Bringing state-of-the-art livestock phenomics to Africa

Increasing productivity and food security in an environmentally sustainable manner

Why livestock matter to the world's poor

Livestock are recognized as a pathway out of poverty for the rural poor. There are an estimated 766 million poor livestock keepers globally, of whom 230 million are in Africa. Livestock fulfil multiple roles for their women and men keepers. They act as savings, generate income, provide food, draught power, transport, fertilizer and eco-system services, among other uses. Livestock related value chains also provide business opportunities and employment.

Livestock provide food and nutritional security to the poor. Livestock products—milk, meat and eggs—are essential to food and nutritional security of the world's poor, providing essential protein, energy and micro-nutrients (often absent in plant-based diet). The demand for milk and meat in developing countries is currently increasing at a never-before-seen rate. Without substantial increases in livestock production and productivity, expected demand will not be met.

The need for state-of-the-art livestock phenomics facilities and capabilities in Africa

The dramatic increase in livestock production and productivity—required to meet Africa's future food requirements—needs to be achieved while simultaneously reducing poverty and addressing environmental, social and health concerns. This challenge will require significant research-for-development (R4D) investments, including into livestock production technologies.

Such research is currently severely hampered in Africa due to the lack of facilities and capabilities to measure livestock performance—a field termed "livestock phenomics".

The ability to measure livestock performance—livestock phenomics—is essential to evaluating new or existing technologies on livestock productivity to help farmers make better management decisions.

Ear tagging of animals so that they can be individually performance monitored

Livestock phenomics

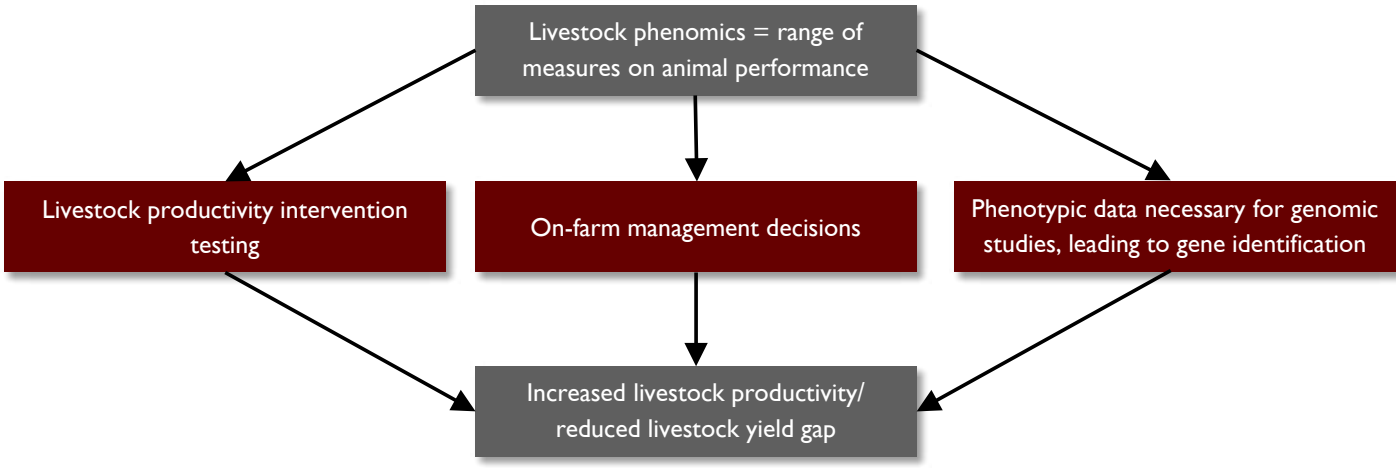
Livestock phenomics is the measurement of physical or biochemical traits of livestock. Phenomics has been described as the next big challenge, as the ability of scientists to characterize phenomes—the full set of phenotypes of an organism—is significantly lagging behind their ability to characterize genomes (Nature Review Genetics 2010, 11:855–866).

Examples of phenomics relevant to African livestock include:

- Rapid and cheap measures for assessing livestock disease burden
- Automated measures of livestock feed intake and growth rates
- Progesterone profiling of milk for monitoring fertility traits
- Automated recording of respiration rates as an indicator of adaption to heat stress
- Use of pedometers or sensors to monitor the behaviour of grazing animals
- Use of rumen boluses with sensors to monitor rumen conditions.

Some of these approaches to phenotyping—such as those that require the use of specialized equipment or training—would be undertaken on-station to answer specific research questions; others—such as those that are easy to use under field conditions—would be undertaken on farm to help farmers make better management decisions.

What CTLGH wants to measure	• Livestock phenotypes related to production, adaptation and welfare including growth rates, feed intake, reproductive performance, health, yields of milk, meat or eggs, rumen functions and heat stress indicators • A range of species under a number of livestock management and environmental conditions
How	• Cheaply, efficiently and accurately • Both on-station and on-farm • At a single time-point or continuously • Automated data capture and feedback • Using the latest technologies, relevant to the African livestock sector



Proposal

We propose to kick-start and sustainably support a livestock phenomics initiative in Africa by establishing facilities and capabilities on an existing research farm owned by the International Livestock Research Institute (ILRI) in Kenya. This farm is based at two locations—one at the ILRI headquarters in Nairobi and closely linked to bioscience facilities, and the other on the Kapiti plains outside of Nairobi. These will be developed for poultry, pigs, goat, sheep and cattle—the main livestock species kept by the rural poor in Africa.

The proposed facilities and capabilities in livestock phenomics will support livestock research in East Africa and elsewhere, and serve as a model for other African countries to replicate.

East African Boran cattle at the ILRI Kapiti Ranch

Expected achievements

The establishment of livestock phenomics facilities and capabilities will:

- Help fill the very large data gap on livestock performance in developing country livestock systems: either by directly measuring animals within the facility, or by facilitating the development of better—quicker, cheaper and more informative—means of measuring animals on-farm.
- Allow the testing of livestock interventions—such as combinations of breed, feed and health interventions—in a controlled environment, thereby reducing the resources required to perform such experiments. The most promising interventions can then be piloted-tested on-farm.
- Allow livestock performance to be evaluated under conditions mimicking future changes in the environment—such as increased temperatures and/or less and poorer quality feed—building an evidence base on the ability of different African livestock breeds to adapt to expected future environments.
- Allow African livestock production systems to increasingly benefit from the genomics revolution, as most uses of genomic information require the associated phenomics information.

These efforts will result in increased livestock productivity, and thus increased benefits from livestock to their keepers in terms of increased incomes, food and nutritional security, and a healthier more sustainable environment.

Increased milk yields are essential to Africa's future food security

The ILRI farm and associated facilities available to the phenomics initiative

	ILRI headquarters, Nairobi	Kapiti Ranch
Area	48 hectares/118 acres	12,959 hectares/ 32,022 acres
Current livestock	200 cattle and 70 small ruminants	2200 cattle and 1600 small ruminants
Key facilities	An animal biosafety level 2 unit	Available laboratory space
	Animal isolation and quarantine units	On-farm conference and accommodation facilities
	Bioscience facilities	
	Environmental science laboratory—including animal chambers; small animal unit; and tick unit	
	On-campus conference and accommodation facilities	

Implementation and anticipated investments needed

The proposed African livestock phenomics facilities and capabilities will be established in several overlapping phases:

Phase 1: Stakeholder engagement to design the facilities and assess capacity building needs on livestock phenomics for Africa.

Phase 2: Construction of the facilities and development of capacity at the ILRI farm in Kenya. The initial focus would be on establishing a core set of facilities and capacities—as determined by the stakeholder engagement. The later focus will be on expanding these facilities and capacities.

Phase 3: Utilization of the livestock phenomics facilities and capacity at the ILRI farms, as proof of concept, to answer specific research questions, and develop new phenomic tools.

Phase 4: Undertaking of advocacy on livestock phenomics to the broader African livestock research community and other key stakeholders, including through the development of collaborative projects with African national agricultural research systems and other R4D institutions, the provision of training using the developed facilities, and support for the establishment of similar research facilities elsewhere.

The anticipated cost of initiating this process is approximately USD 5 million

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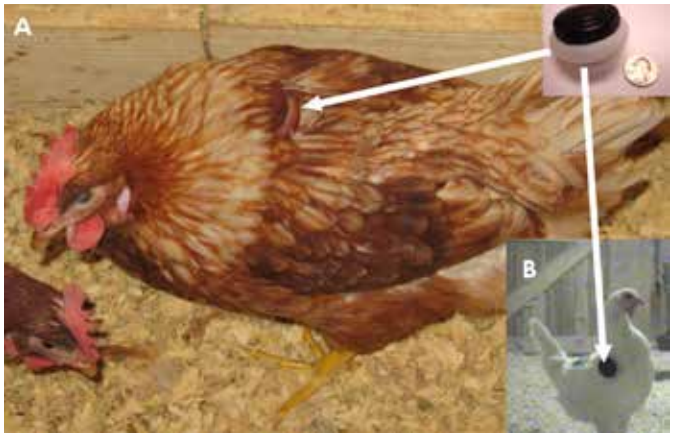

Wireless sensors are being trialled to monitor chicken well-being. Such technology may be critical in helping chickens adapt to changing environments.

For more information on:
ILRI (www.ilri.org)
LiveGene (http://hdl.handle.net/10568/42176)
Centre for Tropical Livestock Genetics and Health (http://www.ctlgh.org)

Contact

Karen Marshall
ILRI, Kenya
kmarshall@cgiar.org

ILRI thanks all donors that globally support its work through their contributions to the CGIAR system

Patron: Professor Peter C Doherty AC, FAA, FRS
Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

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

 March 2017