

Environmental descriptors influencing performance – Beef cattle

Researcher: Prof Michiel M Scholtz D.Sc. Agric

Team members:

Mr	J	Amimo	M.Sc
Mr	A	Bothma	M. Sc
Dr	S	Dube	Ph.D
Dr	M D	Fair	Ph.D
Mr	F J	Jordaan	M.Sc (candidate)
Miss	S M A	Maciel	M.Sc
Prof	F W C	Neser	Ph.D
Dr	A M	Okeyo	Ph.D
Miss	L	Pienaar	M.Sc

Research Institute: ARC-Animal Production Institute

Research focus area: Red Meat Safety, Nutritional Quality and Value

Full Title of the project

Environmental descriptors influencing performance of different beef cattle ecotypes

Aims of the project

- To identify non genetic descriptors influencing reproductive performance of Nguni ecotypes.
- To determine the total profile of nutrients should the results from the pilot study indicate the need for this To identify non genetic descriptors influencing productive performance of Nguni ecotypes.
- To characterize production environments (including the possible use of GIS and satellite images)

Executive summary

This study is being used as a Ph.D at the University of the Free State and is registered with the title “Environmental descriptors influencing performance of the Nguni ecotypes”. All the analyses for the thesis has been completed and the student is in the process of finalizing the manuscript for examination. Three articles have already being published. Two additional articles will be submitted for publication.

The objective of this research was to assess the effect of geographical area of birth and ecotype on the reproductive and productive performance of Nguni cattle raised in sub-tropical environments to enhance strategies for livestock development and restocking programs of rural communities and beneficiaries of land reform within the southern African region.

The first dataset used comprised of a nucleus of females and bulls of the Nguni ecotype (breed) from different farmers in South Africa imported into Mozambique and animals from the Landim, a Mozambican Nguni ecotype, from the Chobela Research Station. These animals were all taken to the Impaputo Breeding Station, where there was another herd of Landim cattle. The Impaputo Breeding Station is in the southern region of Mozambique, which is characterized by irregular rainfall, varying from 400mm to 600mm, with high risk of drought, and large pasture areas mainly composed of sweet or mixed grass species.

The results of the Landim and Nguni ecotypes that were kept at Impaputo Breeding Station indicated that ecotype, place of birth, year and season of birth/calving had significant effects on age at first calving and calving interval.

The following is worth noting:

- Age at first calving for the Landim ecotype was significantly lower than that for the Nguni ecotype.
- Origin of the herd had a significant effect on age at first calving, with heifers born at Impaputo Breeding Station being younger at calving than the ones born at Chobela.
- Both calving interval and calving rate were also significantly influenced by herd of origin, with the South African derived cows having longer calving intervals and lower calving rates than those from Impaputo Breeding Station
- Year-Seasons as well as ecotype-by-Year-Season interaction had a significant effect on calving interval.
- In the dry seasons Landim and Nguni cows had similar calving intervals, while in the wet seasons Nguni cows had shorter calving intervals than the Landim.

It is important to note that although the South African derived Nguni cows had longer calving intervals than those from Impaputo Breeding Station, the Nguni ecotypes borne at Impaputo Breeding Station had similar calving intervals in the dry season and shorter calving intervals than the Landim ecotype in the wet seasons. This indicates that the Nguni ecotypes born at Impaputo Breeding Station were better adapted than those imported from South Africa.

The Nguni cattle exported to Mozambique originated from 11 different herds in the Limpopo Province. These herds were grouped, according to the geographic coordinates obtained by the geographic information system (GIS) of the farm and the veld (grassland) characteristics of the area, into four geographical regions, namely the arid sweet mopani veld (2 herds), mixed sweet acacia bushveld (3 herds), mixed veld (4 herds) and sour veld of high altitude (2 herds).

The study of the reproductive and productive performance of Nguni herds, from which cattle were imported into Mozambique, in their original environments of South Africa found that:

- Age at first calving was lower in dry year-seasons than wet year-seasons
- Dry year-seasons showed shorter calving interval than wet year-seasons
- Breeders (herd) had a significant effect on calving interval
- Birth and weaning weights were significantly affected by the region. Birth weight in region 4 (sour veld of high altitude) were different from regions 1 (Arid sweet Mopani veld) and 2 (mixed sweet acacia bushveld). Weaning weight in region 2 (mixed sweet acacia bushveld) was different from regions 1 (arid sweet mopani veld) and 4 (sour veld of high altitude).

This is the first study to demonstrate that the reproductive and productive performance of Nguni cattle is influenced by various factors such as ecotype, agro-ecological region, origin of the dam, breeder / herd management and year-season of birth / calving. It seems that Nguni cattle in southern Africa perform differently according to the conditions, confirming that environment-by-genotype interactions affect its performance. This provides information which can better aid the planning of future cattle development and stocking programs in southern Africa. This includes caution when moving cattle from one geographical area / climate to another in the process of restocking, since the cattle may not be adapted to the new environment.

It is important that this type of research is also conducted on the other landrace breeds of South Africa (Afrikaner, Bonsmara and Drakensberger).

The use of satellite images

The satellite images that were obtained give a vast amount of information. From this information it is possible to estimate

- Normalized Differential Vegetation Index (NDVI) data for the different sites
- Dry Matter Productivity (DMP) data through the use of satellite images.

The above mentioned information, as well as weather patterns (rainfall, temperature) and altitude was used in an attempt to establish any relationships with weaning weights, age at first calving and calving intervals. Unfortunately, up to now this attempt was not successful. The major constraint seems to be the fact that too many variables are involved. Investigations are still underway to see how this information can be down scaled. An alternative that may be worth investigating is to use the climate data from Schulze, down scaled to homogeneous response zones, to establish any relationships between climate and production. The main climatic factors to be investigated could be precipitation, temperature and growing season, as well as the combination of temperature and relative humidity

Genetic and environmental trends in the Nguni breed

The research also stimulated an investigation into the relationship between genetic change and improved production efficiency in the case of the Nguni breed (as part of a bigger study). It is easy to achieve genetic change, but much more difficult to achieve genetic improvement. This study investigates the influence of selection on the cow efficiency in the Nguni in South Africa over a period of 25 years. Cow efficiency was defined as kilogram calf weaned per cow Large Stock Unit.

In the Nguni there were no genetic improvement over this period and actual cow weights, weaning weights and cow efficiency all decreased. Possible reasons for this are:

- changes in the production environment, production region and production system, e.g. Nguni cattle are currently farmed with in areas that were traditionally regarded as unsuitable for cattle farming
- relative emphasis on pre-weaning and post weaning traits in relation to artificial breed standards and
- effect of climate change.

Opportunities for beef production

This research stimulated investigations into related issues which was included in a position paper on "Opportunities for beef production in developing countries of the southern hemisphere" that was published in Livestock Science. The article includes two sections applicable to this project, viz.:

Description of production environments

This section indicates that adaptation of livestock to their production environment can be characterized indirectly by describing the production environment in which a breed or population has been kept over a period of time and to which it has become adapted. By describing production environments in more detail it would be possible to identify breeds or genotypes that may be adapted to the changed environment of an area. It will thus be necessary to link animal performance with the production environment.

Landscape and epigenetics

Landscape genetics is a combination of landscape ecology and population genetics aimed at providing information about the interaction between landscape features and micro-evolutionary processes, such as gene flow, genetic drift and selection. It includes studies that combine population genetic data with data on landscape composition and configuration (i.e. environment in its widest sense). Epigenetics is the study of molecular mechanisms by which the environment controls genetic activity and provides a means of understanding how environmental factors may alter heritable changes in gene expression without changing DNA sequence