Challenges and Opportunities for Beef Production in Developing Countries of the Southern Hemisphere

M M Scholtz, C McManus, A M Okeyo, L Seixas & H Louvandini

Presented by: Helena Theron

ARC • LNR

Excellence in Research and Development

OUTLINE

INTRODUCTION

Challenges:

- Low production levels
- Global warming
- Adaptation
- Enteric methane production

Opportunities:

- Increase in demand
- Description of production environments
- Recording and improvement
- Genomics




ARC • LNR
Excellence in Research and Development

INTRODUCTION

- Currently cattle are the most important livestock species in Africa & Latin America
- Africa is one of the centres of domestication – large numbers of adapted indigenous breeds.
- Latin America: only camelids (lamas, Alpacas) & guinea pigs are indigenous.
  - All other livestock were imported, & underwent 500 years of natural selection

ARC • LNR
Excellence in Research and Development

INTRODUCTION

- Currently Latin America (Brazil, Argentina & Uruguay) are large exporters of beef.
- Southern hemisphere African countries – only Botswana & Namibia net exporters;
- all others are net importers of beef, despite huge potential of good indigenous beef cattle breeds.

ARC • LNR
Excellence in Research and Development

AIM

What are the challenges and opportunities for beef production in the Southern Hemisphere?

CHALLENGES

LOW PRODUCTION LEVELS

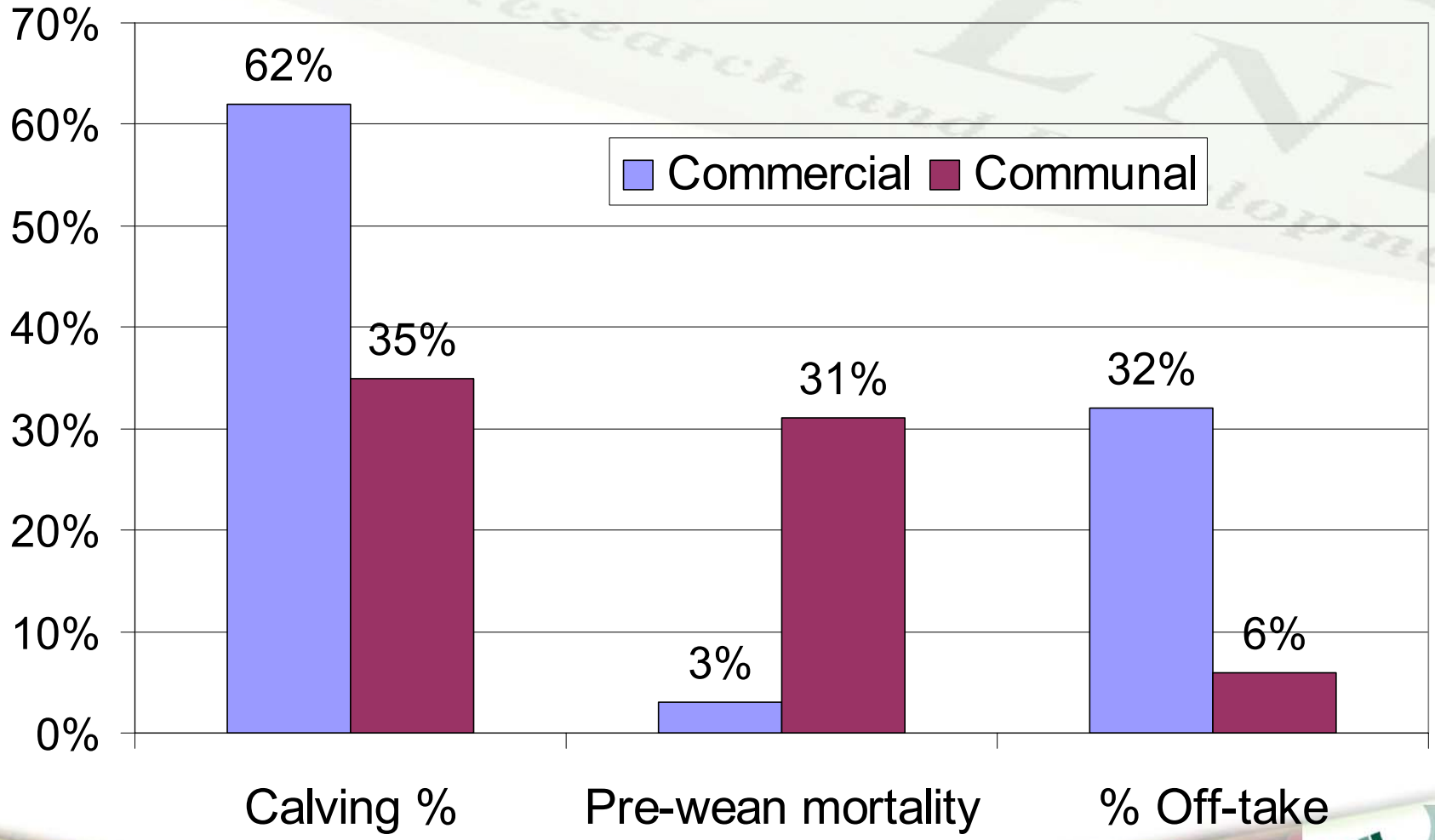
Cattle sector is highly dualistic:

- **communal, subsistence & small scale farmers co-existing with**
- **large commercial farmers.**

Off-take from the commercial sector is high, while it is still low in other sectors as a result of low fertility, high mortality, etc.

ARC • LNR
Excellence in Research and Development

Production in the different beef sectors in South Africa

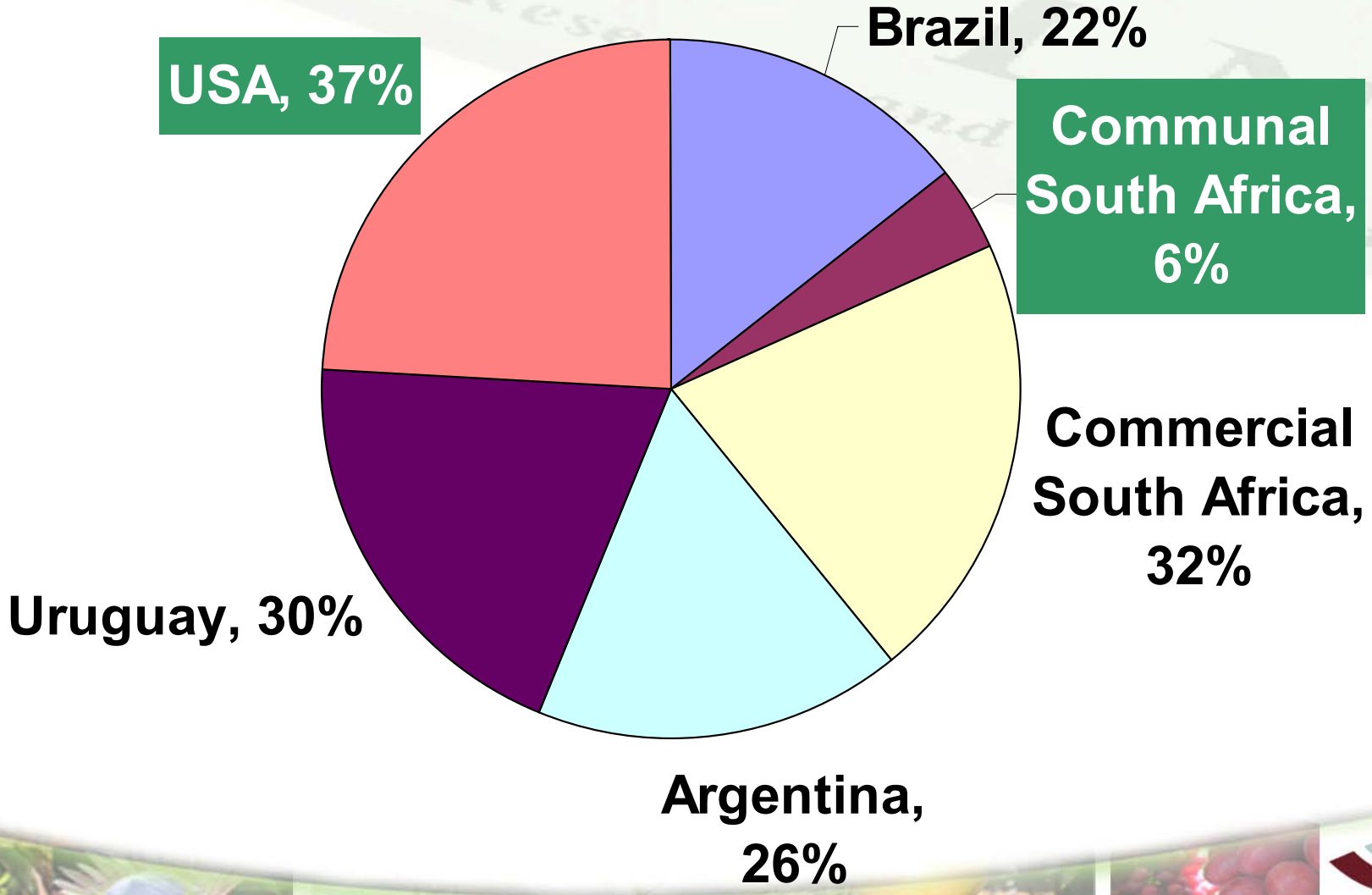


ARC • LNR
Excellence in Research and Development

Beef cattle production in the Brazilian Pantanal following 4 yrs of monitoring

Trait	Start of monitoring	After 4 years
Calving %	45-56%	65-70%
Pre-wean mortality	18-25%	5-10%
Post wean mortality	5%	3%

Comparison of off-takes



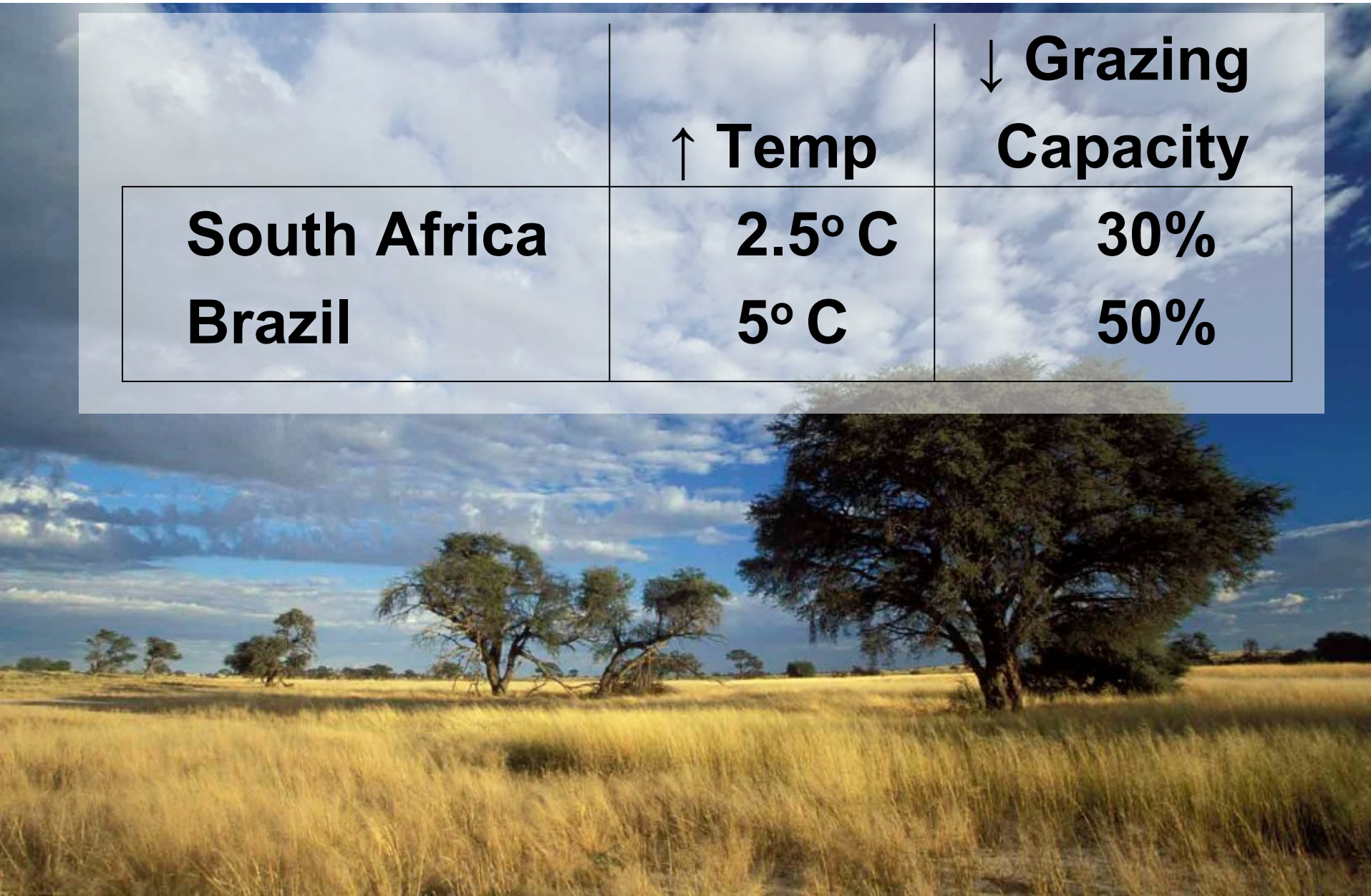
GLOBAL WARMING

Prediction is that climate change will have a more extreme effect on southern than on northern hemisphere

ARC • LNR
Excellence in Research and Development

GLOBAL WARMING

	↑ Temp	↓ Grazing Capacity
South Africa	2.5° C	30%
Brazil	5° C	50%



Effect of global warming on livestock production: Ambient Temperature

Largest direct effect

If livestock is not adapted to high temps:

- reduce feed intake in order to reduce digestive heat production
- reduce grazing time as animals do not graze in hot midday
- increase sweating and water intake

Effect of global warming on livestock production: Nutrition stress

- **Largest indirect effect**
- natural pasture has lower nutritional value and lower tiller density (Tropically adapted C_4 grasses)
- in comparison to C_3 grasses, C_4 has high fibre content, reduced digestibility & higher methane production

Effect of global warming on livestock production: Diseases

- Altered disease patterns that will put even more pressure on production

- recent outbreaks of Rift Valley Fever in Southern Africa

- Climate determines distribution of ticks & vectors (Red water, Gall sickness, Heart water, Corridor disease, East Coast Fever)

ARC • LNR
Excellence in Research and Development

ADAPTATION

- Due to global warming, animals will have to adapt to:
  - higher temperature,
  - lower nutritional value of grasses,
  - expansion of diseases
- Balancing genotype with the production environment is crucial

ARC • LNR
Excellence in Research and Development

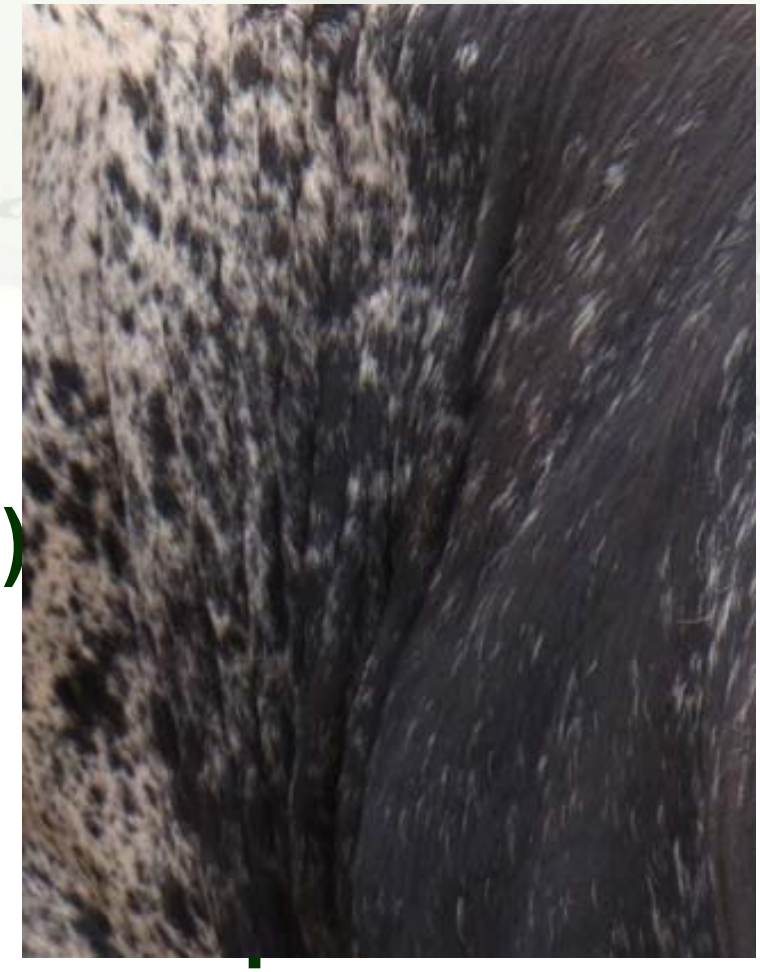
ADAPTATION

- The question is how to measure adaptation and how to select for it
- Adaptability – ability to survive and reproduce within a given environment

Research on adaptation

Direct measurements:

- **rectal body temperature,**
- **respiration rate,**
- **heart (pulse) rate,**
- **sweating rate (water loss)**
- **skin thickness,**
- **hair per cm^2,**
- **heat tolerance test,**
- **temperature change with exercise**

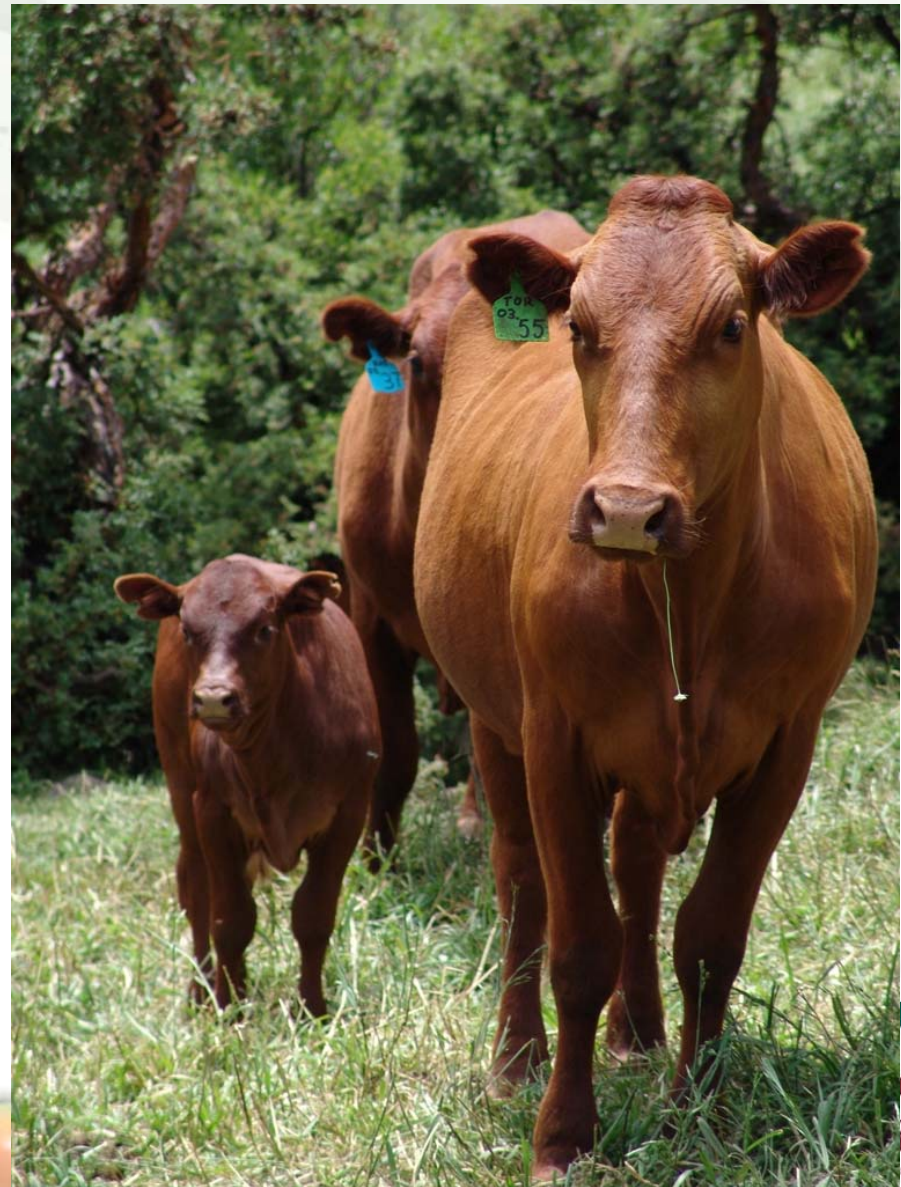


ARC • LNR
Excellence in Research and Development

Research on adaptation

Several proxy-indicators:

- **reproductive traits:**
  - fertility & survival,
  - birth rate,
  - peri-natal mortality,
- **production traits:**
  - growth rate,
  - milk production,
  - mortality,
  - longevity and
- **health traits:**
  - faecal egg counts,
  - external parasites



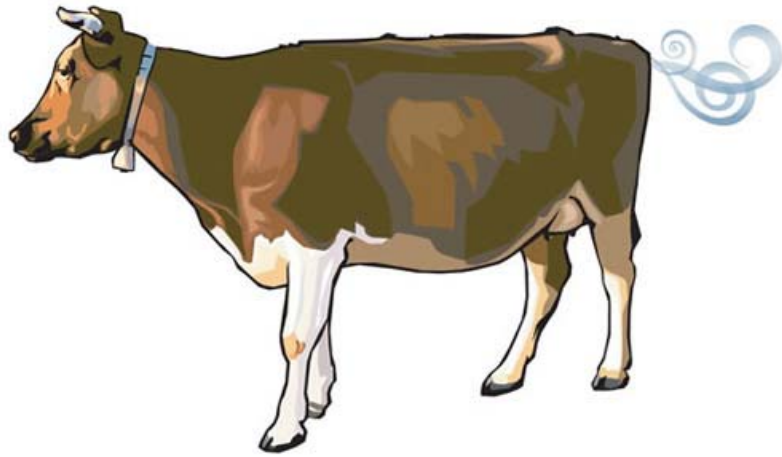
ENTERIC METHANE (CH_4) PRODUCTION

- **Methane facts:**
  - makes up 16% of total world gas emissions,
  - 2nd most important greenhouse gas (GHG)
  - atmospheric warming activity 23 times higher than CO_2
- **Animal digestive tract is main source of methane (28% of global CH_4 emissions)**
- **GHG emission from livestock measured as:**
  - kg CO_2 equivalent per kg product (Intensive grain-fed systems best) or
  - per area of land used (Extensive systems best)

ARC • LNR
Excellence in Research and Development

Can GHG emissions from cattle be reduced? 1: Diet

- **Most research is focusing on manipulating the diet to combat CH_4 emission:**
  - **Use of feed additives**
  - **Genetic engineering of rumen flora**



Can GHG emissions from cattle be reduced? 2: Genetics

- **Genetic improvement results in** permanent and cumulative changes in performance

- **Selection will mitigate GHG in two ways:**
  - higher productivity leads to higher gross efficiency as a result of diluting maintenance cost
  - a given level of production can be achieved with fewer higher yielding animals.

Can GHG emissions from cattle be reduced? 3: Residual Feed Intake

- RFI = Actual $FI_{Production}$ - Expected $FI_{Maintenance}$
- Cattle with low RFI produce up to 28% less methane
- Attributed to different rumen microbial populations
- May be heritable

ARC • LNR
Excellence in Research and Development

OPPORTUNITIES

INCREASE IN DEMAND

- **Increasing population, urbanization & economic development in developing countries - significant rise in demand for livestock products (*Livestock Revolution*)**
- **World demand for meat expected to rise by more than 200%**
  - **229 million ton (1999) → 465 million ton (2050)**
- **Much bigger market opportunities for livestock producers in developing countries.**

ARC • LNR
Excellence in Research and Development

DESCRIPTION OF PRODUCTION ENVIRONMENT

- **By describing production environments in more detail it would be possible to identify breeds or genotypes that may be adapted to specific environments**

DESCRIPTION OF PRODUCTION ENVIRONMENT

- Necessary to link animal performance with the production environment
- Such information can be used in genetic evaluations either as part of the predictive model or as a “post breeding value prediction” calculation

Environmental data

- Good quality environmental data describing production environments already exist
- Variables on
  - temperature,
  - relative humidity,
  - precipitation (including variation in rainfall),
  - day length and
  - radiation

  are available through Geo-referenced Information Systems (GIS) layers
- Important to record GPS waypoints

RECORDING AND IMPROVEMENT

- Animal recording forms the backbone of any improvement programme
- If traits are not measured and recorded improvement is not possible
- Argentina, Brazil, Namibia and South Africa have very well organized recording and improvement programmes in place

RECORDING AND IMPROVEMENT

- South Africa:
  - National Beef Recording and Improvement Scheme supported by government and managed by the ARC

- Brazil:
  - successful beef breeding schemes are run by private companies, universities and EMBRAPA (Brazilian Corporation for Agricultural Research).

Measurement & science

- Statistical science continues to support animal breeding and improvement - very sophisticated, high-dimensional models are applied
- Challenge - to identify fixed and random effects, that account for variation in production environments for use in genetic evaluations

ARC • LNR
Excellence in Research and Development

Proxy-indicators for adaptation

- **Traits linked to fertility and/or survival (days to calving, calving interval, stayability, calving tempo) all influenced significantly by management or arbitrary decisions taken by breeders or scientists**

GENOMICS

- Inclusion of DNA information in the estimation of EBVs may result in substantial increases in genetic gain at reduced cost
- Genomic EBVs (EBVs derived from DNA information combined with conventional EBVs), may speed up the process of breeding animals that are adapted to results of climate change

Genomics

- **May enhance the detection of genes and QTLs that affect tick resistance or methane production**
- **Marker assisted selection will assist in:**

  - selection for disease and parasite resistance/ tolerance

  - traits linked to adaptation (high levels of blood urea to digest low quality C4 grasses)

CONCLUSION

- **Challenges facing beef production in the developing countries of the southern hemisphere include**
  - **variable and low production levels,**
  - **the effect of climate change,**
  - **enteric methane production and**
  - **low levels of animal recording.**

CONCLUSION

- **Several new technologies offer opportunities for beef production in developing countries in next few years. These include**
  - **recording and improvement,**
  - **genomic evaluation methods, together with**
  - **the development of statistical,**
  - **bio-informatics,**
  - **computational and**
  - **geographical information system technologies.**


Thank you