Over the years an excellent and strong research team has been established which is reflected by the many research participants and co-workers. Teamwork and close collaboration with other researchers, research institutes and the animal industry is emphasised.

Continuous contact and/or co-operation exist with collaborators outside the university such as the Agricultural Research Council, Grootfontein Research Institute, Institute for Animal Production: Elsenburg, Universities of the North, Pretoria, Stellenbosch and Lesotho, ILRI Kenya, INRA France as well as several local breed societies. The wide range of topics investigated are dictated by the needs of industry, current research priorities in animal breeding and the research priorities of post graduate students situated at various research institutes. Alliances were also formed with researchers at Fort Keogh, USA and Universty of Georgia, Athens, USA.

The variety of leading and co-authors in the research outputs is an indication of the emphasis placed on team-work and involvement in the development of young researchers and collaborators. Most of the research of the team is now done through post-graduate students who often act as leading author of the subsequent congress contributions and scientific publications.
Because the research plan is a continuation and extension of previously applications a short description of current and completed (during last five years) research projects is included. All research is coordinated by the Post Graduate School in Animal Breeding:

The research plan of this division can be sub divided into 5 different categories:
1. Genotype x environmental interaction
2. Genetic improvement of fertility (reproduction traits) and survival
3. Genetic improvement of animals (different species) in general
4. Breeding objectives (micro economic analyses)
5. Stayability (Herd life, productive life, longevity traits)

Genotype x environment interaction (development of better adapted genotypes)

Livestock production in South Africa is carried out under an extremely wide range of environments utilizing a wide range of genotypes. It stands to reason therefore that studies on genotype x environment interactions should form an important part of animal breeding research in this country. A genotype by environment interaction is manifested when genotypes (individuals, lines, varieties, breeds, etc) show a differential phenotypic response across one or more environments. Stated differently, an interaction occurs when selection gains made in a particular environment are not transferable to another environment. The presence of genotype by environment interaction with widely divergent genotypes and environments is well known and documented in both plants and animals. The problem that remains is the understanding of the genetic basis and being able to accurately predict to what extent a seemingly small genetic and/or environmental change can elicit an interaction of biological and economic importance. Intrinsic to the study of interactions is the subject of adaptation, which is the ability of genotypes to cope with environmental challenges and changes. The following six studies/projects will / have addressed these issues:

- Estimating genetic parameters for early growth traits in Brahman cattle (MSc Agric) (This project has been successfully completed resulting in a MSc Agric degree (Nov 2004)
- A genetic evaluation of the Dohne Merino breed in South Africa (MSc Agric) (This project has been successfully completed in 2006 resulting in a MSc Agric degree
- Genotype x environmental interaction in Afrikaner cattle (PhD) (Completed – May 2005)
- Using cluster analyses to investigate GxE interaction in beef cattle. (Own research) (Completed – November 2006)
- Genotype x environmental interaction in Jersey cattle (PhD) (Estimated completion date – November 2009)

It is believed that genotypes adapted on a total mixed ration (TMR) system fail to produce and reproduce under pasture systems. This aspect will be fully investigated as well as a system where herds are clustered according to the specifications given by INTERBULL (International Bull Evaluation Service). The re ranking of sires (production and reproduction traits) across clusters and production systems will give an indication of the magnitude of the GxE.

- Upgrading of existing dairy breeds to a more adaptable dual purpose breed (Own research) (Envisaged date of completion – 2010)

The low production and reproduction rate of existing specialized dairy breeds under pasture systems necessitate the upgrading to a more adaptable dual purpose breed. This has a further advantage that it opens other avenues of marketing to the farmer (beef and dairy products). This will alleviate the financial problems some dairy farmers experience under

pasture systems. The development of more adaptable genotypes is the result of GxE interaction studies. A further spin off of this project is the possibility to study crossbreeding in dairy cattle.

- The adaptability of different breeds in extreme climatic conditions (M Tech)(Envisaged date of completion – 2010)

It is well known that South Africa's extreme climatic conditions have a severe influence on animal performance. Different breeds react differently to heat and cold conditions. The reaction of six different breeds to these conditions will be monitored, while their performance under these conditions will be recorded. The breeds included in the study are three indigenous, two composites and one exotic.

- The use of reaction norms in the investigation of genotype x environment interaction (Envisaged date of completion – 2011)

A reaction norm describes the pattern of phenotypic expression of a single genotype across a range of environments. One use of reaction norms is in describing how different species—especially related species—respond to varying environments. Different genotypes within a single species will also often show differing norms of reaction relative to a particular phenotypic trait and environment variable. For every genotype, phenotypic trait, and environmental variable, a different norm of reaction can exist; in other words, an enormous complexity can exist in the interrelationships between genetic and environmental factors in determining an animal's performance for certain traits.

Genetic improvement of fertility (reproduction traits) and survival (fitness traits)

Two problems facing animal production in Africa are the extremely harsh environment and the prevalence of a wide variety of diseases. Fertility under these conditions, survival (or death) and disease resistance are probably the most important traits in an African animal production context. Most of these traits are measured on a discontinuous scale and are commonly known as threshold or quasi-continuous traits and their phenotypes are measured by assigning scores to discrete categories which may be either binary (dichotomies) or polychotomous and are usually ordered. Threshold traits have traditionally been analysed by postulating that they follow the laws of the normal distribution and, thus, applying linear methods. The fact that such analytical methods have generally ignored the discrete nature of categorical characters has raised some concerns about the validity and reliability of these predictors. The following four studies/projects will/have address these issues:

- An assessment of component traits for the genetic improvement of reproduction in beef cattle (PhD) (This project has been successfully completed in 2006 resulting in a PhD degree)(One of the team members co-promoter)
- Case Study: The effect of inbreeding on the production and reproduction traits in the Elsenburg Dormer sheep stud (2006)
- The genetic and environmental modelling of reproduction in ostrich females (PhD) (Estimated date of completion – May 2010)

This study can be considered as a first in the world since South Africa is virtually the only country with sufficient infrastructure and data to conduct genetic studies in the ostrich. It will focus on the genetic basis of reproduction traits and forms part of a more comprehensive ostrich research project. Results from this study will be used to formulate guidelines for breeding plans for the ostrich industry.

- Genetic studies of cow traits among five breed types in a South African environment (PhD) (Envisaged date of completion 2011)

Cows from different breeds vary quite dramatically in their performance in terms of cow efficiency, as well as other traits associated with the cow. This study will shed more light on this aspect in terms of the important differences that exist amongst breeds and how it influence profitability.

Genetic improvement of animals in general

The modern South African animal breeding scientist is challenged with the conservation, evaluation, utilization and improvement of the abundant genotypes using the most advanced scientific tools at his / her disposal. The following projects could be categorized as addressing these issues:

- Estimating genetic parameters for early growth traits in Brahman cattle (MSc Agric) (Completed - 2004/2005)
- Genetic characterization of Southern African sheep breeds using DNA markers (MSc Agric) (Completed – 2004)

- The characterization of indigenous chickens of Southern Africa (MSc Agric) (Completed – 2004 / 2005)
- Phenotypic and genetic characterization of indigenous chickens of Ethiopia (PhD) (New)
- Genetic parameters for subjective and objective wool and body traits in the Tygerhoek Merino flock (MSc Agric) (New)
- A genetic evaluation of the Cradock fine wool merino stud (PhD) (New)
- Cow efficiency in dairy cattle (New)
- Effect of corrective mating on the accuracy of breeding values (New)

Breeding objectives (micro economic analyses)

- The development of economic selection indices for the Simmentaler breed in South Africa (PhD) (Completed 2004/2005)
- The development of aggregate genotypes for dairy cattle in South Africa (PhD) (Estimated completion date – 2009)

Stayability (herd life, productive life, longevity traits)

- A genetic evaluation of productive herd life in dairy cattle (PhD) (Estimated completion date (2008)

Replacement costs represent a major component of production costs, especially when culling is involuntary (e.g. due to health or fertility problems). Therefore, animal scientists (animal breeders, epidemiologists, economists, etc.) are often investigating ways to increase the average length of productive life of domestic animals. Herd life in the South African Jersey (nationally) declined from 7.9 lactations in 1970 to 2.3 in 1994. The exact reasons for the current (probably lower) short herd life need urgent investigation. The purpose of this study is to construct appropriate models to analyse the complete data sets from all Jersey and/or SA Holstein cows milk recorded in South Africa, using multiple trait analyses and Survival Analysis techniques with the aim of assisting the SA Milk Recording Scheme to supply accurate breeding values for future selection to the dairy industry.