Centre for Tropical Livestock Genetics and Health

Data Empowers Farmers

From data to smart farm decisions that increase farmer profitability

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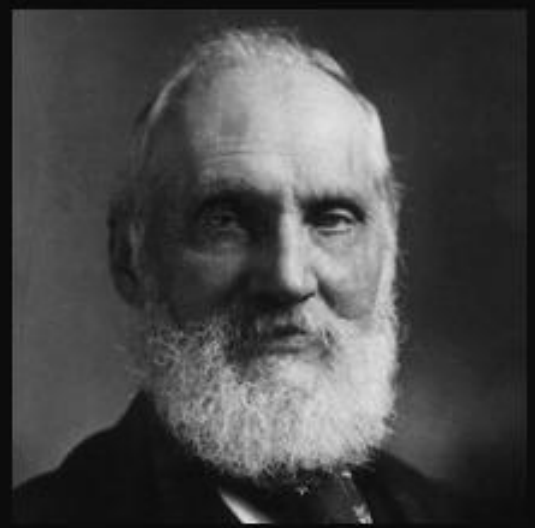
ILRI ● University of Alberta

TRAINING ON GENETIC AND GENOMIC APPROACHES FOR LIVESTOCK IMPROVEMENT
16th – 21st February 2026
International Livestock Research Institute (ILRI),
Nairobi, Kenya.

ROSLIN SRUC ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CGIAR



If you can not measure it, you can not improve it.

~ Lord Kelvin

AZ QUOTES

Historical Background of Animal Breeding

Robert Bakewell of Dishley, painting by John Boultbee (National Portrait Gallery in London)

Robert Bakewell (1725–1795) was the first to implement systematic selective breeding of livestock, particularly sheep and cattle.

He revolutionized animal husbandry during the British Agricultural Revolution by moving away from haphazard mating to a methodical approach to create animals with desirable traits.

His guiding principle was:

"The whole of the art is in choosing the best males to the best females."

This concept laid the foundation for modern animal breeding.

His innovations included:

Progeny Testing He assessed the breeding value of his sires (males) based on the quality of their offspring, a method still used today.

Systematic Selection: He replaced random mating with a deliberate selecting of parents with desirable traits to be parents of the next generation, to improve the next generation.

Focus on Utility: He bred livestock for commercial performance (e.g., meat production) rather than for traditional traits like color, horns, or draft work like others

Record Keeping He kept extensive, accurate records of pedigree, performance, weight gain, and feed efficiency, which was a novel practice at the time.

Leasing Sires He pioneered the practice of hiring out his prize-winning rams and bulls for high stud fees, allowing other farmers to improve their own stock and spreading his methods.

Robert Bakewell widely regarded as the **"Father of Animal Husbandry"**

Data Driven Breeding Goals in today's Livestock Systems

Modern livestock breeding focuses on:

- High production efficiency
- Improved growth and reproductive performance
- Reduced feed intake relative to output
- Enhanced animal health and welfare
- Improve resilience to environmental stressors (temperature, humidity, drought, disease)
- Reduce environmental footprint (e.g., methane emissions, resource use).

Contributions of Data to Animal Breeding to Date

- Increased milk production per cow while reducing total cow numbers
- Significant gains in broiler growth rate, body weight, and breast muscle development
- Improved feed conversion ratios (FCR) across species
- Substantial improvements in lean tissue growth in pigs

Table 1. *Improvements in livestock productivity over the past 40–50 years*

Species	Trait	Indicative performance 1960s	Present (2005)	% Increase
Pig	Pigs weaned/ sow/year	14	21	50
	Proportion of lean meat	0·40	0·55	37
	Feed conversion ratio (FCR)	3·0	2·2	27
	kg lean meat/ tonne feed	85	170	100
Broiler chicken	Days until 2 kg are reached	100	40	60
	FCR	3·0	1·7	43
Layer hen	Eggs per year	230	300	30
	Eggs/tonne feed	5000	9000	80
Dairy cow	kg milk/cow/ lactation	6000	10000	67

Modified from van der Steen *et al.* (2005).

Table 2. *% Change in greenhouse gas emissions and global warming potential achieved through genetic improvement (1988–2007)*

	CH_4	NH_3	N_2O	GWP_{100}
Chickens – layers	−30	−36	−29	−25
Chickens – broilers	−20	10	−23	−23
Pigs	−17	−18	−14	−15
Cattle – dairy	−25	−17	−30	−16
Cattle – beef	0	0	0	0
Sheep	−1	0	0	−1

Sources: Project for DEFRA by Genesis Faraday Partnership and Cranfield University (AC0204).

Contribution of Data to Animal Breeding cont'd

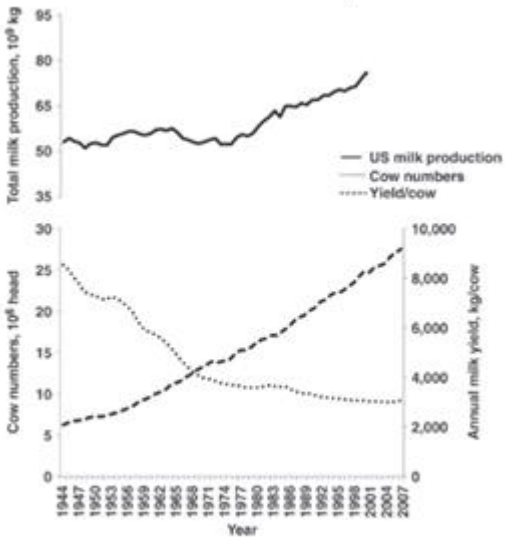
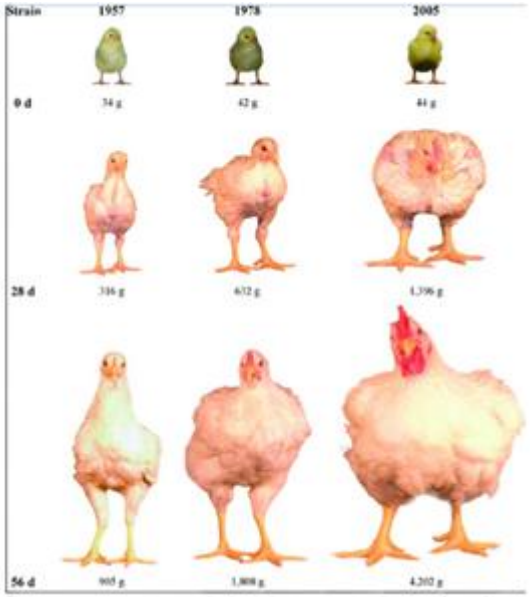
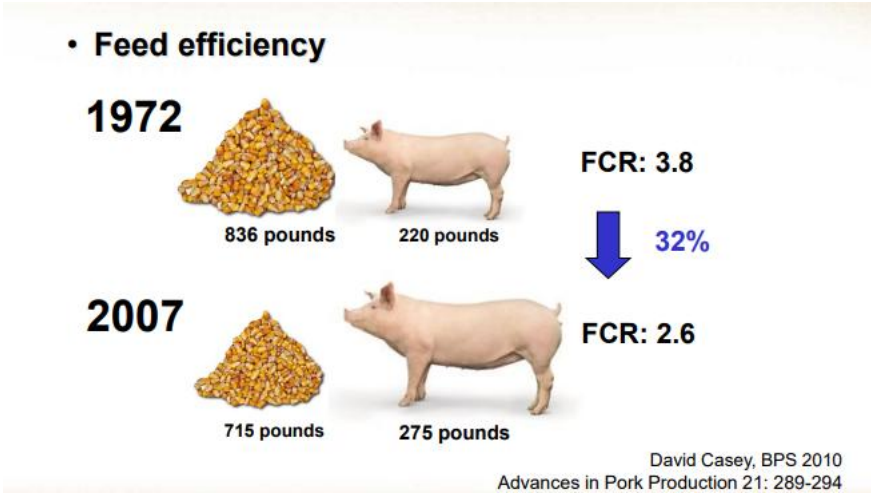


Figure 1. Changes in total US milk production, cow numbers, and individual cow milk yield between 1944 and 2007.

Figure 1. Age-related changes in size (mixed-sex bodyweight and front view photos) of University of Alberta Meat Control strains unselected since 1957 and 1978, and Ross 308 broilers (2005).
Within each strain, images are of the same bird at 0, 28 and 56 days of age.
Forty-two-day feed conversion ratio decreased by 2.55 per cent each year over the same 48-year period.

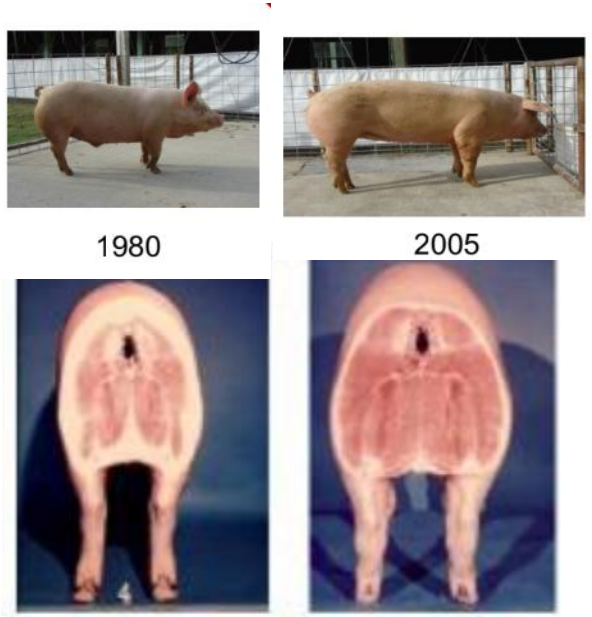


Zuidhof, MJ, et al. 2014 Poultry Science 93 :1–13



David Casey, BPS 2010
Advances in Pork Production 21: 289-294

- High lean tissue growth rate (higher percentage of lean meat)
- Reduce feed conversion rate (improved feed efficiency)
- Low backfat thickness
- Improve litter size

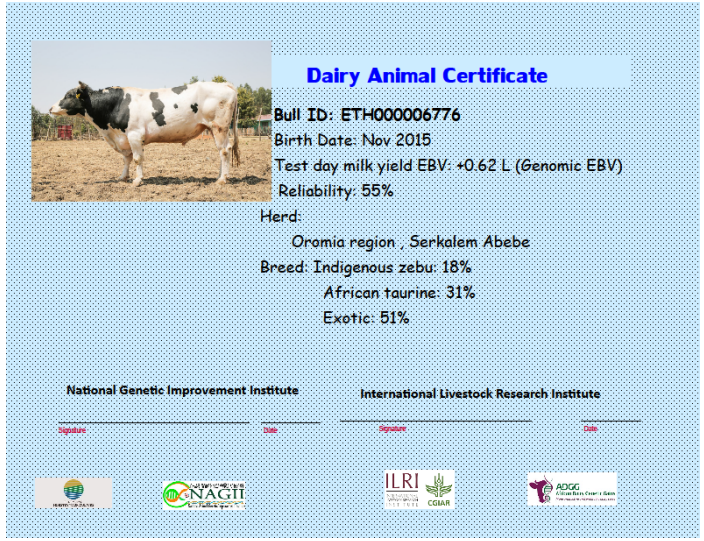


N. Carolina State University

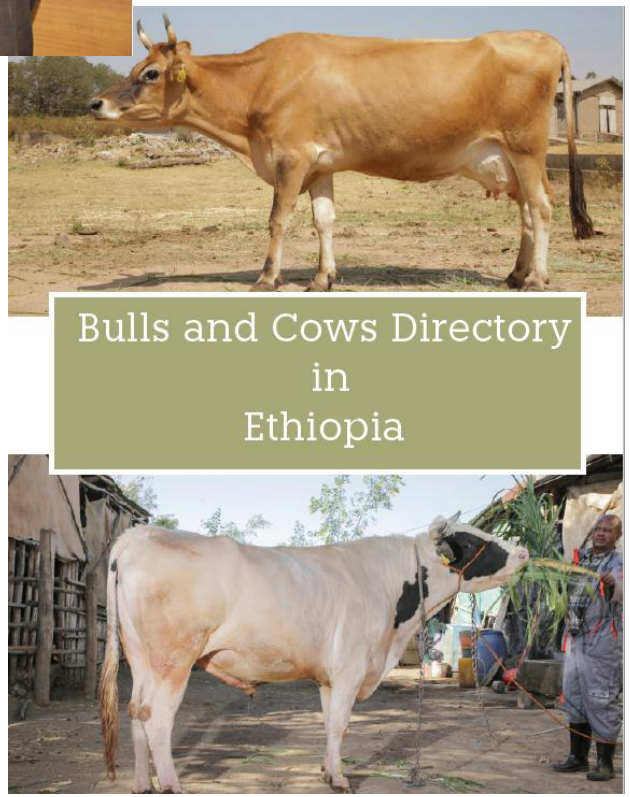
Courtesy of T. See (Fix et al. 2010 Livestock Sci. 128:108-114)

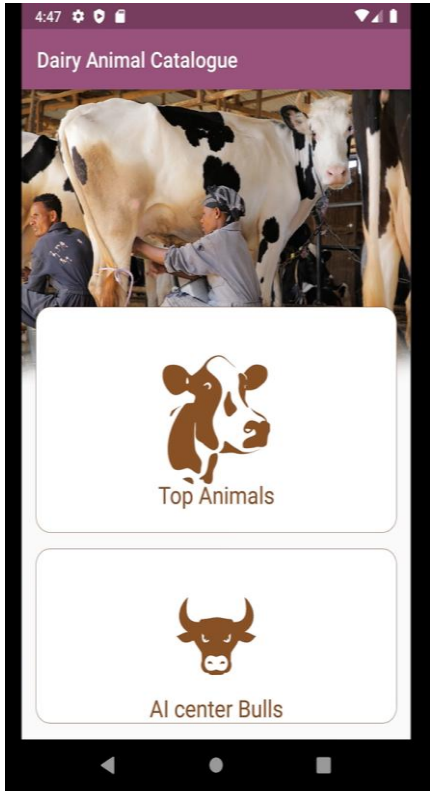
Contributions of Data to Animal Breeding - Dairy Production in Africa

- Ethiopia First dairy animal parade held on Tuesday March 30, 2020, Fikiru Regessa, State Minister of Agriculture (extreme left), Selam Meseret ADGG Ethiopia National Coordinator (middle), and Asrat Tera, Director General of National Animal Genetics Institute (NAGII) Ethiopia.



- ILRI director general, Jimmy Smith (left) and Minister for Livestock and Fisheries Luhaga Mpina (2nd to left) present the award for best bull at a special bull and cow show at the Nane Nane exhibition center in Dodoma, Tanzania, June 2019. Photo ILR





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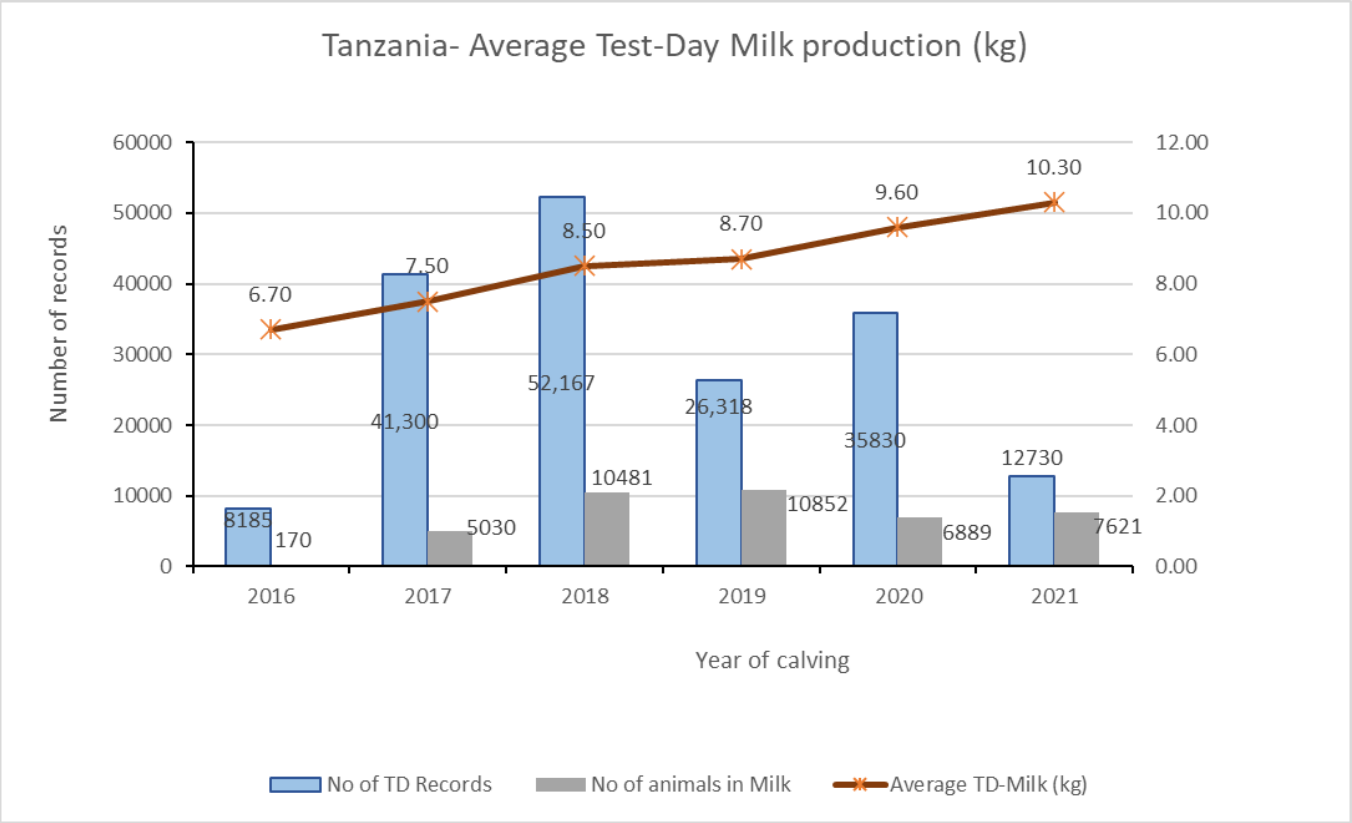
Change in production: Tanzania



Increase in productivity gains achieved

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Data at the Core of Animal Breeding

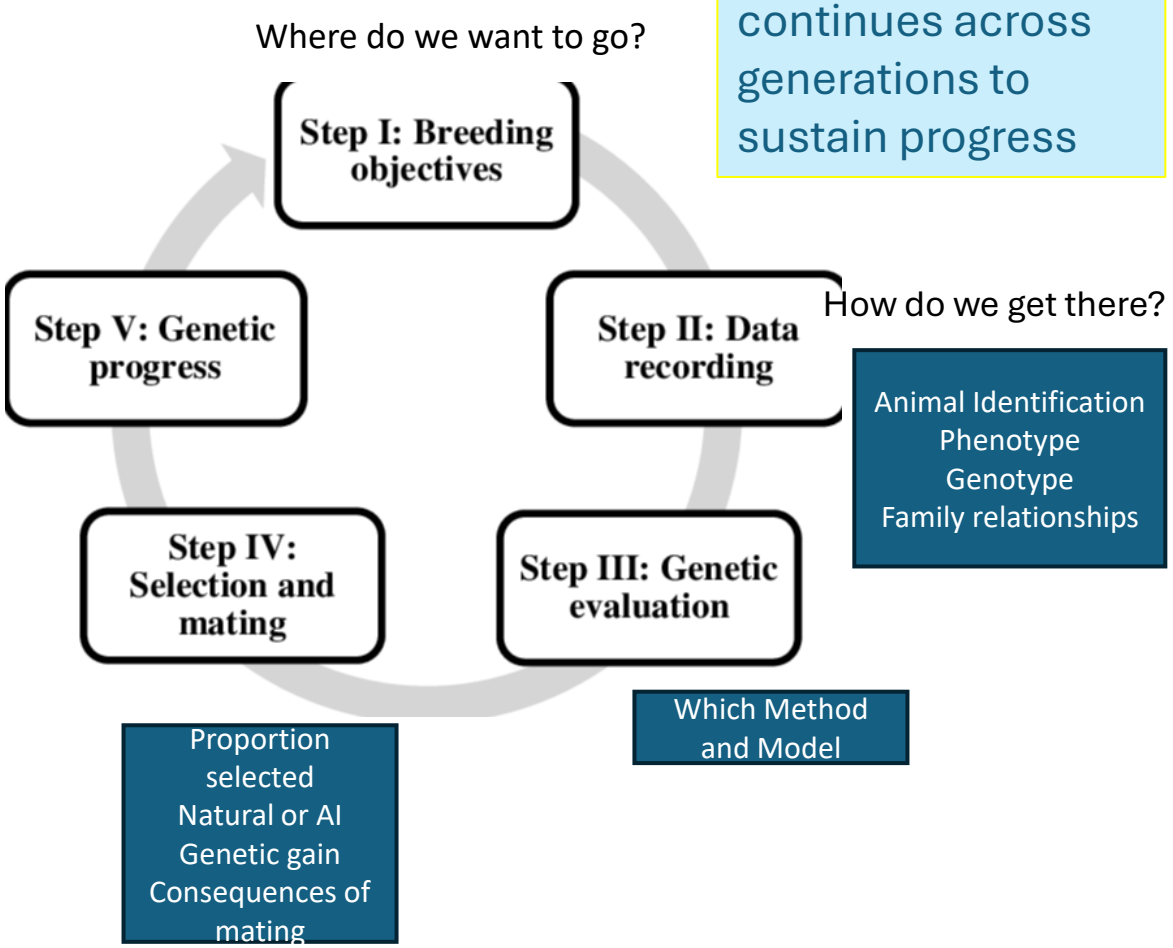
- Animal breeding is based **on predicting an animal's breeding value** which is an estimate of its genetic merit as a parent.
- The goal of this is to **identify animals with superior genetic merit** for specific traits and **select them as parents**.
- Through repeated selection over generations, the proportion of desirable genes in the population increases, leading to **genetic improvement of future generations**
- In animal breeding, animals are characterized by their **traits**, which are **observable** or **measurable**. Traits may describe appearance, such as coat color or horn status or performance, such as weaning weight, milk yield, growth rate, or time to run a distance.
- Together, **phenotypic** and **pedigree data** provide the foundation for animal breeding aimed at long-term population improvement.

How Animal Breeding Works: Breeding Programs

Breeding programs aim to achieve **genetic progress/improvement** by:

- ❖ Exploiting phenotypic and genetic variation
- ❖ Improving productivity, competitiveness, and sustainability
- ❖ Using breeding values to guide selection decisions

This cycle continues across generations to sustain progress



This diagram illustrates the breeding cycle, showing how data collection, genetic evaluation, selection, and mating decisions repeatedly feed back into each other.

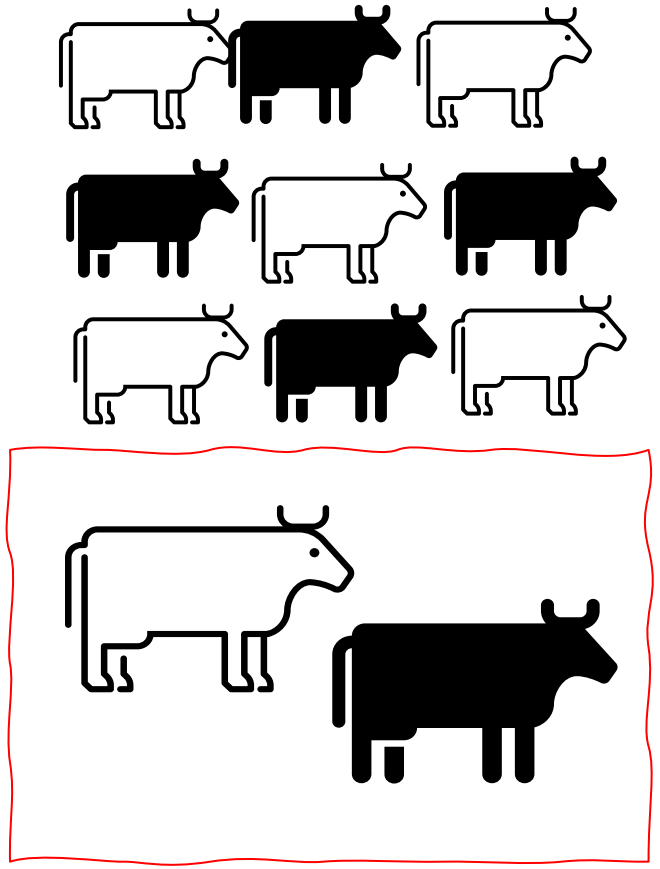
Breeding Programs - Breeding value

Combine phenotype and pedigree (and/or genotype data) to predicted genetic (or genomic breeding values) for selecting genetically superior animals

Genetically superior animals, evaluated and ranked in an objective manner for breeding

pedid	Animal-Mistro ID	Cow No	Reg Name	Sex	EBV_MILK	EBV_AFC	EBV_CI
811	20900054	MKF0054	M50 (321)	M	2.21	-2.27	-0.35
962	20900069	MKF0069	284	M	2.02	-0.29	-0.49
963	20900097	MKF0097	244	M	2.02	-0.29	-0.49
808	20900035	MKF0035	INTAL II	M	1.86	-0.06	-0.17
957	20900019	MKF0019	HOTSHOT	M	0.97	-1.31	-0.13
533	20900034	MKF0034	Q MALGUDO I	M	0.39	-0.92	-0.42
523	20900016	MKF0016	DELIGHT	M	0.31	-1.07	-0.06
965	20900201	MKF0201	S BARRE	M	0.30	-0.92	-0.37
527	20900022	MKF0022	G 3	M	0.26	-0.08	-0.25
465	20900111	MKF0111	ARLINDA ROTATE	M	0.19	-0.67	-0.04
557	20900124	MKF0124	CHARLOT	M	0.18	-0.13	-0.34
959	20900050	MKF0050	BARRE I	M	0.17	-1.64	-0.30
478	20900148	MKF0148	HELIGO	M	0.16	-0.02	-0.17
304	20900110	MKF0110	ARLINDA CHIEF	M	0.12	-0.40	-0.02
806	20900026	MKF0026	MANNIX	M	0.11	-1.67	-1.78
333	20900159	MKF0159	INTENSE	M	0.08	-0.01	-0.09
334	20900160	MKF0160	IVANHOE BELL	M	0.08	-0.27	-0.02

Selection



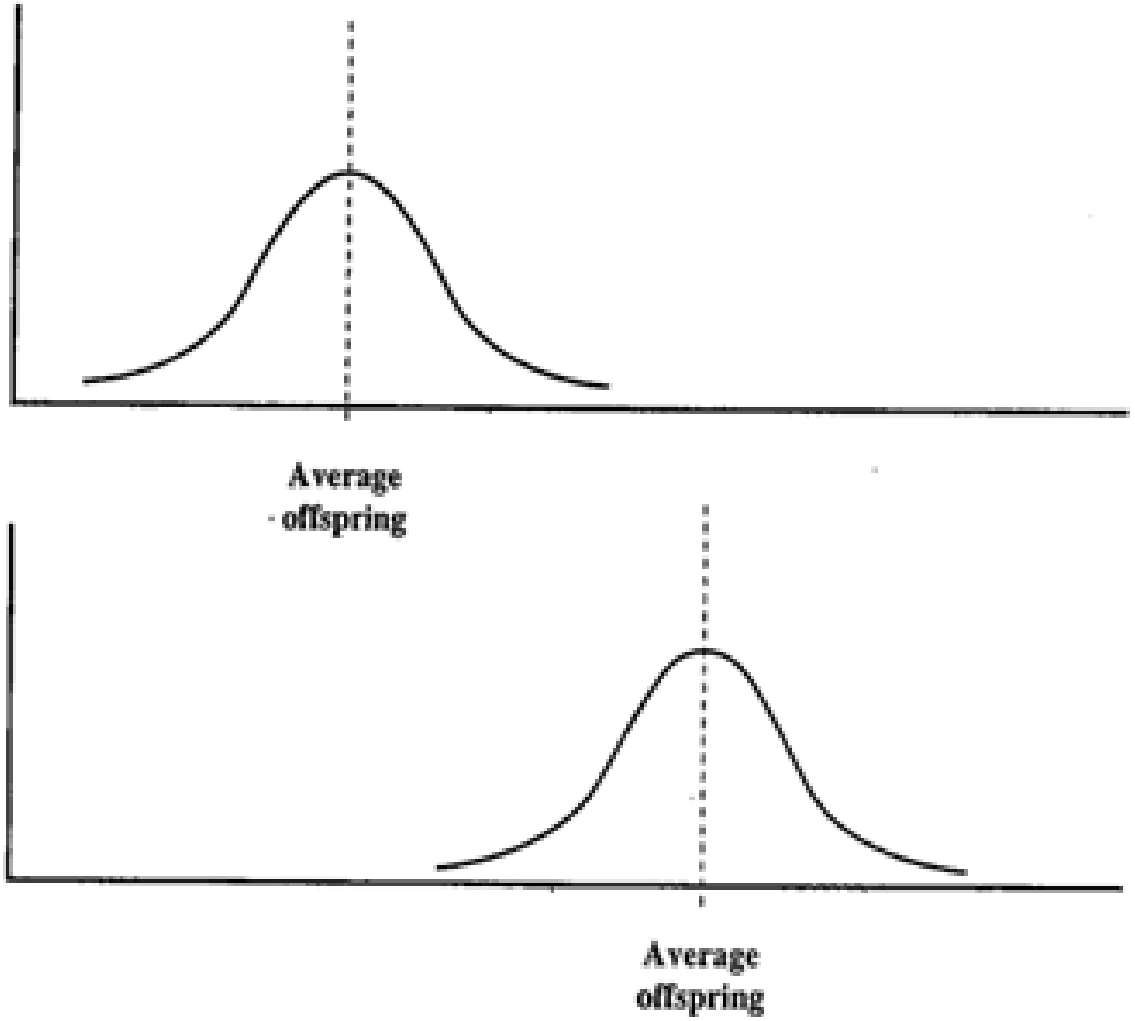
Breeding Decisions Shape Future Populations

Two Key Breeding Decisions: Selection and Mating

Selection – deciding which individuals become parents of the next generation, how many offspring they produce, and how long they remain in the breeding population.

Mating – deciding which selected males are bred to which selected females

The purpose of animal breeding to improve **animal populations** over generations. It is **not** to genetically improve individual animal.



Keeping Records Support Better farming outcomes

Livestock records are essential for:

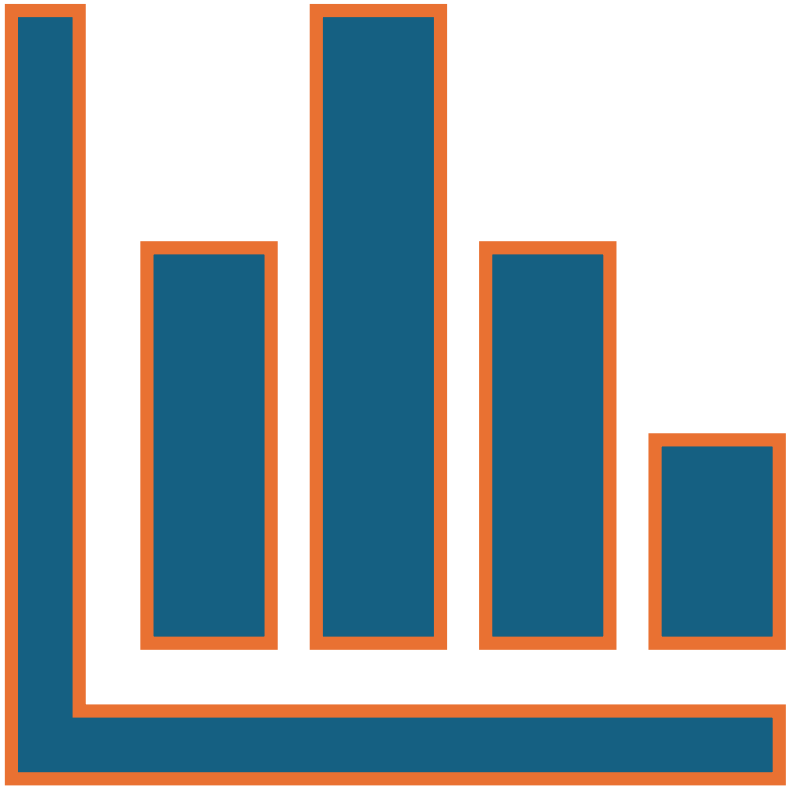
- Monitoring animal performance and welfare
- Evaluating animals for selection and culling decisions to improve efficiency, productivity, sustainability, and genetic progress
- Assessing farm profitability
- Tracking management activities and events

The Basics of Good Livestock Record-Keeping

Well-maintained farm records should capture information on:

- **Animal identification and inventory**
- **Pedigree and genomic information**
- **Key life events**
  Birth, weaning, sales, deaths, movements
- **Breeding and reproduction**
  Insemination or mating, pregnancy diagnosis, calving, age at first service, calving interval, number of services per conception, pregnancy outcomes
- **Production and performance**
  Growth traits (birth, weaning, yearling, and sale weights, average daily gain), milk yield and composition, carcass and fat traits
- **Feeding and nutrition**
  Diets
- **Health and treatments**
  Disease events, vaccinations, medications, treatments
- **Financial and cost records**
  Input costs, treatment costs, revenues

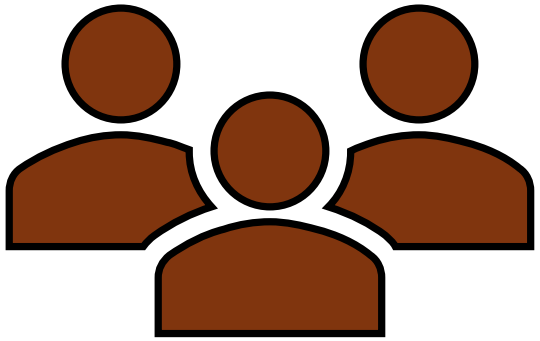
Data Is Only Useful If You Use It



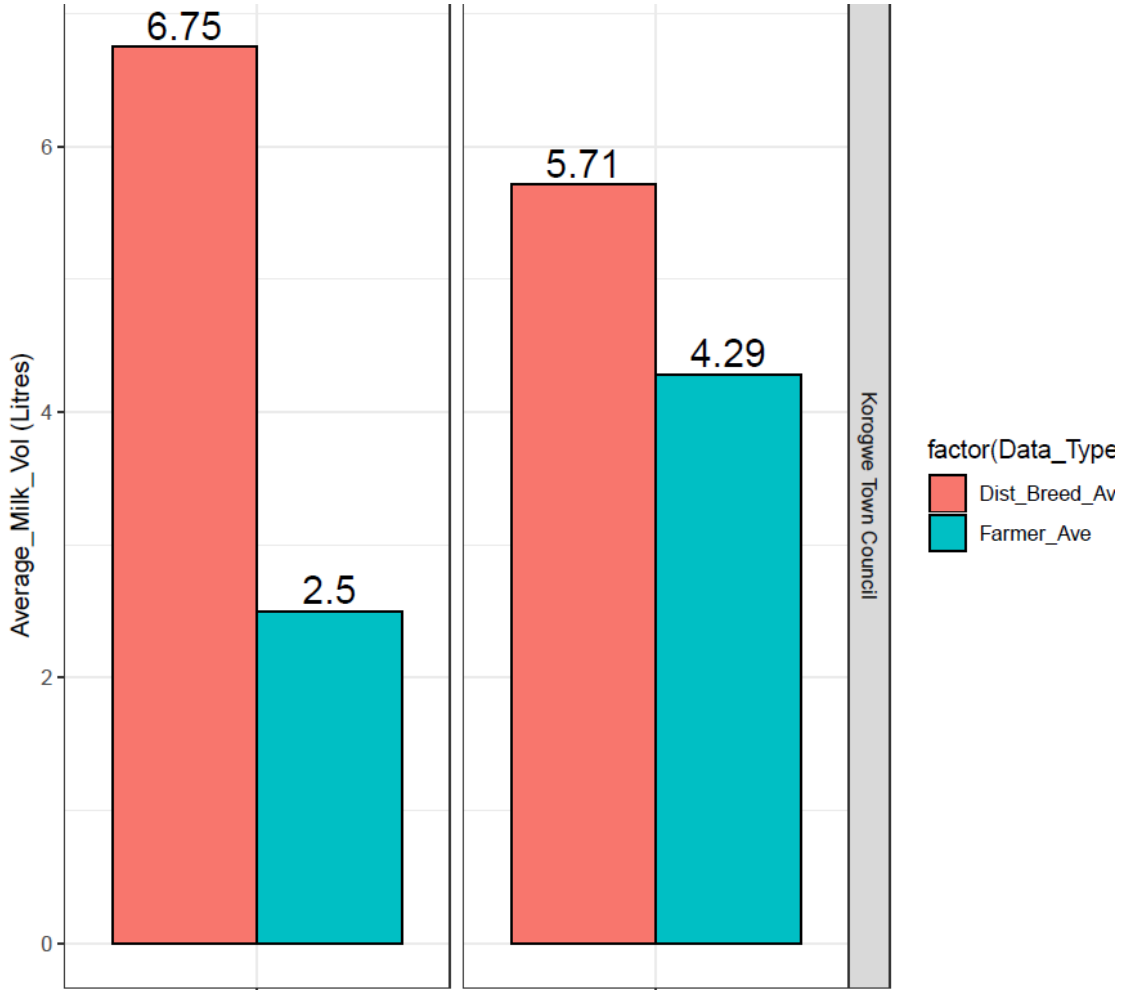
- Convert data into actionable insights
- Use data-driven insights to adjust management practices effectively
- Collecting data alone isn’t enough . It must be processed and applied
- Example: Benchmarking farmers to improve production and efficiency

Production Management

Benchmarking farmers



Demonstrated with farmer milk data



Thanks to CTLGH Funders

Acknowledging the Farmer Facing Programs

Thank you for your attention

? Any Questions