to achieving many of these goals.

The consumption of small amounts of livestock food products provides essential nutrients that contribute to food and nutritional security. Introducing some animal-source foods—just a glass of milk or an egg a day—into the diets of children would improve their physical and cognitive development. Improving livestock production practices in low- and middle-income countries could significantly increase productivity in the sector as well as cut emissions in livestock-related greenhouse gases by up to 30%.

Rapid change in livestock systems, however, poses a range of environmental, health and equity challenges across the highly heterogeneous livestock production systems worldwide. Some production systems need fewer farmers capable of producing more animal-source foods in ways that mitigate the environmental and public health risks of livestock production. In more fragile livestock systems, the emphasis needs to be on enhancing the important role farm animals play in increasing the resilience of people, communities and environments to variability in weather, markets or resource demands. This diversity of needs and endowments will require a range of development responses to feed and sustain our planet into the future. The International Livestock Research Institute (ILRI) works closely with national and international research, private-sector, government and non-governmental organizations in providing evidence to decision-makers, facilitating the adoption at scale of science-based livestock practices and building capacities of key stakeholders. In furthering better lives through livestock, the outcomes of our research-for-development approach—the scientific evidence, proven technologies and development pathways—directly contribute to meeting the SDGs.

This report provides examples of how ILRI and its many partners are helping to meet specific SDGs. These include: reduced incidence and impact of livestock diseases; increased household incomes; improved food safety; greater gender equity and inclusive growth; climate-smart as well as more productive livestock; mitigation of livestock-generated greenhouse gas emissions; and enabling policies and partnerships for a healthy, safe, sustainable and equitable livestock sector.

Our work demonstrates that targeted investment in sustainable livestock research for development can provide much more food to nourish the world's rapidly growing population. It can enhance the efficiency of livestock and related value chains, produce large employment opportunities, particularly for women and young people, and drive inclusive economic growth. Importantly, such investment—intellectual, political and financial—is essential to strengthening the resilience of developing-country peoples and conserving the natural resources upon which their wellbeing, and that of all people and the planet, depend.

Jimmy Smith
Director general of ILRI

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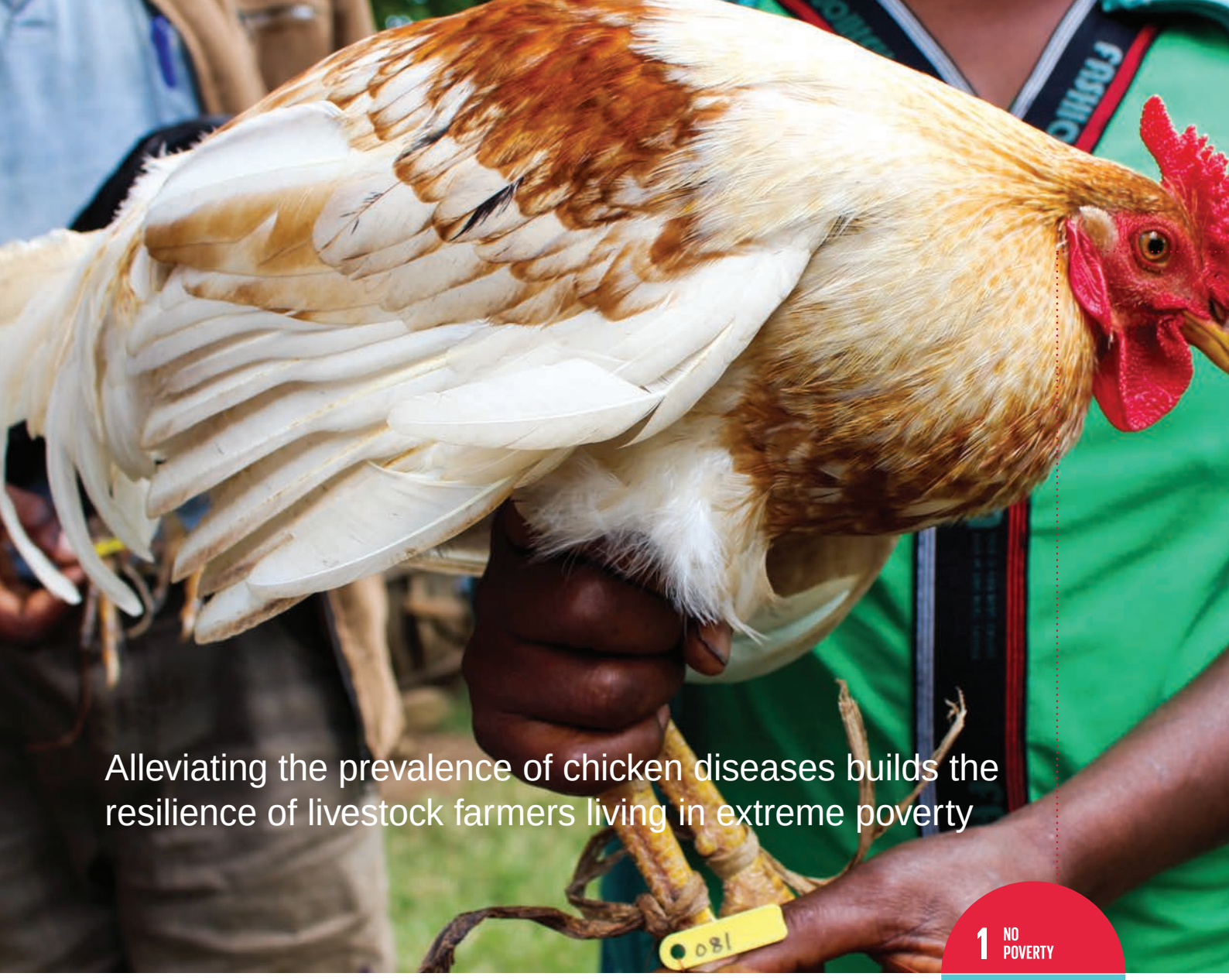
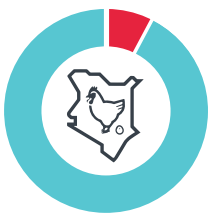
Chair of the ILRI Board of Trustees



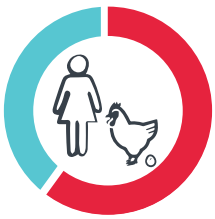
Alleviating the prevalence of chicken diseases builds the resilience of livestock farmers living in extreme poverty

1 NO POVERTY

Poultry sector in Kenya



contributes to 8% of GDP



>60%
of poultry businesses run by women

>50%
of poultry producers are smallholders

Improving control of a chicken disease supports the livelihoods of Kenya's women

Women play critical roles in the small-scale livestock systems that remain ubiquitous in the developing world. While these women typically face severe inequities in being able to own or even access land, capital and other productive resources, they often own or at least manage their household's farm animals, particularly chickens and other small stock. Requiring little space and start-up capital, poultry farming in Kenya is growing rapidly and remains largely dominated by women, who typically invest most of their earnings in feeding their families and educating their children. That is why controlling major poultry diseases, which can wipe out whole flocks, is so important.

Infectious bursal disease is an acute, highly contagious, viral disease of young chickens. The bursa is a specialized organ in birds, located at the hindgut, necessary for development of the immune system's B cells. The disease causes small-scale poultry farmers huge economic losses, both from the many birds that die outright and from lost productivity among surviving birds. Suffering from immunosuppression, surviving chickens become susceptible to other diseases and do not respond well to vaccination. In the last five years, infectious bursal disease has been detected among vaccinated chickens, causing frustration among farmers. The disease has forced many Kenyan farmers out of the poultry business altogether, seriously damaging their livelihoods.

To understand why vaccinated birds were getting the disease, Jane Githinji, head of the virology laboratory at the Central Veterinary Laboratory in Kenya's Directorate of Veterinary Services, needed advanced DNA sequencing and bioinformatics platforms to compare the molecular makeup of the circulating virus strains causing infectious bursal disease in Kenya with the ones used in the commercial vaccines. In December 2015, she was awarded an African Biosciences Challenge Fund research fellowship at the Biosciences eastern and central Africa-International Livestock Research Institute (BecA-ILRI) Hub, one of the few advanced facilities on the continent supporting African and other institutions conducting research on agricultural productivity, food safety and nutritional security. Over the next 12 months, Githinji gained access to technologies, received training and, most of all, support from an international community of bioscientific expertise.

Working closely with scientists from ILRI and the University of Nairobi, Githinji found that some of the virus strains in Kenya's bird populations were far more genetically diverse than previously believed. During her genetic analysis of the virus strains, the first molecular characterization of the infectious bursal disease in Kenya, Githinji also discovered unique amino acids in some of them. Using a technique known as reverse transcription polymerase chain reaction to replicate a DNA segment from the virus, Githinji designed a diagnostic tool with which to characterize and detect virus variants. While further research is needed to verify the efficacy of existing vaccines, this breakthrough allows for more effective tests for infectious bursal disease.

The Directorate of Veterinary Services—responsible for animal health policy formulation and regulation in Kenya—will now be able to use the findings to develop improved vaccination, surveillance and control strategies for infectious bursal disease, such as procedures for virus diagnosis. For instance, if deployed at border inspection posts, the tool would help prevent the importation of infected chickens. Githinji also plans to share the knowledge and methodological approaches acquired at the BecA-ILRI Hub with her colleagues as is it also applicable to the study of other livestock diseases.

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Investors: Bill & Melinda Gates Foundation; Commonwealth Scientific and Industrial Research Organisation; Department for International Development, United Kingdom; Swedish International Development Cooperation Agency; Syngenta Foundation for Sustainable Agriculture

ILRI program: Biosciences eastern and central Africa-ILRI Hub

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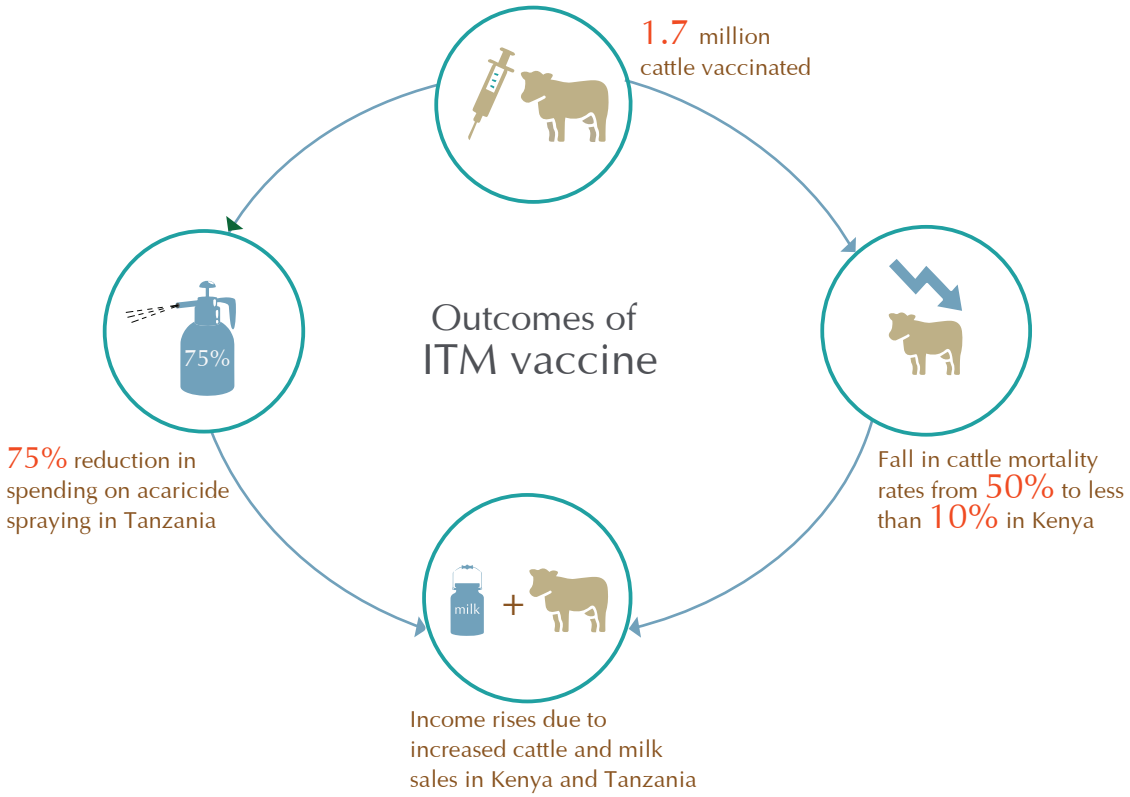
Associated CGIAR Research Program: Livestock

Combating food insecurity and malnutrition through research to raise livestock productivity levels

2 ZERO HUNGER



Vaccinating farm animals helps drive up disposable incomes of smallholders in Kenya and Tanzania

Wide-scale vaccination of cattle against East Coast fever would remove one of the biggest obstacles facing smallholders and herders trying to increase their meat and milk productivity. Endemic in 12 countries in eastern, central and southern Africa, the disease, transmitted by parasite-infected ticks, causes annual losses estimated at more than USD300 million and more than one million cattle deaths. While the vaccine was developed in the 1970s by the now Kenya Agricultural and Livestock Research Organization (KALRO), recent research-for-development approaches have accelerated its uptake and demonstrated how its use is driving increased incomes for small-scale livestock farmers in Kenya and Tanzania.

The vaccine, employing what is known as the 'infection and treatment method', involves infecting cattle with a 'cocktail' of live parasites and simultaneously treating them with a long-lasting antibiotic. This 'live vaccine' method generates life-long immunity to East Coast fever. Expensive, time consuming and difficult to produce on a large scale, it was not until 1996 that the first commercial batch was released by the International Livestock Research Institute (ILRI). While ILRI produced another batch in 2008, uptake was slower than expected, with only 400,000 vaccinations by 2012.

With a range of donors, a consortium of organizations set out to enhance access to the vaccine among livestock keepers in Kenya and Tanzania. ILRI has worked closely with the Global Alliance for Livestock Veterinary Medicines (GALVmed) to provide training and other support to livestock vaccinators, who in turn have immunized approximately another 1.3 million cattle against East Coast fever in both smallholder dairy and pastoral farming systems since 2012. With demand rising rapidly, ILRI and GALVmed supported the Malawi-based African Union Centre for Ticks and Tick-borne Diseases in producing two more batches. GALVmed expects a further one million cattle will be vaccinated by the end of 2018.

ILRI-led research in Kenya with 250 cattle keepers, vaccine distributors and veterinary staff found that vaccination against East Coast fever has led to a significant drop in cattle deaths, from 50% of cattle in affected herds to less than 10%, as well as to reduced household expenditure on regular acaricide spraying (anti-parasitic treatment) to keep the animals free of ticks. Healthier vaccinated animals produced more milk, fetched higher market prices and displayed increased immunity against other infections. The money and time saved on tick spraying allowed women to increase spending on household essentials (clothing, food, health, education) and to participate in women's credit cooperatives.

In Tanzania, a study on the impacts of the use of this vaccine found that 167 small-scale farmers who had vaccinated their animals reduced expenditure on acaricide spraying by 75%. Other benefits reported included increased milk yields, reduced water usage, increased manure with which to fertilize croplands and better traction for pulling ploughs and carts from healthier animals.

Scientists, including ILRI and partner researchers, have taken a two-pronged approach to East Coast fever vaccine deployment and development; both have made substantial progress. The first approach focuses on decreasing wastage by reducing the number of doses per vaccination straw from 40 to 10. Once thawed and diluted, each straw needs to be used within four hours or discarded. This can be challenging as small-scale farmers have few animals. By reducing wastage, this method is expected to drive down the cost of vaccination per animal. The second approach harnesses the latest advances in biotechnology to develop proof-of-concept for a next-generation vaccine based on parasite molecules rather than live parasites, which should make it safer, cheaper and easier to manufacture and administer.

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Partners: African Union Centre for Ticks and Tick-borne Diseases; African Union-Interafrican Bureau for Animal Resources; African Union Panafrican Veterinary Vaccine Centre; Animal Disease Research Unit, United States Department of Agriculture; Dulle Veterinary Centre; Food and Agriculture Organization of the United Nations; GALVmed; Institute for Genome Sciences, University of Maryland; Institute of Tropical Medicine, Belgium; Jenner Institute, University of Oxford; KALRO; Pharmavacs; Ronheam International Tanzania; Roslin Institute, University of Edinburgh; Royal Veterinary College; Scotland's Rural College; University of Copenhagen; University of San Martín, Buenos Aires; University of Toronto; University of Washington; Vetlife Consultants; Sidai Africa; VetAgro Tanzania; VetAid Kenya; Veterinary Council of Tanzania; Washington State University, Pullman

Investors: Bill & Melinda Gates Foundation; CGIAR Research Program on Livestock; Department for International Development, United Kingdom; United States Agency for International Development; United States Department of Agriculture

ILRI programs: Animal and Human Health; Policies, Institutions and Livelihoods

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Associated CGIAR Research Program: Livestock

Enhancing food safety through the implementation of early warning and risk reduction systems

3 GOOD HEALTH AND WELL-BEING

Better pork food safety policies enhance nutritional security and livelihoods in Vietnam

Protecting the importance of pork to well-being in Vietnam

Principle source of protein: 75% meat consumed

83% produced by smallholders and sold in informal markets

65% rural households depend on pig farming for livelihoods

Translating food safety research into policy action in Vietnam

The agri-food sector, particularly livestock, plays an important role in the economy, livelihoods and nutritional security of Vietnamese people. Regular consumption of pork makes it an integral part of Vietnam's diverse and rich culinary tradition. Typically eaten daily with steamed rice and vegetables, pork is an affordable as well as favourite protein source, accounting for 40% of household expenditure and 75% of the meat consumed. More than 83% of pork is produced by small-scale farmers and sold in traditional fresh-food markets, and 65% of rural households depend on pig farming for their livelihoods.

Rising urbanization and a growing middle class have driven changes in dietary patterns, leading to increased pork consumption. In recent years, the Vietnamese government has acknowledged scope for evidence-based decision-making in reducing the prevalence of food-borne disease in traditional markets. Improved safety in the food supply chain has the potential not only to protect the health and welfare of poor livestock producers, sellers and consumers, but also to grow the economy through the increased competitiveness of Vietnam's food products and the opening of premium markets. Conversely, food safety hazards—or perceptions thereof—impose a significant economic burden, impeding value chain development and exports.

In 2013, scientists at the International Livestock Research Institute (ILRI) teamed up with national and international partners to establish the Vietnamese National Taskforce of Food Safety Risk Assessment. The taskforce conducted a series of cutting-edge studies on risk assessment and the cost of illness and, based on the findings, developed guidelines and support materials to enhance food safety in pork value chains. These materials have been used in assisting key ministry officials and researchers to bring risk-based approaches to food safety management. For instance, national researchers have used the materials and ILRI training to undertake risk assessment of food safety in pig value chains in Vietnam and provide training to national and regional counterparts.

After establishing a track record of providing timely evidence-based pro-poor policy proposals on food safety to the authorities, ILRI was invited to join the nascent Vietnam Food Safety Working Group in 2015. The initiative, led by the Food and Agriculture Organization of the United Nations (FAO), was set up to bring together government agencies and international development partners to share knowledge and support policymaking in the country. Two years on, Vietnam's government is responding with changes in food safety policy—moving from an inspection-and-enforcement approach to a risk-based inspection and monitoring system bolstered by compliance incentives.

With the publication of a comprehensive report by the working group—Food safety risk management in Vietnam: Challenges and opportunities—the government has committed to implement measures to improve risk assessment, communications and management and the surveillance of food-borne diseases. The Hanoi, Ho Chi Minh and Hai Phong city authorities have begun developing plans to implement the report's recommendations.

According to the World Health Organization, measures reducing the impact of food-borne diseases could save the Vietnamese economy up to USD1 billion a year due to improved production, health and related market efficiencies. ILRI-led research found that improved food handling and cooking practices could save up to USD6 million in reduced pork Salmonella-related hospitalization costs alone.

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Partners: Australian government; Belgian Embassy in Vietnam; Canadian Embassy in Vietnam; FAO; Fruit and Vegetable Research Institute, Vietnam; Hanoi Medical University; Hanoi University of Public Health; Ministry of Agriculture and Rural Development, Vietnam; Ministry of Health, Vietnam; National Centre for Veterinary Hygiene Inspection, Vietnam; National Institute for Food Control, Vietnam; National Institute of Hygiene and Epidemiology, Vietnam; National Institute of Nutrition, Vietnam; National Institute of Veterinary Research, Vietnam; Rakuno Gakuen University; Swiss Tropical and Public Health Institute; Vietnam National University of Agriculture; World Bank

Investors: Australian Centre for International Agricultural Research; CGIAR Research Program on Agriculture for Nutrition and Health; Swiss Agency for Development and Cooperation; World Bank

ILRI program: Animal and Human Health

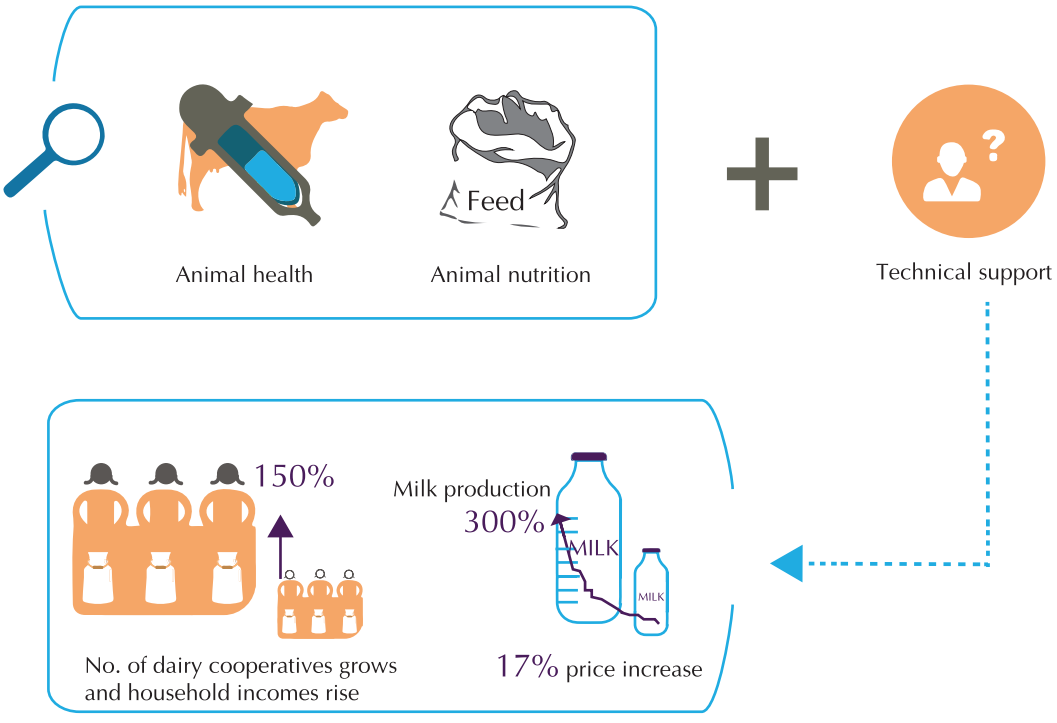
Program leaders: Delia Grace (d.grace@cgiar.org) and Vish Nene (v.nene@cgiar.org)

Associated CGIAR Research Program: Agriculture for Nutrition and Health

Ensuring women equal access to, control over and ownership of economic, land and other resources

5 GENDER EQUALITY

Expanding dairy businesses in rural India



Decentralized dairy cooperatives support livelihoods of thousands of women in rural India

Dairy farming is one of the most important sources of income and nutrition for rural communities in India. Dairy enterprises not only feed rural communities, they also supply milk to urban centres providing high quality protein and other essential nutrients to the population. Driven by rising urbanization and a growing middle class, demand for milk has increased substantially in recent years in India, including in the northern state of Uttarakhand. Strengthening the efficiency of the Uttarakhand dairy market offers major opportunities to smallholders to expand production and sales of milk.

Unorganized markets, transportation difficulties and inaccessible input and extension support services are but a few of the obstacles facing villagers wishing to start dairy businesses in Uttarakhand. The lack of storage facilities acts as an incentive to farmers to keep unsold milk and mix it with the next day's batch, causing higher levels of milk spoilage and contamination, as well as financial losses. Faced with these obstacles, increasing milk production and making a reasonable profit is extremely difficult for Uttarakhand's small-scale dairy farmers.

This situation began to change in rural Uttarakhand in 2008 when the Himmotthan Society started assisting a group of dairy-farming women to establish self-help federations, pooling their resources and knowledge to improve milk quality and cattle productivity. The women formed livestock producer groups: one group per village, with 12–15 villages per federation, and one dairy enterprise per federation. Each federation received a grant to purchase equipment for transport, storage and the testing of milk quality. Milk collection centres were established within 16–20 km of each dairy enterprise and 40 km from end markets, and vehicles were hired by each federation to transport the milk to market. But access to feed, veterinary health and breeding services and technical knowledge to improve milk yields remained a problem.

A year later, the International Livestock Research Institute (ILRI) teamed up with Himmotthan to provide research and technical support to help address the major productivity constraints facing Uttarakhand's small-scale farmers. ILRI research identified measures to increase the supply and nutritional quality of animal feed by increasing the fodder yield from wheat and barley, while also increasing the grain yields for humans. ILRI scientists also supported the training, including development of extension materials, of 200 young villagers to become artificial insemination technicians and preventative health-care workers. Better nutrition, together with veterinary treatment, helped improve the health and fertility of the animals. This combination of research-tested interventions, technical support and training has delivered striking improvements in productivity and sales.

Eight years on, Himmotthan and ILRI have rolled out a dairy business cooperative model for hundreds of women farmers in remote areas. Twenty-five small dairy enterprises, up from 10, now support the livelihoods of 5,680 women farmers in 320 villages in Uttarakhand, demonstrating that rural dairy enterprises are viable, generating incomes for farmers and delivering high-quality products to poor consumers at competitive prices. Milk prices and production levels have increased by 17% and 300% respectively. There have been clear improvements in the livelihoods of families involved in the federations. The women have used the income from dairy production largely for household expenses, such as school fees, but have also invested in new farm inputs. Some households have also purchased crossbred improved livestock, such as poultry.

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Investor: Navajbai Ratan Tata Trust
ILRI program: Impact at Scale
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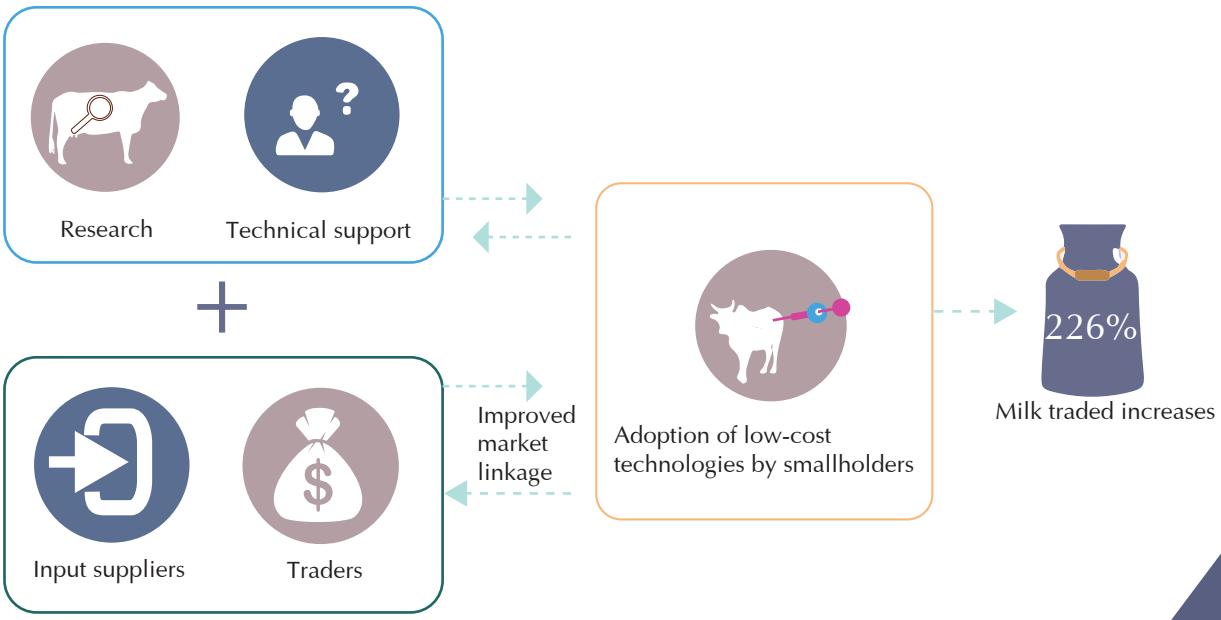
Associated CGIAR Research Program: Livestock

Achieving higher levels of productivity and market participation through technological innovation

8 DECENT WORK AND ECONOMIC GROWTH

Accelerating market orientation in Ethiopia



Research spurs increases in milk production, productivity and sale in Ethiopia

Livestock play a crucial role in national development in Ethiopia, accounting for 40% of agricultural gross domestic product. With one of the largest dairy cow populations in Africa at 10 million, Ethiopia produces nearly 3 billion litres of milk a year. Rapidly rising incomes have increased demand for dairy products faster than supply, pushing up prices and increasing the importation of powdered milk. Increasing milk yields and the sale of dairy products hold huge potential for the rural population whose livelihoods largely depend on livestock farming.

While productivity in the dairy sector has improved in recent years, there are still opportunities for considerable improvements in milk production. Most small-scale dairy farmers have limited access to knowledge and technologies, higher-performing crossbreed cattle, veterinary services or a regular supply of quality animal feed. Their hardy indigenous cattle produce little milk, 1.5 litres a day per cow, up to 20 times less than crossbreeds in industrialized countries. With few connections with input suppliers—feed suppliers, processors and transportation companies etc.—those dairy farmers producing enough milk are often unable to sell it. This reduced supply increases milk prices and decreases consumption.

Between 2013 and 2017, the Livestock and Irrigation Value Chains for Ethiopian Smallholders project (LIVES), led by the International Livestock Research Institute (ILRI), identified low-cost technologies, undertook research on their effectiveness and provided support, including the development of training materials and provision of mentoring, to facilitate adoption. LIVES staff established innovation platforms in the Amhara, Oromia, Southern Nations Nationalities and Peoples and Tigray regions of Ethiopia involving more than 1,500 livestock-keeping households and 400 public-sector employees, processors and input suppliers. National researchers, farmers and input suppliers participated in LIVES-led trials; and they in turn demonstrated the new technologies and practices to others to encourage adoption.

More than 110,000 smallholder households began producing milk using improved technologies and management practices—better animal housing, feeding and healthcare. For instance, the introduction and adoption of pregnancy testing kits and artificial insemination techniques increased the use of improved cows by 66% to nearly 62,000 animals, while use of milking machines and cow mats to keep the barn clean reduced udder diseases, as well as improving hygiene and food safety.

Project partners helped establish and train more than 100 private and cooperative dairy processors and milk sellers. Participants received training and mentoring support on milk quality testing and hygiene, and butter and yoghurt processing, as well as help accessing credit. Following demonstrations of improved production practices, more than 27,000 households set aside approximately 12% of their land holdings and started producing irrigated fodder crops.

Over the life of the project, LIVES has contributed to marked increases in dairy productivity and market orientation. In the project intervention zones, the number of households selling milk has increased by 81%, from 17,900 to 32,000, and the volume of milk traded increased by 226%, from 14.6 million litres to 47.6 million litres, a 36% increase in the number of litres sold per cow.

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ILRI program: Impact at Scale

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Associated CGIAR Research Programs: Livestock; and Water, Land and Ecosystems

Strengthening scientific and technological capacity to move towards more sustainable patterns of food production

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Integration of crop-livestock production

80,000 adopted mucuna-based animal feed

7–10% rise in profits from beef production

22,000 of whom received up to

USD600 more per steer sold

USD50 more per goat sold

Improved technologies bolster food production efficiency and incomes in rural Zimbabwe

Most rural people in Zimbabwe depend on crop–livestock farming, growing cereals and legumes, and raising goats and cattle. In recent years, overdependence on rain-fed irrigation, poor soil fertility and a lack of access to inputs, particularly animal feed, have hindered productivity. In addition, falling yields, cash constraints and inefficient links between smallholders and consumers have contributed to food deficits, limiting livelihood opportunities and forcing much of the population to rely upon food aid. But with growing food demand, the adoption of crop and livestock technologies and more efficient markets offer opportunities to enhance agricultural production, food security and resilience in rural Zimbabwe.

In 2012, research by a host of national and international partners, including the International Livestock Research Institute (ILRI), identified opportunities to introduce crop and livestock technologies and improved practices along six target value chains in six rural districts in the Zimbabwean provinces of Mashonaland East, Matabeleland South and Matabeleland North. Appropriate cereal and legume crop-and-livestock technologies were introduced to farmers and on-farm research generated empirical evidence to support the adoption of promising technologies and practices, including nitrogen fixing crops and improved feeding practices.

The formation of productive partnerships among private and public institutions—via the multi-stakeholder platforms—helped facilitate regular dialogue, knowledge sharing and capacity building. With support from agricultural extension personnel and project staff, multi-stakeholder platforms increased understanding among supply chain actors of market mechanisms. Participating farmers also organized themselves into cooperatives to buy inputs more cheaply in bulk and sell their livestock for greater profit. And scientists evaluated the outcomes and shared their findings through the platforms.

Five years on, more than 170,000 farmers have translated this increased knowledge and capacity into higher incomes. Enhanced soil fertility has improved grain and biomass yields, better feed and feeding practices have driven livestock productivity growth, and better links with markets have increased crop and livestock sales.

The production of livestock feed—for household and commercial use—has improved through increased use of forage legumes (*Lablab purpureus* and *Mucuna pruriens*) and higher quality crop residues (e.g. stalks and leaves of groundnut). Giving livestock improved feeds on-farm rather than off-farm grazing, where they often fall prey to wild animals, has led to higher milk yields and fewer deaths. Among 80,000 participating farmers using *Mucuna*-based supplements, the net profits from beef production increased by 7–10%. In Nkayi district alone (Matabeleland North), steer and breeding goat prices received by nearly 22,000 farmers rose by up to 150% (from USD400–1,000) and 250% (from USD20–70) respectively.

Participating farmers who employed conservation agriculture practices—minimizing disruption to soil structure, composition and biodiversity—and practised rotations of cereals and legumes reported improved household food security. Nearly 40,000 farmers—who alternated maize with a nitrogen-fixing legume crop—produced an extra 1.3 tonnes of maize on average, from 0.7 in 2012 to 2 tonnes per hectare in 2016, increasing annual net profits by USD185 per household, enhancing soil fertility and reducing the need to apply inorganic fertilizers.

The solutions developed are now being taken up in neighbouring districts and beyond. In some districts, the technologies, approaches and experiences have been mainstreamed into cross-cutting government schemes, such as Zimbabwe's command agriculture scheme, loan schemes, safety nets and nutrition programs. They have also been transferred to other research and development programs across the country and in the region, for instance, in the European Union-funded crop-livestock integration projects in Malawi.

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Partners: Agricultural Technical and Extension Services, Zimbabwe; Catholic Relief Services; Cluster Agricultural Development Services, Zimbabwe; Commonwealth Scientific and Industrial Research Organisation; Community Technology Development Trust, Zimbabwe; Department of Livestock Production and Development, Zimbabwe; Goromonzi, Gwanda, Murewa, Mutoko and Nkayi and Uzumba district councils, Zimbabwe; Help Germany; International Crops Research Institute for the Semi-Arid Tropics; International Maize and Wheat Improvement Center; Matopos Research Institute; Ministry of Agriculture Mechanization and Irrigation Development, Zimbabwe; SNV Netherlands Development Organisation; University of Queensland

Investor: The Australian Centre for International Agricultural Research

ILRI program: Sustainable Livestock Systems

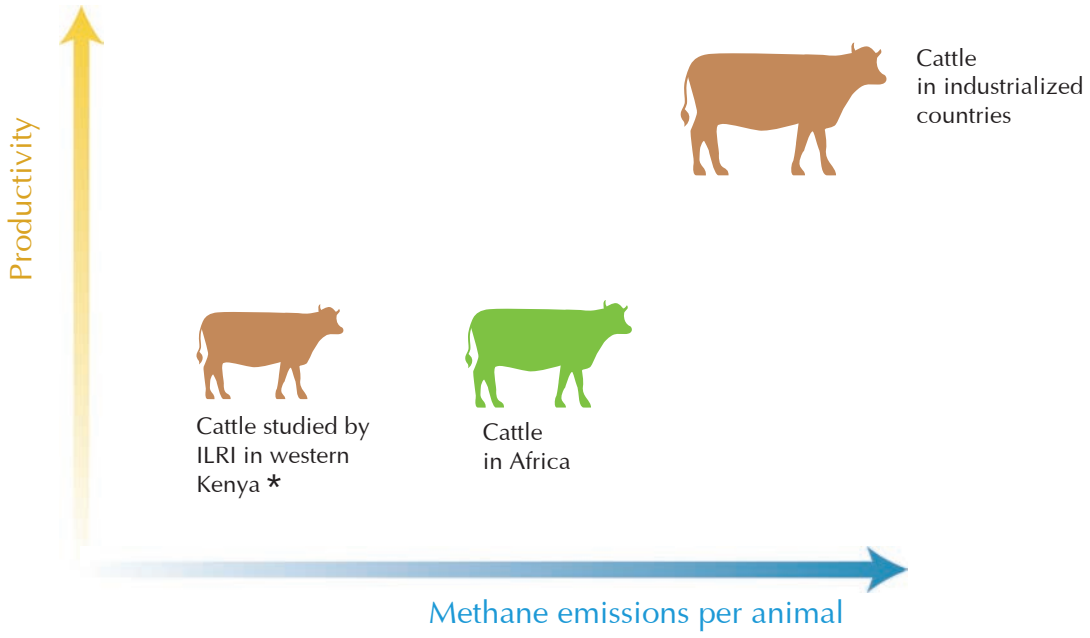
Program leader: Polly Ericksen (p.ericksen@cgiar.org)

Associated CGIAR Research Program: Livestock

Ensuring livestock development is compatible with effective climate change-related planning and management

13 CLIMATE ACTION

First study reveals that the enteric methane emissions from cattle in East Africa are lower than those based on findings from cattle in industrialized countries



*ILRI study found emission rates up to 40% lower than Tier II estimates

Science helps tailor livestock-related climate change mitigation strategies in Africa

Livestock contribute greatly to livelihoods and food security in Africa, yet they are both vulnerable to climate change and a major contributor to greenhouse gas (GHG) emissions, a known driver of climate change. Climate change is expected to alter the quantity and quality of available animal feed and impact livestock directly through increased heat stress, changes in water availability and a greater range of livestock diseases. And higher levels of poverty in Africa exacerbate the effects of GHG-induced climate change on vulnerable populations.

Existing estimates suggest that the livestock sector in Africa contributes to more than 70% of the continent's agricultural GHG emissions, mainly due to methane and nitrous oxide emissions, two particularly potent GHGs, predominantly from cattle and their manure. The implementation of effective mitigation strategies relies on accurate GHG emission data. But what if the underlying assumptions upon which these GHG emission estimates are based are inaccurate?

The measurement of GHG emissions faces significant challenges in quantifying the environmental impact of livestock in Africa. Guidelines to estimate GHG emissions provided by the Intergovernmental Panel on Climate Change (IPCC) suggest an approach for regions in which in-situ data is scarce or unavailable, such as sub-Saharan Africa. This approach involves extrapolating estimates, referred to as Tier I estimates, based on the knowledge and GHG emission factors of livestock systems for farm animals raised in high-income countries often on sophisticated diets tailored to maximize productivity. These livestock systems, however, are mostly high-intensity dairy and beef farming systems with very different breeds, feeding regimes, veterinary services, climatic regions and landscapes than those found in sub-Saharan Africa.

The assumptions upon which the extrapolation is based may well be misleading; in other words, there may be large uncertainties in their applicability to African livestock systems. Three years of research by scientists at the International Livestock Research Institute's (ILRI) Mazingira Centre has produced the first series of in-situ GHG emission estimates from livestock, manure and soils in Kenya, referred to as Tier II estimates. The preliminary results indicate that the actual enteric methane emissions from cattle in small-scale livestock systems are up to 40% lower than current IPCC Tier I estimates. Furthermore, GHG emissions from livestock manure and urine applied to soils in western Kenya are between 50% (methane) and 90% (nitrous oxide) lower than the IPCC estimates.

African governments are working to ensure that agriculture contributes to climate change mitigation by including projected livestock emissions in their National Determined Contributions, following the 2015 Paris climate accord. However, available GHG emissions data is unreliable as it is based on extrapolating knowledge gathered in developed countries and policy responses may be inaccurate if based on existing Tier I estimates.

A body of knowledge needs to be built upon which to draw sounder conclusions for policymakers wishing to achieve mitigation targets through interventions in the livestock sector. Countries require accurate in-situ baseline (Tier II) GHG emissions estimates upon which to measure progress towards minimizing GHG emissions. African nations need to know whether the practices they are adopting are truly contributing to more sustainable and resilient food production, while reducing the environmental impact of their livestock.

The Mazingira Centre research findings present a snapshot of the GHG emissions from a few cattle breeds in selected livestock systems in western Kenya; more work is required before reliable baseline data can be estimated for the country and ultimately the continent. The new data will be incorporated into the IPCC Guidelines for National Greenhouse Gas Inventories and eventually used to update the existing Tier I estimates. ILRI is also testing and quantifying potential mitigation strategies based on the recently derived data. In the future, improved Tier II estimates will help African states report more accurate GHG emissions to the United Nations Framework Convention on Climate Change and develop and implement more targeted interventions.

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Partners: Center for International Forestry Research; Egerton University; Imperial College London; International Center for Tropical Agriculture; Karlsruhe Institute of Technology; Kassel University; Kenyatta University; Lancaster University; University of Hohenheim; World Agroforestry Centre

Investors: CGIAR Research Program on Climate Change, Agriculture and Food Security; CGIAR Research Program on Livestock; Deutsche Gesellschaft für Internationale Zusammenarbeit; International Fund for Agricultural Development; European Commission

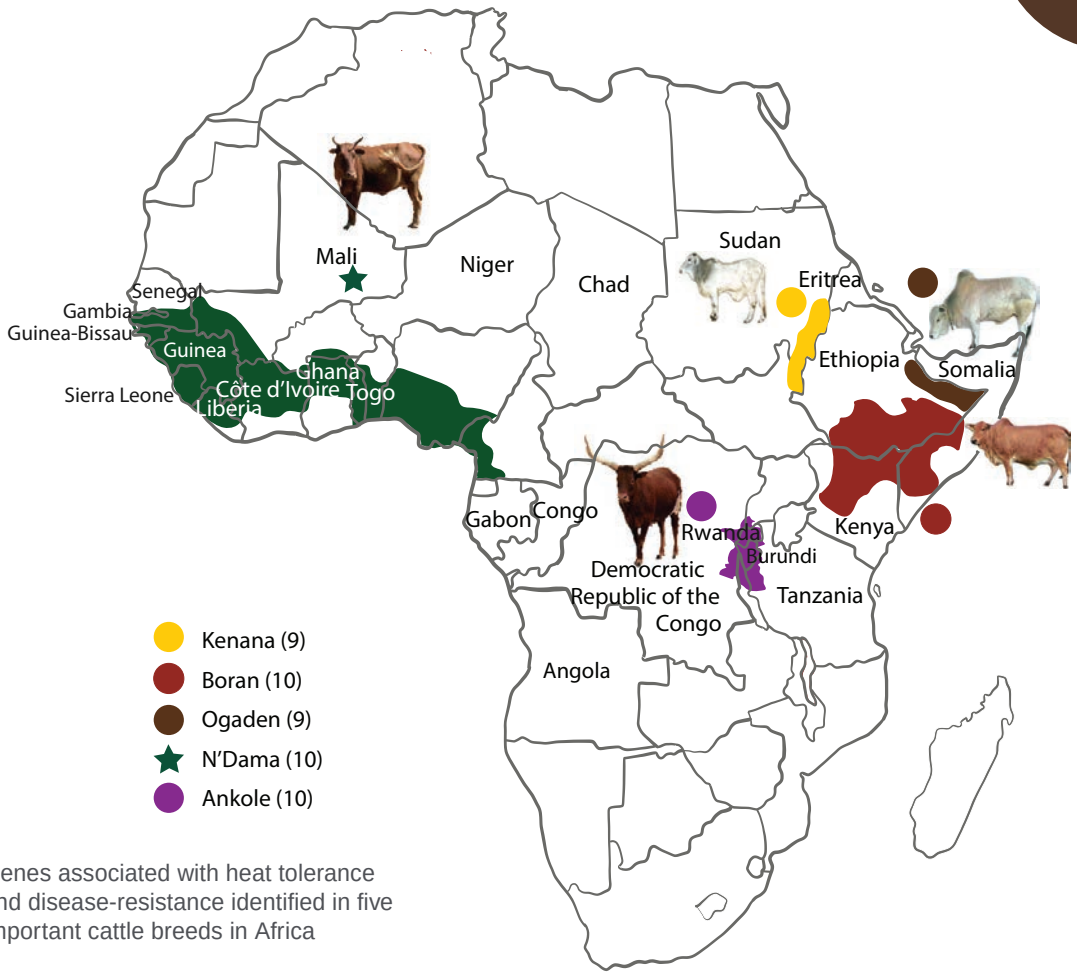
ILRI program: Sustainable Livestock Systems

Program leader: Polly Ericksen (p.ericksen@cgiar.org)

Associated CGIAR Research Programs: Climate Change, Agriculture and Food Security; and Livestock

Conserving the genetic diversity of farm animals and promoting access to, and fair and equitable sharing of, benefits arising from such resources

15 LIFE ON LAND



Genes associated with heat tolerance and disease-resistance identified in five important cattle breeds in Africa

Adapted from Kim, J. et al. 2017. The genome landscape of indigenous African cattle. *Genome Biol.* 18:34

DNA sequencing of indigenous African cattle reveals vital clues to increasing productivity

Since their introduction to Africa thousands of years ago from the Middle East and the Indian subcontinent, cattle breeds have gradually adapted to cope with hugely varying environments, from the Sahelian desert to the subhumid tropical forests. These cattle are important sources of meat, milk, traction and manure across the continent. With rapid population growth and a rising urban middle class, they will become even more significant as demand for meat and milk is expected to more than double in sub-Saharan Africa from 2000 to 2030.

Identifying the genetic basis underlying heat tolerance and resistance to killer diseases—major production constraints—offers huge opportunities to increase meat and milk productivity to meet rising demand. It opens the way to the scaling up of breeding programs for these specific key traits, potentially enhancing the incomes of hundreds of millions of smallholders worldwide.

The greatest challenges facing researchers are cost and time. Though the cost has dropped in recent years, the opportunity to explore this treasure trove may be short lived, as the nature of cattle breeding on the continent today is contributing to a significant loss of diversity. Africa is witnessing major transformations of its agricultural systems and rapid loss of indigenous livestock, representing an irreversible loss of unique traits that may serve as vital insurance against future challenges, such as increasing drought or emerging pests.

Conscious of these challenges, scientists at the International Livestock Research Institute (ILRI) and partners selected five of the 150 breeds of cattle in Africa—analysing DNA samples of 48 animals—based on their economic importance to smallholders, representativeness of the sample to each breed and geographical spread throughout the continent. They analysed the genome of each animal and looked for characteristics particular to the breed. And their ground-breaking findings identifying useful genetic adaptations have justified the decision to proceed with a relatively small number of breeds.

Scientists pinpointed the specific genes involved in helping African cattle cope with rising temperatures and disease, such as the tsetse-fly-transmitted trypanosomiasis which in Africa has been estimated to cause up to USD4.5 billion in annual losses due to illness and death. They then generated a catalogue of genetic variants in the breeds and identified the unique DNA of each breed that gives them an advantage.

Genes were identified associated with feeding capacity under tropical climatic conditions in the West African taurine N'Dama, horn development and coat colour in the Central African Ankole, and heat tolerance in the three zebu breeds (Boran, Ogaden and Kenana) from East Africa. Genes associated with tick resistance were also identified in all five breeds. The findings will better inform breeding and crossbreeding programs designed to improve cattle productivity and resilience in sub-Saharan Africa, while preserving the unique genes in these indigenous cattle species.

These findings have helped scientists secure funding to undertake the DNA sequencing of a further 50 cattle, chicken and sheep breeds. In line with the Nagoya protocol to the Convention on Biological Diversity on fair access to and equitable sharing of benefits arising from the utilization of genetic resources, ILRI's broader aim is to catalogue the genetic information on all 10,000 breeds of domestic livestock in the world before that diversity disappears. The good news is that the exciting new science of genomics enables geneticists to unravel the genetic make-up of cattle breeds and to identify, and breed for, those traits best suited to the world's diverse environments, while helping government institutions conserve this precious diversity. This work would cost approximately USD70 million, a small investment for such a large global public good.

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Partners: Bahir Dar University; Centre for Tropical Livestock Genetics and Health; Chonbuk National University; Georgia State University Institute for Biomedical Sciences; Kyungpook National University; Ministry of Livestock and Animal Production, Guinea; National Institute of Animal Science, South Korea; Nelson Mandela African Institution of Science and Technology; Roslin Institute, University of Edinburgh; Seoul National University; Shinshu University; University of Khartoum; University of Illinois; University of Nottingham

Investor: Rural Development Administration, South Korea

ILRI program: Livestock Genetics

Program leader: Steve Kemp (s.kemp@cgiar.org)

Associated CGIAR Research Program: Livestock

Strengthening partnerships that mobilize and share knowledge, expertise and technology in promoting sustainable livestock development

17 PARTNERSHIPS FOR THE GOALS

Research + Support

to development partners enabled

the implementation of disease control protocols

a reduction in African swine fever contamination

the improvement of market linkage through the creation of 10 pig cooperatives and >24 pig producer groups

Partnerships to increase pig production in Uganda

Livestock is the world's fastest-growing, highest-value agricultural subsector, accounting for about 40% of agricultural gross domestic product globally. Driven by rising incomes, demand for animal-source foods in Africa and Asia is expected to increase up to 200% by 2030. Efficient crop and livestock production and natural resource use will drive employment, environmental, nutrition and income gains in a subsector likely to be dominated by smallholders.

In 2012, the CGIAR Research Program on Livestock and Fish began working in nine countries to increase access to animal-source foods by the poor by strengthening targeted value chains in which the poor benefit significantly. The initiative—led by the International Livestock Research Institute (ILRI)—took a solution-driven research-for-development approach. In Uganda, scientists selected the pig value chain, a major livestock source for more than 1.1 million households, because of its relatively high return-on-investment potential. Pigs grow quickly, feed on leftover food and crop residues, can be sold to meet household needs and provide investment capital to grow crops. Investment in research offers major opportunities to increase productivity and build partnerships to enhance knowledge and technology transfer.

ILRI mapped the stakeholders in five main pig producing districts and identified the opportunities and challenges along the value chain. Scientists identified disease prevalence as a key production constraint—particularly the highly contagious, often fatal, African swine fever. The findings informed priority interventions along the pig supply chain, including the development and testing of tools and training materials for the control of African swine fever. Local district extension and veterinary officials then supported producers to participate in best-bet interventions rolled out as pilot programs, such as the application of farm-level protocols to prevent and control disease outbreaks and capacity building of butchers on appropriate pig slaughter and pork hygiene. ILRI-led evaluations involving 960 farmers and 300 input and service providers, traders and butchers revealed significant progress in the adoption of practices to prevent the spread of African swine fever.

Drawing on ILRI-led research and technical support, local extension and veterinary officials, pig producers and traders, service providers and retailers established multi-stakeholder platforms. The platforms have since become dynamic at local, regional and national levels, raising awareness of the importance of the subsector as a public policy and investment priority. For instance, the 2016–2020 government agriculture strategy highlighted the role of the pig subsector in protecting nutritional security and set aside USD5.5 million to control African swine fever.

Ugandan pig farmers readily embraced collective action. The regional platforms have facilitated the creation of market linkages, for example, between input suppliers, auxiliary service providers and farmers. In the greater Masaka region, the stakeholder platform catalysed the establishment of 10 pig farmer cooperatives and dozens of pig producer groups. The pig cooperatives in turn came together to establish the Greater Masaka Pig Cooperative Union to further strengthen their advocacy activities and improve pig production and marketing in the region. And the national multi-stakeholder platform has begun engaging with ministry officials on the incorporation of improved standards into the revised national animal feeds bill, a process which is ongoing.

The CGIAR Research Program on Livestock will build on this model to enhance efficiency of the pig value chain through the adoption of improved technologies by increasing the number of small- and medium-scale farmers and businesses and market-oriented policies in Uganda. The Uganda pig value chain is expected to make important contributions to the ambitious 2022 program targets, which include poverty alleviation, inclusion and equity for nearly 11 million women and young people worldwide through the adoption of improved technologies and market-oriented practices.

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CGIAR Research Program on Livestock
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Partners: CGIAR Research Program on Agriculture for Health and Nutrition; Hoima, Kamuli, Lira, Mukono and Masaka district authorities; International Center for Agricultural Research in the Dry Areas; International Center for Tropical Agriculture; Makerere University; National Livestock Resources Research Institute, Uganda; Swedish University of Agricultural Sciences; WorldFish

Investors: CGIAR Fund Council Windows I and 2 donors (Bill & Melinda Gates Foundation; governments of Australia, Canada, France, India, Japan, Netherlands, New Zealand, Norway, South Korea, Sweden, Switzerland, United Kingdom and United States of America, and the World Bank); Department for International Development, United Kingdom; Deutsche Gesellschaft für Internationale Zusammenarbeit; European Commission; International Fund for Agricultural Development; Irish Aid; United States Agency for International Development

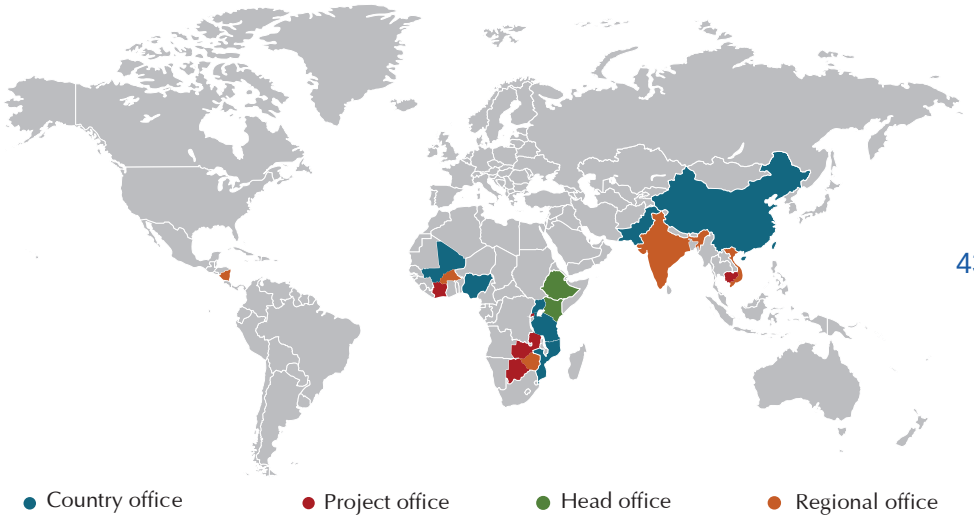
CGIAR Research Program on Livestock

Program director: Tom Randolph (t.randolph@cgiar.org)

Associated ILRI programs: Animal and Human Health; and Policies, Institutions and Livelihoods

ILRI worldwide

Offices and staff worldwide



Staff as of 31 December 2017

438 65% 35% 236

39 different nationalities

ILRI capacity development in 2017

31,355
No. of participants in short-term training courses

147
No. of short-term training courses

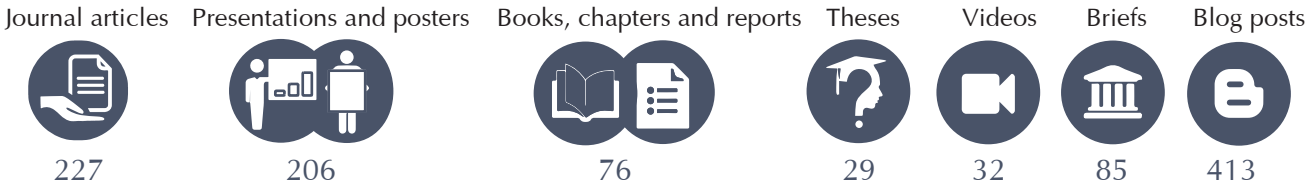
Long-term training
31 Interns
80 Research fellows
148 Graduate fellows

29%

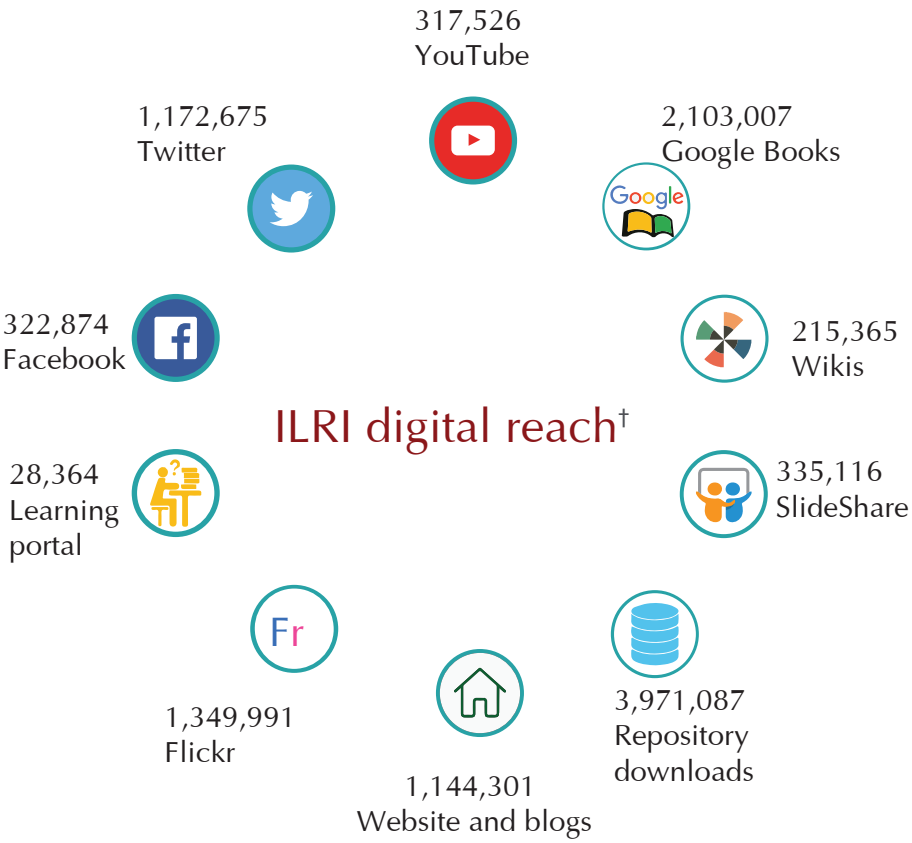
37 nationalities

71%

ILRI information products in 2017



ILRI digital reach†



† All statistics refer to views except otherwise stated

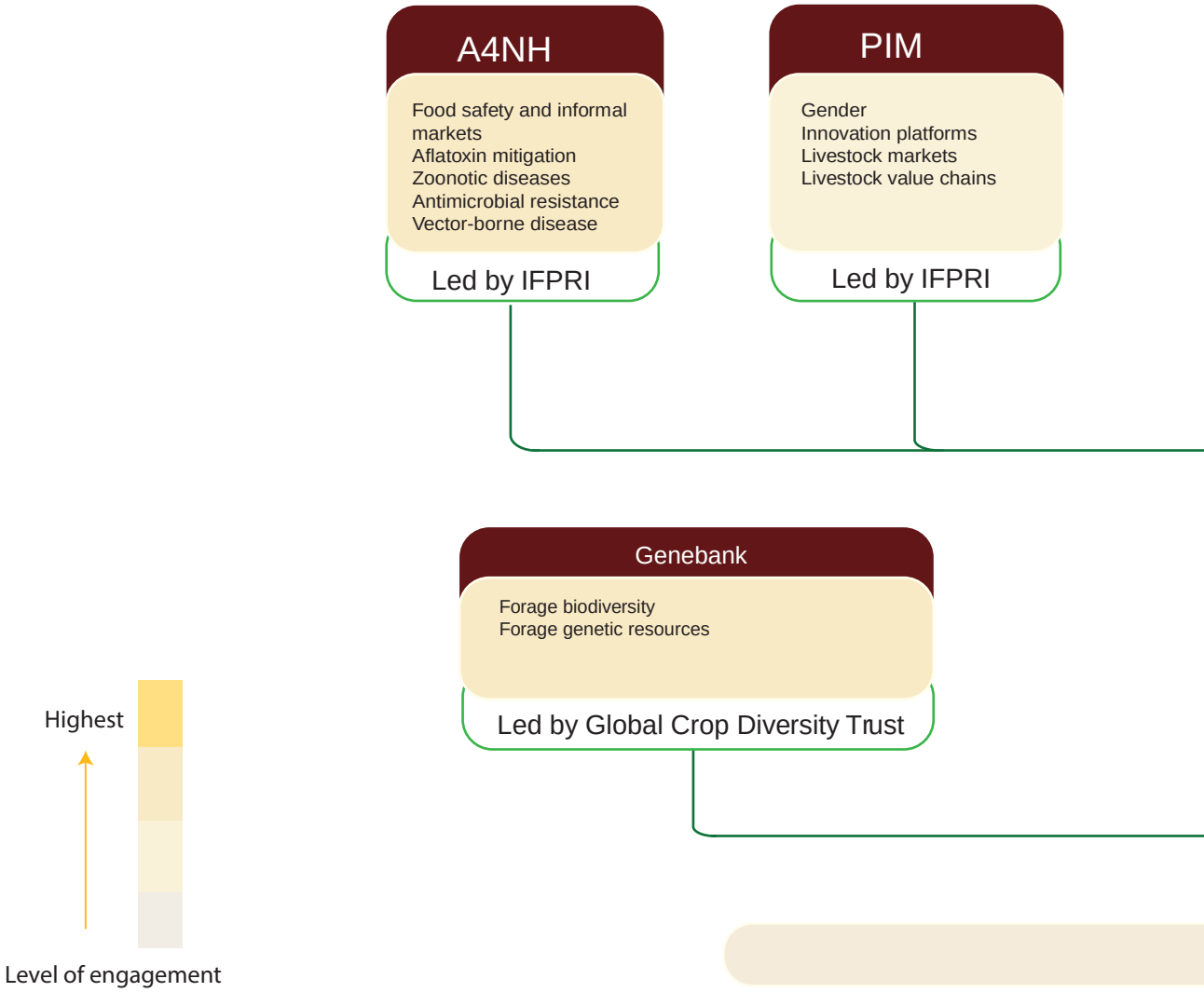
ILRI in CGIAR

The CGIAR research portfolio of activities are multi-centre, multi-partner initiatives based on three core principles: impact on the CGIAR system-level outcomes (reduced poverty, improved food and nutrition security, and improved natural resources and ecosystem services) and the United Nation's Sustainable Development Goals; making the most of the centres' strengths; and building strong and effective partnerships.

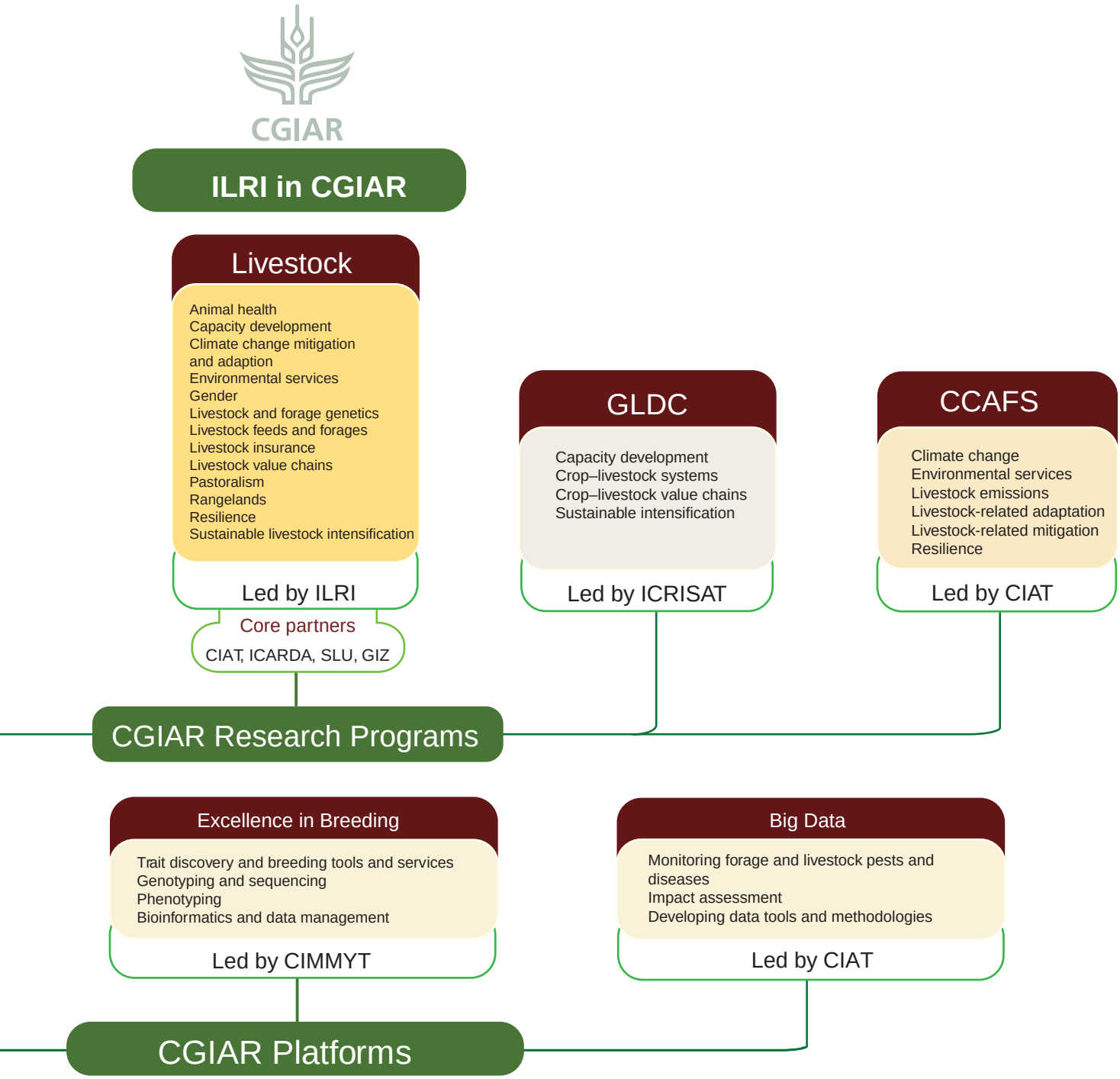
The portfolio comprises CGIAR Research Programs (CRP) and platforms. The CRPs are structured around two interlinked clusters of challenge-led research. The first of these is the innovation in agri-food systems which involves adopting an integrated, agricultural systems approach to advancing productivity, sustainability, nutrition and resilience outcomes at scale. The second cluster consists of four cross-cutting global integrating programs framed to work closely with the agri-food systems programs within relevant agro-ecological systems.

ILRI leads the CRP on Livestock which works to increase the productivity of small-scale livestock systems in sustainable ways, making meat, milk and eggs by and for the poor available and affordable in nine developing countries—Burkina Faso, Ethiopia, India, Kenya, Nicaragua, Tanzania, Tunisia, Uganda and Vietnam. ILRI also leads 'Food Safety' and co-leads, with the London School of Hygiene and Tropical Medicine, 'Improving Human Health'—two of five flagships of the CRP on Agriculture for Nutrition and Health (A4NH), and makes a substantial contribution to the CRP on Climate Change, Agriculture and Food Security (CCAFS).

In addition, ILRI contributes to two other CRPs: Grain Legumes and Dryland Cereals (GLDC) and Policies, Institutions and Markets (PIM). Underpinning the work of the research system, ILRI is a major partner in the Genebank Platforms and participates in the CGIAR Platforms for Big Data in Agriculture and Excellence in Breeding, as well as the Collaborative Platform on Gender Research.



CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
SLU	Swedish University of Agricultural Sciences



Cross-cutting CGIAR Collaborative Platform on Gender Research

Smallholder livestock farmer taking care of newly born goats, Bale, Ethiopia (photo credit: ILRI/Apollo Habtamu)

Governance, leadership and research programs

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Research programs and leaders

Animal and Human Health

Emerging infectious disease epidemiology, food-borne and zoonotic diseases, food safety, herd health, immunology, nutrition, One Health/EcoHealth, parasitology, social science, vaccine development and veterinary epidemiology.

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Feed and Forage Development

Forage agronomy, forage diversity and conservation, animal nutrition, phenotypic and genotypic forage characterization.

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Impact at Scale

Impact assessment, partnership management, and development and management of projects taking outcomes to scale.

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Livestock Genetics

Animal genetics and genomics, next-generation diagnostics and veterinary epidemiology.

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Policies, Institutions and Livelihoods

Agricultural economics, agri-food value chain economics, agricultural trade, animal health economics and policy, foresight analysis, gender, impact assessment, monitoring, evaluation and learning, and innovation systems.

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Sustainable Livestock Systems

Climate adaptation and mitigation, ecosystem services, environmental sciences, sustainable intensification, modelling, mapping and spatial analysis, natural resource management, pastoral and dryland systems, rangeland ecology, resilience, social science and systems analysis.

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†Joined during reporting period
††Left during reporting period

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Small-scale farmers produce most of the milk in developing nations, helping reduce stunting and wasting in young children, southeastern Kenya (photo credit: ILRI/Stevie Mann)

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Scientists from ILRI and the Chinese Academy of Agricultural Sciences collaborate on a range of livestock and crop genetic research, Beijing, China (photo credit: ILRI/Stevie Mann)

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