Vol 26 | No 3 | SEPTEMBER 2022 | ISSN 2463-3011

THE JOURNAL

The Official Publication of the New Zealand Institute of Primary Industry Management Incorporated

ANIMAL WELFARE FARM-LEVEL GHG MANAGEMENT PLANS **VIRTUAL FENCING IN PASTURE-BASED FARMING**
ECONOMIC PATH FOR AGRICULTURAL SECTOR RESEARCH INTO GHG MITIGATION TECHNOLOGIES
ADAPTATION TO 190N CAP **COMPUTER VISION AI FOR EARLY FRUIT SIZING**

NZ Institute of Primary Industry Management

nzipim

NZ Institute of Primary Industry Management

Thanks to our conference sponsors:

FMG Advice & Insurance

Ministry for Primary Industries
Manatū Ahu Matua

DairyNZ

Deer Industry New Zealand

FARMAX

Overseer

PIONEER.
BRAND · PRODUCTS

trev

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

National SCIENCE Challenges

qconz

Rural Support

NZ Institute of Primary Industry Management

THE JOURNAL

The Official Publication of
The New Zealand Institute of Primary Industry Management Incorporated

Volume 26
Number 3
September 2022
ISSN 2463-3011

The Journal is published quarterly and provided free of charge to NZIPIM's members from across the rural profession including farm management advisors, rural bankers, farm accountants, fertiliser consultants, rural valuers, specialised service providers, farm managers, representatives from industry good organisations, CRIs and universities.

National Office
Gleneagles Building
Level 3, 69 The Terrace, Wellington 6011
PO Box 5304, Wellington 6145
(04) 939 9134
admin@nzipim.co.nz
www.nzipim.co.nz

President
Julian Gaffaney

Chief Executive
Jo Finer
jo@nzipim.co.nz

Editor
Helen Greatrex
helengr57@gmail.com

Editorial Committee
Alison Bailey, Julian Gaffaney, Dave Gray, Phil Journeaux, Don Kennedy, Lee Matheson, Nicola Morris, Nico Mouton and Ian Williams

Print Production
Bluestar Petone
021 391 349
tracy.willmers@bluestar.co.nz

NZIPIM Membership Enquiries
admin@nzipim.co.nz

Annual Subscription Rates
$75+GST (NZ)
$100 (Australia)
$120 (other countries)

Contents

Feature articles

Profile


8

JO FINER CEO

The good, the bad and the ugly of animal welfare

World-leading animal care is critical for our primary industry and New Zealand.

Our sector works relentlessly to prioritise good animal welfare outcomes and to provide training to build the skills to support the best standards of care. We work to understand consumer and market expectations about animal welfare, then ensure that the scenes from New Zealand's pastoral livestock industry reflect these good standards, where every animal is treated with care and respect.

The Animal Welfare Act 1999 provides a clear statement to New Zealanders – and to the rest of the world – that animals in our nation have a right to proper and sufficient care. Animal owners or those in charge are obliged to meet an animal's physical, health and behavioural needs, and must alleviate pain or distress. The Act also contains provisions to prevent the ill treatment and inadequate care of animals.

However, it's not uncommon to see shocking cases where animal health and welfare has been neglected – viewed either first-hand or through the media. Ugly sights that we simply don't want associated with our pure and natural New Zealand story. The primary sector is right to want to eradicate such abhorrent behaviour towards livestock and at times that requires the Government to step in.

Amendments to the Animal Welfare Act came into force in May 2015, strengthening the protection of animals in New Zealand by allowing for stronger animal welfare standards and providing the ability to make regulations which MPI can enforce. The first regulations which sit under the Act were gazetted in 2016 and regulations continue to be developed, with the Dairy Cattle Code of Welfare recently out for consultation. The challenge is how to balance the need for regulation and enforcement, while allowing farmers to implement appropriate systems to control what occurs behind their farm gate in a straightforward and cost-effective manner.

There are aspects of the proposed Dairy Cattle Code of Welfare that potentially go too far, which some say are typical of the Government's propensity to try to get too far inside the farm gate. The question is whether these additional regulations, often seen to be imposing, have a positive or negative outcome for New Zealand's pastoral livestock farmers. Examples include feeding of calves, where the requirement to feed them twice a day until they are three weeks old, and specifying the volume of milk per day, may put undue demands on farmers during the intense spring season.

Intensive wintering situations also raise issues for current farming systems, as it's been proposed that farmers will be required to provide a minimum area for livestock to lie down, access to clean water, and relocation to a suitable area at a specified time ahead of calving.

There are also some restrictions around the proportion of fodder beet allowed in the animal's diet and the need for a gradual change of feed. Plus, if changes to the transport minimum standards for end-of-life lactating cows are gazetted, they will likely come at additional cost and time requirements. Regulating increased veterinary involvement is a concern too, given vets are under pressure with the current veterinarian shortage in New Zealand.

Many of the proposals are changes to minimum standards within the Code of Welfare and are therefore considered to reflect good practice and are not legally binding. However, once minimum standards are developed within regulations they are typically expected to be adhered to and are often included in supply agreement conditions and audits. The Dairy Cattle Code of Welfare should be viewed as a valued tool to help ensure that the welfare of cattle is kept to a high standard and farmers know what actions they should be taking to achieve this. DairyNZ expressed concern in their submission that many of the changes proposed add a layer of complexity and prescriptive outcomes and the value of the Code will be lost as it becomes increasingly difficult to navigate and use.

But is regulation all bad? As a sector, we want to dial up the good scenes and be assured there are no ugly behaviours lurking amongst our pastoral livestock farmers. So it may be that we need to accept there are some challenges that are best dealt with through updates to the animal welfare codes so we can be assured of more of the good practices and less of the ugly. But let's do it in a way that reduces complexity, minimises pressure, and is cost and time efficient J

GWYNETH VERKERK

ANIMAL WELFARE IN NEW ZEALAND AN UPDATE

Chairperson of the National Welfare Advisory Committee Gwyneth Verkerk outlines the work of NAWAC and its relationship to the Animal Welfare Act, and also discusses animal code of welfare reviews and recent developments in this area.

NAWAC and the Animal Welfare Act

The National Animal Welfare Advisory Committee (NAWAC) was established under the Animal Welfare Act 1999 and reports to the Minister of Agriculture and the Associate Minister (Animal Welfare). The Act identifies NAWAC's primary function as providing advice to the Minister, which can be on any matter relating to the welfare of animals in New Zealand. This includes recommendations for codes of welfare, and advice on issues such as good practice for hunting, and traps and devices for pest management.

NAWAC (see www.nawac.org.nz) has nine ordinary members, a NAWAC Chairperson and the Chairperson of NAEAC (National Animal Ethics Advisory Committee), its Sister Committee that considers the use of animals in research, testing and teaching. All are appointed by the Minister and the Act requires that they collectively possess a broad range of knowledge, including the veterinary, agricultural and animal sciences, commercial use of animals, companion animals, ethical standards and conduct in respect of animals, animal welfare advocacy, the public interest in respect of animals, and environmental and conservation management.

Secretariat services are provided to NAWAC from the Animal Welfare Team at the Ministry for Primary Industries (MPI). These officials have strong science backgrounds and provide significant support to the Committee's work. The full Committee meets on a quarterly basis, with much of the work done out of session by Subcommittees that form according to the workplan's requirements. The website www.nawac.org.nz gives access to meeting minutes, Committee guidelines, our workplan, various reports to our Ministers, the Opinion Paper on selective breeding and NAWAC's interpretation of sentience.

Codes of welfare

The development of codes of welfare and associated regulations are likely the NAWAC functions of most direct relevance to members of NZIPIM. While changes to standards and regulations resulting from the current review cycle will undoubtedly cause some angst for farmers and others in the rural sector, it is important to reflect that strengthening our codes of welfare will support the marketing of New Zealand's animal-derived products in the global marketplace. They are an appropriate contribution to the vision of the Primary Sector Council and MPI for New Zealand's primary industries in the roadmap Fit for a Better World.

We must also be cognisant that code reviews only happen intermittently. We need robust codes that will still be relevant 10 years and beyond, and that align with evolving societal views about animal use that increasingly demand ethical farming systems. All this needs to be considered within the context of the increasing pressures from many sources on the social licence of animal farming, recognising that the welfare of the animal is but one component of the provenance of an animal-derived product.

Why all the recent action?

Many of our codes were developed in the first decade of this century and aspects of them are outdated as animal management practices, scientific understanding and technologies have evolved. In June 2018, the Associate Minister held an animal advocacy hui in Auckland and identified four key areas for specific focus to improve New Zealand's animal welfare system in a 'framework for action on animal welfare'. One of these was that welfare codes were to be strengthened.

This need was further acknowledged when the Associate Minister met with the Farm to Processor Animal Welfare Forum in August 2018. The Forum subsequently examined their respective codes for continued fitness when considered against international standards, and recent developments in good practice and technology. These reviews were reported to NAWAC in 2019.

Code reviews

NAWAC's workplan is now heavily vested in code reviews with 'Strengthening the Codes' being one of its three strategic pillars. At the time of writing (June 2022) we are undertaking public consultation on discussion documents produced for the pig and dairy codes. Subcommittee work is well advanced on the sheep and beef and deer codes. Grouped together as the pastoral codes, there are many common elements between them such as the provision of shade and shelter.

Their contemporaneous review, which we appreciate creates additional workload for our stakeholders and advocacy groups as submitters, will we hope create greater consistency of standards and regulations across the sectors. The next group of codes queued for review are poultry and those relating to supply chain systems – Transport within New Zealand, and Commercial Slaughter.

The codes follow a similar layout. In each part there is an Introductory Statement which includes reference to any regulations that might be relevant. This is followed by Minimum Standards, worded with the imperative 'must' and a list of Example Indicators, which would demonstrate that aspects of the standards have been met, although this is not intended as an exhaustive list. The final sections cover Recommended Best Practice and General Information. The Act sets out the general processes that NAWAC must use when developing and reviewing codes, which includes the requirement for public consultation.

The development of codes of welfare and associated regulations are likely the NAWAC functions of most direct relevance to members of NZIPIM.

Subcommittee work is well advanced on the sheep and beef and deer codes. The next group of codes queued for review are poultry and those relating to supply chain systems.

How does NAWAC apply the law?

The Act requires that when proposing standards for the care of animals NAWAC must be satisfied they are the minimum necessary to ensure that the purposes of the Act will be met.

Part 10 lays out the scope of these obligations for the care of animals – that the 'physical, health and behavioural needs' of the animal are met in accordance with both 'good practice' and 'scientific knowledge'. The phrase 'physical, health and behavioural needs' is further defined in Part 4 which lists:

- Proper and sufficient food
- Proper and sufficient water
- Adequate shelter
- Opportunity to display normal patterns of behaviour
- Protection from and rapid diagnosis of any significant injury or disease
- Physical handling in a manner that minimises the likelihood of unreasonable or unnecessary pain or distress.

The Act then adds that these are needs 'which, in each case, is appropriate to the species, environment, and circumstances of the animal.'

The matters upon which NAWAC must deliberate when deciding to recommend minimum standards that will place a line that defines minimum acceptability include:

- What is good practice?
- What does the science say?
- Does the standard deliver appropriately to the need that is being considered?

The Evaluation Report which accompanies draft discussion documents for public consultation sets out the details of the science literature and other evidence relied upon when proposing amendments, and its reasoning for changes.

The 2015 Amendment

Several changes were made when the Act was amended in 2015 that have had implications for NAWAC's approach when considering animal welfare.

Introduction of regulations

Previously, prosecutions could only be made under the terms of the Act itself (e.g. the burden of proof needed to be for failure to meet Part 10 about obligations to provide care or Part 11 requiring alleviation of unreasonable or unnecessary pain or distress). These prosecutions were challenging and expensive, so the ability to develop regulations for specific breaches was granted by Parliament in 2015.

Regulations allow compliance officers to impose infringement notices where specific breaches occur, providing a more flexible approach to prosecutions. The introduction of the bobby calf regulations has had a huge impact on ensuring the safety of those vulnerable animals as they move through the supply chain. We have since seen many new regulations relating to care and handling procedures, as well as significant surgical procedures across both production and companion animal species. The development of regulations is charged to MPI, with NAWAC being a party to be consulted.

Sentience

The first change to the Act in 2015 was to the Long Title to include one purpose of the law reform as 'to recognise that animals are sentient', but Parliament provided no further guidance as to how this might look, leaving it open to interpretation. As a means to address this gap and develop its own position, NAWAC held a workshop in 2017 with a broad range of stakeholders. The final position statement is published in full on the NAWAC website, but our primary understanding of animal sentience is expressed in the following paragraph from that statement:

> *The National Animal Welfare Advisory Committee (NAWAC) understands animal sentience to mean that animals have emotions, feelings, perceptions, and experiences that matter to them. These can be negative (such as pain or boredom) as well as positive (such as pleasure or comfort). We don't know whether animals' emotions, feelings, and experiences are similar to those of humans. We also don't know if they are felt with the same intensity. But they matter to individual animals and have an impact on their welfare.*

Acknowledgement of sentience requires NAWAC to consider the impact or enhancement of providing (or not) for an animal's needs on its mental (affective) state and brings into play the concept of positive welfare. As a simplistic example, if food is inadequate the animal will experience hunger, which has a negative impact, but a good meal would ensure satiety, which would have a positive impact. But when we consider the elements of 'proper and sufficient', we must acknowledge that the food could affect the animal's mental state in other ways. Food that presents variation (e.g. providing cows with a mixed pasture sward that contains a

Acknowledgement of sentience requires NAWAC to consider the impact or enhancement of providing (or not) for an animal's needs on its mental state and brings into play the concept of positive welfare.

range of herbs rather than ryegrass alone) allows them the opportunity for choice in their intakes and may enhance a cow's experience of satiety.

This apparently minor change to the Long Title of a piece of legislation has therefore had a significant impact on the way that NAWAC considers minimum standards and recommended best practices. The needs of the animal must now be considered in a somewhat different context than has previously been the case, also considering mental state and the imperative to provide for more positive experiences.

Scientific thinking has continued to develop these concepts of welfare. The Five Domains Model was developed over several iterations by researchers at Massey University, in particular Professor David Mellor. It is an analytical tool with which to examine the available science on welfare-related issues. In its latest (2020) format, it provides a useful lens through which to consider the affective state of an animal by applying the available scientific evidence in a systematic, comprehensive and coherent manner. The rapid expansion of knowledge in the field of applied ethology over the past 30 years supports this approach.

During its recent review of pig farrowing and mating systems, NAWAC used a Five Domains approach to analyse the impacts and enhancements of a range of management systems. This has been published as part of the documentation for the Pigs Code Review (some 70 pages long). Although it is acknowledged that this analysis has somewhat stretched the use of the model by applying it to systems, it provides an opportunity for reflection on how an analysis of affective state can assist the development of standards that protect the animal's affective state.

Exceptional circumstances clause

Clause 78(3) of the 1999 Act provided an 'escape clause'. Part 78 describes the 'Matters to be Considered' when NAWAC is recommending a draft code to the Minister and clause 78(3) allowed that, in exceptional circumstances, the Committee could make recommendations that did not fully meet the purposes of the Act, having regard to a number of matters including feasibility and practicality of transition, religious and cultural practices, or economic effects of any transition.

In 2005, when finalising the first code of welfare under the Act for pig management systems, NAWAC invoked this clause for farrowing systems that closely confine the sow during lactation on the basis that they deprived the sow and litter of a range of important behaviours, and particularly nest building. The 2008 review of that code, which developed standards requiring that sows be group housed during gestation, also relied on the clause to continue to permit farrowing crate use.

The amendment to the Act in 2015 removed the options provided by Clause 78(3), requiring instead that if a standard could not be implemented then NAWAC is required to recommend a transition period of up to 10 years for changes to be made, with transitional approaches needing to be developed as regulations.

This obligation around pig farrowing and mating systems was clarified in 2020 when the New Zealand Animal Law Association and SAFE requested the High Court conduct a judicial review. The review concluded that, in removing Clause 78(3) in the 2015 amendment, Parliament had effectively made the standards relating to the use of farrowing crates and mating stalls 'invalid and illegal'.

As result of this decision, Cabinet put in place a regulation to the effect that current use of pig farrowing and mating systems cannot continue beyond 2025, and a code review was triggered to develop alternative approaches that will meet the requirements of the Act.

Other work

Other animals and insects

NAWAC's current workplan also includes the development of codes for fin-fish aquaculture and rabbits, while codes for companion animals (dogs, cats, horses and donkeys) will come up for review in due course. NAWAC is also currently considering a Ministerial request to develop a code of welfare for bees. Currently, insects are not recognised under the Animal Welfare Act (although crayfish are!) so there are a number of implications to be worked through.

The 3Es

The broad use of animals in Exhibition, Entertainment and Encounter (the 3Es) is another area that NAWAC engages with. The rationale for animal use in many 3E activities is very different from that for production animals and the nature of their use is many and varied. NAWAC have recently published a new guideline (Guideline 15 on the website) that includes key principles to guide thinking when the Committee considers these uses. The 3Es Subcommittee also provides regular advice to Ministers on activities to improve animal welfare in greyhound racing and rodeo activities.

While the legislation paints our intention, it does not maintain our credibility in the marketplace unless the imperative is translated into good welfare practices by all who use animals, particularly in our primary industries.

Wildlife

The Wildlife Subcommittee is central to NAWAC's function to provide advice on the humane management of wildlife, in particular guidelines for the use of traps or devices, and the hunting and killing of animals in a wild state. Guideline 9 describes how traps and devices for pest management should be tested for effectiveness to ensure a humane kill. NAWAC and the Game Industry Council together promote the development of best practice guidelines for hunters that protect the welfare of the wildlife concerned.

Concluding thoughts

New Zealand unashamedly trades its primary produce in the international marketplace on its reputation for high standards of animal welfare. The basis for this sits within the world-leading animal welfare legislation that supports the efforts of our trade negotiators. The codes of welfare and practice guidelines produced by NAWAC are part of this. While the legislation paints our intention, it does not maintain our credibility in the marketplace unless the imperative is translated into good welfare practices by all who use animals, particularly in our primary industries.

Raising the bar requires a stronger focus on positive welfare delivery, not simply avoiding the bad. Farm planning and management systems that build sustainability into future farm systems need to integrate their environmental and animal management practices. Delivery of high standards of animal care largely depends on the skills and knowledge of those on the farm, but the support provided by our rural professionals is an important part of that equation.

Gwyneth Verkerk is Chairperson of NAWAC based in Hamilton. Email: gwyneth.verkerk@gmail.com J

BRIAN DELA RUE & CALLUM EASTWOOD

VIRTUAL FENCING
A REAL OPPORTUNITY FOR PASTURE-BASED FARMING?

Virtual fencing systems bring new opportunities for farmers, but also prompt a range of questions for them to consider before investing. Rural professionals can support farmers to navigate investment decisions, adapt farming practices and capture value. Appropriate evidence that the systems meet industry and public expectations of animal care will also be required.

Smart farming technology

It is not surprising that farmers are excited about virtual fencing (VF), a potentially transformational technology that promises to improve labour productivity, environmental outcomes and possibly farm profitability. This development has happened at a time when there is a severe shortage of farm labour and an increasing commitment to farming within environmental limits.

DairyNZ estimates that dairy alone is short of around 4,000 farm workers and has challenges in recruiting and retaining a skilled and motivated workforce. In response, the Great Futures in Dairying Plan has highlighted advances in technology as an option for improving workforce outcomes for farmers.

Innovators of smart farming technologies like VF are already taking up this challenge and focusing on delivering a product or system that hits the innovation sweet spot (**Figure 1**) and offers a desirable, feasible and viable solution.

It is challenging for farmers to evaluate how close a technology gets to the innovation sweet spot for their own farms, particularly where there is an absence of evidence-based performance data and investment analysis.

In addition to finding the sweet spot, the broader implications of transformative technologies are increasingly

being assessed via frameworks for Responsible Innovation (see www.rri-practice.eu). This involves looking past just technological feasibility to assess the impact of technology on people, animals, the environment, communities and consumers during the early stages of an innovation.

The aim of such approaches is to help innovators, investors and purchasers anticipate and adapt to issues that may influence the long-term viability of an innovation.

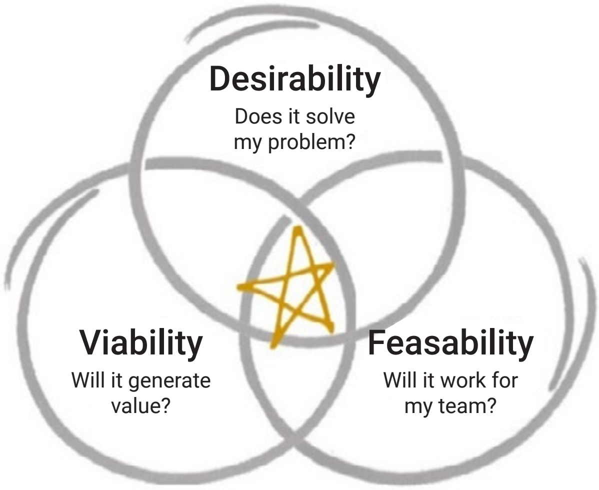

Figure 1: Innovation sweet spot.
Source: Adapted from ideo.com

What is virtual fencing?

The construction and maintenance of permanent fencing is expensive, and the fixed location of fences limits grazing management flexibility where paddock areas are not well matched to feed allocation plans. Break fencing within the paddocks that allows for accurate feed allocation, one of the pillars of profitability grazing, is a significant time burden for dairy farmers.

On occasion, motivated pasture managers may invest further time adjusting the position of the electric fence during a grazing event to ensure animal intake, pasture harvest and pasture residual targets are met. This is where VF systems become appealing, offering farmers time saving, flexibility and greater options in grazing management, with low labour break fencing and herding of cattle.

VF has been under development for several decades in countries like the US and Australia, mostly for beef cattle, but also for goats and sheep. Recent improvements in satellite availability, GPS technology, cloud computing and battery technology have focused VF development on animal collar-based devices.

Use of cow collars and virtual fencing

Key components of VF cow collars are typically:

- A GPS device
- Single or dual speakers for audio cues (some systems include vibrational stimuli)
- Electrode surfaces in contact with the cow's skin to deliver electrical stimuli
- A radio frequency transmitter for communications
- An accelerometer to measure animal behaviour
- A computer circuit board to control the device processes
- A battery
- A counterweight on the collar that maintains the VF device on top of the cow's neck for devices that use a solar panel for recharging the battery.

Once the farm is digitally mapped, the VF systems allow the farmer to set virtual fence lines within the farm or existing paddocks using an app. The position of the virtual fence is sent to the cow collars via wireless radio frequency communications from a farm base station linked to the system's cloud-based web interface.

The fence position can be stored on the collar for a few hours in case of power or internet interruption. The base stations also provide a ground truth GPS position to improve collar location accuracy, which may be around a 5-10 m radius of the true position for a raw GPS location, but less than 1 m for a corrected position.

Cows are either contained within the allocated grazing area or they self-herd to a destination by responding to cues from the collar. Each VF collar tracks the location, direction and speed of the cow in real time. A cow becomes aware that it is approaching the invisible virtual fence line when it receives audio cues from the collar, which may be singular or from the left or right to provide directional guidance.

Should the cow cross the virtual fence line it will typically receive vibrational cues as a second stage warning. If required, the vibration is followed by an adverse stimulus (a short electrical pulse) as a deterrent to continuing to proceed further and to guide the cow back into the prescribed area.

Through associative learning cows have been shown to typically respond appropriately to the audio cues within a week in small-scale research studies in Australia. However, these studies recommend further research in larger group settings in conditions typical to commercial farming.

Software algorithms control the cues according to both the animal's location and their behavioural response to the cues so that the number of adverse stimuli is limited. For example, a cow that is moving at speed (as in running and potentially stressed) will not receive continued adverse stimuli.

The technical details of the stimuli are unavailable due to commercial confidentiality, but studies using pre-commercial devices report the electrical stimuli to be a 0.8 kV pulse delivered in under 1 second, less than that of a typical electric fence for cattle (estimated at around 2-4 kV).

Virtual fencing systems

The historical target market for VF development has been extensive cattle farming systems where fencing the properties is expensive and herding cattle is time-consuming. VF also offers options for greater rotational grazing within these large unfenced areas.

A small number of VF systems have recently progressed from pilot studies to commercial availability:

- Nofence (www.nofence.no) is a system that began development in Norway in 2011 and piloted with goats in 2016, then later with cattle and sheep in Europe in 2020
- Vence (www.vence.io) was founded in 2016, instigated by a Gisborne livestock farming enterprise and developed in the US in conjunction with Dean Anderson, an early developer of VF. It is currently solely focused on large-scale cattle operations and is near commercial release in the US and Australia.

Two systems that are likely to be of most interest to New Zealand farmers are the solar-powered VF collars from Gallagher and Halter. The Gallagher eShepherd system – eShepherd (www.gallagher.com) – was originally developed by CSIRO Australia in 2005 and then further developed for commercialisation in 2014 by start-up Agersens. This system has been tested in research projects in Australia and New Zealand with several published research trials. The market focus for this system is currently beef farming but may include dairy in the future. The commercial launch of eShepherd is expected soon.

Halter (www.halterhq.com), an animal monitoring system that includes VF, has been developed for dairy farming and is the first VF system commercially available in New Zealand. Dairy has unique challenges of daily herd movements and requires higher accuracy in pasture allocation, while restricting cows that are grazing to low pasture residuals from entering areas of fresh pasture.

Benefits and barriers to adoption

Several years before VF became available to farmers, an exercise to anticipate the potential benefits and barriers to adoption of this technology in New Zealand was run with a panel of experts. The 25 selected rural professionals on the panel included farmers, researchers, veterinarians, animal welfare experts, agricultural technology developers and agribusiness specialists, each familiar with VF.

The ranked list of benefit and barrier statements provides a useful framework to consider how well VF technology enables farmers to capture value and address the potential limitations in practice.

The top five perceived benefits for VF were:

1. **Environmental protection** – it will improve the protection of environmentally sensitive areas, including riparian margins and erosion-prone soils
2. **Improved feed allocation** – it will assist in more efficient feed allocation, promoting the best balance of pasture production, pasture quality and pasture utilisation
3. **Access to previously unavailable areas** – it will allow grazing of areas that are currently not grazed because they require a capital investment in fencing (e.g. forestry blocks)
4. **Labour savings** – it will create savings in this area
5. **Individual animal management** – it will allow the mustering and individual management of animals in a herd.

The top five perceived barriers in order related to:

1. Device reliability
2. Perception of value
3. Perception of animal welfare
4. Farmer feed budgeting skills
5. Animal trainability.

How well is VF currently stacking up in hitting the innovation sweet spot and achieving the benefits raised by the expert panel? There is little doubt that VF is a desirable solution to labour availability and providing low labour options to improve pasture management. On feasibility the Halter system, for example, has been installed in many dairy farms in the Waikato, Canterbury and Taranaki, with anecdotal reports indicating that the system is providing the key functions without significant technical issues.

Farmers using the system report that it is generally easy to operate and animal training time has not been particularly challenging. Because VF automates current tasks there are relatively few changes to farm operations compared with other labour-saving technologies like robotic milking with voluntary milking over 24 hours. For most new technologies, however, device reliability and the consequences of device or system failure will take a few seasons for farmers to fully assess.

The expert panel ranked environmental protection as the greatest benefit as VF would be easier and cheaper than traditional fencing for keeping cows out of waterways. The potential for improved feed allocation (if realised) was ranked second by the expert panel, reflecting the importance of optimising pasture harvest in farm profitability. The time required to fine-tune grazing management to increase pasture harvested has been a challenge to many farmers. Motivated farmers with good pasture managements skills are more likely to invest time in utilising the increased flexibility offered by VF to gain a financial return from improved pasture management.

However, the expert panel contend that farmers who do not currently achieve best practice pasture management may only gain a time saving from VF rather than increased profit from pasture. Whichever technologies are used (or not in the case of many expert farmers), few would argue that optimal pasture management requires time spent in the paddock, whether it is assessing the actual pasture cover, pasture quality and uniformity across the paddock, or grazing residuals.

Accessing previously unavailable grazing areas (ranked third) will be significant for some farmers, particularly in extensive beef systems. Labour saving is a key benefit of VF that is obvious to farmers, where automating break fencing and moving cows to and from the dairy or crops could potentially save 20-40 hours per week, depending on the number of herds.

Rural professionals are likely to have a role as credible independent advisors in supporting farmers to evaluate whether VF is the best solution for their farm business.

While improving labour productivity is important and valuable, not all hours saved necessarily convert directly to reduced farm labour costs to offset investment costs. New technologies often create new tasks. Time saved is used for other farm tasks or results in reduced hours for existing staff. The farm team are often multi-tasking when out on-farm so while one task is automated other tasks may still need to be done. Consideration also needs to be given to the unintended consequences of reducing the number of farm workers, such as having fewer people on the milking roster or to cover illness or injuries.

Perception of value was ranked by the expert panel as a potential barrier to adoption, although this was less of a barrier to the first tranche of farmers adopting the Halter system. Early adopters may be less risk averse when investing in technology and willing to determine for themselves whether a technology delivers value, which may be return on investment (ROI) or just solving labour issues. However, the next wave of potential users may have more information available and different key performance indicators (KPIs) in mind for technology investments. It is too early for most farmers to assess how much of the proposed financial benefits are being captured to offset the costs.

Financial costs and returns gained from using VF will be farm and farmer-specific. As an indication of costs and benefits (and in the absence of other VF cost models), at the time of writing the Halter system (which includes VF and animal monitoring technologies) has a subscription of $16/cow/month plus installation costs. These costs can vary, depending on the number of stations required for the property size and terrain. For a dairy farm milking 350 cows producing 400 kg MS/cow, the investment cost could be an annual subscription fee of $67,200 plus around $12,500 for a simple installation.

To put this in perspective, it would represent an annual cost close to $0.50/kg MS. The benefit most likely achieved by all farmers is in time saving, while some farmers may make further financial gains through a combination of increased pasture harvest and improved pasture quality, improved heat detection and lameness detection, and health monitoring. Independent analysis of farm data is required to better assess ROI outcomes being achieved by farmers for a range of VF farms.

Further considerations

What is the industry and policy-makers take on VF? This is currently not clear as VF is in the early stages of commercialisation, but it may be one of cautious optimism. While labour productivity gains will be welcomed, little is known of the short and long-term impacts of VF on animal wellbeing and how consumers will respond to a system with the occasional use of adverse stimuli. This needs to be viewed against a backdrop of increasing emphasis on farming practices that reduce negative and increase positive experiences for animals.

The expert panel identified animal welfare perception as a potential barrier where VF could be perceived as cruel to animals by consumers and the public due to administering pulses from a collar, particularly during training. Transparency in the use of technology and evidence which shows that they are not causing pain and distress to animals will therefore be important to alleviate concerns.

Small-scale studies in Australia have indicated that there may be no significant differences in measures of stress levels between cows with and without VF collars. Further studies under conditions reflecting commercial farm management were recommended.

A risk for VF systems may lie with a lack of user competency or unintended user error outside of the safeguards built into the systems. There may be an opportunity for confusion or distress to cows if the VF system is poorly operated (e.g. poorly sited virtual fences that exclude access for cows to water, sufficient feed or their newborn calves). It is therefore of paramount importance that the farmer who is responsible for the welfare of the animals has adequate training and timely reporting of excessive use of stimuli so that mitigations can be made with urgency and cows not suited to the VF system have other options.

The recent use of VF by farmers on commercial dairy farms suggests that it has the potential to be the next best thing since electric fencing from a technical perspective at least. This early success needs to be supported with appropriate evidence that it also meets industry and public expectations of animal care and farmers being clear on the value proposition. Rural professionals are likely to have a role as credible independent advisors in supporting farmers to evaluate whether VF is the best solution for their farm business, assess realistic ROI, and help optimise farm operations to get the best value from the technology.

Brian Dela Rue and Callum Eastwood are scientists at DairyNZ. Corresponding author: brian.delarue@dairynz.co.nz J

SUSAN KILSBY

THE ECONOMIC PATH AHEAD FOR NEW ZEALAND'S AGRICULTURAL SECTOR

Export earnings have risen sharply in recent years, but costs have lifted rapidly as well and are now putting downwards pressure on profits. ANZ Bank Agricultural Economist Susan Kilsby notes that to improve farm profitability, it is key that farms are operated in a sustainable manner that meets the approval of the consumers of the future.

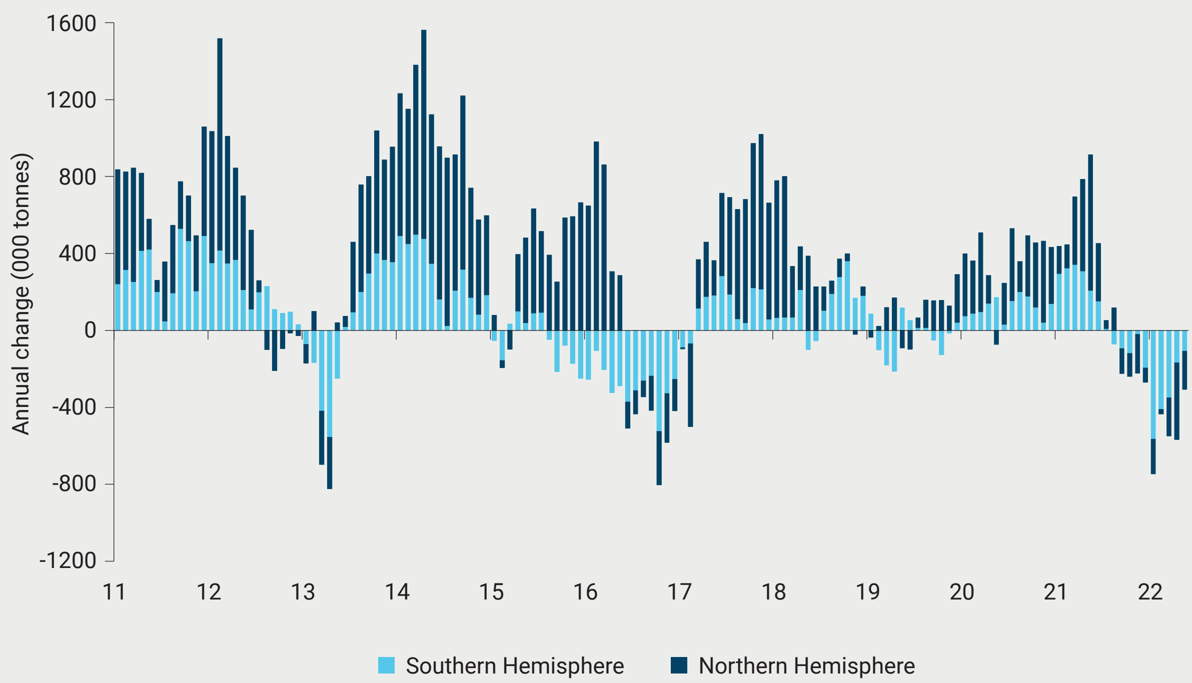

Figure 1: Year-on-year change in milk supply in major exporting regions.
Source: DCANZ, Dairy Australia, USDA, Eurostat, CLAL and ANZ Research

Favourable outlook

New Zealand goods export earnings have risen dramatically over the past few years, but is this a function of design or just good fortune? According to the June 2022 Ministry for Primary Industries (MPI) *Situation and Outlook for Primary Industries* report, export revenues are estimated to have reached $52.2 billion for the year to June 2022, a 9% increase on the previous season.

The jump in export returns exceeded expectations, but was driven largely by factors outside the control of New Zealand businesses. Increased returns were due primarily to higher prices being attained for most of the foods exported, particularly dairy and meat.

The general outlook for New Zealand's primary sector remains favourable in both the short and longer term. The outlook is not without its share of challenges, but these will also become opportunities for those producers who are prepared to understand what consumers really value.

Farmgate prices for most of our dairy and meat products have been extremely strong over the past year and this trend is expected to persist in the short term. However, prices are expected to normalise over the longer term, as the current strength in prices is largely a function of limited supply rather than exceptional demand. The global supply of dairy and red meats, in particular, has been constrained (**Figure 1**).

Locally, for farm profitability reduced output has been more than offset by higher farmgate prices, but it is debatable how sustainable this trend is. We cannot just farm in the hope that the rest of the world doesn't increase production.

An easing in prices would require either a decrease in demand or an increase in supply, both of which are feasible, but the supply side response is most likely to remain relatively muted in the short term. Tighter monetary policy combined with high prices will erode some consumer demand, which is expected to take some of the heat come out of protein prices. However, commodity prices are still projected to remain well above their long-run average.

MPI forecasts export returns will be relatively stable for the next couple of years. For this to be achieved, prices will need to remain near their current levels, as it is unlikely that there will be a significant production response.

We cannot just farm in the hope that the rest of the world doesn't increase production.

Farm operating costs

Farm operating costs have increased at nearly twice the rate of the Consumer Price Index in the past year. The Statistics New Zealand data to Q1 2022 shows dairy farm costs have lifted 12.7% year-on-year, while costs on sheep and beef farms have lifted 10.6%. The major contributors to higher costs are fertiliser, fuel and labour.

Fertiliser prices lifted 23% year-on-year and fuel costs increased by 54%. This data shows only a modest increase in labour costs, but this is more a reflection of a lower than otherwise head count rather than wages not rising quickly. Some farms have reduced total labour costs, but this is mainly due to a lack of labour available rather than the price being paid for it. Indeed, in the *ANZ Business Outlook* survey the agriculture sector is reporting the highest wage pressure across the economy.

These rates of on-farm inflation do not include interest rate changes. Data from Beef + Lamb New Zealand's economic service shows on-farm inflation is at the highest level recorded in the past 20 years, exclusive of interest payments. When these payments are also considered, farm cost inflation was actually higher in 2008 (following the Global Financial Crisis).

The recent rapid increase in costs is having the greatest impact on more intensive farming operations, as they tend to spend more on fuel, fertiliser and labour than our extensive farming operations.

In seasons where farmgate prices are high, as has recently been the case, costs can easily escalate. In this environment it is very easy to lose track of budgets. When incomes are higher there are more choices to be made about where to spend your hard-earned cash. The recent trend has been towards repaying debt and careful thinking about what on-farm investment may be required to meet tightening regulatory changes.

Looking ahead, the cost of operating farms is expected to rise further this season. The AgFirst Financial Survey 2022 shows the cost of operating a dairy farm in the 2022/23 season will be significantly higher than the previous season. The 'breakeven' milk price has increased by 69c/kg milksolid (MS) to $8.44/kg MS. The breakeven price takes into account all the costs required to run a farm, including farm working expenses, debt servicing, living expenses, tax and replacing capital items. In the 2018/19 season the breakeven milk price was nearly $3/kg MS lower at $5.53/kg MS.

Fertiliser prices lifted 23% year-on-year and fuel costs increased by 54%.

Profitability and debt

The focus of New Zealand farm businesses has shifted away from maximising production to farming in a profitable and sustainable manner. Many businesses are still figuring out exactly what this looks like for their business. It has not been easy to develop a business plan while regulations have been evolving so quickly, so during this time many farming businesses have opted to use the high returns to improve their financial position.

According to the June 2022 Reserve Bank data, total borrowings by dairy farmers have decreased by $5.2 billion (or 12%) since debt levels peaked in 2018. Borrowings have decreased by 5% in the past 12 months alone, as cashflows have improved considerably due to several seasons of relatively high milk prices. Some of these higher returns are being eroded by higher costs, but those who have been able

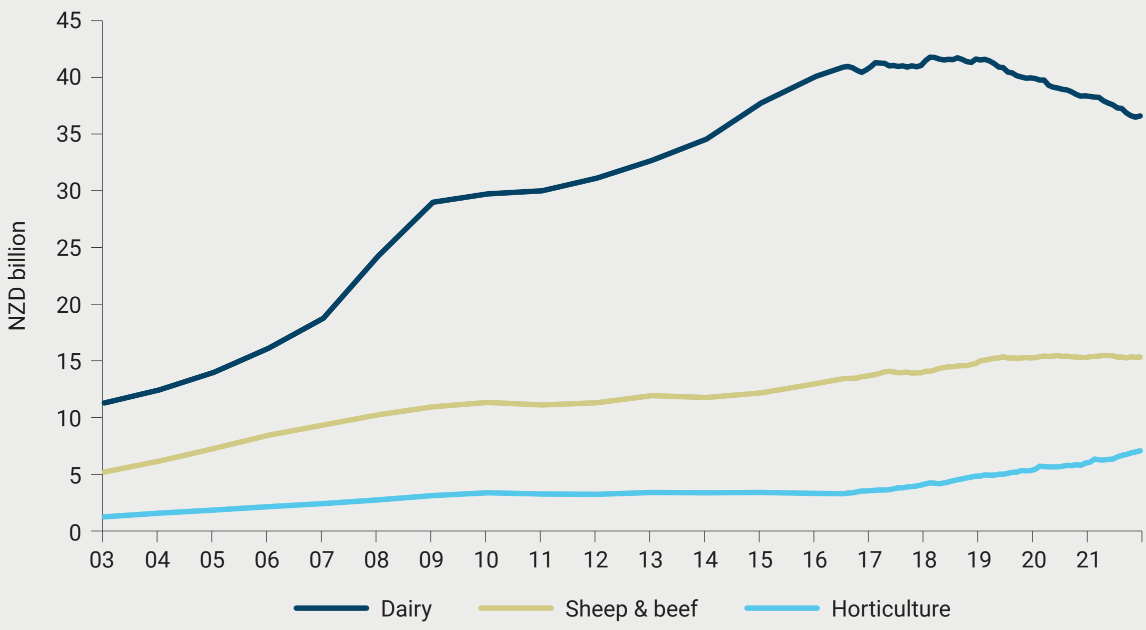

Figure 2: Agricultural debt by sector. Source: RBNZ

There is a group classified as 'climate-conscious consumers' who are looking for goods that they don't feel guilty consuming. Eco-anxiety is driving purchasing decisions and is one of the major consumer trends in 2022.

to repay debt are now in a better position to manage as interest rates continue to rise (**Figure 2**).

Paying down debt is a way to strengthen the financial resilience of your business so that you have more options to respond to tomorrow's challenges. Despite the recent trend to repay debt the AgFirst survey shows interest costs for the season ahead are expected to be 20c/kg MS greater than they were last season. Farmers who are highly leveraged, and/or have a higher risk grading, will carry an even greater burden as interest rates rise.

Connecting the dots

Looking ahead the most immediate challenges we are facing are inflation and regulatory changes, which can be relatively burdensome and won't excite most farmers. Looking further ahead the broader challenge is to strengthen our connection with consumers. If we understand what consumers value then our farming systems can be tailored to meet their requirements within our operating constraints.

New foods and production methods will continue to be developed, but the advantage New Zealand farmers have is that how our farms are currently operated is largely liked by consumers. In fact, by 2035 alternative proteins are expected to account for only 11% of the total protein market according to the 2021 Boston Consulting Group and Blue Horizon Corporation *Food for Thought, The Protein Transformation* report. However, it is clear there is a need for other forms of protein as traditionally produced milk and meat will not be able to keep up with consumer demand. Alternative methods of producing protein will help alleviate some of the stress to the environment from traditional production methods.

There is also a group classified as 'climate-conscious consumers' who are looking for goods that they don't feel guilty consuming. The January 2022 Euromonitor Top 10 Consumer Trends research shows eco-anxiety is driving purchasing decisions and is one of the major consumer trends in 2022. Products that carry climate-related labelling, such as carbon zero claims, are meeting the needs of this group of consumers who want to feel good about their purchases. Not all consumers are looking for alternative proteins. Most want to continue to eat traditionally produced proteins, but they are also looking for proof that what they are consuming is not harming the planet.

Our farms will continue to evolve as we better understand how to farm in a way that can be sustained for generations to come and that will also meet the needs of the future consumer. The challenge now is to connect the dots between our farms and our consumers so more value can be derived from our pasture-based farming systems.

Susan Kilsby is an Agricultural Economist at ANZ Bank.
Email: susan.kilsby@anz.com J

SINEAD LEAHY & HARRY CLARK

Researcher working on rumen-related research in a laboratory

STATE OF PLAY
RESEARCH INTO GREENHOUSE GAS MITIGATION TECHNOLOGIES

Technologies for reducing greenhouse gas emissions from the agricultural sector are emerging. But what are these technologies, where is the science at, and will they be applicable in a pasture-based grazing system?

Reducing agricultural greenhouse gases

Technologies that reduce agricultural greenhouse gases (GHGs) – methane and nitrous oxide – are needed to support New Zealand's transition to a low emissions future. Researchers are working hard to discover and develop practical cost-effective solutions that will be beneficial to farmers and growers.

In New Zealand, the main source of agricultural GHG emissions is the ruminant animal. Ruminant methane comes largely from the digestive tract of ruminants produced via a process known as enteric fermentation, while nitrous oxide emissions come mostly from microbial soil processes acting on urine patches deposited onto pastures during grazing.

Technological innovations to reduce agricultural emissions are emerging, but there are several constraints that will need to be overcome to facilitate their adoptability in our pasture-based grazing systems. A selection of emerging mitigation approaches are discussed in this article.

Low methane emitting animals

Selective breeding provides for methane emissions reductions that are sustained and accumulated over generations. Sheep vary naturally in the amount of methane they produce per kilogram of dry matter consumed. This trait has been shown to be heritable and thus enables the breeding of low methane emitting sheep.

New Zealand researchers have used direct selection of sheep with low and high methane yields to create two divergent progeny lines, resulting in an average difference of 10–12% between lines. The low methane emitting sheep have been found to have 20% smaller rumens, with a different microbial fermentation profile, and there is some preliminary evidence that these changes are associated with a leaner animal carcase.

Screening rams for their methane emitting characteristics is currently being trialled in the industry. Building on the successful breeding of low emitting sheep, work to breed for low emitting dairy cattle is now underway in New Zealand. Early results indicate that dairy cattle show similar variation in emissions to sheep. Methane emissions are being measured from young breeding bulls in existing sire evaluation schemes, with the aim of identifying whether it is possible to select for low methane emitting cows.

Building on the successful breeding of low emitting sheep, work to breed for low emitting dairy cattle is now underway in New Zealand.

To overcome the challenge of direct measurement of methane emissions for the thousands of animals needed to validate the low emissions trait in dairy cows, researchers are working on low cost and practical approaches to identifying a low emitting animal by, for example, proxy indicators based on milk constituents or rumen microbial profiles. If successful, it is expected that this technology could be rolled out within the next five years.

Methane inhibitors

A methane inhibitor is a chemical compound fed in small amounts that suppresses the activity of methane-forming microbes (methanogens) present in the forestomach (or rumen) of ruminants. Inhibitors can be delivered as a feed additive or as a bolus (a small capsule containing the active compound inserted into the rumen).

3-Nitrooxypropanol (3-NOP or product name Bovaer) is one such inhibitor that has been shown to consistently reduce methane emissions by around 30% in Total Mixed Ratio (TMR) farm systems without compromising animal productivity. 3-NOP has more limited applicability in grazing systems as it decays within a few hours in the rumen, although in some dairy systems it may be possible to devise feeding systems that overcome this.

Researchers are trying to develop slow-release approaches that might extend its applicability to most dairy systems. In parallel, New Zealand researchers are looking at how 3-NOP in its current formulation could be delivered in this country's farm systems. However, it is expected that a lower efficacy rate would be achieved in such systems. 3-NOP is expected to be commercially available in some countries within the next two years.

Bromoform-containing seaweeds (*Asparagopsis taxiformis* and *A. armata*) are another type of methane inhibitor that have been shown to reduce ruminant methane emissions by 20-98% in short-to-medium term trials. Its persistence over multiple seasons remains unclear. Researchers are also investigating whether it is possible to provide synthetic bromoform directly to the animal rather than through seaweed.

The active ingredient bromoform raises some challenges from a regulatory and market acceptability perspective, given that it is classed by the US Environmental Protection Agency as an animal carcinogen and a probable human carcinogen. However, bromoform is found in water (as it is formed as a by-product when chlorine is added to drinking water to kill bacteria) so maximum acceptable limits already exist for water.

Some animal trials with bromoform-containing seaweeds have detected residues in urine and milk. Open questions remain about its palatability to livestock, animal health and the ability to produce and supply seaweed at a large scale, especially to extensively grazed livestock. However, if these concerns can be addressed, bromoform-type inhibitors could be commercially available within the next few years.

Methane vaccine

Vaccination against rumen methanogens could be a practical and cost-effective way to reduce ruminant methane emissions in pastoral grazing systems. Research into a methane vaccine remains in the development phase and efficacy has not yet been demonstrated in live animals. However, all major components of a vaccine chain have been demonstrated:

- Genome sequencing of methanogens has identified targets that stimulate antibody production
- Antibodies can be created by host animals and detected in saliva and the rumen and they have been shown to suppress pure methanogen cultures in vitro.

Researchers to date have not identified any reason why a vaccine approach could not work, but a significant research investment is still required to prove proof of concept. The efficacy of a vaccine is necessarily speculative, but a reduction of 30% is considered plausible, given the efficacy of methane inhibitors. Commercial availability of a vaccine is estimated to take seven to 10 years after the demonstration of a prototype. Vaccine adoption could be facilitated by administering it in combination with other widely-used animal vaccines.

Vaccination against rumen methanogens could be a practical and cost-effective way to reduce ruminant methane emissions in pastoral grazing systems.

Nitrification inhibitors

Nitrification inhibitors are chemical compounds that inhibit the formation of nitrate in the soil via microbial processes, and thus the potential for nitrous oxide production. Nitrification inhibitors exist commercially and include compounds such as 2-chloro-6-(trichloromethyl)-pyridine (Nitrapyrin), dicyandiamide (DCD) and 3, 4-dimethylpyrazole

Sheep having their methane measured in respiration chambers at the NZ Animal Ruminant Methane Measurement Centre in Palmerston North

phosphate (DMPP). Eco-N and DCn were two nitrification inhibitor products (both containing DCD) previously sold on the New Zealand market.

DCD was used both as a coating on fertilisers and as a spray on pastures. Numerous studies have shown that both nitrous oxide emissions and nitrate leaching from urine patches can be significantly mitigated by treating grazed pasture with DCD, with potential reductions in nitrous oxide emissions from urine patches reported between 61-73% and reductions in nitrate leaching from a grazed pasture by 21-56%.

However, the discovery of residues in milk in 2011, and subsequent adverse reactions by several overseas trading partners, led to its voluntary withdrawal from use in this country and it is not currently available to New Zealand livestock farmers. Although DCD has been used in cropping for decades and is recognised as non-toxic, there is no declared Maximum Residue Limit under the Codex Alimentarius (international food safety standards), hence a default limit of zero residue applies.

A process has been completed by the New Zealand Government to fast-track risk assessment and provide for a cut-off level below which residues do not need to be considered under the Codex Alimentarius. While this could help facilitate the re-introduction of DCD for commercial use, there may still be reservations about its re-introduction, given the history of the product. As researchers know that nitrous oxide inhibitors can work, there are several lines of research looking to identify and commercialise new nitrous oxide inhibitors that have a wider availability, lower cost, and equally low or lower risk of residues as DCD.

New nitrification inhibitor products might be expected to hit the market some time in the next five years. In combination, researchers are seeking to develop appropriate delivery systems to accurately deliver the inhibitor to the urine patch in pastoral grazing systems. Research is also being undertaken to investigate whether some plants, for example plantain, may be able to produce nitrification inhibitors naturally in the soil.

Animal wearables

Industry is investigating the possibilities of using smart technology to reduce methane emissions from ruminants via a completely different approach. Rather than eliminate methane at source these technologies involve a wearable device that when fitted over the animal's head captures exhaled methane and then uses some form of catalytic converter to break methane down into a combination of carbon dioxide and water vapour. Preliminary reports with prototype devices have recorded >50% reduction in methane emissions from individual animals (ZELP device) indoors.

Recently New Zealand researchers reported a new mitigating technology (Ecopond), which can reduce methane emissions from dairy effluent ponds by up to 99%.

Equipped with sensors, it is envisaged that GHG reduction would be just one benefit of such a device, and others would include the ability to collect large amounts of livestock data to help farmers improve animal performance and health, while reducing labour costs through precision agriculture approaches. Researchers are still working to improve the breakdown of methane once captured, understand any animal welfare issues, and obtain more evidence to support efficacy.

International research has focused on indoor housed animals, and trials will be needed to understand efficacy in New Zealand's grazing systems. The development of animal wearables is in its infancy, and it is likely to be several years before they are available commercially for grazing animals.

Manure management

Although methane emissions from the digestive tract of ruminants is the largest source of agricultural methane emissions, they also arise from the storage and spreading of animal waste. Manure collection and storage provides farms, particularly dairy farms, with an important capacity to recycle valuable nutrients to the land for future plant uptake and to manage risks to freshwater quality.

Manure is often stored in a liquid storage facility (earthen manure storage pond or a manure storage structure) or as a solid stack for many months. Most manure management emission reduction options are well established in principle and available now (such as covered ponds, bio-digestors), but the cost-effectiveness of these technologies is challenging, particularly for year-round grazing systems where the quantity of manure collected is relatively small.

Recently New Zealand researchers reported a new mitigating technology (Ecopond), which can reduce methane emissions from dairy effluent ponds by up to 99%. The technology works by adding poly-ferric sulphate to the manure pond, changing the environmental conditions of the pond, making it an unfavourable environment for methanogens to survive and produce methane. Ferric sulphate is approved by the US Food and Drug Administration (FDA) as a 'food additive' and is affirmed as 'generally recognised as safe' (GRAS) for human consumption. The cost of the technology is likely to be less than for existing manure management approaches.

Conclusion

Reducing agricultural methane emissions will be critical to achieving New Zealand's domestic target of reducing biogenic methane by at least 10% below 2017 levels by 2030 and between 24-47% by 2050. Reducing nitrous oxide emissions will support achieving the 2050 target of net zero for all other GHGs. Currently, a limited range of options exist to reduce emissions from pasture-based livestock farming, but technological innovations are coming. The question remains for New Zealand – can they come quickly enough?

Sinead Leahy is the Principal Science Advisor at the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) based in Palmerston North. Harry Clark is the NZAGRC Director. Corresponding author: sinead.leahy@nzagrc.org.nz

PHIL JOURNEAUX

FARM-LEVEL GREENHOUSE

This article outlines what the author sees as the main constituents or components of a farm-level plan for managing reductions in greenhouse gas emissions.

Objectives and strategy

The first requirement is to establish the objectives of the greenhouse gas (GHG) plan. There may well be a number of objectives, but possibly the two key ones are:

- Establishing what the current level and drivers of GHG emissions on-farm are, and
- The degree of reduction desired (or required) and whether this will be achieved via mitigation, offsetting or new technologies, or a combination of all of these.

How any reductions will be achieved directly leads into a discussion on strategy – what will your strategy be to achieve them? For example, the objective may be to reduce emissions by 30% – the strategy is to achieve 10% via mitigations and 20% via offsetting. This strategy therefore needs to be articulated clearly at the start of the GHG plan, as it then leads into a discussion on how the reductions will be achieved.

Current situation

This requires documentation of the current farm situation, stock types and inputs relative to the level of GHG output. To this end, the GHG plan needs to capture data on:

- Area(s)
- Stock type and numbers
- Performance levels (e.g. kg milksolids, lambing %, stock carcase weights etc)
- Supplementary feed inputs – types and tonnes
- Nitrogen fertiliser inputs – types and tonnes.

Much of this will be captured within the GHG calculator you are using, which is fine. Just remember to keep a separate file for the base and subsequent years. Given software programmes can change, and that it might not be possible to load files from previous versions, keeping a hard copy (especially of the base year) could be a good idea.

There are a range of GHG calculators available (www.hewakaekenoa.co.nz). The main requirement is to use the same calculator to ensure the consistency of the estimate of GHG emissions over time, as you cannot directly compare results between different calculators. Of those currently available, the two most detailed for inputs are Overseer™ and Farmax. It is also worth noting that for pricing emissions under He Waka Eke Noa there will be a central calculator developed.

Inasmuch as the pricing mechanism will differentiate between methane and nitrous oxide, it is important to differentiate these within the base and subsequent emissions. CO_2 from nitrogen fertiliser is also included in the pricing mechanism, so it also needs to be identified.

GAS MANAGEMENT PLANS

Mitigation

The next step, assuming mitigation is part of the reduction strategy, is to detail out how the mitigation will work. The three main drivers of biological GHG emissions from pastoral farms are the amount of:

- Dry matter (DM) consumed by livestock
- Protein in the diet
- Nitrogen fertiliser used.

The main driver is DM consumed. The mitigation strategy therefore needs to detail how reductions in each of these factors will be carried out.

Reducing DM consumption could involve several factors, the key one usually being a reduction in stocking rate accompanied by an improvement in the productivity of the remaining animals. Or it could involve finishing animals to a similar weight, but within a shorter time period, or swapping out breeding animals for finishing animals. These approaches have a range of farm management implications, especially around grazing management, which would need to be highlighted in the GHG plan. Such strategies could also take several years to achieve, and again this needs to be detailed.

DM input into the farm may also be reduced by lowering the amount of supplementary feed into the system or swapping a higher protein feed for a lower protein one. If these strategies are to be used, again they need to be detailed in the GHG plan.

Similarly, altering your nitrogen fertiliser practice will impact on GHG emissions. While there are some direct nitrous oxide and CO_2 emissions from nitrogen fertiliser, the main effect is through growing more DM, which is then consumed. Changes could involve soil testing for nitrogen, using precision application techniques, altering rates and/or altering fertiliser type, all of which would need to be detailed in the GHG plan.

All of the above factors have implications for farm productivity and profitability. While it may not necessarily involve detailing this within the GHG plan, it certainly needs to be understood (usually through modelling) before any action is undertaken. It is also important to note that the actions discussed above do not represent an exhaustive list of mitigation strategies.

A complete change in farm system may be envisaged (e.g. swapping from bovine to ovine dairy). As long as the new system is less intensive, total GHG emissions should be reduced. Once the mitigation strategy is decided, the GHG plan should also indicate the level of reduction in these emissions over time.

Offsetting

Offsetting basically involves sequestering carbon via forestry and using the credits obtained to offset emissions from the farm. There are now two forms of forestry regarding sequestration – the Emissions Trading Scheme (ETS) and through He Waka Eke Noa. The ETS was established in 2008, has a number of rules around eligibility, and applies to forests planted or regenerated since 1990.

The GHG plan would therefore need to outline any ETS forest in detail:

- Area – by species and by age
- Location on the farm
- Sequestration rates being claimed – either via the Ministry for Primary Industries' Look-up Tables or field measurement, which relates back to the size of the forest
- The sequestration system being used (e.g. stock management) or for any new forests post-1 January 2023, whether averaging or permanent.

Offsetting involves sequestering carbon via forestry and using the credits obtained to offset emissions from the farm.

In the fullness of time an international carbon trading scheme is likely to be developed, which means the forest could be planted anywhere in the world.

The averaging scheme covers production forests where carbon credits are obtained for a set period within the first rotation (e.g. 16 years for pine forests), whereas permanent forest are just that, and carbon credits are obtained over the period it takes for the forest to reach equilibrium.

If the forest is under the averaging scheme, it would also be useful to note in the GHG plan: (a) how long credits may be carried forward; and (b) what the plan of action is once the forest is out of the averaging period and carbon credits are no longer available for offsetting.

If a forest (or further forestry) is planned, again the GHG plan needs to detail this along with the expected impact on total net emissions. A key aspect here is that often the forest is planted on land that has low levels of pasture production, which then frequently results in an increase in stocking rate on the better land, which in turn leads to higher GHG emissions from the pastoral area.

Another aspect to remember is that the forestry block does not need to be on the farm itself. It could be planted anywhere in New Zealand, with the credits then being used to offset the farm emissions. Also, in the fullness of time an international carbon trading scheme is likely to be developed, which means the forest could be planted anywhere in the world, with credits again brought back to offset farm emissions.

The He Waka Eke Noa forestry sequestration regime as outlined in their proposal to government broadens out the definition of a 'forest' in many areas, possibly the main one being the inclusion of native forests existing prior to 2008. It is important to note that it is still provisional – its fate will be part of the government announcement by the end of 2022 about whether they will accept the He Waka Eke Noa provisions.

But taking an optimistic view that the sequestration regime is accepted, again this needs to be detailed within the GHG plan, particularly:

- Areas
- Whether stock are excluded or the GHG plan is to achieve this (for pre-1990 native)
- Sequestration rates that will apply to the different categories.

Mapping

This is integral to the offsetting/forestry component of the GHG plan where map(s) can show the location and area, and type of forestry, being carried out. This will be especially so for any He Waka Eke Noa forestry, given it allows a much more diversified type of forestry (i.e. small blocks down to 0.25 ha, shelterbelts or riparian strips), and these need to be clearly identified on a map to allow for verification.

A map showing soil type/land use classification would also be useful (even though it should be a standard part of the farm management already) in helping with adjustments to the farm system under any mitigation programme.

Land use change

The issue with land use change is in identifying suitable land within the current farm for alternative (i.e. non-pastoral) uses. Often this relates to forestry for offsetting, but can also involve changes into horticultural or arable uses.

Carrying out such land use change is complex and there are a number of key factors that need to align (e.g. access to capital, the capability to manage the new enterprise, access to (skilled) labour and to an existing value chain). Possibly the main thing to include within the GHG plan is a discussion on the possibility of such changes, and the likely subsequent reduction in GHG emissions.

In most cases, the addition of an orchard to a farm will result in an averaging down of the GHG emissions, given that GHG emissions from an orchard are often much less than from a (pastoral) farm. In noting this, the He Waka Eke Noa proposals also include the possibly of claiming some carbon credits from permanent horticultural crops, which could be used for offsetting.

Carbon dioxide

While the carbon levy discussed below relates only to biological emissions, this is not to say that CO_2 emissions from energy usage should be ignored. Some calculators (e.g. Overseer™) can calculate CO_2 emissions from energy use, and on some farms (e.g. cropping) these may be significant as a result of high fuel usage. So, reductions in this area should also be included within the GHG plan, and it may also include consideration of alternative energy sources, such as solar, wind or on-farm hydro schemes.

New technologies

There are a range of new technologies being researched, such as low methane genetics, methane and nitrogen inhibitors, and a methane vaccine. When (or perhaps if) these come to market, they then offer alternative means of reducing biological GHGs, and as such need to be incorporated within the GHG plan.

This need not be the case immediately, given nothing is yet available. But when they do become available, and the farmer is contemplating using them, such use needs to be detailed within the GHG plan (especially the impact on reducing GHG emissions and the time period over which such reductions will occur).

A classic example here is the use of low methane genetics – how this will be incorporated into the breeding programme and the time period over which reductions will be achieved needs to be detailed. Remember that if selecting on a single trait, it takes ~12 years before 100% of the flock or herd exhibits 100% of the gene.

How these technologies will be verified and their efficacy at a farm level remains to be seen, but they will add further tools to the toolbox.

Carbon levy

While the carbon levy (and its payment) is outside the bounds of any GHG plan, the information collated within the plan will directly relate to the amount of the levy, and the calculation of the levy amount will in turn very likely result in alterations to the plan.

He Waka Eke Noa is proposing an on-farm pricing mechanism, using the formula A + B – I – C, where:

- A = kg (or tonnes) of methane
- B = CO_2e from nitrous oxide + CO_2 from nitrogen fertiliser
- I = reductions from mitigation technologies (e.g. inhibitors)
- C = sequestered carbon (measured as CO_2e).

Prices for these will be different, with methane having a separate price (yet to be announced) from nitrous oxide/CO_2 from nitrogen fertiliser. There will also be two different prices for 'C' – carbon sequestered from ETS forests will obviously use the ETS price, whereas He Waka Eke Noa sequestered carbon will have a separate price (again yet to be announced).

Farmers can use He Waka Eke Noa sequestered carbon to offset farm emissions, but cannot sell the carbon, although it could be traded within a collective of farmers. Having a value, but not being able to sell it, is an oxymoron but let's not go down that rabbit hole.

The other thing to remember is that the A + B – I – C equation needs to be worked through in dollar terms, which: (a) maximises the value of any sequestered carbon; and (b) gets around the issue (via the Zero Carbon Act) of not being able to offset methane with sequestered carbon.

The key issue here for the carbon levy in our GHG plan is that a good understanding of the levy, and its implications for the farm business, will be a major factor in deciding what strategy(s) the farm needs to undertake to either mitigate and/or offset emissions. Farmers, like all good business managers, will need to work through what is the least cost option(s), which then needs to be reflected in the GHG plan.

From 2025 onwards, farmers will need to do an annual 'greenhouse gas return' somewhat akin to their annual financial return for tax purposes. Inasmuch as prices and the level of liability will vary, this annual exercise will then provide feedback about any changes required in the overall GHG plan/strategy.

Table 1: Summary of components of a GHG management plan

Objectives	Intended targets for reduction/offsetting
Strategy(s)	The means by which the objectives will be achieved
Base situation	Farm description
	Current level of emissions: methane, nitrous oxide, CO_2 from nitrogen fertiliser – both per ha and total farm emissions
	Base livestock numbers and performance
	Base supplementary feeds – types and tonnes
	Base nitrogen fertiliser – types and tonnes
	Indicative levy cost
Mitigation strategies	Strategies to reduce GHG emissions, reduce stocking rate/ improve productivity, reduce supplementary feed input, reduce nitrogen fertiliser input, improve effluent management etc
	Expected GHG reductions over time
	Implications for farm management and how these will be managed
Offsetting strategies	Current ETS and/or He Waka Eka Noa forests – areas, species of trees, location, level of offsetting
	Plans for any new forestry – areas, species of trees, location, level of offsetting
	Maps showing locations of forests
	Strategy once carbon sequestration opportunity is finished
Land use change	Potential land use change opportunities and implications for GHG emissions
Carbon dioxide	Potential reductions in energy usage/alternative energy sources
New technologies	Description of which technologies will be used, how, and their efficacy
Summary	How all the proposed actions add up to the reduction/offsetting target

Integration with wider farm environment plan (FEP)

While the purpose of this article is to discuss aspects of what components need to be covered within a GHG plan, yet another key consideration is that it needs to be an integral part of the overall FEP, particularly around strategies to reduce impacts on water quality. In many ways, these strategies will directly overlap with many of those used to reduce GHG emissions, and vice versa, and the GHG plan needs to recognise and discuss these.

This then leads to something of a quantum leap – to suggest an integrated farm plan covering the range of issues it needs to (e.g. GHG emissions, water quality impacts, biodiversity). The advantage of this approach is that the issues are discussed in a (hopefully) integrated way within one plan. The danger is that, apart from the cost, the resultant plan closely resembles a second edition of *War and Peace*, and subsequently gets chucked in a drawer and forgotten. So, keep it simple and practical.

Summary

Coming back to our GHG plan, a summary of the approach discussed in this article is outlined in **Table 1** above.

Phil Journeaux is an Agricultural Economist at AgFirst based in Hamilton with wide expertise in on-farm GHG issues. Email: phil.journeaux@agfirst.co.nz J

JULIAN GAFFANEY

ADAPTATION TO THE 190N CAP IN A GROUP OF CANTERBURY AND NORTH OTAGO DAIRY FARMS

From July 2021 it became illegal to apply more than 190 kg of synthetic nitrogen fertiliser per hectare to any grazed land. This article summarises the transition of a group of intensively monitored and benchmarked dairy farms over three seasons from an average of 274 kgN/ha down to 175 kgN/ha and the impacts on pasture and milk production and supplement use over this period.

New cap for synthetic nitrogen fertiliser

The first announcement of a cap for synthetic nitrogen fertiliser in pastoral farming systems in New Zealand was around May 2020, resulting from the Government's essential freshwater reforms. The initial proposals that were announced in a discussion document in September 2019 gave three potential pathways for reducing nitrogen (or more specifically nitrate) levels in freshwater:

- Catchment caps in high nitrate level catchments
- A nationwide cap for nitrogen fertiliser use on a per hectare basis
- Using existing 'farm plans', with a newly incorporated schedule for reducing nitrate leaching and with progress being monitored by independent auditors.

The place we ended up in as of May 2020 was the per hectare cap for the use of synthetic nitrogen fertiliser to be enacted from 1 July 2021. The cap was set at 190 kgN/ha and is set for review by 2023, which we are well on the way towards.

Farmer response to the imposition of a cap was varied, depending on how intensive or leveraged up on nitrogen fertiliser their farm systems were, with high users viewing the cap as government regulation interfering with their farming businesses in a restrictive way. Lower (per hectare) nitrogen fertiliser users were generally less stressed by the imposition of a cap, with a reasonable proportion (estimated at around 25%) having already been focusing on reducing their use in response to the broad and increasing publicising of negative environmental impacts associated with higher use over the preceding five or more year period.

The imposition of a regulated cap on nitrogen fertiliser use for pastoral grazed land in New Zealand has been a significant step away from the previous 'output'-based regulatory framework.

A smaller proportion of dairy farmers have never been high users of nitrogen fertiliser (i.e. using less than 150 kgN/ha), and have kept their farm systems 'un-leveraged' off high use and generally had a higher focus on biological nitrogen fixation by legumes.

In general, the imposition of a regulated cap on nitrogen fertiliser use for pastoral grazed land in New Zealand has been a significant step away from the previous 'output'-based regulatory framework. This framework was primarily based on Overseer™ modelling outputs in combination with farm environment plans (FEPs) and had become embedded in the regional council policy settings for the two regions that this study encompasses.

The study

I work with around 40 dairy farming clients, mostly across the regions of Canterbury and Otago, and some work on the West Coast of the South Island. For most of these clients the dairy farm units are modelled with Farmax dairy software. This study compares the changes in a group of intensively benchmarked dairy farms over a three season period, which encompasses the time from prior to the N cap announcement (the 2019/20 season) through to the first season (2021/22) under the 190 kgN/ha cap.

These farms have been selected as they cover a similar climatic zone, are all irrigated and have a high regular standard of information recording, which validates the basis for comparison of changes in pasture grown and harvested, nitrogen fertiliser use and farm performance over the study period.

Farmax modelling software

The use of Farmax software allows the farms' production systems to be accurately modelled, centred around an animal lactation and nutrition model that encompasses milk production, pasture and supplementary feeding levels and nutritional properties, pasture cover levels, growth rates and a nitrogen fertiliser sub-model.

The combination of these science-based sub-models within the overall Farmax software makes it a really effective farm modelling and production system recording tool, with a base 'plan' configured and set for the season that encompasses historical averaged pasture growth rates and other productive performance attributes of the farm system. This base plan is then set as the Target and an actuals-based 'monitoring' file is run to both record and monitor farm performance relative to the plan, as well as provide a tool to test different scenarios or possible management options and what the likely productive and financial impact would be.

In the context of comparing a large group of farms, Farmax gives the ability to be able to open multiple files and make comparisons between the physical performance and features of the farms/systems, and also to total the group's figures to give averages across the group on a number of physical measures (see **Table 1**).

Initial state – 2019/20 analysis

The group of 16 farms had an average stocking rate of 3.64 cows/ha, which is slightly above the Canterbury average of 3.45 cows/ha for the 2019/20 season. Average production per cow is 467 kg of milksolids (kgMS/cow), which is higher than the averages for South Canterbury (423 kgMS/cow) and Otago (400 kgMS/cow) for the 2019/20 season (see **Table 1**).

The average effective farm area was 246 ha and per hectare production was 1,701 kgMS, and the total number of cows peak milked was 14,308, which had an average of 262 days in lactation. Pasture production averaged across all farms was 15,358 kgDM/ha as assessed by Farmax, which takes into account typically between 40 and 45 actual average pasture cover assessments entered into the monitoring files, as well as pasture feeding levels across the season.

Nitrogen fertiliser (synthetic form) use is also recorded in the monitoring files by type, nitrogen content and applied areas by date across the season and average response rates, plus the duration of response for time of season are used in the nitrogen sub-model. The average fertiliser nitrogen use for the 2019/20 season across the farms was 274 kg of nitrogen/ha.

The range of pasture growth rates and average pasture covers exhibit a typical large range and variation, as is often seen across large groups of farms. The geographical range of the farms extends from coastal Waitaki and the South Canterbury plains to inland as far as Duntroon in North Otago to Fairlie in South Canterbury and as far north as Lyndhurst in Mid-Canterbury.

Greenhouse gas (GHG) emissions from the farms based around production levels, livestock and fertiliser use are also assessed by the Farmax models and this gives us an opportunity to compare the differences over time that the changes to the farm systems are having on emissions using an accepted measurement tool. The average net CO_2^e (CO_2 equivalents) assessed for the 2019/20 season (see **Table 1**) were 13,507 kg CO_2^e/ha or 7.9 kg CO_2^e per kg of product.

Comparing pasture cover readings on rising plate-meters

GHG emissions from the farms based around production levels, livestock and fertiliser use are also assessed by the Farmax models.

Mid-state – 2020/21 analysis

The same group of 16 farms had an average stocking rate of 3.68 cows/ha, which was a slight lift on the 2019/20 season. Average production per cow was 465 kgMS/cow, which was similar to the 2019/20 season.

The average effective farm area was 248 ha, which lifted slightly due to some more area being used as dairy platform on a couple of the farms. There was a slight lift in per hectare production to 1,714 kgMS, and the total number of cows peaked across the group of farms was 14,596, which had an average of 246 days in lactation. Pasture production averaged across all farms was 15,170 kgDM/ha as assessed by Farmax, which was a reduction of 188 kgDM/ha or 1.2%.

The average fertiliser nitrogen use for the 2020/21 season across the farms was 228 kg of nitrogen/ha, and this rate represents a 16.5% reduction in synthetic nitrogen fertiliser use from the previous season. This reduction was basically voluntary as there was no regulatory requirement (no cap) to reduce levels in the 2020/21 season. However, it was driven by an intent to reduce levels over a staged period of two seasons to allow for an easier adaptation to operating the farm systems under the forthcoming cap, and this in turn was driven by farmers and also by consultancy advice recommending a staged approach.

Supplement usage for the 2020/21 season mirrored the 2019/20 season, with supplement offered per cow and per hectare being at the same overall levels. Another point to note was that the total production for the 2020/21 season was around 1.5% ahead of the 2019/20 season, despite the pasture grown per hectare being slightly lower and the same supplement level being used. This outcome is reflected in the feed conversion efficiency (of feed offered) being 0.3 kgDM more efficient for the 2020/21 season.

The average net CO_2^e (CO_2 equivalents) assessed for the 2020/21 season were 13,268 kg CO_2^e/ha or 7.7 kg CO_2^e per kg of product.

2021/22 analysis – operating under the cap

The same group of 16 farms had an average stocking rate of 3.59 cows/ha, which was a moderate reduction on the 2020/21 season. Average production per cow was 465 kgMS/cow, which was the same as the 2020/21 season (see **Table 1**).

The average effective farm area was 246 ha, which reduced slightly due to one farm losing some leased area that had been used as dairy platform. There was a small reduction in per hectare production to 1,672 kgMS (down 2.5% on 2021/22). The total number of cows peaked across the group of farms was 14,135, which had an average of 258 days in lactation.

Pasture production averaged across all farms was 14,459 kgDM/ha as assessed by Farmax, which was a reduction of 711 kgDM/ha or 4.7%. Of particular note was that the season had marked slow early spring growth, which is estimated to have reduced total pasture production by around 300-400 kgDM/ha.

The average fertiliser nitrogen use for the 2021/22 season across the farms was 175 kgN/ha, and this rate represents a large 23% reduction in synthetic nitrogen fertiliser use from the previous season, and a larger 36% reduction over two seasons. This reduction was achieved through judicious planning and the implementation of the seasonal fertiliser nitrogen programmes, and in the case of some of the farms a genuine policy to use well under the 190 kgN cap limit.

Supplement usage for the 2021/22 season was higher than the two previous seasons by around 100 kgDM per cow or 400 kgDM/ha (Farmax rounds these figures). Another point to note was that the total production for the 2021/22 season was around 3.1% lower than the 2020/21 season – this compares favourably with the New Zealand average of around 5% in the previous season. The feed conversion efficiency (of feed offered) was 0.4 kgDM less efficient than the 2020/21 season as measured by Farmax.

The average net CO_2^e (CO_2 equivalents) assessed for the 2021/22 season were 12,701 kgCO_2^e/ha or 7.6 kg CO_2^e per kg of product.

2021/22 – farm management changes

The reduction in synthetic nitrogen fertiliser has not been a change made in isolation. In all of these farm systems there has been a focus on all factors limiting potential pasture production aside from nitrogen only, which has included:

- A broader focus on soil fertility, optimising pH levels and other macro-nutrients from whole-farm soil testing regimes, and plant tissue testing to diagnose potential trace element deficiencies including boron and molybdenum, which are essential for healthy legume rhizobia function
- Efficiency and optimisation of irrigation systems
- Effluent area and distribution optimisation
- Increasing clover content of pastures, with additional clover seed being introduced to existing pastures and higher rates and a wider range of clovers sown in new pasture mixes
- The inclusion of plantain into pasture mixes, which has been shown to improve nitrogen retention in the soil and increase nitrogen utilisation efficiency.

The promising signs from this analysis are that pasture production and milk production are not being majorly impacted by the nitrogen fertiliser cap.

Conclusions

There are some interesting trends from the group analysis of the transition to lower nitrogen systems over the three seasons studied, with the key standout being that synthetic nitrogen fertiliser use has been reduced by 36% while production per hectare has reduced by less than 2.5% over the same period.

What should be borne in mind though is that supplement use was also increased over the same period by around 10.5%. Countering the increase in supplement use however is the fact that pasture production was estimated to be reduced by around 350 kgDM/ha due to poor spring growth conditions, which would equate to a reduced supplement requirement of around 8% over the same period.

Season-on-season comparisons are difficult given inter-season variability, but the promising signs from this analysis are that pasture production and milk production are not being majorly impacted by the nitrogen fertiliser cap.

Given that the key reasoning behind the setting of the cap is to ultimately reduce nitrogen leaching losses through the soil profile to groundwater, the 36% reduction in synthetic nitrogen fertiliser use would be expected to align with a lower risk of leaching losses. This outcome has not been specifically assessed with this study as there is no corresponding Overseer™ data to compare. However, an indirect assessment of nitrogen that could be leached is available from the Farmax modelling, which is 'nitrogen balance'.

Farmax calculates the difference between nitrogen inputs (nitrogen in fertiliser and supplements) and nitrogen outputs in products (milk, meat) and this metric is also commonly referred to as a nitrogen surplus. The average Farmax assessed nitrogen balance level was 159 kgN/ha for the 2019/20 season, and this level reduced to 87 kgN/ha for the 2020/21 season, a reduction of 45%. It must be noted though that there is no direct correlation between nitrogen surplus and nitrogen leached.

Another positive outcome is seeing GHG emissions reduced by close to 10% in relation to a 6% reduction in pasture production and only a 1.7% reduction in milk production per hectare between the 2019/20 and 2021/22 seasons.

Julian Gaffaney is Director of TransformAgri based in Timaru. Email: julian@transformagri.co.nz

Table 1: Summary of three seasons of data across farm study group

Category	Description	Value			Units
		2019/20	2020/21	2021/22	
Farm	Effective Area	3,930	3,960	3,935	ha
	Stocking Rate	3.64	3.68	3.59	cows/ha
	Comparative Stocking Rate	73.4	75.0	74.7	kg Lwt/t DM offered
	Potential Pasture Growth	16.5	16.4	16.4	t DM/ha
	Nitrogen Use per total ha	274	228	175	kg N/ha
	Feed Conversion Efficiency (offered)	12.6	12.3	12.7	kg DM offered/kg MS
Emissions	GHG	13,507	13,268	12,170	CO_2^e/ha
Herd	Cow Numbers (1st July)	14,532	14,784	14,709	cows
	Peak Cows Milked	14,308	14,596	14,135	cows
	Days in Milk	262	246	258	days
	Avg. BCS at calving	5.0	5.0	5.0	BCS
	Liveweight per total ha	1,570	1,583	1,583	kg/ha
Production	Milk Solids total	6,683,837	6,788,080	6,576,524	kg
(to Factory)	Milk Solids per total ha	1,701	1,714	1,672	kg/ha
	Milk Solids per cow	467	465	465	kg/cow
	Peak Milk Solids production	1.90	2.11	2.03	kg/cow/day
	Milk Solids as % of live weight	108.3	108.3	105.6	%
Feeding	Pasture Offered per cow	4.2	4.1	4.0	t DM/cow
	Supplements Offered per cow	1.0	1.0	1.1	t DM/cow
	Off-farm Grazing Offered per cow	0.7	0.7	0.8	t DM/cow
	Total Feed Offered per cow	5.9	5.7	5.9	t DM/cow
	Pasture Offered per total ha	15,358	15,170	14,459	kg DM/ha
	Supplements Offered per total ha	3.8	3.8	4.2	t DM/ha
	Off-farm Grazing Offered per total ha	4.9	4.5	5.1	t DM/ha
	Total Feed Offered per total ha	24	23.5	23.8	t DM/ha
	Supplements Total	14,934	15,048	16,527	t DM

POWERED BY FARMAX

DERRICK MOOT

WHERE HAVE ALL THE DATA GONE AND HOW CAN WE FIND IT?

This article describes the rationale for the creation of the AgYields open access database that provides flowering dates, yield and growth rates of different crop and pasture species in locations across New Zealand. The importance of past, present and future data collection and access is reviewed.

Historical data still available

One of my first jobs during my PhD research in 1990 was to scour the journals for pasture growth rate data for different locations in New Zealand. The excellent work of the Ministry of Agriculture and Fisheries (MAF) and the Department of Scientific and Industrial Research (DSIR) technicians, who had diligently recorded fortnightly or monthly data from research stations across the motu, provided most of the data.

Today, those data are still available in the Lincoln University Farm Technical Manual, along with the short descriptions I wrote about the location and conditions under which the data were collected. The methods used for that data collection are the standard used by students, farmers and technicians since the 1970s.

Creation of national forage database

But what has happened to all the other pasture growth rate data collected since? That question needed to be asked – how many datasets are sitting on the shelves of researchers and commercial organisations that had served their original purpose, but were now forgotten or likely to be so in the near future? Fortunately, colleagues Mike Dodd, Wendy Griffiths and David Chapman had been asking the same question – and trying to find answers to it as part of their work.

They had created a national forage database for DairyNZ from which we determined the basic structure of what is now New Zealand's open access pasture and crop yield database – AgYields (www.agyields.co.nz). We collectively identified several reasons for wanting an open access database, including:

- The use of models for land use planning and evaluation that require this fundamental data
- Emerging challenges to crop and pasture productivity and persistence (e.g. climate change, environmental regulations), which require data on a range of species for informed decision-making
- The need for local data for different species for feed budgeting for individual farms within social and environmental boundaries
- The ongoing loss of legacy knowledge about where and when such data have been collected historically
- The cost and risk of archiving paper-based material, such as old reports and associated data
- The need for data from publicly-funded research projects to be readily available in an open access form.

The T.R. Ellet Trust realised the importance of such an asset and funded its creation, while Lincoln University is hosting it as part of its service to (and engagement with) the rural sector.

For anyone wanting to know the yield of a pasture or crop grown in their local district the database is the first place to look. Under the Hill Country Futures research programme we have populated it from many journal papers, but recognise there are a lot more data to be added. A feature of the database is that it allows published and unpublished datasets to be entered and users can then determine their relevance for themselves. Published datasets are from peer-reviewed journal articles. Unpublished datasets are technical reports, monographs, dissertations and data sheets that have not been published in a peer-reviewed

Figure 1: Pasture measurements from research fields and farms across New Zealand using different techniques (e.g. quadrat cuts, plate meter and exclosure cages)

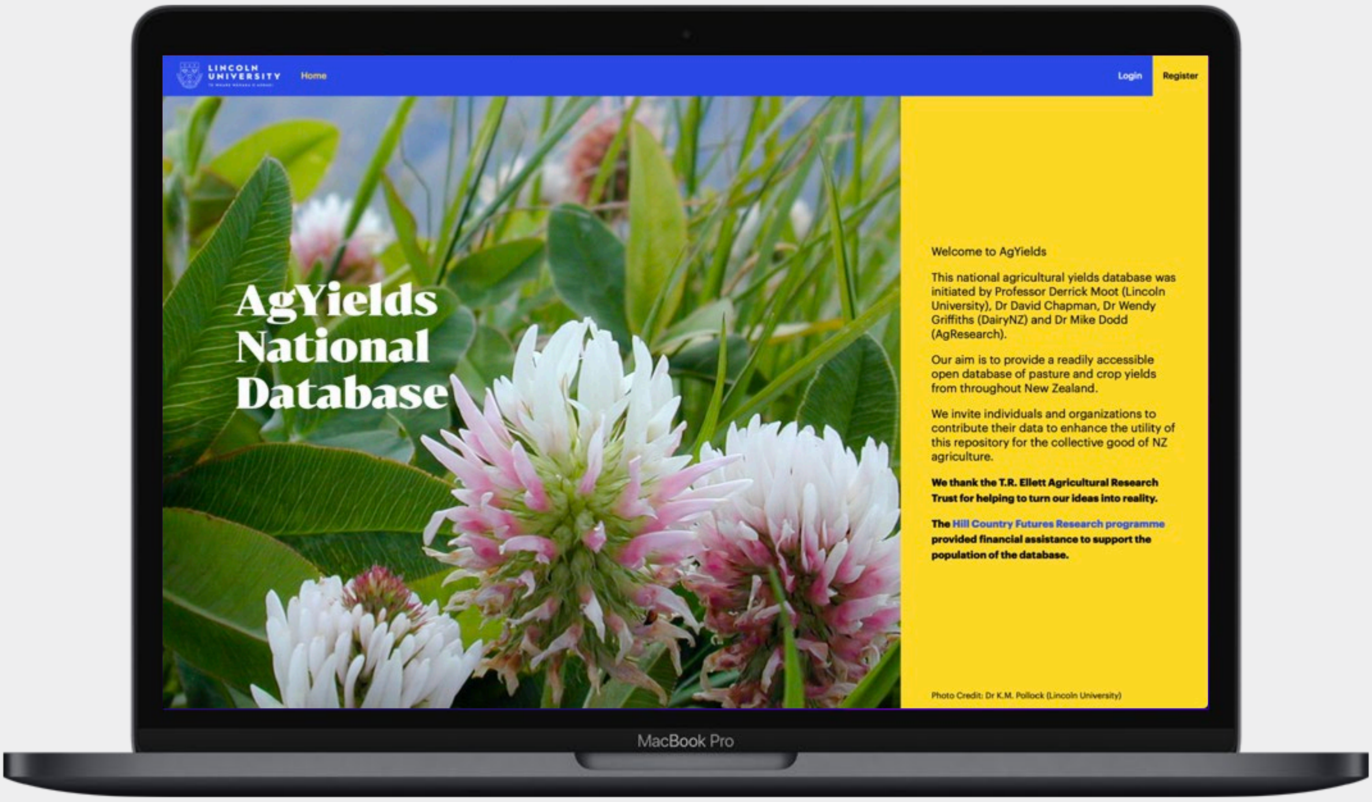

Figure 2: The AgYields National Database homepage (www.agyields.co.nz)

A feature of the database is that it allows published and unpublished datasets to be entered and users can then determine their relevance for themselves.

journal, which can include unpublished commercial trials.

The regions with the most data currently entered are Canterbury, Northland and Bay of Plenty. Recent farmer questions about the production and persistence of pastures in Northland have centred on perennial ryegrass. However, when Beef + Lamb New Zealand commissioned a literature review on other species it was expedient to gather as many datasets as we could and enter them into the database.

To date, there are over 50 entered datasets for the region with the earliest peer-reviewed dataset from 1960. The list also includes unpublished, but valuable, datasets from the Northland Beef for Profit programme. The ability to enter the data in one place means future researchers can be spared the time we spent searching journals and reports to review the scattered data.

Value of the database

The value of the database became obvious even before it was written. Word had gotten out that the database was underway and books of field data started arriving from Martin Hawke – a retiree who had been entrusted with an array of data collected by the late Tom Gee (Thomas M. Gee) in the Bay of Plenty-Rotorua region. His family knew that Tom had spent many thousands of hours collecting the data and were reluctant to throw it out, so had given it to Martin for 'safe-keeping', but he was at a loss to know what to do with it.

We have now collated that data, entered it in the database and analysed mean pasture growth rates for the region. They illustrate the importance of having a central repository for information that will become more valuable as the digital age demands more information, but the funding for the physical labour to collect it is reduced.

In the 1980s, there were MAF and DSIR stations and farms dotted around New Zealand. Many important experiments were undertaken at these locations that answered questions for local farmers in their environment. The reforms of the 1980s led to the rationalisation of scientific expertise to what are now four main centres, and in closing other sites much of the data have been 'stored'.

It is hoped those responsible for its collection or storage still have their memory, the time and energy to retrieve it and enter it into the database. These localised data are invaluable to farm consultants and others wishing to look at pasture and crop options for their district. Indeed, a lack of local data is often the main impediment to farmers wanting to try new crop or pasture options.

Once research stations closed the commercial sector became important for demonstrating the value of new crop and pasture genetics to farmers. Often this requires the growing of several species or cultivars in a location and inviting local farmers to view those results. These on-farm trials and demonstrations are invaluable extension opportunities.

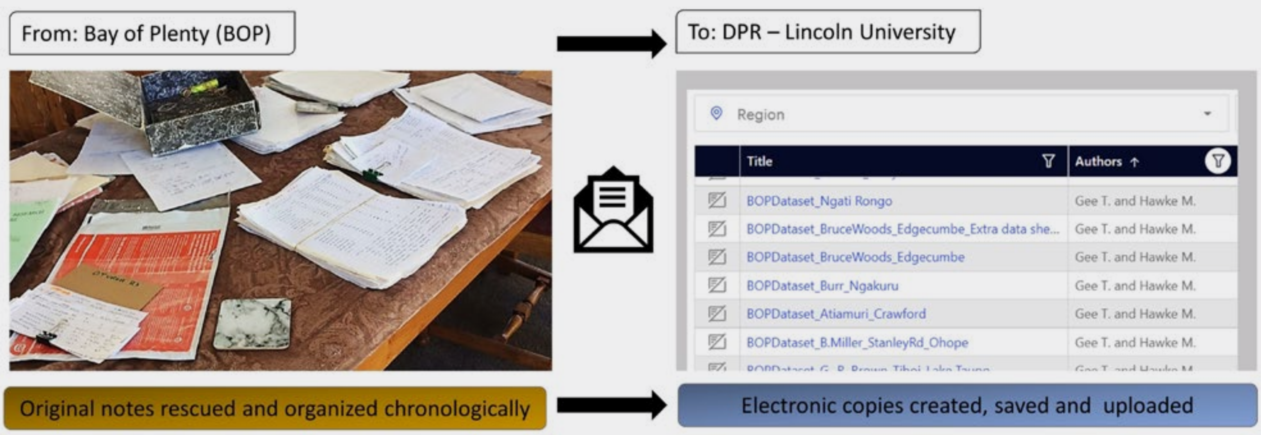

Figure 3: Field notes have been digitalised, stored and uploaded into AgYields

On the database data entry mode there is also a list of >130 soil types organised by common names, the New Zealand soil classification system and the US soil taxonomy nomenclature.

The agronomists responsible for collecting the data have usually summarised it for two to three years, but not had the time to formally publish it in a peer-reviewed format. The database provides the opportunity for that hard work to live on as an unpublished dataset. Equally, the cultivar names are optional so any commercially sensitive information can be maintained simply by entering the data at the species level.

We also know that over the years many farmers have collected their own on-farm pasture growth rate data. Many discussion groups have also collected data through monitor or focus farms. These are seldom done in sufficient detail or replication to be published, but they are useful to the farmer and others in the district.

The range of species being used in New Zealand has also expanded greatly over time. The database contains a drop-down menu that contains many of those commonly, and not so commonly, used across the country. Indeed, the review of information from Northland led to a major expansion of the species list and therefore additional programming work for our developers. On the database data entry mode there is also a list of >130 soil types organised by common names, the New Zealand soil classification system and the US soil taxonomy nomenclature.

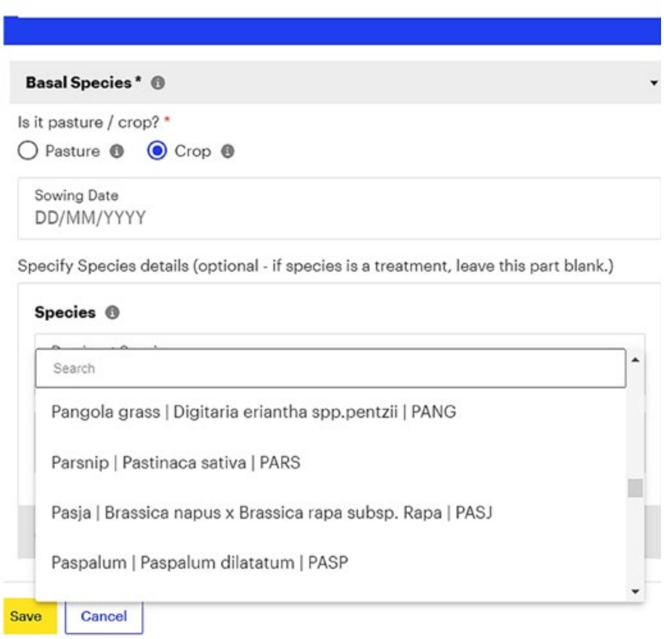

Figure 4: Detail from the species drop-down menu from the AgYields data entry mode page

Development challenges

As always, a database is not perfect and we are sure there are aspects of this one that will frustrate users. Feedback will allow us to further develop the interface and ensure it is meeting the diverse range of users who we hope will engage with it.

A challenge that developed during the database creation was the expansion of the number of species included in some pasture mixes. Over time, the pasture composition will change and some will become more dominant than others. However, there is flexibility at data entry to allow users to select dominant and additional species to include as many as required.

The base information related to fertility, defoliation management and irrigation can be entered for the site. Or if an experiment was, for example, comparing fertilisers then the rates and types of fertiliser can be added at the experimental level. Having started to populate the database it became evident that capturing the diversity of experiments would be a challenge, but we hope we have added sufficient flexibility to allow users to define these.

Having entered data it can be checked before submission, which is done by populating the data entry grid and then returning to the list of datasets. All submitted datasets will be present, but your draft dataset is there, which only you as the person creating the dataset can see. By downloading this, a CSV (comma-separated values) file is created that you can then check to see if it has captured the data as you wanted it. If not, you can re-enter the data or create a new experiment that captures the base information before deleting the incorrect version.

The data entry and download processes are outlined in the Help Guide which can be visualised on a new tab or downloaded as a pdf document. To help users enter their data there are tips and guidelines available on main entry boxes and by hovering the mouse over the information icon (ℹ). There are also a series of help guide videos and examples being prepared to assist users to navigate the website menus, enter and save their data, and download datasets for further processing.

To date the emphasis has been on pasture data, but the database has been designed to allow arable yields and flowering dates to also be captured. The base data of grain and biological yield can be entered. However, it was not feasible to include other data such as associated weather files or photos of sites. These add complexity to data storage and security, but we have offered a tick box that allows notification of their availability.

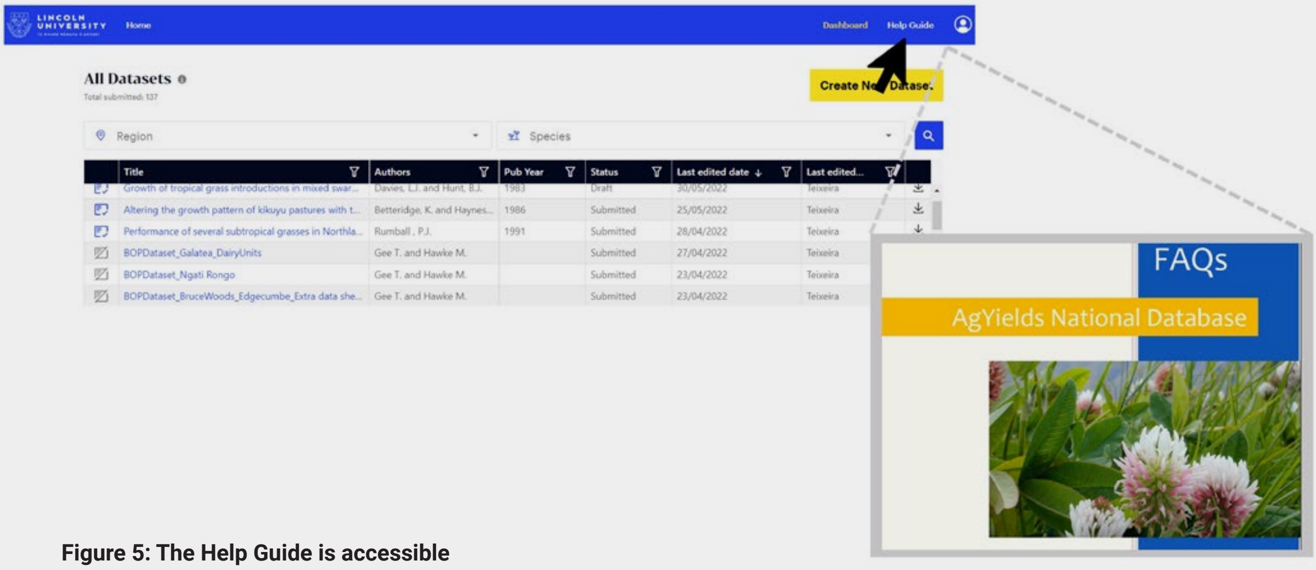

Figure 5: The Help Guide is accessible on the AgYields Dashboard top menu

To date the emphasis has been on pasture data, but the database has been designed to allow arable yields and flowering dates to also be captured.

The associated files are likely to be invaluable to those wanting to model data at the crop level while the actual yield data can be used to ground truth model predictions. This aspect has recently been completed to validate the thermal time lucerne model and its more sophisticated cousin APSIM_Lucerne.

Legacy of the data

The uses to which the database is put are likely to increase as the digital savvy generation replaces those of us more familiar with a notebook. Our aim is to ensure the legacy of the data remains alive to help shape the future of the primary sector. Future post-grads will be uploading their data directly from a digital device and sighing knowingly at their greying supervisor as they reach for a filing cabinet or old notebook to show how it was done 'back in our day'.

How all those data get used in future is up to those who follow. With AgYields, we aim to provide the base data in one place to allow future users to stretch their imagination and use it as they see fit for the benefit of all New Zealanders.

Acknowledgements

Thanks are due to Carmen Teixeira and the Dryland Pasture Research Team at Lincoln University for populating the database with assistance from MAF technicians who collected data from the 1970s, Peter Burton who assisted Tom Gee, and the Gee family who gave their data to Martin Hawke who organised all the field notes and provided information about the sites.

Funding for this project was provided by Beef + Lamb New Zealand, the Ministry for Business Innovation and Employment, Seed Force New Zealand and PGG Wrightson Seeds under the Hill Country Futures research programme (BLNZT1701) and Extension Tools for Hill Country Futures (Project Number: 21126). The T.R. Ellett Agricultural Research Trust funded the software development for the AgYields database.

Professor Derrick Moot leads the Dryland Pastures Research Group based at Lincoln University in Canterbury.
Email: derrick.moot@lincoln.ac.nz J

KYLIE HALL

COMPUTER VISION AI DELIVERING FRUIT SIZE DATA EARLIER THAN EVER BEFORE

New Zealand-led agritech – technology for agriculture, horticulture and aquaculture – is making waves in the global fruit-growing community with its innovative real-world applications. This article looks at early fruit sizing and computer vision AI, now being used by some of the largest companies in the world.

New Zealand agritech landscape

In June 2022, the Hon Stuart Nash, Minister for Economic and Regional Development noted, 'Our agritech sector is developing innovative solutions for the primary sectors in New Zealand and the world, increasing their productivity and sustainability.'

Reference was made to the TIN (Technology Investment Network) Agritech Research report which highlighted the growth of the sector. Commissioned by the Ministry of Business, Innovation and Employment and the Ministry for Primary Industries, this report celebrates the success and growth of this dynamic technology sector (see https://tin100.com/product/2022-agritech-report/).

During the past year, the largest 22 agritech companies in New Zealand had a revenue growth of 8% and export growth of 6.4%. Companies with revenue over $200 million grew at a rate of 7.7%, while those with revenue of up to $50 million grew remarkably at about 30%.

UN projections

By 2050, the United Nations estimates that a further 1.6 billion people will need feeding. Projections indicate that to feed this population crop production will need to increase by 60-100%. Although the population is not doubling, more people will be affluent. Add to that the greater focus on plant-based foods and health, and fruit becomes a popular pick.

To meet that future demand growers will need to produce more proportionately from less land, reduce their wastage, and also get more product to market, all at a time when agricultural labour markets are shrinking. Innovation and the use of technology such as computer vision AI will be crucial if the world's producers are to succeed in rising to this global challenge.

Computer vision AI – a photo of a fruit bin gives growers and packers almost instant size data

Computer vision AI

Computer vision is the field of computer science that focuses on replicating parts of the complex human vision system. It enables computers to identify and process objects in images and videos in the same way that humans do. Computer vision is about training a computer to see the world (and objects within it) in the same way that humans see them. Here are some explainers:

- Take a look at your hand and your eyes will see five fingers. Computer vision is where a camera or computer system can give you the same information without you having to count.
- No-one tells a child how to see. If you think of a child's eyes as cameras, they take a picture every 200 milliseconds. So by age three, the child will have seen hundreds of millions of pictures, which is an extensive set of images for our 'human computer' to use for learning. The same happens with computer vision. The computer is fed thousands of images so we can teach the computer what it is seeing.

Computers are first fed relevant images and then with the help of AI (such as machine learning), computer models and algorithms can be used to detect, count and size objects very quickly and accurately – faster than humans could ever do.

Early size data and why it matters

When it comes to fruit production in general there are some key characteristics that affect the saleability of fruit. Flavour, appearance (especially colour and blemishes, firmness, shelf-life and size) are just some of them. Different markets have different requirements, but size is generally a key consideration for all.

Taking apples as an example, when a bin leaves the orchard and arrives at the packhouse size is a key determining factor as to which market that fruit will be sold into. That decision will inform many successive decisions, including:

- When is the best time to sell this fruit into that market?
- How long should this fruit be stored? Apples can be stored in temperature-controlled cool rooms for six months or more
- Which storerooms should these bins go to? These rooms are kept sealed at specific temperatures unless the fruit is needed
- What type of packaging will be required?
- How should the pack line be set up and where should staff be placed for optimal efficiency?
- What freight needs to be booked/managed/cancelled?
- Will the company be able to meet the sales orders it has committed to?

Computer vision is the field of computer science that focuses on replicating parts of the complex human vision system.

The Spectre for Apples computer vision fruit-sizing tool begins detecting apples from the top of the bin

CASE STUDY

A New Zealand agritech solution – apples and citrus

During grower and packhouse discussions, the team at agritech company Hectre would often hear about the problems caused by a lack of size data. It soon became obvious this was an issue that was affecting the industry.

The computer vision AI and machine learning solution Spectre for Apples app was initially developed by the company for the apple industry to detect the fruit and size them.

With this technology, apple growers and packers can use an iPad to take photos of, for example, 10 full bins of apples, load them up to the app, and within seconds receive a size estimation based on a sample of 1,250 apples or an average of 125 apples per bin, which equates to a 5% sample size. This technology provides an increase of 4,500+% in sample size compared with traditional manual size sampling and in less time.

This type of computer vision AI has been built with user simplicity to the fore. This is critical when developing technology for industries that are dealing with labour scarcity, and which are often reliant on labour from countries that may have English as a second language (the app is trilingual).

The app helps with the communication chain from the field, to the warehouse and to sales, and is now being used by apple growers and packers in many countries. Sage Fruit and Washington Fruit & Produce in the US, BC Tree Fruits Cooperative in Canada and apple innovator Rockit Global in New Zealand are some of the early adopters of this technology.

Similarly another app, Spectre for Citrus, which makes early fruit-sizing estimations for lemons, oranges and mandarins, is being used by New Zealand's largest citrus distributor, First Fresh NZ. It is also an excellent tool for growers as they can scan bins in real time to ensure adherence to size picking requirements, leaving smaller fruit for a later pick when it will have greater value.

A worker at First Fresh NZ using Spectre for Citrus to gain early sizing data on Meyer lemons, New Zealand's highest value citrus export

> **Everything that is of concern for the apple industry is doubly so for cherry growers and packers due to their severely contracted pick, pack and ship timeline.**

Traditional approaches

Due to the labour-intensive nature of manual size sampling, and the fast pace of harvest, any estimates undertaken produce insignificant sample sizes and are often not representative of the fruit in the bin. Large packhouses pack hundreds of thousands of bins of fruit each year. Decision-making cannot be optimal if critical data inputs are missing or incorrect.

Before the introduction of computer vision AI technology, when full bins of fruit were arriving at packhouses very little data was available on their size. Traditional size sampling would vary from simply eyeballing the fruit and taking a best guess approach through to manual sampling. Manual sampling involves quality control staff selecting a number of fruit, then using calliper hand tools to individually measure each piece to arrive at estimations of the size of fruit in the bin.

For apples, due to the very time-intensive nature of manual size sampling, often only 25 apples across 10 bins would be measured. Each bin contains approximately 2,500 apples so it is an extremely small sample size of 0.1%.

International cherry market

Global cherry production amounts to more than 4 million metric tonnes p.a. Of that, US cherry production accounts for 350,000 metric tonnes, claiming the position as the second largest producer in the world. Washington state alone produces more than 65% of the US sweet cherry volume.

Fruit quality and size becomes even more critical when exporting produce. The US is the third largest exporter of sweet cherries globally, with exports valued at more than $750 million dollars in 2020. Chile leads the way, with Hong Kong in second position.

For those who are working with premium fruit crops like cherries, the challenges posed by a lack of early fruit size data become even greater. Cherries are often packed and shipped within 24 hours of harvest and there is no time for inadequate decision-making.

Sales teams need to know what size cherries they have so they can confidently secure orders at the earliest time possible. Freight needs to be booked very quickly and mistakes are costly. Packing operations need to be extremely efficient to process the cherries at speed and meet the despatch timeframes.

Everything that is of concern for the apple industry is doubly so for cherry growers and packers due to their severely contracted pick, pack and ship timeline. Gaining early, reliable and significant size data becomes even more crucial.

The future

In addition to the early fruit-sizing applications, this type of technology is also being used in the development of crop counting and on-tree fruit-sizing technology. US fruit packers are looking to take this type of technology to the next level, where further automation will bring even greater efficiency and valuable data to their operations.

There are many companies trying to deliver on-tree, but industry expectation is that it will take quite a few years before there is a viable commercial product available. Hectre have carried out early testing of on-tree detection and counting and the results are very encouraging.

Kylie Hall is based at Hectre, an agritech start-up in Auckland city. Email: kylie@hectre.com J

HANNAH FRENCH

This profile looks at the life and career of Hannah French, Agribusiness Consultant, who is based at BakerAg in Masterton.

Massey years

Hannah grew up on a lifestyle block in mid-Canterbury. Spending school holidays on her grandparents' farms in Ashburton was a highlight and piqued her interest in a career working with farmers. Through high school she spent most weekends riding horses or playing hockey and both taught her important skills and resilience. At that stage her chosen career path was that of a vet, so in 2009 she packed her bags and headed to Palmerston North to follow her dream.

Unfortunately, like so many the dream of being a vet didn't come to fruition after the first semester so she changed path and completed agriculture papers for the rest of her first year, graduating with a Bachelor of AgriCommerce in 2012. In her final year she realised farm management was her passion and that her real interest was in helping farmers.

After finishing her degree Hannah stayed on at Massey and gained a Second Class Honours degree in AgriScience in 2013, with farm management consultancy the focus of her dissertation. This was a great insight into what would become her future career.

During her time at Massey, Hannah, like so many others, became involved in the Young Farmers Club. This was a rite of passage for the ag students on campus. She held various committee roles over her four years at uni and during this time also met her future husband Richard.

Landcorp Pamu experience

At the end of her Honours year she was fortunate to spend time with Landcorp (Pamu) Business Managers on a trip to some of their Te Anau farms. Shortly after she was offered a Business Analyst role on the Wairakei Pastoral Dairy Developments in Taupo. This role was exciting, fast-paced and a once-in-a lifetime opportunity. Her day-to-day was varied and ranged from writing business plans and helping build project timelines for the development farms to overseeing the construction of houses and cowsheds.

After 18 months in this role an opportunity arose to also oversee the dairy support operations as farms transitioned from forestry to dairy. One of the best parts of these roles for Hannah wasn't the work itself but the team she was a part of – a small group with a good mix of experience and youthful enthusiasm. Ross Shepherd was Hannah's manager and a great mentor, to whom she credits a large amount of her success in her career.

As development slowed down, the Livestock Team within Pamu was restructured. This presented an opportunity to move into a Livestock Business Manager's role working alongside seven sheep, beef and deer properties in the Central North Island. Here she dealt with the good and tricky sides of people management while working alongside a great team. The Livestock Business Manager role was key to Hannah's understanding of what makes farms and people tick, how to best fit policies to pasture curves, and how to take a team along on a journey of change.

The Livestock Business Manager role was key to Hannah's understanding of what makes farms and people tick, how to best fit policies to pasture curves, and how to take a team along on a journey of change.

A move to BakerAg

In 2018, Hannah took on a new role with BakerAg as an Agribusiness Consultant (Sheep and Beef) based in the Wairarapa, which marked her coming full circle from her Honours project. She loves the variety of the work, the challenging conversations with clients and discussion groups, and the constant and steep learning curve.

In Hannah's opinion, Wairarapa farmers are some of the most underrated in the country, while punching well above their weight in innovation and on-farm performance. Consultancy also fulfils her passion of helping people. She sees her role as helping farmers fill the gaps in their toolbox. In her experience, most farmers become farmers because they love working outdoors with dogs and stock. They didn't become farmers to manage a team, do budgets or write business plans, and this is where her complementary skillset adds value to her clients' businesses.

Farming and family

Her husband Richard was a fellow ag student turned graduate rural bank manager turned sheep and beef farmer. Early in their relationship they spent time mapping out their future. Richard's passion was farming and Hannah loved being outdoors so they decided the long-term goal was farm ownership.

Richard's father farms 400 ha about 30 minutes east of Masterton and a further 680 ha is leased an hour away in Alfredton. The home farm is a finishing block, while the Alfredton farm is the breeding block. The climates on the two farms complement each other, which is a real strength of the business.

In 2018, Hannah and Richard moved onto the farm, bought a small block of land and built their home. In 2022, they entered an equity partnership with Richard's family, the first major step on their journey to farm ownership. Although not usually involved in the day-today activities on-farm, Hannah has a supporting role with the tactical decision-making.

There is never a dull moment in the fast-paced high-performing operation. Stock (lamb and bulls) are finished on high-quality forages (red clover, plantain and clover, chicory or new grasses) year round. Richard's father, Len, had been frustrated with the seasonal variations, especially droughts that were becoming more and more common. In 2017, he began working on building an irrigation dam to take the climate risk out of the operation.

Like many projects there were a number of challenges along the way, but in January 2022 work began on the 16 ha dam complex on-farm comprising a wildlife reserve, recreation and 4 ha of newly established wetlands. This will provide enough water to irrigate 135 ha for the season, allowing the business to optimise production. Water also unlocks potential future land uses, which is an exciting prospect for Hannah and Richard.

In January 2022, they also started wearing another hat – that of parents – and for Hannah there couldn't have been a better time to be at home. Being able to be on-farm during the dam construction and irrigation installation has been exciting. This, coupled with a bit of time helping out in the yards and looking over the pasture covers on her farm walks with the pram in tow, has helped her keep her eye in for her clients while on parental leave.

Professional development

During her time at Pamu, Hannah was fortunate to have been supported through a number of NZIPIM short courses from leadership to project management. In 2017, she also went through the Kellogg Rural Leadership Programme. For her it was a fantastic experience being a part of a group of such inspirational and forward-thinking leaders.

Since joining BakerAg, she has completed the Advanced Sustainable Nutrient Management course through Massey University. This has been useful to support clients through policy changes on-farm while taking a comprehensive 360 degree view of the business.

Thoughts on the sector

Hannah feels farmers and agribusiness professionals are incredibly resilient and innovative, which has been demonstrated time and time again. In her view, it will again be shown as the sector faces challenges ranging from labour to land use to government policy. These challenges have left morale mixed, despite experiencing a period of record prices and delivering outstanding products to markets. She believes that once the agri sector has weathered the storm of current challenges it will be stronger, more agile and more innovative than ever before.

In her experience, farmers love spending time in their business working with their stock and dogs. Working on their businesses and developing teams is a secondary focus, which means this often gets pushed down the priority list for farm owners. This, coupled with limited career progression, has led to some excellent people exiting the industry.

Competition for farmland by forestry has reduced the number of larger-scale farms out there as final steps for farm managers, while many of the smaller farms in areas that were typically 'first farm' communities have been sold to forestry. This has made the goal of farm ownership less achievable without taking on excessive debt. Farmers who remain in these areas are typically top performers, but attracting and retaining good teams is becoming increasingly difficult with communities being marginalised. Those who do remain, and the staff who enter the industry will be in a strong position to produce the best protein in the world while maintaining our competitive advantage.

Farmers and rural professionals working together

Government legislation has pushed land prices up and, in many cases, forestry is providing more lucrative returns than sheep and beef. This has provided an opportunity for farming families with no obvious successor to sell at record highs. Hannah has noticed that a shrinking community has led many of the remaining farmers to reconsider whether to stay or also look to move to other areas. She notes that if farming families do choose to stay in communities that are shrinking and becoming more isolated they will need support. She sees this as an opportunity for rural professionals to partner with other service providers to broaden their service offerings.

For younger farmers looking to enter the sector, Hannah sees challenges from a reduced training offering to high land prices as a barrier to entry. Again, farmers have been innovative, forming training programmes, increasing on-the-job training and looking into alternative ownership structures such as equity partnerships.

Hannah sees the agri sector as being at a crossroads, but believes that if farmers and rural professionals are innovative and support each other then future challenges can be weathered successfully.

Email: hannah@bakerag.co.nz

Hannah sees the agri sector as being at a crossroads, but believes that if farmers and rural professionals are innovative and support each other then future challenges can be weathered successfully.

Hannah French with husband Richard on their Wairarapa property

Working for the good of
the Rural Profession

NZ Institute of
Primary Industry
Management

nzipim.co.nz