

IRT/BASF funded project

Project 1: An investigation of the role of polyunsaturated fatty acids in preventing metabolic and genital diseases in transition cows in South Africa.

Theme A

The focus of the first study was on the impact of dietary negative energy balance on various indicators of body energy metabolism, immune and reproductive function as well as genetic markers for the uterine microbiome and immunity in dairy cattle.

The project has been designed to achieve the following objectives:

- To investigate the incidence of metabolic diseases in South African transitional dairy cows during wet and dry seasons and in different farming systems (extensive-pasture based system and intensive – Total Mixed Rations based system);
- To identify molecular and systemic markers of metabolic and genital health in transition dairy cows under induced negative energy balance status;
- To evaluate the effect, if any, of conjugated linoleic acids (CLA) supplementation on metabolism, uterine immune responses and fertility of transition dairy cows.

Practical tool

The project will eventually result in the design of a practical tool for small and emerging farmers to enable them to prevent diseases in their livestock and increase productivity on their farms.

Local research on this scale in the dairy industry is uncommon and this project therefore fills a large gap in the knowledge base and points to important management tools which can be used by dairy farmers to improve their sustainability.

Project leaders: Prof Pete Irons

A graduate of the University of Pretoria, **Prof Pete Irons** has practiced as a veterinarian and worked in academia in both the United States of America and South Africa. He holds a PhD, is a registered specialist and a Diplomate of the American College of Theriogenologists. Prof Irons has a C-rating from the National Research Foundation.

Prof Pete Irons and Dr Giulia Esposito



In addition to teaching and research activities he is also an active clinician and specialist consultant in animal reproduction. As head of the clinical department responsible for the training of veterinarians to serve the agricultural sector he has a passion for food security and the central role that the veterinary profession can play at the interface between animal, human and environmental health.

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Dr Giulia Esposito obtained a veterinary degree (*cum laude*) in 2006, with an experimental thesis: “Effect of prostaglandin F2α at the time of A.I. in Italian Mediterranean Buffaloes.”

In the same year she was awarded a Fellowship for Specialization in Animal Nutrition, at the Faculty of Veterinary Medicine, “Federico II” University, in Naples, Italy. In 2007 she was admitted to the PhD programme in production and health of food animal products in the Department of Soil, Plant, Environment and Animal Production Sciences (DISSPAPA) at the same institution.

During her PhD studies she spent 18 months as a visiting student at Cornell University, Ithaca, New York and subsequently joined the university as a graduate assistant researcher.

Before her appointment to the Faculty of Veterinary Sciences of the University of Pretoria Dr Esposito worked as a research officer at the University of Queensland in Australia. Her current research focuses on uterine and metabolic health in farm animals; effect of dietary supplementations on reproduction, metabolism and product quality in farm animals; in vitro maturation and fertilization of oocytes, and embryo culture.

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Team member:

- Prof Edward. Webb – Department of Animal and Wildlife Sciences; (UP Faculty of Natural and Agricultural Sciences);

Project partners:

- BASF South Africa

Project 2: Determining the water footprint of commercially important irrigated crops in South Africa using in-field measurement, crop modelling and remote sensing

In many South African catchments the demand for water currently outstrips supply. Population growth and improved standards of living will exacerbate this constraint even further in the future. In addition, freshwater quality is adversely affected by increasing pollutant loads from the domestic, industrial and agricultural sectors.

[Project K5/2079/4]

Urgent management interventions are required to protect the country’s ground and surface water resources.

Irrigation is estimated to use around 60% of South Africa’s freshwater. However, there is growing pressure to divert some of this water to be used by other sectors such as domestic and industrial users. Farmers are faced with the challenge of producing more food for a growing population using less water.

Data on the week-to-week use of crop and irrigation water use efficiency are also essential in achieving optimal water use and savings at the field and farm scale. The project uses water footprint accounting as a tool to determine both direct and indirect water consumption and pollution of a process or a product.

Accurate information

The envisaged outcome of this project is to acquire accurately determined information on the impact of crop production on water resources and to find ways that this information can be used to improve the management of these resources from the field to catchment scale.

The project will also build capacity in the use of remote sensing to determine crop water use,

and in determining the water footprint of different agri-food products. Water footprint information has the potential to assist commercial companies to identify risks in their supply chain and reduce their water consumption.

Improved understanding of crop water use and the water footprint of agri-food products is essential to produce food in a sustainable way. This information can be used to guide farmers to become more water-efficient at the field scale and empower policy makers and water management authorities to make decisions on freshwater allocation that contribute to higher levels of food security in South Africa. This project has also improved multi-disciplinary collaboration between crop scientists and agricultural economists at UP.

Remote sensing data has been collected for irrigated wheat, maize, lucerne, groundnuts and potatoes grown in the Douglas region. Estimates of crop biomass accumulation and evapotranspiration (ET) determined using satellite imagery are currently being compared to estimates using in-field measurements. The ways in which farmers can use this information operationally, in real-time, are also explored.





Project leader: **Prof John G Annandale**

Prof John Annandale is the Acting Head of the Department of Plant Production and Soil Science in the UP Faculty of Natural and Agricultural Sciences. A graduate of the University of Pretoria he obtained a PhD in Soil Physics at Washington State University in 1991.

He is the developer of the user-friendly Soil Water Balance (SWB) model which has been used for practical irrigation scheduling, but also as a tool to develop and guide his research programme in quantitative environmental biophysics. He is currently involved in research on modelling water use of fruit tree crops and pastures, determining nutritional water productivity and contributing towards food security of vulnerable communities, establishing green and blue water footprints of various crops through the use of satellite technology, and fine tuning the recommended municipal sludge guidelines for agriculture.

Professor Annandale has developed and taught courses in Agronomy, Irrigation Management, Agricultural Climatology and Environmental Biophysics. He has supervised or co-supervised over 20 master's and 10 PhD students, and his group has received numerous awards for their papers and presentations at congresses. He is

a Fellow of the South African Society of Crop Production and has published close to 60 peer reviewed papers in scientific journals.

Dr Michael van der Laan is a senior lecturer in the University of Pretoria's Department of Plant Production and Soil Science. He is responsible for lecturing undergraduate courses on sustainable crop production systems and agro-climatology. He is primarily involved in research on



crop water use and water footprinting, acid mine drainage, solute leaching, cropping system carbon and nitrogen dynamics, and the use of life cycle assessment to determine the environmental footprint of agriculture. Dr Van der Laan also serves as an Associate Editor for the *South African Journal of Plant and Soil* and is the secretary for the International Commission on Irrigation and Drainage's Working Group for the Environment.

Team members:

- Dr Mark Gush – CSIR;
- Dr Seb Dzikiti – CSIR;
- Mr Gerhard van der Burgh –Bureau for Food and Agricultural Policy;

Students supported by the project:

- Miss Nosey Matlala
- Mr Mpendulo Dlamini
- Mr David Taverna-Turisan

Project partners:

- The South African Water Research Commission
- The Council for Scientific and Industrial Research (CSIR)



Project 3: Mnisi Community Programme – a platform for collaboration

The Mnisi Community Programme is a ground-breaking multi-disciplinary initiative between the University of Pretoria's academic faculties, provincial and local government and the Mnisi traditional authority in Mpumalanga.

The programme, launched in 2008, addresses the complex challenges associated with disease transmission between wildlife, domestic animals and human communities sharing the same environment.

It has grown into a multi-disciplinary research, training and community engagement which is attracting strong local and international interest and participation. More than 60 research projects have been started – including 25 new initiatives during the 2012/13 period.

The close relationship between the Mnisi Traditional Authority and the University of Pretoria ensures that research themes are relevant, the community is informed and involved at all times and important findings are channelled back to the people.

One Health

The University of Pretoria is leading research in South Africa on the global concept of One Health. As the only academic institution in the country that has faculties for medical, veterinary, natural and agricultural sciences it is uniquely placed to contribute to research and understanding of the One Health approach to science.

In a world that is continuously shrinking due to population expansion, new technologies and increased human and animal movement, the boundaries between countries, rural and urban areas are becoming more and more blurred. Today over 60% of recognised human infectious diseases are zoonoses in that they originate from the movement of pathogens mostly from

wildlife and livestock to humans.

Rapid outbreaks of infectious diseases such as avian flu, Ebola fever and the West Nile virus have raised public concerns about the impact of such diseases on human health and spurred research on early detection, control and treatment.

The Mnisi community is located in the north-eastern corner of the Bushbuckridge Municipal Area in Mpumalanga, bordering on the Kruger National Park. The study area falls within the savannah ecosystem and forms part of the greater Kruger to Canyon Biosphere, a unique biodiversity hotspot.

The multi-disciplinary nature of the Mnisi Community Programme (MCP) brings together researchers and academics from the University's faculties of Veterinary Science, Natural and Agricultural Sciences and Health Sciences who regularly share their findings. In addition it has attracted research interest from academic institutions in the United States of America, the Netherlands and Belgium.

The MCP addresses the challenges relating to disease transmission between wildlife, domestic animals (both livestock and companion animals), and humans living in the same environment.

Adding to the complexity of the disease ecology, epidemiology and control of such infectious diseases are control policies, integrated land use systems and priorities, environmental limitations as well as socio-economic challenges.

Community sustainability

The MCP responds to aspects beyond disease

itself and also focuses on the well-being and sustainability of a particular society. It demonstrates how a healthier animal population, conservation systems and the ecosystem could contribute to the conservation of biodiversity as well as household and community sustainability and resilience.

The vision of the MCP is to be an international platform in One Health for integrated teaching, learning, research, and community engagement at the livestock/wildlife interface. Its mission is to improve the health and well-being of people, animals (wild and domestic) and the ecosystem through;

- Scientifically informed interventions and services to monitor and promote health and well-being;
- Promotion of resilient and productive ecosystems for sustainable biodiversity conservation, food production and livelihood strategies;
- Training and capacity building through multidisciplinary collaboration and mutually beneficial partnerships.

These objectives are achieved through:

- research in the fields of zoonotic and trans-boundary animal diseases, livestock and wildlife management and production, animal and ecosystem ecology, socio- and agricultural economics, food security, trade and marketing;
- multi-disciplinary collaboration;
- teaching and learning at both post- and undergraduate levels;
- community development through capacity building and the strengthening of long-term sustainable relationships; and
- contributions to conservation initiatives.

Local and international presence

Since its inception in 2008, the MCP has grown into a multidisciplinary research, training, and community engagement platform with a strong local and international presence. It has supported and facilitated over 60 research projects to date of which 40 are still on-going. The main research themes during the initial five years have been disease ecology and emergence (mainly zoonoses) as well as animal health management and control.

Other project themes covered by research include policy, trade, and market access, economics of societies, health and production,

natural resource management and utilisation, as well as livestock production, animal (wildlife and livestock) ecology and food security.

The significant growth in the research activities is evident in the approximately 25 new projects listed during 2012/2013. In total eight PhD projects, 35 master's, and five honours projects have been part of the MCP. An estimated 30 publications have emerged from postgraduate and collaborative research projects.

A primary highlight of the MCP has been its success in the establishment of networks and relationships, capacity building and the growth of longitudinal research platforms.

Three such platforms have been established in recent years, namely the continuous monitoring of rangeland change, a health and demographic surveillance system among all cattle as well as a health and demographic surveillance system of owned-dogs in villages.

Contribute to improved health

Existing and new projects within the MCP will significantly contribute to our insight into the role food and nutrition play in the well-being of communities in resource-constrained environments.

It will lead to a greater understanding of the complex relationships between food production, food security and well-being at household and community level. It will also contribute to improved health and productivity of livestock, strengthened disease control measures and address the impact of climate change on impoverished and resource-constrained communities.

The MCP holds great potential to test and implement interventions to improve food, nutrition and well-being in a programme while their impact and success can be monitored and scientifically proven.

Existing research projects will continue in partnership with the Mnisi community and the national and provincial governments. At least two multi-disciplinary initiatives are being planned, including the expansion of the UP Department of Family Medicine's very successful Community-Oriented Primary Care model.

A pilot research project in partnership with the National Institute for Communicable Diseases is being conducted in the MCP in which the role of zoonotic pathogens in patients presenting with febrile syndromes at community health clinics is being investigated. This is expected to result in the establishment of a long-term health surveillance site in the community in partnership with the MCP.

Project leaders:

The main project leaders within the MCP have been:

- Prof Darryn Knobel - Associate Professor: Department of Veterinary Tropical Diseases, (UP Faculty of Veterinary Sciences);
- Prof Anita Michel - Associate Professor: Department of Veterinary Tropical Diseases, (UP Faculty of Veterinary Sciences);
- Prof Maxime Madder - Head: Veterinary Entomology Unit, Department of Biomedical Sciences, Institute for Tropical Medicine, Antwerp, Belgium;
- Prof Vic van Rutten - Division of Immunology, Dept of Infectious Diseases and Immunology; Faculty of Veterinary Medicine, Utrecht University, The Netherlands;
- Prof Eddie Webb - Head of Department: Department of Animal and Wildlife Science, (UP Faculty of Natural and Agricultural Sciences);
- Prof Geoffrey Fosgate - Professor: Department of Production Animal Studies, (UP Faculty of Veterinary Sciences).

The main institutional partners are:

University of Pretoria:

- Faculty of Veterinary Science:

- Faculty of Natural and Agricultural Sciences:
- Faculty of Health Sciences
- Department of Family Medicine

External partners:

- Institute for Tropical Medicine, Belgium
- Faculty of Veterinary Medicine, Utrecht University
- School of Veterinary Medicine, University of California – Davis
- Oregon State University
- AHEAD – Greater Limpopo Transfrontier Conservation Area (GLTFCA)
- Kruger to Canyons Biosphere Reserve
- South African National Parks
- Buffelshoek Trust
- Mnisi Traditional Authority
- Mpumalanga Department of Agriculture, Rural Development and Land Administration (DARDLA) – Thulamahashe, Bushbuckridge
- Mpumalanga Veterinary Services, Orpen and Thulamahashe Offices
- Department of Agriculture, Forestry and Fisheries – Skukuza offices
- Department of Environmental Affairs – Expanded Public Works Programme

From left to right: Prof Nick Kriek (Veterinary Pathology), Ms Marie Watson (Centre for Veterinary Wildlife Studies), Prof Darrell Abernethy (HoD: Dept. Veterinary Tropical Diseases), Dr Mohamed Sirdar (PhD student), Prof Peter Thompson (Dept. Production Animal Studies), Dr Laura Salisbury (MSc student), Prof Pete Irons (HoD: Dept. Production Animal Studies), Prof Gerry Swan (Dean), Prof Darryn Knobel (Dept. Veterinary Tropical Diseases), Mr Jacques van Rooyen (MCP coordinator), Dr Nicola Collins (Dept. Veterinary Tropical Diseases), Dr Anne Conan (Postdoc Fellow), Mr Choopa Chimvwele (MSc student)

