

RESEARCH – WHAT IS NEW? WHERE ARE THE DOLLARS GOING?

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Introduction

A successful dairy production industry requires evolving and adaptable farming systems. As the political and environmental landscape changes so do appropriate farming systems. New Zealand dairying has to be profitable, which, in the prevailing political and environmental climate, means productive, sustainable and competitive. It is unlikely that one size will ever fit all.

Developing the next generation farming systems involves tackling big problems with far-ranging targets but often involving progressive change and not always leaps and bounds. For some time in New Zealand, farm-targeted research sights have been set to the short-term, this season and maybe next, and on small-scale studies, usually plots and paddocks. These have been often uncontrolled and poorly repeatable studies. Farms work on different scales of operation and true success is based on medium to long-term achievement.

To deal with the big problems, DairyNZ Research has created big projects, actually programmes, with big ambitions and stretch targets using truly farm-scale studies and properly scientific measures. A key part of this is to perform science that is recognised as innovative, trustworthy and entirely credible. This is for our industry, our investors and ourselves. Nothing creates enthusiasm in a scientist better than recognition and credibility.

DairyNZ Research will not be megalithic ,but rather become the hub of partnerships and networks. The milksolids levy is being used to attract large sums of additional funding to create the large projects needed. Over the past two years, six new big projects have been created, trebling external income to more than \$5.5M/yr. These projects last for five to six years to allow stretch to occur. The funding is mostly from the Foundation for Research, Science and Technology and is matched by DairyNZ levy funds. Enhancement from other sources is also useful. Importantly, the projects are not all led by DairyNZ; the Liggins Institute and AgResearch have key roles. The projects described later all include partners, especially

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Lincoln University, the Hopkirk Institute, LIC, AgResearch, the WTAR Trust and ViaLactia in New Zealand, and DPI in Victoria.

Research projects

Feed conversion efficiency (FCE)

This project will exploit the genetic potential in the New Zealand dairy herd to identify individuals which use feed most efficiently, both for body maintenance and production of milksolids. The predicted outcome is an improvement in feed utilisation of up to 7% that is delivered by animal breeding. Thus, the same milk could be produced by 7% less feed.

The project, based largely in Taranaki at WTARS where a purpose-built feed centre has been created, has been running for nearly two years. Initially, the studies are measurement of feed to body weight conversion efficiency in calves. The hypothesis is that the same biochemical mechanisms are used for maintenance, growth and to produce milk. The most and least efficient animals are being selected from 1000 calves to be retested for milksolids production in the second lactation. The experiment is being repeated in Victoria to get sufficient scale to find that 7% targeted difference. This is how partnering can be applied to make research viable and affordable, and to create really big and adventurous studies. The genomic basis of FCE will be determined as all animals are being DNA-tested. The net effect will appear in animal breeding via the LIC partners in about 5 years time, after any possibility of adverse influences, e.g. lower fertility, can be discounted. A project this large allows other benefits and opportunities. Already the animals are being used in separately-funded, climate change studies to show that the more efficient animals produce less methane; and post-graduate students will carry out parallel studies to the main trial allowing development of the next generation of scientists.

Novel tools for control of mastitis

This project is really about finding cows with the greatest natural resistance to mastitis. It is a project directed by a fundamental shift in thinking about mastitis. For decades now research has been about detecting and treating mastitis, worrying about the 15-25% clinical cases each year. This project targets why and how 35% cows never suffer clinical mastitis or a raised cell count in their production life. These are the unseen cows that make a farm profitable by costing little.

Populations of cows with no history of mastitis have been identified from DairyNZ farms and from the databases belong to LIC project. The phenotypic characteristics of these cows are being determined and compared with herd averages to show in which characteristics they are different. The 'level' of resistance is being tested experimentally by exposure to bacteria to determine the importance of the immune system, the teat canal and the natural

antibacterial mechanisms of the cow. All of these levels of resistance vary between cows. They are being quantified and related to the mastitis history.

A secondary project is to look at the potential for a vaccine against *Streptococcus uberis* mastitis by enhancing the white blood cell defences whilst not creating the large response that results in a high cell count and clots. Traditionally, vaccines seemed likely to aid mastitis control but only by creating a mastitis. Creating an effective defence using white blood cells is necessary because antibody defences alone appear insufficient defence against bacteria gaining entry to the mammary gland.

Lactation management

This research will contribute to maintaining the cost-effectiveness of the NZ dairy industry through increased milk production by strategic use of lactation management tools and genetic technologies to optimise daily milk production and the number of days in milk of dairy cows. The knowledge gained will be delivered to the dairy industry by providing on-farm management strategies to manipulate milk production through changes to milking frequency, reproductive interval and/or nutrition, and by identifying biomarkers for optimised individual animal responses to such systems.

The project aims to determine the effects of manipulating milking frequency and/or nutrition on the milk production profile, mammary function and nutrient partitioning during a standard 270-day lactation and a 670-day extended lactation. The outcomes will be lactation and nutrition strategies that improve on-farm profitability through increased milksolids production per cow and reduced production costs. Once phenotypes (the most suitable cows) have been identified, genetic markers, especially for extended lactation, will be sought.

Improving fertility

Fertility in the higher producing dairy cow is a concern to all, even more so when we rely on a seasonal system and tools such as calving induction which will be confined to history. The target is to achieve 70% cows calving by 4 weeks and 95% calving by 8 weeks after the planned start of calving, with 88% of cows pregnant within 8 weeks after the planned start of mating. The initial work is to improve reproductive health by understanding the effect of subclinical infections, how 'clean' the cow might be and how this affects the ovary and the uterus. Various assays will indicate the effects of micronutrients and hormonal status. These

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can affect fertility by altering the degree of inflammation of the infected reproductive tract such that the ovum has poor viability, or the fertilised ovum does not implant or placental development is insufficient. A key issue is early embryo loss even in those cows ovulating and served with viable sperm. It is not a conception failure that is necessarily the priority issue but the next stage of development. This work builds on the understanding of gross nutrition measured by body condition score where clear targets for body condition score are well understood for calving and mating knowing.

Animal welfare

The well-being of production animals is key to farmers' freedom to operate, whether it is about tail-docking, body condition or inductions. The joint AgResearch-DairyNZ project aims to deliver quantifiable, acceptable and practical farm animal welfare assessment systems and guidelines based on good science. The measurements have to be objective by understanding the effect of management systems on physiology and productivity, often translated to more easily observable effects such as body condition, health and fertility. The indicators of good welfare have to be developed and adopted. They must be acceptable to consumers.

AgResearch will be carrying out a series of experiments to identify indicators of well-being. DairyNZ will primarily transpose these into achievements and adoption targets that are practical. In the past New Zealand has been criticised internationally on several industry practices. Recently however, New Zealand has become recognised as leader with the Code of Dairy Cow Welfare now the basis of the International Dairy Federation documents on welfare and likely to be included in the OIE standards that underpin trading in animal products.

Dairy systems for environmental protection

This project seeks advances in animal selection, pasture and nutritional management, and information technology to lead to new designs of farm systems featuring fewer, but more nitrogen efficient cows, higher milk yields from more diverse and higher quality pastures and decreased environmental impact.

The work starts with attempts to alter the relative distribution of dietary nitrogen from forage protein to milk protein and faecal nitrogen, rather than urinary nitrogen. Once efficient cows have been identified then genomic markers can be sought. Realisation of the best effects will vary with farm management practices including feeding, so various feeds such as low and high-sugar grasses, and seasonal low-energy feeds will be studied. The plant component will use grazing and feeding trials to test if increased feed diversity, including grasses, legumes and herbs, can increase feed intake, reduce N leaching and improve water use efficiency. Including plant preference and intake studies will enable dairy farm systems to be designed to reduce the environmental impacts, but maintain profitability. The various trials and model studies are

planned to achieve 1200 kg milksolids/ha with a 50% reduction in nitrate leaching (<25 kg N leached per ha).

A key part of this project is the partnering between DairyNZ and Lincoln University that has led to the creation of the new research dairy farm at Lincoln. The resource will be used as the basic research site for future work and the base for post-graduate students.

Other projects

A number of existing projects continue including measuring pasture grown using new technologies whether they be a motorbike mounted pasture meter, use of radar or a combination of satellite images and modelling and effects of winter housing systems.

The South Island way forward

Many of the current DairyNZ projects have a North Island base related to facilities and science core. That is not simply the Waikato, as the Feed Conversion Efficiency studies and the Lactation Management studies are largely in Taranaki.

Three years ago DairyNZ had little research commissioned in the South Island and no local research staff; involvement was confined mostly to the Lincoln University Dairy Farm (LUDF). Investment was grown through projects at Lincoln, on the West Coast, at the Southland DF, looking at wintering systems and animal welfare, as well as LUDF. Then there was one researcher. Last season a technician was added and for next season another scientist is being sought. More than this is the partnering with Lincoln University. This includes the joint funding of the Chair in Dairy Production with plans to add two or three more joint appointments. The project on Environmental Protection brings the plant and feeding work to Lincoln University and that brings three postgraduate students allowing more capability growth. A new feed project is planned to start in Southland. Lincoln University and DairyNZ now have the basis, in levy investment, science and expertise, for a Centre of Excellence in Dairying.

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