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ENABLING SMARTER FARMING FOR A BETTER NEW ZEALAND

Spring 2021 EDITION 13

"Animal welfare and production is the pinnacle for us"

Ruby Mulinder, Waihora Farm, Taupo

Campaigning for our strong wool

Sector innovation gains momentum

Nitrates and drinking water

Sorting the facts from the fiction



Welcome to the 13th edition of Ground Effect®

One of the things that attracted me to the CEO job at Ravensdown was the opportunity to join not just one of the country's great companies, but to formally join a constituency of invested, passionate and truly innovative stewards and architects of the rural economy who significantly influence our national fortunes. The prescient challenges around environmental sustainability, climate change and intensification of land use are the source of debate for all New Zealanders. While as a nation we are still learning how to constructively hold these debates, our shareholders are consistently standing toe to toe with these challenges.

Committed to smarter farming for a better New Zealand, our publication, Ground Effect, is both a call to action for our industry and a showcase of the commitment that smarter farming throughout the sector is no pipe dream. There are many precedents to follow and we see Ground Effect as the platform for their celebration and sharing.

It is both impressive and informative to see contributions from Manaaki Whenua – Landcare Research on soil carbon stocks, or the Our Land and Water National Science Challenge on N and P mitigations.

Whether you're new to farming, been around the traps for a while, or returning to the agsector like me, the changing landscape in which we find ourselves means that learning and evolving practices have never been more important, and is indeed stepping up in both pace and involvement.

Wool has suffered from these changing patterns more than most, so it's inspirational to see the Ramsden family who farm at iconic Moanaroa Station near Dannevirke work with Big Save Furniture to circumvent the supply chain and add value to their wool clip. Milled wheat and consumer tastes are also put under the microscope by Ivan Lawrie from the Foundation for Arable Research on page 34.

In the dairy sector, Camden Group in Canterbury show how they've managed the nitrogen change to a 190kg/ha limit and the importance of testing and tracking fertiliser use to monitor production.

Speaking of nitrogen, there's been a lot of focus on nitrates and drinking water and quite a bit of misinformation, so it's great that we hear directly from the authority on this subject. Professor Frank Frizelle is a colorectal surgeon and chief advisor



to Bowel Cancer New Zealand. He, along with colleague Dr Jacqui Keenan, are eminently more qualified to address this important topic than freshwater ecologists and activists.

We also visit a young Taupo couple, Ruby Mulinder and Sean Nixon, who, against the odds, have managed to purchase their first farm. They are treading their own path by diversifying into sheep milking while still maintaining a sheep and beef model. On page 20 we see our consultants have been helping with engagement in the Waikato on Farm Environment Planning. The behind-the-scenes policy and advocacy work that the co-operative's specialists carry out for shareholders is also of enormous value, covered on page 38.

I hope you find this edition as informative as I did and that these positive examples of how to thrive in a changing landscape inspire new ideas and understanding.

I'd love to hear from you at the email address below.

Best regards Garry Diack Ravensdown Chief Executive

CEO@RAVENSDOWN.CO.NZ

Ground Effect® Spring 2021



This edition

From farm to furniture: 6 adding value to wool

Moanaroa Station and Big Save Furniture are showing what's possible for coarse wool with their direct supply partnership

12 Soil carbon stocks

Where does New Zealand sit in the scheme of things?

Walking the path 14 less trodden

Young Taupo farmers Ruby Mulinder and Sean Nixon talk about buying their first farm and transitioning to sheep dairy

Measure, monitor, manage Canterbury dairy group Camden Dairy Farms Ltd discuss the practicalities of reducing nitrogen under an N-cap

Thought leaders



4 **Campaigning for** our strong wool By Tom O'Sullivan



18 Nitrates: when the

hype gets in the way By Professor Frank Frizelle



34 To eat wheat: local or imported? By Ivan Lawrie

Science and advice

17 HawkEye: N-190 heat mapping By Rangi Holland

20 **Preparing for the FEP** journey By Adrian Brocksopp

22 Water quality - we're on

the right track Our Land and Water scientists

28 **ClearTech for the** transport industry With Frew's Transport

29 **Can gibberellic acid** substitute nitrogen fertiliser? By Melanie Miller

32 Elementary essentials #4: Sulphur (S) By Dr Ants Roberts

36 The right rhizobia By AgResearch scientists

38 In your corner: advocating policy By Anna Wilkes and Allanah Kidd

40 Source code

Behind the scenes

Ravensdown is **Enabling Smarter Farming for a Better** New Zealand

Queens birthday honours

Congratulations to Ravensdown director Bruce Wills on receiving the Order of New Zealand Merit (ONZM) in the Queen's Birthday Honours for his regional, national and international contributions to the agricultural sector and the environment.



BRUCE WILLS WITH THE AGRI WOMEN'S DEVELOPMENT TRUST ESCALATOR **GRADUATES 2020**

Also picking up an ONZM honour was Ravensdown shareholder Jim Brownlie of Ngā Tuhoe Station in Ruakituri Valley near Wairoa. Jim was involved with the establishment of the East Coast Farm Cadet Scheme in 1980 and opened his farm to be used as a training and operations base for Search and Rescue exercises close to Urewera National Park. He began his ongoing involvement in mentoring trainees with the formation of the Agriculture Industry Training Organisation (Ag ITO).







2 Spring 2021



New Zealand Dairy Industry Awards

Congratulations to Manoi Kumar and Sumit Kamboj from Hawke's Bay/Wairarapa for winning the 2021 New Zealand Share Farmers of the Year. Waikato's Christopher Vila won the 2021 New Zealand Dairy Manager of the Year and Ruth Connolly from Waikato won the 2021 New Zealand Dairy Trainee of the Year. They shared prizes from a pool worth over \$210,000.



FMG Young Farmer of the Year

Taranaki Manawatu finalist and ANZ banker Jake Jarman was named the 53rd FMG Young Farmer of the Year in Christchurch in July, with runner-up East Coast competitor Joseph Watts (not pictured). The FMG Junior Young Farmer of the Year was won by Eddie Millichamp and Sophie Adkins (Mount Hutt College), while the AgriKids contest was won by Ben Hartshorne, Dustin Young and Henry Chittock (Blue

Hugh Williams Memorial **Scholarship**

Massey University student Sophie Ridd is the 2021 recipient of Ravensdown's Hugh Williams Memorial Scholarship.

Sophie, 19, is in her second year of study towards a Bachelor of Agricultural Science at Massey University's Palmerston North campus. She says the scholarship will reduce her financial burden and open up new opportunities for her to pursue tertiary study at higher levels.

"I am absolutely stoked to receive this support as it will enable me to pursue my passion even further," she says.

Sophie was encouraged to apply for the Hugh Williams Memorial Scholarship by her parents, John and Jenni. The family are long-time Ravensdown shareholders and run an arable farm, along with sheep and beef finishing and winter dairy grazing north of Feilding.



Thought leader: Tom O'Sullivan

Growing the demand for New Zealand wool

With Tom O'Sullivan. Words by Shannon Dunn



TOM O'SULLIVAN, CAMPAIGN FOR WOOL INITIATIVE CHAIRMAN

It's an industry in crisis, yet Hawke's Bay woolgrower and New Zealand chairman of the global Campaign for Wool initiative, Tom O'Sullivan, believes there is a brighter future for home-grown wool.

In the not-so-distant past, using, wearing and innovating with pure wool was as natural as eating. Most farmers grew it, baby boomers knitted it, fashion houses designed with it and upholsterers relied on it for furniture that was second to none. Wool was a mainstay that was expected to stay.

Yet, despite the buyer boom of the early 1950s and what became known as the strong wool heyday, petroleum-derived synthetics began to take over the market. Consumers were lured with promises of wearability and all of the style without the cost. What they weren't told about was the detrimental effect such materials would have on the planet and human health.

Now, as consumers have become accustomed to sleeping on, sitting on and wearing plastic-derived synthetic fibres, the wool industry is in crisis mode and facing an economic quandary.

The disappointing returns for wool mean shearing has become a significant animal-health cost. Last year it cost us \$30,000 to shear our sheep and dispose of the wool. Farmers can't carry such hefty costs long term. The bottom line is, if we don't start to see an improvement in wool prices, farmers will move towards Wiltshire sheep, a breed that sheds wool, or they'll find an alternative to wool. Such moves would signify an end to wool as a natural resource. This would be a two-fold tragedy, a loss of part of our country's historical economic fabric, and a major cost to the environment and human health with the manufacture of synthetic alternatives.

Consumer demand brings hope

Yet, amid this worry, shoppers are beginning to awaken and opt for wool again; however, change needs to happen much more quickly to sustain farmers who continue on, despite the cost burdens.

While strong wool has long been used to make carpets, until recently there's been little product development. But this is changing. We're starting to support companies that commercialise value-added wool products. We're also seeing exciting movements towards wool in home and office environments. While it's still important to get the message out about the benefits of wool, we need more people to demand and buy wool products. Once consumers understand the myriad of wool benefits, the decision to choose wool becomes a lifelong, conscious-minded decision.

Campaign for Wool, a global collective of farmers and professionals who understand why the world needs wool, remains optimistic that the shift can be harnessed to fuel recovery for wool as a premier natural fibre, despite years of plummeting prices.

Collaborating for success

Linking arms with visionary business owners and organisations is proving to be one strategy that is reaping rewards for the farmer, retailer and consumer.

One such partnership is with Kiwi-owned Big Save Furniture. Campaign for Wool has supported their move into producing furniture upholstered with strong wool, as well as bedding, with a nationwide launch planned this year.

Big Save's move to support wool is a great example of a company recognising the consumer trend towards wanting more natural products. We anticipate a knock-on effect, with more manufacturers and businesses innovating and changing stock to meet consumer demand. It would be fantastic if we could get more furniture made from wool into New Zealand homes.

"While it's still important to get the message out about the benefits of wool, we need more people to demand and buy wool products."

Educating for the future

While the industry is making great strides for a revival in the wholesale and retail sectors, it is grassroots education that will make the biggest impact overall, inspiring young Kiwis to think big when it comes to innovative and rewarding ways to use one of the most durable fabrics on the planet.

Wool in Schools, a programme run from two purpose-built shipping containers, is one initiative that's received promising feedback from teachers and students alike.

In March this year, Campaign for Wool also held a live webinar for the New Zealand Institute of Architects, detailing the history and science of wool and why it should be considered by architects and designers when specifying buildings. Due to the programme's success, the Campaign for Wool is looking to replicate the event around the world.





Getting back on track

In 2020, a government report about New Zealand's wool sector highlighted the need to get the sector on track, calling for action to improve governance and co-ordination, while developing a strategic strong-wool roadmap.

A marketing-focussed Strong Wool Action Group (SWAG) has been launched and I'm keen to contribute positively to the SWAG initiative. It's vital the strong-wool industry recognises the urgent need for a new, transformational strategy. We must pull together with a single mission. We have to get confidence back into the industry to build a profitable future for wool fibre, all the while investing in the health of Kiwis.

The National Council of New Zealand Wool Interests has also been instrumental in the introduction of wool to the New Zealand Farm Assurance Programme (NZFAP).

The marketing around strong wool needs to state that fleece, yarns and any products featuring strong wool are assurance branded, telling they are from audited, well-managed farms that comply with the New Zealand Animal Welfare Act.

The "getting back on track" sentiment is one echoed by that well-known Campaign for Wool spokesman, Prince Charles, who, during a visit to New Zealand in 2019, was quoted as saying that while the environmental message pertaining to wool had once fallen on deaf ears, change was happening.

Unlike synthetic fibres, wool is natural and renewable, sun safe, naturally flame-retardant, biodegradable, breathable, non-allergenic, durable and elastic, easy care, multi-climatic and naturally insulating. Wool is also one of the most sought-after fabrics used in recycling.

I do feel optimistic that with good, smart marketing and an understanding of what consumers want, we can turn this sector around.

Tom O'Sullivan is a Hawke's Bay woolgrower and New Zealand chairman of Campaign for Wool. He comes from a family of sheep farmers - his grandparents started farming Corriedale ewes in Canterbury in the 1940s. Today, he and partner Rachael, daughters Ruby, 9, and Tess, 8, oversee the running of Pukenui Station in southwestern Hawke's Bay. They run Perendale ewes, Angus cattle and Red deer, wintering an average of 11,000 stock units.

From farm to furniture: adding value to strong wool

At the small windswept costal settlement of Ākitio, south-east of Dannevirke, a generational farming family is embracing a new direction for their crossbred wool by supplying New Zealand-owned manufacturer Big Save Furniture. Ravensdown visited the Ramsden family on the iconic Moanaroa Station to find out how their wool is transitioning from farm to furniture.

Moanaroa is a place of long-held traditions, etched deep into the fabric of the small coastal hamlet of Ākitio. It's beautiful, but by the same token a wild and isolated place to farm.

Ravensdown shareholders Dan and Barbara Ramsden came to the coast 50 years ago when they purchased 1215ha (effective) inland property Ware Ware Station from members of Barbara's family. Dan began supervising Moanaroa in 1980 and in 1999 the couple took over the 1450ha (effective) property Moanaroa, also owned by family members.

Dan and Barbara live in the homestead at Moanaroa, and son Hugh now manages the property. Daughter Fiona runs Ware Ware Station 15km inland from the coast, and the whole operation is rounded out with a 400ha finishing property near Pongaroa. The latter property gives them flexibility in dry conditions, which Hugh says are as often as three out of every five years these days.

The coastal environment can be harsh, so animals are bred for the conditions. Moanaroa runs 60% Romney sheep and 40% Angus

cattle across steep hill country balanced by 10% flat. Moanaroa's Angus stud (1908) is the second oldest in New Zealand, while the sheep flock has been based off Ware Ware's small Romney stud.

Wool has always been a big focus on the property, and despite the price being in the doldrums, Fiona says they've worked hard to maintain a quality product. "We've always put an emphasis on the quality of our wool and we've bred for weight and yield," she says. "We are careful around quality control and at auction everyone knows our brand, so we've been able to command a premium on it."

Dan has focussed on bringing the quality of the wool up during his time running the station. "Colour in wool is the big thing," he says. "Once you get into January, the heat and the moisture quickly colour the wool." For that reason, they are one of the first in the district to shear in November.

Fiona has a background in interior and fashion design and a love of textiles. She completed a diploma in wool classing at Lincoln University and now classes all the wool on the stations. "Dealing with the wool is quite a big passion of mine and working with Big Save has been a really good thing," she says.

On farm, the supply opportunity has led to a change in the Ramsden's shearing policy.

Hugh has always done the second shear but at Ware Ware, Fiona has maintained part second-shear, part full-wool to maintain flexibility across the operation. However, with Big Save Furniture coming on board, they have changed the whole policy to second shear, allowing for the 3-4cm length across more bales. "It's good for animal health and keeping the wool clean too," Fiona says.

The micron taken off at Moanaroa's shearing in May is up to 40. Fiona classes the hogget wool, which is full length, into two lines of 33 micron and up to 35. On Ware Ware, Fiona is concentrating on taking the wool finer to get a better price. "We've got into Headwaters rams for the finer edge as well as the meat side of it. We'll put one or two seasons over them, then go back into a Romney."

The family has a management plan in place to ensure quality is kept high. They spray for thistles every year, and there is no gorse on the property to reduce vegetable matter (VM) in the clip.

"Anything that's a potential quality factor in our wool we keep it to a minimum. We even separate the crutching wool from the dags ... not many people do that," says Fiona. "We are quite fussy with our wool."

"People are making product decisions based on sustainability and material issues, and we thought, where can we go with that?"

Daniel Norman, Big Save Furniture

Carving a different path

Big Save Furniture, owned by the McKimm family, approached the Ramsdens to supply wool directly. Fresh off a successful endeavour to make beds from recyclable plastic fished from the ocean, Big Save saw the potential that wool offered, as a sustainable, biodegradable fibre with a low carbon footprint.

"It was casual conversation about how the wool prices were so low, and Big Save said, 'why don't we do something about it?"" says Fiona. "That casual conversation has escalated into something pretty special."

National buyer for Big Save, Daniel Norman, says they were shocked to learn of the wool industry's plight.

"When you start turning these rocks over and begin talking to people who have wool and can't sell it, who are thinking of reducing stock or changing breeds to something that is self-shedding ... you realise there's this Pandora's box."

COVID-19's disruption to overseas travel and trade-show viewings meant Big Save had to adapt too, turning to in-house product development as a key process for new products. Daniel says the success of the upcycled plastic bed - their initial stock ran out due to demand, and it's since become one of their best-selling queen beds - led them to consider more sustainability-focused options.

"When we started digging it became evident that consumers were actively choosing this option because of the positive impact it was having in the world. People are making these product decisions based on sustainability and material issues, and we thought, where can we go with that?"

A meeting with Napier woolscourers Woolworks and some Australian guests the company was hosting led to discussions around the issues faced by the coarse wool industry.

Daniel says it was this meeting, coupled with the chat the McKimm family had with Hugh about the strong wool direction, that spurred them to take action. "There's all these great ideas within the wool industry, but they seem to only get part of the way along, suddenly losing momentum. It was almost as if they needed another entity to pull the ideas whilst the wool industry pushed."

Big Save Furniture are looking at how they can use wool in both textile and stuffing form across their product range in volume. That has included sofas, beds, beanbags, internal wool layers, seat cushions and back cushion fill.

Daniel says the benefits of wool, including fire retardancy, lower carbon footprint and the fact that it was a natural, renewable fibre made sense, and they could see how the story of wool could work in the marketplace. "There were a lot of things that wool used to be used for, and then plastic and all the materials that were easy to manufacture at volume came along, so everyone just started using those. With wool we just started ticking all these boxes and as a group we were really impressed by the positive impacts on a product when we incorporated wool into it."

Big Save started working closely with Woolworks, researching how wool worked with the look and feel of the products. "Now we are asking ourselves how wool can be used in other areas where volume is key, putting those great natural benefits to use - that's our next step," Daniel says. (continued page 10)







Maintaining productivity on Moanaroa

Soil testing for trend data is normally undertaken every two years on Moanaroa Station, but last year this was upset by drought and COVID-19. Ravensdown Agri Manager Ainsley Harte handles the fertiliser recommendations and has also supported the Ramsdens in using HawkEye to record their on-farm data.

"We look at the soil tests and work out the best bang for buck," Ainsley says. "This year it was soil pH, but because it is such a big farm it will be expensive, so it's important to think about what will be economically viable as well. Maintenance phosphorus (P) levels are also a big driver, as is the use of strategic N on the calving paddocks, primarily because of the [dry] seasons they've been having."

The finishing farm has also been soil tested this year. "It has really good fertility and good contours too, so it's ideal for finishing," Ainsley says.

Inland station Ware Ware is due for soil testing in September. "We have been doing a liming programme there because the pH was the limiting factor. The Olsen Ps came back really good, so the pH was the big thing ... and hopefully we've improved overall fertility."

Hugh Ramsden and Ainsley have been using HawkEye to draw in the waterways and exclusion zones on Moanaroa. "We've actually cut down on the hectares getting fertilised quite a bit, just because we've taken out exclusion zones and waterways," says Ainsley.

"Waterways are a big one and it's a waste of money putting fertiliser there."

Moanaroa is linked up with TracMap integration, so all the GPS files following the spreading job completion are saved in HawkEye.

"It's all in one place for everyone," says Ainsley. "It makes it easy for me, Hugh, or the top-dressing pilot because everyone is looking at the same map."

"And having proof of placement is key too," says Hugh. "If the technology is there - why not?"



Going direct

Big Save Furniture analysed the supply chain and were surprised to learn how many cuts were being taken out along the way. By going directly to the Ramsden family as suppliers they could offer them a better price (currently \$4.50/kg) for their wool - a win-win for both parties. "The thing about Big Save is they buy direct, they get great value and they pass that on," says Daniel.

Fiona says, "Now it's going through five people rather than 18 or 19, keeping the costs down, and the traceability is simpler as well." Daniel says offering a sustainable price for the wool was

important.

"We want to make sure that in three years' time this is still a viable project, because otherwise this was all for nothing. So that's where we set the \$4.50 purchase price. We can sell it for 'x' amount of retail and it still works.

"For us, we will always pay this much for wool used in furniture. It's always going to be \$4.50 at the very least, if not going up in price at some point."

Big Save and the Ramsden family are positive for the future of wool and excited about the bigger implications for the industry.

"While I think we are a couple of years from it taking off, there's been more positive talk about wool in the last 12 months than there has been in the last 10 years," says Hugh. "There are so many different applications for wool ... it's [about] getting people to think wool first."

"With wool being eco-friendly, biodegradable and carbon efficient, surely it goes hand in hand with what's trying to be achieved [nationally]," says Fiona, "so hopefully the government and other industries can get behind it."

Ākitio - a pioneering landscape

Moanaroa, which translates to 'long seacoast', was established in 1908. It was once part of 14,800ha neighbouring property Marainanga ('many whitebait') and runs 16km between the Ākitio and Aohunga rivers. The hills of Moanaroa stretch sharply above the coastal settlement of Åkitio, and from the windy tops take in an unencumbered view of coastline curving towards Cape Turnagain and back down to Castlepoint in the Wairarapa

The climate is wild, with a tale of man and horse being blown across a fence by coastal winds. The land has a rich cultural heritage for Māori, having served as part of a coastal highway. Preferred station access was by boat, and at its peak, shipping would call once a week to the mouth of the Ākitio River. Three historic landing sheds at the settlement held thousands of wool bales supplied by local sheep stations, also serving as drop-off points for farm provisions and other manufactured goods. Wool was shipped from the station up until mid-1940. In his writing Akitio: A country school and its community, James K Baxter provides a glimpse into the pioneering life, documented in 1957.

"Bullock wagons were used to bring wool to the coastal steamer until 1944. The bullock driver stood waist high in the surf, cracking his long whip, while the bullocks plunged out and pulled the wagons alongside the lighters. A wagon still rusts on the sand above the ruined beach jetty, of which the broken supports remain and one horizontal slab of timber pointing like a gun seaward. Until a bridge was built in 1914, draught horses brought the baled wool by dray from Åkitio homestead to the river, where it was ferried across in a boat. This boat now rots in a pine plantation below the bridge, orange-coloured needles raining down upon it, mossy but solid still, with square-headed copper nails in its thwarts and small saplings growing through its hull."

Rich in paua, crayfish and game fish, Åkitio remains a popular recreational spot for fishers and surfers alike, although in recent years Ākitio's permanent population has dwindled and the school has now closed. Several ships have been lost in the Åkitio bay, including the Pleiades in 1899, parts of which can still be found at low tide or scattered around local historic landmarks.



The Moanaroa woolshed remains as a monument to the station's pioneering history. Built in 1883, the distinctive building was well planned with 12 stands for blade shearers. A spacious partitioned area within the shed has cubby holes for the storage of blade shears, something unique to New Zealand, and the original screw press welcomes visitors to the shed. Prior to 1908, when the property was still part of Marainanga, 28,000 sheep were shorn in it. The woolshed was re-piled in 2002 and is still in sound working condition.

N-190 Heat Map: recording and reporting with HawkEye®

By Rangi Holland, HawkEye Customer Technology Specialist



HAWKEYE CUSTOMER TECHNOLOGY SPECIALIST

With new nitrogen (N) limits now in place, checking your nitrogen fertiliser applications throughout the season is going to be vital to ensure you are staying compliant. To help do this, HawkEye now includes an N-190 Heat Map to help you stay on top of your N-use.

What is the N-190 Heat Map?

The N-190 Heat Map is a colour-coded visual representation of the nitrogen fertiliser you have applied on farm by paddock for the current reporting year. As fertiliser applications with an N component increase, the map colours change from green to yellow to red as you approach 190 units of nitrogen applied (Figure 1). The date defaults to the year beginning July 1 to match with current regulatory reporting dates. The reporting options also include a table showing the effective area of the paddock, N applied in kg/ha, and a running total of where your paddocks are in relation to N-190. The map can be generated in HawkEye under Reports>Nutrient Reports.



HawkEye - your partner in on-farm nutrient record keeping

With the wheels of national farm compliance now in motion, one of the most important things you can do is keep reliable records for all fertiliser purchases and applications on your property. Keeping records will also be beneficial when it comes to creating a Farm Environment Plan.

*Customers using spreading contractors with TracMap technology will require a subscription fee of \$125 a year

How are the nitrogen levels calculated?

The nitrogen levels come from all fertiliser applications that have been recorded on farm with a nitrogen component. These can come from Ravensdown joint venture spreading data, TracMap spread data, and from manual recording of activities. The figures exclude any effluent applications you may have recorded on farm. If there are no nitrogen applications for a paddock, it will not be included on the heat map.

Whv N-190?

The new National Environmental Standards for Freshwater include an annual N-Cap of 190kg/ha for nitrogen fertiliser use on pastoral land. These came into force on 1 July, 2021 and dairy farmers will be required to report their N-use figures to

Features. hazards and ordering

Exclusion zones are now an option in Features and Hazards on your farm. This tool allows you to draw the areas on your farm where you do not wish to have any fertiliser spread and these recordings will flow through to the map received by your spreader. Exclusion zone areas are removed from the effective area of the paddock when ordering or creating your own activities.

Create, maintain and share important points of interest on your farm using points, lines and polygons. You can:

- Individually name features and tag your hazards
- Edit and delete features and hazards as your farm changes
- View and print only the features and hazards you need to see
- Select your feature type, e.g. buildings, feed pads, gates, riparian areas, troughs and water pipes.

Do I need to be a Ravensdown customer to use HawkEye?

While you do not need to be a Ravensdown customer to use HawkEye, Ravensdown customers can access additional benefits and functionality such as ordering directly from their agronomy

To learn more about how HawkEye can help you, head to www.hawkeye.farm

New Zealand's carbon soil stocks: what do we know?

New Zealand has on average 90 tonnes per hectare of carbon (C) stored in its soils, which by world standards is high (Table 1 opposite). Manaaki Whenua - Landcare Research soil scientist and research area leader Dr Paul Mudge discusses why soil carbon stocks are important and where we sit on the world spectrum when it comes to the carbon levels in our soils.

Soil organic carbon is critical for overall soil health, and because soils contain more than twice as much carbon as the atmosphere, any increase or decrease will impact atmospheric CO₂ concentrations and therefore climate. Carbon continuously cycles in soil, so stocks can change over relatively short time scales in response to changes in land use and management (and changes in temperature and precipitation regimes).

Soil carbon has important functions, such as:

- Maintenance of soil structural stability which • influences root growth, air and water movement and therefore runoff and erosion
- Water retention
- Food source for soil biota ٠
- Nutrient storage and cycling. •

In general, losses of carbon can occur faster than gains. Concern over climate change is prompting nations, organisations and individuals to implement actions to curb greenhouse gas (GHG) emissions and sequester carbon above and below ground.

"New Zealand has on average 90 tonnes per hectare of carbon (C) stored in its soils, which by world standards 🜌 is high."

> Soil carbon stock (tonnes/ha)

50 100 150 200

Image: Manaaki Whenua – Landcare Research¹

FIGURE 1: NEW ZEALAND'S SOIL CARBON STOCKS

Soil C stocks to 30cm depth

In general, New Zealand has lots of soil carbon and we want to maintain or increase (where possible) the amount of carbon in our soils.

Table 1: Soil C stocks worldwide¹

Average for all NZ:	~90 t/ha
Australia	~30 t/ha
South Africa	~30 t/ha
Brazil	~40 t/ha
France	~70 t/ha
UK	~100 t/ha (peatlands)

There are several reasons why New Zealand soils contain large amounts of carbon:

- Our soils are geologically young and human settlement has occurred comparatively recently.
- Our soils have generally been well managed with little intensive tillage and cropping practices that have decreased soil carbon in many other countries.
- Most of our pastures are long-term perennial, meaning soils are rarely devoid of growing plants.
- New Zealand has a temperate climate that mostly supports year-round plant growth, resulting in continuous inputs of carbon into our soils from plants.
- The chemical and physical properties of our soils mean they generally have a large capacity to protect carbon from loss.

A large proportion of our pastures are grazed by livestock, which recycle carbon in the form of dung. From this high starting point, it's considerably harder to add to New Zealand's soil carbon stocks than in other countries where more challenging environmental conditions and/or long-term intensive cropping have resulted in low baseline soil carbon stocks.

Changes in New Zealand soil carbon stocks

It's highly uncertain whether soil carbon stocks across all of New Zealand's managed pastures are increasing, decreasing or stable. Current evidence suggests that:

- and 2010.

Allophanic and Gley soils have previously lost carbon, but it's not known whether losses are ongoing. Drained peat soils continue to lose carbon at quite high rates. Some hill country grassland soils (which occupy about 4 million hectares or 38% of New Zealand's grazed land) gained carbon at a rate of up to 0.6t/ha/year between 1980 and 2010. However, it isn't clear how widespread these gains were or whether they're ongoing. More spatially and temporally comprehensive data are needed to better determine soil carbon trends in different physical environments, land



• For grazed pastures on flat-to-rolling land, soil carbon stocks in most soils did not change between about 1980

uses and management practices. Ongoing research and benchmarking/monitoring programmes² will provide some of these data.

The impact of soil erosion is important to consider. Erosion redistributes topsoil (and any carbon it contains) around the landscape. Some carbon is buried and stabilised (for example at depth in the soil, or in lake and ocean sediments) and some is decomposed. Research by Manaaki Whenua has found that soil carbon stocks on uneroded soils average around 100t/ha but only 60-65t/ha on sites with extensive landslide and gully erosion. Soil carbon stocks do build back up again in eroded sites, however not to the same extent as uneroded sites. Research is ongoing to understand the effect of human-induced erosion on net carbon dioxide emissions from soils

Right now, New Zealand pasture soils generally have high stocks that seem stable under contemporary management practices. But there's a lack of scientific evidence about practices that increase soil carbon.

Because of the uncertainty around how New Zealand's soil carbon stocks are changing within any land use, and how changes are influenced by specific management practices, New Zealand's national greenhouse gas inventory does not currently account for changes in soil stocks within a land use. Reporting is limited to accounting for soil carbon stock changes when land use is changed, for example from arable to pasture. You can read more about this type of soil carbon accounting on the Landcare Research website², Ministry for the Environment website³ and the AgMatters website.4

Walking the path less trodden

A risk-averse lending sector and carbon farming sales have left many of our younger generation with limited options for farm ownership. But tenacity, determination and good old-fashioned hard work have seen a young couple buy their first farm on the shores of Lake Taupo. Ravensdown shareholders Sean Nixon and Ruby Mulinder talk Ravensdown through the process of first-farm purchase, running a smart sheep and beef system in a nutrient sensitive catchment, and their venture into sheep milking.



The path to farm ownership for Sean Nixon and Ruby Mulinder has been hard graft. But now they're across the line they're working hard to create a profitable operation while still working their day jobs off farm.

Sean grew up on a support block that was part of a family dairy business at Ngakuru. He studied chemical engineering at the University of Waikato, worked as a process engineer in the dairy industry in both New Zealand and the UK, and then ventured out on his own when he returned to New Zealand in 2017. Ruby grew up in Central Hawke's Bay where she was exposed to a wide range of farming systems, setting the direction for a future in the agricultural sector. After completing a Bachelor of Agricultural Science at Massey University, she worked at Landcorp Pastoral where she was involved in dairy farm conversions between Taupo and Reporoa. She followed with two years in the UK dairy industry and more recently has been working as a FarmWise consultant in South Waikato, specialising in dairy, sheep dairy, land use feasibility and group facilitation.

The couple arrived home from the UK with farm ownership on their minds. Their interest in sheep milking had grown and they wanted a farm that could suit that system - an older dairy farm with a small shed or a sheep and beef farm that could be converted. Sean says they were investigating a block on the western side of Lake Taupo when a friend suggested they talk to Mike and Sharon Barton, founders of Taupo Beef, about farming in the Lake Taupo

catchment. "Ultimately we decided not to put an offer in on that difficult. "We've both been squirrels which is how we've got to this [initial] block, but a month after that Ruby got a phone call from position, living within our means and saving as much as we could Mike saying he'd been thinking about selling and would we be [as well as] working two off-farm jobs." interested in looking at their block. It just went from there - the farm The farm is 142ha, with 20ha retired and planted out in a mix of was a bit bigger than what we had initially considered, but we Douglas fir and natives. They lease 8ha from their neighbours, balancing out to 130ha effective. They are 100% permanent pasture managed to structure a deal with the bank that eventually got it over the line." but are open to looking at more summer-safe options such as Sean says one of the positives is that the size of the block has cropping in the future.

Sean says one of the positives is that the size of the block has given them more scope. "If we'd bought a smaller block of 50ha, it would have been a five-to-ten-year maximum property. This property gives us options because it's that much bigger."

Getting across the line

Ruby describes the process of borrowing without a large amount of equity as incredibly difficult, even though the budgets stacked up. It was right when rural lending had dried up, and Sean says the fact they weren't actively farming made things difficult.

"An interesting concern of the banks was that we hadn't actually been farming full time," he says. "But if I had been working as a shepherd, I would never have been in the position to buy a farm ... we were better off working our professional careers and then making the move to farming, so that was kind of ironic in a way."

Ruby says it's worth people realising that even if you work your way up to management level, getting to ownership is still very



They farm 70ha of flat and 60ha hill country, which Ruby says provides an awesome balance for lambing ewes, providing shelter over the early spring period. "When we walked around the farm before we purchased it, the balance of flat and sheltered northfacing hill was a real plus for us."

They winter 1,550 stock units, a mix of sheep and beef. They run 670 ewes, and as they transition to a sheep-dairy model are considering the right balance of cattle for the property. Prior to purchase the farm hadn't run sheep for more than 20 years. "Having the balance of sheep and cattle has dramatically improved our pasture management. We run an intensive rotational grazing system with our cattle which are on daily shifts all year round, enabling us to drive intakes, protect our soils and manage pasture residuals. Being able to utilise the ewes to help tidy up pasture has been a great way to redistribute nutrients more evenly," Ruby says.

Their current policy focuses on buying weaners and finishing everything by 20 months of age as it works from a nitrogen leaching



perspective. They supply Taupo Beef and Lamb, and this season they're on track to do 395kg CW/ha. "That's something that we've been exploring - challenging the system to find where the best margin lies for us and how it works practically with the sheep dairy model," says Ruby.

Their initial focus has been on improving the farm's pasture quality. Soils are pumice-based light volcanic sandy loams with good levels of topsoil. The flat country is cocksfoot and clover dominant with brown top, native grasses and limited clover on the hillsides. They take a critical thinking approach to nutrients and fertility, using OverseerFM for scenario planning. This is particularly important as the Taupo catchment has a nitrogen discharge allowance (NDA), which means both inputs and stocking rates are effectively capped. They are careful to keep their N use low and strategic at 20kg/ha/year on average over the whole farm. "In spring we use a little bit of N to kick us off and bridge the gap between winter and spring," says Sean.

They are mindful of soil acidification and the roll-on impacts of different fertilisers, particularly as they have experienced palatability problems on parts of the farm. "Lime is a key thing that we'll be doing every year, and [monitoring] our potassium levels to grow as much clover as we can," says Sean. "In a red meat system clover is what makes money ... basically the more legumes we can get into our animals, the better our milk and meat production will be."

"Every nutrient we put on we want to be utilised and grow more palatable grass," says Ruby. "We're trying to optimise our soil health and not become reliant on nitrogen."

Sean says they've been using HawkEye® to order and monitor fertiliser applications and map their farm. "I'm starting to add other features of the farm to the map layers, so if someone's coming in to look after the farm, I can have it marked up nicely on HawkEye rather than the old original farm map from when it was surveyed off."

"It's an awesome tool ... really helpful," says Ruby.

A hands-on approach

Animal welfare is a central pillar for the couple, and they base their system around ensuring their stock maintain condition. Animals are on a daily shift, even in winter, to limit any pugging and maximise regrowth time.

"Our whole mentality on the farm is to keep stock moving. The farm is managed pretty intensively considering we both work other jobs," says Ruby.

"It has to be," continues Sean. "The block is too small to have any sort of dilution. To try and make money off it we need to manage it quite intensively with good attention to detail."

The sheep milking gave them the option to diversify and walk a path less trodden. Initially it was still very niche, so the challenge would have been processing the product and marketing it themselves.

"There are not many farming businesses where you can end up being a farmer, marketer and a processor and do it successfully, particularly from a time perspective," says Sean. "When [sheep milking operations] Maui Milk and Spring Sheep began offering supply contracts, that changed the pathway and made things clear-cut." The couple has signed a contract with Maui Milk and will begin supply in spring.

"The real appeal is that it remains a sheep and beef system, which we like," Sean says "And because milking sheep is quite different to milking cows - there's no real cookie cutter way to do it - we can set up our own system. Ultimately, on a farm this size, it makes it more economically viable."

About 50-60% of income will come from milk and the balance from beef and lamb. "It's based around a wholesome food story really - nothing is a by-product," says Ruby. "It's not solely economic, but it's still a big part because we need to improve our EBIT [earnings before interest and tax] so we can get to a position that we're not 90 years old and still servicing debt."

Sean describes their flock as a 'mish-mash' commercial base with dairy breeds being first introduced six years ago. Following the arrival of new milking genetics from Europe, they have started using French milking breed Lacaune and UK genetics to improve milk yields and udder confirmation in their flock.

"We are focussing on breeding our own dairy composite where we select the traits that suit our system," says Sean.

"We're trying to breed a different sheep to most other sheep dairy operations," continues Ruby. "Our key focus is the ewe is a good mum and is able to rear her lambs - we don't have the ability or budget to have four labour units driving out to rear 1,000 lambs."

The ewes will rear their lambs up until early weaning. Post-weaning the lambs will stay on meal and ideally be finished on farm. The ewes will then be milked twice a day from September through to April.

The farm is in the conversion phase, with equipment being put together off site to avoid travel costs. When set up, it will be a 30-a-side, rapid exit herringbone parlour with swing-over cups, suitable to be run efficiently by a sole operator. The initial stages will see Sean and Ruby operate a twice-a-day model, but longer term they would like to explore once a day.

"We are trying to find that right balance of per ewe productivity and labour demand as the genetics coming in from Europe do not entirely suit an outdoor New Zealand system," Sean says. "They don't have the robust conformation or the constitution for it so there's going to be a fair bit of selection pressure in the coming generations of sheep."

"We're just sticking to our guns on what we want," says Ruby. "We're not going to end up with the equivalent of the 500 kgMS cow, but something that works in our system as well as valuing the lamb."

"Every nutrient we put on we want to be utilised and grow more tasty grass."

SEAN WITH AGRI MANAGER EVA BRAKENRIG



 $\label{eq:manaaki} \textbf{MANAAki} \textbf{WHENUA} - \textbf{LANDCARE RESEARCH MONITOR N-LOSS ON THE PROPERTY}$



RUBY AND SEAN ARE FINDING THE RIGHT BALANCE OF PRODUCTIVITY WITH THEIR EWES

Hype gets in the way of cause and effect

Colorectal cancer surgeon Professor Frank Frizelle and researcher Dr Jacqui Keenan highlight the potential misconception in confusing 'association' with 'cause and effect' when it comes to nitrates and cancer.



PROFESSOR FRANK FRIZELLE COLORECTAL CANCER SURGEON

Professor Frank Frizelle MBChB. MMedSc. FRACS. FACS. FASCRS, FNZMA, FRCSI Frank is Professor of Surgery at the University of Otago and a colorectal surgeon in Christchurch, working in both public and private sectors since 1996. He researches the aetiology of bowel cancer, and outcome-based research across a range of surgical treatments for colorectal disease processes.



DR JACOULKEENAN COLORECTAL CANCER RESEARCHER

Dr Jacqui Keenan

Jacqui is a researcher in the Department of Surgery, University of Otago Christchurch. Her research is centred around risk factors for colorectal cancer, with a focus on gut bacteria.

The levels of nitrates in water have been studied in relation to many illnesses, especially a wide variety of cancers (brain, breast, bladder, kidney, colorectal, stomach, oesophageal, thyroid)¹⁻⁷, and no consistent and/or reliable association has been found. Other studies have even suggested that oral intake of nitrates might have some health benefits that include reducing blood pressure^{8,9}.

One study that caught New Zealand media attention was a Danish one reported in the International Journal of Cancer in 2018¹⁰. In this study the research group reported an association between nitrates in drinking water and the incidence of colorectal cancer. This was a very large study of 2.7 million people from Denmark and it showed that there was a 16% increased risk of colorectal cancer in those with the highest levels of nitrates in their water when compared with those with the lowest¹⁰. In marked contrast however, similar studies elsewhere in the world (Canada, USA, Italy, Finland, Spain, UK, China, Indonesia, Taiwan)¹¹⁻¹⁸ undertaken prior to the Danish study failed to find any association or, at best, a weak association between nitrates in drinking water and the incidence of colorectal cancer. A recent (November 2020) meta-analysis of these nine different studies¹⁰⁻¹⁸ (including the

Danish study) found that intake of nitrate from drinking water was not associated with colorectal cancer risk19.

It is well recognised that rural communities have higher levels of nitrates in their water due to run off from fertilised land and animal effluent. It is also well recognised that rural communities have higher rates of colorectal cancer²⁰⁻²² for a wide variety of causes that may be associated with increased red meat and fat consumption²²⁻²³. However, as colorectal cancer is higher in rural communities, we would likely find a stronger association with many rural items, for example the presence of farm tractors. No one really believes that tractors cause colorectal cancer, but the association would be there. This illustrates one of the key issues when interpreting studies, which is the need to have a believable physiological mechanism that might explain the association, and it is hard to see one with regard to tractors.

Colorectal cancer is common, with New Zealand having an age-standardised rate of 35.3 per 100,000 (14th equal in the world) and Denmark's is even higher at 41 per 100,000 (6th in the world)²⁴. While at times colorectal cancer may be due to an inherited genetic mutation or a chronic bowel

disease (such as ulcerative colitis or Crohn's We have spent more than 25 years

disease), most cases of colorectal cancer (about 90%) are considered sporadic (bad luck). We know that certain lifestyle factors impact on an individual's risk of developing sporadic colorectal cancer. In 2015 the WHO listed processed meats as being a class 1 carcinogen^{25,26}, and there are other factors also implicated, such as red meat, alcohol, lack of exercise, and being overweight^{27,28}. studying the relationship between bacteria and cancer, most of it in regard to bacteria's possible role in colorectal cancer. We have shown that chronic bowel infection with certain bacteria increases the chance of getting bowel cancer²⁹. These bacteria are different from those which cause gastric cancer but they work in a similar way, in that they produce a toxin that can, over time, and in the right environment, cause changes in cells that lead to cancer^{29,30}. We know that dietary intake may affect the virulence of such bacteria, i.e. red meat consumption stimulates toxin production, while dietary fibre may counteract the toxin's effect on colonic cells. If nitrates were to have a similar effect on

toxin production in these bacteria it would have to get to the colon, however nitrates

"No one really believes that tractors cause colorectal cancer, but the association would be there."



are absorbed in the proximal small bowel⁹. making it difficult to see a link.

Approximately 80% of dietary nitrates are derived from vegetable consumption; sources of nitrites include vegetables, fruit, and processed meats. Nitrites are also produced endogenously through the oxidation of nitric oxide and through a reduction of nitrate by commensal bacteria in the mouth and gastrointestinal tract. Nitrite and nitrate in certain foods and diets can be reduced back to nitric oxide. promoting beneficial cardiovascular and cytoprotective effects^{8,9}.

In summary, one has to be careful not to confuse associations with cause and effect. One shouldn't believe that tractors cause bowel cancer, though the two will be associated, as both bowel cancer and tractors are more common in the rural community. There might be many reasons why a community might want lower levels of nitrates in drinking water, but the possibility of nitrates in the water causing colorectal cancer should not be one of those reasons. However, colorectal cancer is common, and those with rectal bleeding and/or a change in bowel habit should get checked out, regardless of their nitrate consumption.



Farm Environment Planning: preparing for the journey ahead





ADRIAN BROCKSOPP, RAVENSDOWN PRINCIPAL ENVIRONMENTAL CONSULTANT

Farmers often have ideas about what they'd like to achieve on farm, but can struggle with documenting actions and prioritising them. Ravensdown Principal Environmental Consultant Adrian Brocksopp discusses how a workshop run in the Waikato helped several farmers take their first actions in preparation for Farm Environment Planning. Farmers across the country generally accept that Farm Environment Planning (FEP) is a concept we will need to engage with over the coming years. However, for many reasons it can be hard to gain enough clarity around the FEP process to be confident in taking the first step.

This can leave farmers in a period of flux, as they are wanting to do the right thing and get started on their FEPs, but are unsure what is required, how much is enough, or what should be tackled first.

To help get farmers on the right track, the Waikato Regional Council, Open Country and a number of consultants including Ravensdown engaged in a pilot programme to provide farmers with a circuit breaker for the current situation.

The aim of the programme was to provide farmers with the knowledge and support to allow them to take ownership and engage in the fundamentals of Farm Environment Planning for their own farms.

To encourage this engagement, a four-stage support process was developed (Figure 1). Farmers attended three workshops where they were stepped through the process of assessing their farms for risk of potential contaminant loss and benchmarking themselves against industry-agreed 21 Principles of Good Management Practices (GMPs). They were then able to determine and prioritise actions to put in place on farm.



FIGURE 1: FOUR-STAGE SUPPORT PROCESS

In between the workshops, the farmers applied their learnings to their own farms, recording information of GMPs achieved or noting potential risks for action. They were given support between sessions via a facilitator, and the process was trialled with small groups of farming families and key staff. This engagement was important as farm workers and share milkers are often in charge of implementing actions on farm that can increase or decrease risks on the environment.

As a result of the workshop, many farmers found they were well on the way to achieving GMPs without really realising it – some plan actions were simply a case of putting in processes to better provide evidence they were doing the right thing – for example getting the GPS mapping report from their Spreadmark registered spreader to show proof of placement of fertiliser application.

Documentation of our individual decision-making process is another area that can be helpful, especially when it comes to grazing management. Simply using a map to document what you do and why you do it can significantly reduce the risks of pugging and soil run off (e.g. identifying paddocks that are grazed early in the autumn due to the risk or pasture and soil damage from grazing too late) and can help demonstrate thought processes around sustainability.



After completing the workshop, farmers were able to create a Farm Environment Plan that provided them with an understanding of the change trajectory they will be working towards in the short term. Once the final details of FEP requirements are determined by central and local government, Ravensdown will be able to support farmers in the transition of this valuable exercise to the final product.

Farmers involved in the workshop say the process enabled them to take credit for the things they had already achieved on farm, gain an understanding of their individual farm risks, and finally it allowed them to create a time-based action plan based on what was practical for them to achieve.

Planning for your environmental future may be a scary thought, but support is available to help you on your journey. Taking the first step to seek support and advice from a trusted advisor will ensure you can take ownership of the process that you want for your business and farm. It is in your hands.

If you would like to talk to the Ravensdown team about getting a Farm Environment Plan started, get in touch with your Agri Manager or call the customer centre on 0800 100 123.

Why I'm not on my FEP journey yet:

- I'm waiting for a final plan change to be released in my region
- I need more clarity on the process
- I want a confirmed template
- I do not know what actions to do first.

What are the contaminants?

Nitrogen, phosphate, sediment and *E. coli* are all part of our farming systems. If they enter water courses, they can negatively influence water quality which can impact on our ability to use this vital resource for drinking water, recreational activities, such as swimming, and traditional uses for our waterways such as Mahinga Kia.

Learnings from the programme

- Beginning with the basics of understanding risk and good farm practice has helped improve plan development
- Continuous engagement is important
- Farmers need and want support in the FEP space
- Farmers have found the workshop environment useful to facilitate helping and learning from each other.

Water quality: we're on the right track

Our Land and Water scientists' modelling of on-farm mitigation actions shows that if all mitigation techniques are adopted, most catchments will meet current water quality objectives by 2035.

A nationwide assessment measuring the impact of improved farming practices (on-farm mitigation actions) on waterways shows that by 2035 most catchments will meet their water quality objectives if farms continue adopting practices known to protect waterways.

The projections were made by modelling current environmental farming practices, implemented between 1995 and 2015. It revealed that significantly more nitrogen (45% more) and phosphorus (98% more) would have entered rivers from dairy farms if farmers hadn't adopted new practices to shield rivers from harm.

While the mitigations were not sufficient to offset the increased nitrogen loads brought about by the expansion of dairy (land-use expansion of 40% and a production increase of around 160%), or sheep and beef (beef farming area contracted but production per hectare increased), it did save us from a much worse fate. The scientists' conclusion is that accelerating the adoption of these mitigation actions that are already proving effective will lead to significant further improvement in water quality.

What is working?

Modelling shows that if all known and developing mitigation actions were implemented by all dairy and sheep and beef farmers by 2035, the potential load of contaminant entering rivers would decrease by 34% (nitrogen), 36% (phosphorus) and 66% (sediment).

The most effective nitrogen and phosphorus mitigation practices both on dairy-farmed land and sheep and beef are:

Dairy mitigations

- Stock exclusion
- Improved effluent management
- Better irrigation practices. Sheep and beef mitigations
- Planting more trees •
- •
- Excluding stock from waterways

Soil conservation.

We know these mitigation techniques work because the researchers were able to combine the data from geographic and mitigation efficacies for about 130 farm typologies in 2015 and compare it to potential contaminant loads in the following scenarios.



Best-case scenario for 2035

If all known and developing mitigation actions were implemented by all dairy, sheep and beef farmers by 2035, the potential load of contaminant entering rivers would decrease by 34% (nitrogen), 36% (phosphorus) and 66% (sediment) compared to 2015.

Potential (5) to reduce TN loss from land to water



FIGURE 1: THE POTENTIAL FOR MITIGATION STRATEGIES TO REDUCE TN LOSSES FROM LAND TO WATER BY 2035.

What does this mean for the future?

Researchers estimated that, compared to 2015, if all known and developing mitigation actions were implemented, the potential loads of nitrogen and phosphorus entering rivers from dairy and sheep and beef farms could decrease by one third, and sediment by two thirds by 2035.

The research assumes that actions are implemented 100%, which is often not the case. In addition, for some catchments and farms, applying all known and emerging mitigations may be less pragmatic than some change in land use or land-use intensity.

Existing catchment management groups have helped farmers and others take collective responsibility to try to achieve desired water quality outcomes. With further leadership and engagement, this approach could evolve into a more accountable, innovative and effective vehicle for advancing environmentally sustainable agriculture.

This, along with more effective support for catchment collectives, will hopefully see more farmers and catchment groups learning from each other and instil confidence to act.

Key Points

• Our rivers would be in much worse condition today if farmers had not adopted better practices between 1995 and 2015. Significantly more nitrogen (45% more) and phosphorus (98% more) would have entered rivers from dairy-farmed land between 1995 and 2015 if farmers hadn't changed their practices. On sheep-and beef-farmed land, 30% more sediment would have entered rivers between 1995 and 2015 if farmers hadn't changed their practices.

Researchers Professor Richard McDowell **Ross Monaghan** Andrew Manderson **Chris Smith** Peter Pletnyakov **Project timeline**



Researchers estimated that if all known and developing mitigation actions were implemented by all dairy and sheep and beef farmers by 2035, potential loads of nitrogen and phosphorus entering rivers might decrease by one third, and sediment by two thirds, compared to 2015. For many catchments, this will be enough to meet current water quality objectives.

Our Land and Water National Science Challenge AgResearch Manaaki Whenua - Landcare Research AgResearch AgResearch October 2016 - December 2019



"[Soil] has to be managed carefully so we are not intensifying areas at the wrong times of the year."

Measure, monitor, manage: N-190 on a Canterbury dairy farm

CAMDEN FARM MANAGER ALVIN **CAPAROS AND TERRY KILDAY**

Canterbury dairy farming operation Camden Farms have been focusing on lowering their nitrogen (N) use ahead of the N-190 nitrogen cap that came into effect in July 2021. Camden Group General Manager Terry Kilday oversees the group's six Canterbury dairy and dairy support farms. He talks to Ravensdown about their farming philosophy and putting actions into place on one of their properties, an 800-cow, 214ha effective unit at Bankside, near Dunsandel.

When referring to N use on farm, the team at Camden Dairy Farms Limited know what they are trying to achieve. Their farming philosophy is measure, monitor and manage - a concept that infiltrates their management across all facets of their operation.

Camden Farm was one of the early dairy conversions in the area, converted from dryland sheep in 1994. It's a reasonably easy-managed system-three dairy farm, with four full-time equivalent staff milking through a new 54-bail rotary shed. The soil is stony silt loam but over the course of the last 25 years the organic matter has developed and the soils now have good water-holding capacity.

The protection of the soil is something Terry refers to often. "Soil type is probably one of the biggest limiting factors," he says. "It has to be managed carefully so we're not intensifying areas at the wrong times of the year. When the cows come back onto the platform on 20 July, we've already allocated them the paddocks that weren't grazed in the last rotation. They come back to paddocks with high covers so we can feed them really well and not run the risk of doing damage to the pasture, and we also have forage crop on farm for the later calving cows."

They aim to produce 18tDM/ha of pasture, topping up with 500 kg/ha of grass silage in the shoulder periods. This year they have

managed to keep it down to 372 kg/ha. The way they use N fertiliser hasn't changed, just the amount they use. "We've always been believers in 'measure, monitor, manage'," says Terry. "You've got to do each of those things - one follows on from the other."

They changed to Whole Farm Soil Testing (WFST) in 2016 following advice from their Ravensdown Senior Agri Manager Sonya Perkin who has worked with the Camden Group for 11 years. While they took a bit of convincing initially, the collective benefits gained from WFST have been immeasurable. Terry says WFST information allows them to design a good fertiliser plan to make sure all paddocks are at the optimum levels.

"We were worried that it was going to cost us more, but the reality is it probably saves us money because we're not putting phosphate fertilisers on paddocks that already have the optimum Plevels. We're not chasing pH just because we think we need lime ... we actually know what we need, so we can apply it accurately and at the right times. When we apply nitrogen, we know it's being utilised. There are no limiting factors in the soil or in the pasture that will prevent pasture from taking it up and using it effectively."

Sonya says whole farm soil testing has been huge for the Camden Group. "I could really see the need for it because otherwise you're just making assumptions off about six soil tests on a dairy farm. This farm was already close to optimal when we tested, but some of the newer farms we've done quite a bit of work on."

They have dropped their total N use from 230kgN/ha back to 174kgN/ha and have tweaked some of their grazing strategies. Terry says it's been reassuring to see they've still grown a similar amount of pasture as in the past. "Dare I say it, it's been a reasonably easy transition for us because we weren't big users of N before, so cutting it back was relatively easy to do. The hardest bit was having confidence that we were still going to produce the pasture, which we've proven to do."

"We use N-Protect through hot periods if we think we're not going to be able to water the fertiliser on as quickly as we'd like."

They do one N application per paddock monthly and have a policy of not following cows to ensure their N application paddock round-lengths are at least a month long. They set an N limit for the farm managers to apply each month, allowing them to follow their own plans for the individual operations. They also use other products, including coated urea.

"We use N-Protect through hot periods if we think we're not going to be able to water the fertiliser on as quickly as we'd like," says Terry. "We can put it on the ground and know it's not going to volatilize ... once we get water on it's going to go into the soil where the plant can actually use it."

They use Ravensdown's online monitoring system HawkEye to record their fertiliser placements, loading the nutrient information at the start of the season so the team can order up to the limits set in the program. Once ordered, the information is sent to their preferred supplier spreader, and they have peace of mind knowing the truck will only spread the required amount in the chosen areas. It also means they can't double up in any given month. "From our point-of-view, it's relatively easy to achieve [the N-190 cap] because all we need to do is make sure the right information is loaded into the system," Terry says.

Camden Farm's centre pivot and sprinkler irrigation system has been designed around soil type with flexibility for both water and effluent application in mind. They use Aquaflex strips for soil moisture monitoring to ensure they are putting on the right amounts of water at the right time. The irrigation system was updated following a devastating windstorm in 2013 that destroyed 90% of the farm's shelter belts. "We've put on what we believe to be the most efficient irrigation systems for this particular farm, because we've got very good control of how much we put on at any given time," says Terry. "We can put on smaller amounts more often to keep the soil moisture level under field capacity to avoid leaching, and above wilting point to achieve optimum pasture production."

Effluent is captured and pumped out in two different ways - a small traveling irrigator, which can be put in a set location around the farm and moved at any time, used mainly in the shoulder periods. They also send effluent out to different portions of the pivot. "We keep very detailed information about when it's going out and where exactly it's going. And because of that, we can differentiate from where we're putting any other nitrogen across the farm, ensuring the target effluent areas don't get as much nitrogen as non-effluent areas."

A few years back, they experienced diminishing pasture production as a result of invasive grasses and weeds re-establishing in the pasture swards. Clover root weevil had also decimated the clover, so they embarked on an ambitious plan to regrass throughout the group. "We wanted to do a third of each [farm] every year to try to cover the whole lot," says Terry. "We didn't quite hold our nerve with that, but we still managed to turn over 85% of each farm in four years. Our target was to put in new, better varieties of ryegrass along with good, strong white clovers."

They work closely with drilling contractors, using a machine that drills the ryegrass and broadcasts clover seed behind. "We're placing the white clover between the drill rows, which means it's not having to compete when it's striking. It's able to get up and established.

"Broadcasting clover between drill rows helps stop other invasive weeds coming in as well and we've achieved renovation with minimal sprays, just making sure we get a really good kill with the initial spray-out."

What's next for the Camden Group?

One of the areas the Camden Group will tackle next is greenhouse gases (GHGs). "We are already measuring those now but until we see some guidelines at a government level, then we're not going to know what targets we're reaching for," Terry says.

"We'll give ourselves some benchmarks, and then look at strategies around trying to lower them if required, but we do lots of other little things that are not just environmentally sound, but give us a good social licence to farm. If we do occasionally have dead stock, they are removed off farm immediately, and all rubbish is too."

As for reaching N-190 targets, Terry reiterates the importance of planning as the starting point for managing N use.

"To have a plan, you need to know a bit of background about what's happening on your farm. If you measure, monitor, manage – you measure what's going on in your soil and you make sure that everything else that's required to grow a good, healthy pasture is as it should be, then from there you can put together a good fertiliser plan.

"At the end of the day, we're trying to match feed supply with feed demand. If you can get that through good strategies around grazing and nitrogen application, then you're going to win clear enough."

Tips to lower N use

- Get to know the background of what's happening on farm measure, monitor and manage. This will allow you to make a plan for your N use.
- Maintain your profitability. That comes first because if you're profitable, then it's going to give you options to make changes, whether that involves capital expenditure or not.
- If you are unsure about how to meet the regulations, reach out - there's plenty of people out there who are doing it well.
- Get involved in industry-good projects. Camden Farms are part of DairyNZ's Selwyn/Hinds catchment project looking at reducing N use on dairy farms.
- Go for the low hanging fruit first -the changes that are not going to cost you a lot and are easy to manage.
- Consider Whole Farm Soil Testing getting the base fertility right can help identify limiting factors and save you money in the long run.
- Use OverseerFM to model alternative scenarios and/or a financial modelling tool such as Farmax to support any scenario changes.
- Know your baseline number.
- Tweak little pieces of your system, like obviously reducing nitrogen, or reduce your stocking rate a little bit. Are you going to produce a little bit more per cow to effectively earn yourself the same per hectare?
- Use your fertiliser representative and their knowledge. Challenge them and let them challenge you!
- Be prepared to try a different form of N, such as N-Protect, when the conditions warrant.
- Know there are many ways to do things and one size does not fit all.

Frew's Transport: keeping the wheels turning with ClearTech®



Twenty years ago, drawing water for truck-wash was a relatively straightforward exercise for Frew's Transport, a livestock and trucking operation based in Darfield, Canterbury.

Today's operating environment is vastly different. Not only have the number of dairy farms increased in the area, but effluent is now classified as 'industrial waste' by Environment Canterbury (ECan). This has meant the original consent for 7,000 litres of water a day over five days would fall short of new consenting requirements for wastewater discharge when it came time for renewal. With its sizeable fleet of trucks, including 10 stock trucks split between Darfield and Oxford, this created a problem.

"Our consent wasn't designed for the new dairy farming practices of the area, and with *Mycoplasma bovis*, we had to wash out more often," says Chaz Frew, Transport Manager for Frew's Construction.

"It was all about our water use ... we had to look to find an alternative." That alternative needed to meet water-take consent requirements of 15,000 litres a day over seven days, a considerable decrease from the average 23,000 litres a day the company was using at the time.

The potential worst-case scenario would have seen Frew's carting 20,000 litres of wash off site every day. At a rough cost of \$500 a day to do so, a shutdown would have been inevitable.

It was around the same time that ClearTech®, the effluent treatment system created by Ravensdown and Lincoln University, was creating interest amongst dairy farmers as a yard wash and water recycling solution. It was suggested that the system could also be a viable solution for Frew's truck-wash water issue - a suggestion that ClearTech Product Manager Carl Ahlfeld was able to bring to fruition following site visits and effluent and wastewater testing.

Once installed, one of the immediate advantages of ClearTech was the ability to integrate with Frew's existing watercleaning infrastructure, made up of three effluent disposal systems.

Fresh water drawn from the town supply also reduced by an impressive 65%. But the big tick for ECan was ClearTech's removal of 99.9% of *E. coli* from wastewater before it went to ground. This was a hugely important factor in an area with no septic water system.

The payback from the ClearTech installation came with a new consent granted in December 2020, allowing Frew's to draw an additional 5,000 litres water on top of their existing 7,000 litres a day. Consent was also granted to discharge 15,000 litres a day and the total system is currently averaging 10,000-12,000 litres a day.

"ClearTech's allowed us to successfully get a new consent through its ability to treat [wastewater] and take all the nasties out before returning it to the ground," says Chaz. "Without ClearTech we wouldn't have got the consent."

Not surprisingly, good news travels fast in the industry and Chaz says there's been a bit of interest from transporters in the North Island about the system. "Looking at the road ahead, ClearTech's ability to work with dairy farming and transport operations is enabling Frew's to continue to refine the system and drive the business forward."

About ClearTech

Developed in conjunction with Lincoln University, Ravensdown's ClearTech system uses a coagulant to bind colloidal particles together to settle them out from the water. This clarifying process reduces the environmental and safety risks linked with farm dairy and stock effluent by killing 99% of *E. coli* bacteria in the clarified water, reducing the effluent odour and the risk of phosphorus leaching from a farm's dairy effluent applied to pasture.

Can gibberellic acid substitute nitrogen fertiliser?

As farmers seek new ways to maintain pasture production and feed supply under 'capped' nitrogen (N) fertiliser, alternatives such as gibberellic acid (GA) should be explored. As part of a series of experiments exploring opportunities to use GA in dairy farm systems, Lincoln University PhD student Melanie Miller asked questions about the timing and application rate of GA and whether farmers can partially substitute N fertiliser applications for GA to maintain feed supply. Melanie's research is supervised by Dr Racheal Bryant and Professor Grant Edwards.



Gibberellic acid (GA) is a naturally occurring plant growth hormone that responds to environmental signals such as light and temperature and is part of a signalling pathway that leads to the "switching off" of dormancy. This in turn triggers a response for leaf and stem elongation by mobilising root reserves. Commercial forms of GA, when applied to pasture, can improve herbage production particularly in autumn, winter and early spring when natural levels of GA are low. The following studies, conducted at Lincoln University investigated:

- **1.** The use of GA in place of N fertiliser in late lactation and the effects on pasture and milk production
- **2.** The use of single or multiple GA applications in place of N fertiliser
- **3.** Timing of GA applications in spring and autumn.

Substituting N fertiliser with GA in late lactation on dairy cow production

Autumn N fertiliser application is an important tool on many farms for lifting average pasture cover, improving animal condition, and reaching production goals for the season before drying off. Autumn is also an important time of year for feed supply, with potentially reduced plant growth and N uptake. Depending on the season, some farmers may have already reached their N limits under the N-190 cap.

Two late lactation grazing studies were carried out to investigate the effect of using GA or N to manage feed supply in late lactation. In the first study we compared GA (8g GA/ha) with an N fertiliser control (50kg N/ha) which was applied to perennial ryegrass and white clover pasture in March and grazed by lactating dairy cows



four weeks later in April. The GA-treated pastures had more clover than N treated pasture (18.7% vs 7.4%, respectively) but herbage yield was similar. At the same allocation of pasture DM, there was no effect of GA on milk yield (14.4L/day) or composition (1.45kg MS/day) compared with N fertiliser. To try to combat excess dietary N in late lactation we hypothesised that GA would reduce herbage N compared with N fertiliser. However, because GA stimulated clover growth, applying GA did not reduce N intake of grazing cows compared to those grazing N fertilised pasture.

Our next grazing study was later in autumn and used an area of the farm where there was very little clover under the effluent irrigation. We applied N (50kg/ha) and GA (8g/ha) or no treatment (control) in April and grazed the treated areas four to six weeks later in May, when herbage mass was 3,000kg DM/ha (estimated from plate meter, kg DM/ha = 140*compressed height +500). In that study we found, compared to the control, there was no effect of N or GA treatment on milk yield (14.6L/day) or composition (1.42kg MS/day) largely as a result of there being no difference between treatments for herbage yield. We may not have seen a response because of the long regrowth interval (GA-treated pasture should be grazed within three to four weeks to capture the effect), and possibly because base soil N from effluent paddocks was adequate to meet slow autumn growth.

Substituting annual N fertiliser on dry matter production

We asked how many N fertiliser applications we could replace before reductions in pasture production became evident. To test this, we conducted a 'cut and carry' plot study for two years where we replaced one, two or three N (25kg N/ha) applications with GA (8g GA/ha) in spring and autumn (Tables 1 and 2). Yield cuts were taken after an average regrowth interval of four weeks between August and May.

We also wanted to know whether there would be an effect on herbage yield if the replacement GA occurred in the first, second, or third grazing rotation in those seasons. These questions acknowledge the increasing (spring) or decreasing (autumn) daylength and temperature. In both years the first of the three applications were applied in August and March, and treatments were labelled according to the order with which the product was applied at each of the three application dates, e.g. GNN means that GA was the first application followed by two N applications. We compared these with three controls, 1. No N or GA (control), 2. N at all harvests throughout the year (GA+N). Table 1: Annual applications and rates of nitrogen (N) fertiliser or gibberellic acid (GA) applied to perennial ryegrass and white clover pastures and two-year average accumulative annual yield.

	N fer	tiliser	Gibberellic acid						
Treatment	(apps/ year)	(kg N/ha/ year)	(apps/ year)	(g/ha/ year)	Yield (t DM/ha)				
Control	0	0	0	0	13.6c				
NNN	10	250	0	0	17.1 _a				
GA+N	10	250	10	80	17.0 _{ab}				
GNN	8	200	2	16	16.2 _{ab}				
NGN	8	200	2	16	16.3ab				
NNG	8	200	2	16	16.3ab				
GNG	6	150	4	32	16.1 _{ab}				
GGN	6	150	4	32	15.4 _b				
NGG	6	150	4	32	15.7 _{ab}				
GGG	4	100	6	48	15.7 _{ab}				

Dry matter values followed by the same subscript are not significantly different.

Table 2: Timing of nitrogen (N) fertiliser or gibberellic acid (GA) applied to perennial ryegrass and white clover pastures at rates of 25kg N/ha or 8g GA/ha per application.

reatment	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Control	Nil									
NNN	N	N	Ν	Ν	N	Ν	N	N	N	N
GA+N	GA+N	GA+N	GA+N	GA+N	GA+N	GA+N	GA+N	GA+N	GA+N	GA+N
GNN	GA	N	Ν	Ν	Ν		Ν	GA	N	Ν
NGN	N	GA	N	N	Ν		N	N	GA	N
NNG	N		GA	N	Ν		N	Ν	N	GA
GGN	GA	GA	N	N	Ν		Ν	GA	GA	N
NGG	N	GA	GA	N	Ν		N	N	GA	GA
GNG	GA	N	GA	N	Ν		N	GA	N	GA
GGG	GA	GA	GA	N	N		N	GA	GA	GA

All treatments had better dry matter production compared to the control (13.6t DM/ha). Although there was a response to treatments immediately after application, there was no statistical effect of rate of GA (i.e. 0, 16, 32, 48 or 80g GA/ha/year) on annual herbage yield (mean, 16.1 ±0.84t DM/ha). On the other hand, there was a positive relationship between N fertiliser rate (i.e. 0, 100, 150, 200 and 250kg N/ha/y) and annual herbage yield, with the most pasture produced when N was applied at 250kg N/ha/y (mean, 17.1±0.04t DM/ha; NNN and GA+N).

Differences in annual yield were most influenced by differences in herbage yield in spring. The importance of N fertiliser is evident with both GA+N and NNN having similar and highest yields in spring (Table 1). As N was increasingly substituted by GA, yields declined. We did not find a consistent effect of timing of GA in spring.

In autumn, we found that using GA in May produced a similar herbage yield as the N treatment, suggesting that there was no yield penalty by substituting N with GA at this time. Across the three regrowths between April and May there was no difference in cumulative herbage yield for the autumn period (means for three months across two years) for any of the treatments that used GA and N (Table 2).

Is GA a substitute for N fertiliser?

It is likely that a response to GA will occur in late autumn and early spring when temperature or daylength are limiting pasture growth. However, as discovered in the second grazing study, to capture the benefits of GA the pasture should be grazed within three to four weeks of regrowth.







FIGURE 2. EFFECT OF NUMBER AND SEQUENCE OF GIBBERELLIC ACID (G) OR N FERTILISER (N) APPLICATIONS ON HERBAGE DRY MATTER (DM) YIELD OVER THREE SUCCESSIVE REGROWTH INTERVALS IN AUTUMN.

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Ή.															He		
³ Li	⁴Be						s	Julphu	r			⁵B	۶C	⁷ N	^{\$} 0	° F	Ne
ุ้Na	¹² Mg												¹⁴ Si	¹⁵ P	¹⁶ S	¹⁷ Cl	¹⁸ Ar
¹⁹ K	Ca	²¹ Sc	²² Ti	²³ V	²⁴ Cr	²⁵ Mn	Fe	27 Co	²⁸ Ni	29 Cu	³⁰ Zn	³Ga	Ge	³³ As	^{³₄} Se	³⁵ Br	³⁶ Kr
³⁷ Rb	³⁸ Sr	³⁹ Y	⁴⁰ Zr	Nb	Mo	⁴³ Tc	Ru	⁵Rh	Pd	Ag	⁴⁸ Cd	⁴⁹ In	⁵ Sn	^{₅₁} Sb	⁵² Te	53	Xe
⁵⁵ Cs	⁵ Ba	₅ La	Hf	⁷³ Ta	⁷⁴ W	⁷⁵ Re	⁷⁶ Os	⁷⁷ Ir	⁷⁸ Pt	⁷⁹ Au	™ Hg	⁸¹	⁸² Pb	⁸³ Bi	⁸⁴ Po	⁸⁵ At	⁸⁶ Rn
⁸⁷ Fr	** Ra	⁸⁹ Ac	¹⁰⁴ Rf	105 Db	Sg	¹⁰⁷ Bh	¹⁰⁸ Hs	¹⁰⁹ Mt									
		58 Ce	59 Pr	٥٥ Nd	^{₅₁} Pm	Sm	⁶³ Еи	⁶⁴ Gd	₅₅ Tb	⁶⁶ Dy	⁶⁷ Ho	⁶⁸ Er	^₀ Tm	⁷⁰ Yb	⁷¹ Lu		
		⁹⁰ Th	⁹¹ Ра	92 U	93 Np	94 Pu	⁹⁵ Am	⁹⁶ Cm	⁹⁷ Bk	⁹⁸ Cf	⁹⁹ Es	¹⁰⁰ Fm	¹⁰¹ Md	¹⁰² No	103 Lr		

Elementary essentials #4: Sulphur (S)

By Dr Ants Roberts



DR ANTS ROBERTS, RAVENSDOWN CHIEF SCIENTIFIC OFFICER

The non-metallic element sulphur (S) is the 16th element in the periodic table and is one of the 19 elements essential for life in all higher plants and animals on Earth. Sulphur ranks ninth in abundance among the elements. Sulphur, after calcium and phosphorus, is the third most abundant mineral element in

Discovery of sulphur

mammalian bodies.

Prehistoric humans used S as a pigment for cave paintings, Egyptians used sulphur dioxide to bleach cotton from 1600 BC, while the Chinese have used S in explosives and fireworks since 500 BC. "Greek Fire" containing sulphur was made in the Middle Ages to burn opposing wooden ships or buildings.

Sulphur was recognised as an element in 1777 even though most S occurs naturally as either metal sulphides, e.g. galena (lead sulphide) or blende (zinc sulphide), or sulphates, e.g. gypsum (calcium sulphate) or barite (barium sulphate). Coal, oil and natural gas also contain S.

Elemental S is found in volcanic regions as a deposit where hydrogen sulphide from the activity oxidises in the air and forms crystalline pale-yellow elemental S. Much of the S used today is recovered from natural gas, oil refining, and the processing of copper, zinc and lead ores. About 85% of all sulphur produced is converted to sulphuric acid and used mostly in fertiliser manufacture, e.g. superphosphate and ammonium sulphate. Sulphur, after calcium and phosphorus, is the third most abundant mineral element in mammalian bodies.

Why is S essential?

Plants take up S from the soil they grow in. Its key functions are:

- Protein production. Sulphur is a constituent of three S-containing amino acids (cysteine, cystine and methionine) which are the building blocks of protein. About 90% of plant S is present in these amino acids
- Chlorophyll formation
 (photosynthesis)
- Synthesis of oils (critical for oilseeds)
- Activation of enzymes.

 In animals, the key functions for S are:
 Production of the three S-containing essential amino acids methionine, cystine and cysteine - although in the ruminant these are produced by rumen micro-organisms
 Production of the B vitamins thiamine and biotin (again by

thiamine and t rumen 'bugs') Hair, wool and

• Hair, wool and milk production. Animals ingest sulphur in their diets, derived almost exclusively from proteins. Proteins contain between 3% and 6% of the three sulphur amino acids. A very small percentage of S comes in the form of inorganic sulphates and other forms of organic sulphur present in foods such as garlic, onion and broccoli.

The vital role of S in agriculture

There are two forms of S in soil. Sulphate S is immediately plant available but is mobile in most soils except volcanic ash soils with high anion storage capacities (ASC). The second form is organic S which soil micro-organisms mineralise into



sulphate S, which the plants can then use. Organic S levels are greater in soils with higher organic matter content such as brown and allophanic (volcanic) soils.

Fertiliser S comes in two forms, both sulphate (the form in superphosphate as gypsum) and elemental S, (as either Sulphur 90 prills or sulphur super products), which have molten S added to superphosphate during the manufacture. Soil bacteria, e.g. Thiobacillus thiooxidans, use elemental S as an energy source and convert the elemental S to sulphate S which the plants then use. This oxidation process acidifies the soil, and eventually a liming agent should be used to correct this acidification.

Environmental impacts

At present, while S as sulphate is relatively mobile in soils and can be leached to ground or surface water, it is not recognised as causing any environmental issues. However, the principles of the 4Rs (right place, time, rate, and form) for S fertiliser application should still be followed.

To eat wheat: local or imported?



IVAN LAURIE, ARABLE FOOD INDUSTRY COUNCIL (AFIC) CHAIRMAN, AND FOUNDATION FOR ARABLE RESEARCH (FAR) GENERAL MANAGER OF BUSINESS OPERATIONS

Most of us eat grains every day, in bread, cereals, biscuits, pasta and more. But do you know where the grain in this food has come from - or more specifically, the wheat? Ivan Lawrie is Arable Food Industry Council (AFIC) Chairman, and Foundation for Arable Research (FAR) General Manager of Business Operations. He's followed the story of milling wheat in New Zealand for many years. Here he sets the record straight about milling wheat in New Zealand and introduces a project aimed at improving grower returns by increasing consumer demand for New Zealand 'grown' bread.

New Zealand farmers grow approximately 400,000 tonnes of wheat every year. To put that into context, a small car weighs just over a tonne - so that is a lot of wheat. However, that wheat is mostly used for feeding animals, not for human consumption. Why? As Foundation for Arable Research (FAR) General Manager of Business Operations I have followed the story of milling wheat in New Zealand for many years, and there have been many cycles since the removal of controls in the New Zealand wheat markets in the late 1980s and 90s.

Over the past 18 months, the industry has been looking at opportunities to grow the amount of milling wheat that's consumed in New Zealand. There has been a decreased volume in milling wheat over time and that particular grain has lost traction against other more attractive propositions, from growing feed wheat which is higher yielding, or feed barley for the animal industry.

The other factor that contributes to the lack of milling wheat grown in New Zealand is competition with Australia. In the North Island in particular, about 90% of wheat being milled was imported. In this current year alone approximately 230,000 tonnes of milling wheat has been imported from Australia. We are struggling to get New Zealand milling wheat production to exceed 100,000 tonnes, even though we've made progress in the last two seasons, we'd "Ultimately, the goal is to increase the amount of milling wheat grown in New Zealand through increased consumer demand."

hit rock bottom in 2018 with just under 70,000 tonnes.

I believe consumer awareness of food origin is on the rise internationally, and this knowledge is critical if we want to increase the amount of locally grown wheat used in baking and other food products.

In a loaf of bread, there's no telling where the wheat comes from. In a South Island loaf, it could be New Zealand wheat, but in the North Island it's most likely imported.

While there are cost inefficiencies associated with lack of infrastructure and internal transport within New Zealand, the main change needs to be driven by consumer behaviour.

The want for New Zealand-milled wheat is only going to be driven by consumer demand, targeting products that have local produce contained in them.

FAR conducted a market survey of almost 1,000 bread-buying Kiwis, (survey conducted before COVID-19). The survey identified 51% of consumers would be happy to pay up to 50 cents more per loaf of bread if they had proof the bread was made with New Zealand-grown grains, and a further 13% indicated they would "maybe" pay up to 20 cents more. Therefore, collectively there was an indication that two-thirds of bread consumers in New Zealand would be happy to pay a few cents more per loaf if it was proven their bread was made with New Zealand grain.

This small increase would make a significant difference to the growers of milling wheat in New Zealand.

In any loaf of bread today, be it a \$1 loaf or a \$6.99 artisan ciabatta, there's about 38-40 cents worth of wheat in it. So, if by some miracle of the value chain, you could put the extra cents going back on that loaf of bread to the value on the wheat that goes back to the grower, it would have a positive impact on production volumes. Now, we're not saying that it is only the grower who needs to have access to that benefit. Everybody in the value chain should benefit from a New Zealand story around provenance, and ultimately to provide good, sustainable, traceable products to the New Zealand consumer in general.

Another recurring reason for the lack of use of New Zealand wheat is the historic perception that New Zealand milling wheat quality is not up to standard. Whilst there were questions around the quality of our own milling wheat in the past, the quality of imported milling wheat is no longer perceived as being as good as it used to be. On the other hand, the genetics have advanced in New Zealand during the last two and a half decades to such an extent that some of our strongest wheats are actually stronger than the Australian imports, and probably too strong for some of the mechanical dough processing used in New Zealand. So, that's myth number two that can be counteracted with the development of really good cultivars suited for New Zealand conditions.

FAR and the growers have a vested interest in the growth of the milling wheat sector for New Zealand. Millers and bakers have the option to use imported wheat or flour, so it is primarily in the interest of the growers that we need to promote locally grown grains. To do this, we need to back our initiative with facts.



FAR has commissioned an independent report of New Zealand milling wheat quality data, looking at all the current varieties in the market and comparing them to equivalent imports. Sustainability and good farming practices are also key to the consumer. To address this, we have asked for a full lifecycle analysis on locally grown wheat to understand its environmental footprint. We need to be leading on this front.

As well as this, FAR is collaborating with millers, bakers and plant breeders to develop a suite of new varieties unique to New Zealand, with reduced allergenicity for that sector of the public that is intolerant to wheat-based products. FAR also has regional initiatives that will contribute to understanding new ways to commercialise grain; one of them is to develop a market for durum wheat flour grown in the Wairarapa for pasta and other uses. This project, with funding from the Ministry for Primary Industries and FAR, brings in-depth consumer studies together with chefs and food manufacturers to develop a new market for the region. The learnings will help mould other regional initiatives.

Ultimately, the goal is to increase the amount of milling wheat grown in New Zealand through increased consumer demand. This in turn will create long-term confidence among the growers.

The right rhizobia

With farmers under pressure to reduce fertiliser nitrogen (N) inputs, a team of AgResearch scientists, supported by the Ministry of Business, Innovation & Employment, DairyNZ, KiwiNet, and Grasslanz Technology, has been investigating an opportunity to match superior strains of rhizobia with modern white clover cultivars to improve biological nitrogen fixation (BNF).

Biological nitrogen fixation is the process of converting atmospheric nitrogen to ammonia through the legume-rhizobia symbiosis. N fixed by rhizobia in root nodules is available for plant use, and this process can be harnessed to improve N fertility on farm in a sustainable way.

White clover rhizobia are not native to New Zealand soil. The importance of inoculating white clover seeds in the New Zealand pasture system became fully apparent in the 1950s when clover failed to establish during large-scale pasture development on land cleared from bush.

Inoculation of seed with rhizobia has been common practice since the 1960s. Because of the long history of inoculation, white clover rhizobia are now commonly present in pasture soils. This led to the assumption that clover seed inoculation



FIGURE 2: RHIZOBIA POPULATION SIZE IN SOIL (LEFT) AND SYMBIOTIC EFFECTIVENESS OF SOIL RHIZOBIA POPULATIONS (RIGHT) IN A SINGLE PADDOCK¹.

Rhizobial number per g soil (log)



FIGURE 1: SYMBIOTIC POTENTIAL: LARGE NUMBERS OF RHIZOBIA IN SOIL DON'T NECESSARILY MEAN THE POPULATIONS ARE EFFECTIVE AT FIXING N¹.

(1,2) see Source Code page 40

was no longer required, especially where clover had been grown previously.

At the beginning of the research programme, AgResearch scientists wanted to find out whether this was in fact the case - and whether the current symbiotic relationship between soil resident rhizobia and white clover was as effective as it could be.

Scientists collected soils from 26 pasture sites across New Zealand, estimated the soil rhizobia population size and tested the N-fixing ability of these soil populations by measuring biomass production under N-limited conditions. Rhizobium

population size and symbiotic effectiveness varied widely between sites. In addition, they found high numbers of rhizobia in soil does not always mean high efficiency of N fixation (Figure 1: symbiotic potential).

More detailed field surveys also revealed large spatial variability of rhizobium population size and symbiotic effectiveness with white clover both within farms and within paddocks (Figure 2). These results indicated that naturalised rhizobia may not be providing optimal BNF and suggested that many sites would benefit greatly by inoculation using an effective rhizobium inoculant.

Matching clover and rhizobia for better effectiveness

The next question was how can biological nitrogen fixation by the white clover-rhizobia symbiosis be improved?

The first step was to identify highly performing rhizobia strains with greater symbiotic effectiveness (BNF) with modern white clover cultivars than the current commercial strain. With naturalised rhizobia being widespread in pasture soils, the elite rhizobium strain also needs to be highly competitive and outcompete other less effective rhizobia to form nodules with clover plants. More than 500 strains of clovernodulating rhizobia were isolated from

New Zealand pasture soils, with more than 90 demonstrating greater N-fixation capacity with white clover than the current commercial strain. In some cases, selected strains isolated from New Zealand soils can occupy 80% of the root nodules, while the current commercial strain only formed 20% of nodules, when supplied in the same ratio.

Field validation was completed in three trials. Some strains showed significant increases in clover growth by 12-38% over the uninoculated control (relying on naturalised resident rhizobia for nodulation) at three sites (Figure 3). Inoculation with the current commercial strain² did not show any increase in clover biomass compared to the uninoculated control in two of the trials.





FIGURE 3: SOME STRAINS CAUSED SIGNIFICANT INCREASES IN CLOVER GROWTH BY 12-38% OVER THE UNINOCULATED CONTROL

The outcome

Strains of rhizobia have been identified that are superior to the current commercial strain in terms of their N-fixing efficiency and competitive ability to form nodules. These elite strains have the potential to improve the performance of white clover and as a result, N fixed on New Zealand farms. In addition, further improvements in performance are possible through using new seed-coating technology or the alternative granule technology.

For more information, please contact the programme leader Shengjing Shi, scientist at AgResearch: Shengjing.shi@agresearch.co.nz



ELITE STRAINS OF RHIZOBIA HAVE THE POTENTIAL TO IMPROVE THE PERFORMANCE OF WHITE CLOVER AND AS A RESULT. N FIXED ON NEW ZEALAND FARMS

In your corner: how Ravensdown works to influence policy matters



ANNA WILKES, RAVENSDOWN ENVIRONMENT AND POLICY MANAGER



ALLANAH KIDD, RAVENSDOWN SUSTAINABILITY MANAGER

Policy. In the current climate, the word itself is enough to send shivers down New Zealand's rural backbone. But policy is unlikely to go away any time soon, so the best option for Ravensdown and other industry bodies is to take a stand to ensure sensible outcomes for our farmers. Ravensdown's Environmental and Policy Manager Anna Wilkes and Sustainability Manager Allanah Kidd tell us how Ravensdown works in this space for the good of our shareholders and the farming community at large.

Over the past few years, Ravensdown's involvement in policy advocacy has risen, particularly as environmental regulations for farming have become increasingly complex.

Our farmers' time is better spent farming, not necessarily advocating their cause as a lone voice in a council hearing or environment court process, and this is why we act on behalf of our shareholders to represent their interests in these processes. The benefit for farmers is that Ravensdown can call on specialist advisors when we need help to present a robust case, helping drive pragmatic outcomes that are both achievable for farmers and necessary for environmental improvement.

When it comes to policy, it's important to consider the broader context of what we can achieve. Typically, a regulator is focussed on a narrow issue such as water quality. Our approach is to look for opportunities that will enable a farmer to gain multiple wins as they make changes on their farm. For example, an action to reduce sediment losses by retiring an area of erosion-prone land and planting with native species would have benefits for water quality, biodiversity and climate change. All these benefits would then be reflected in a robust Farm Environment Plan.

We do not have the time or resources to submit on every consultation process that comes our way. We review documents released for consultation and consider the material impacts of the

outcome on our shareholders and on our own manufacturing, distribution and quarrying activities. We also consider where our interests may be better or more adequately represented by other industry bodies. During 2020 and 2021 we have been involved in 16 different policy or plan review processes, which are at various stages of the submissions, hearings and appeals processes.

Industry collaboration saves time and money

We work closely with a range of primary industry bodies on environmental policy, including DairyNZ, Federated Farmers, Environment on a guidance document for the nitrogen fertiliser Beef + Lamb New Zealand and Horticulture New Zealand. We also cap requirements. In addition, Ravensdown's environmental collaborate with Fonterra and other processors, and sometimes with consultancy and field teams have been fielding many queries from our counterparts at Ballance Agri-Nutrients through The Fertiliser farmers looking at compliance with the various policy requirements Association of New Zealand (FANZ). Regulatory processes are and the staggered dates for implementation. both costly and time consuming, particularly at the appeals stage. Increasingly, the primary sector is looking to work together, aligning **Tackling climate change** views and sharing resources to present a united front that ultimately carries more weight for the sector.

How we work for shareholders

Ravensdown prepared a submission on the Essential Freshwater package of proposed regulations announced by Environment Minister David Parker in 2018. Our submission was one of more than 17,500 received by the Government. Since the regulations were released in August 2020 we have presented a summary of the key points at shareholder meetings around the country and have more recently been providing feedback to the Ministry for the



"We are helping drive pragmatic outcomes that are both achievable for farmers and necessary for environmental improvement."

Climate change is a growing threat and there's renewed focus on reducing greenhouse gas emissions which has come with much political discussion and consultation with industry. Ravensdown contributed to the Sustainable Business Council's briefing to the incoming government on climate action priorities, and the Climate Change Commission's draft advice to government. Membership to the Sustainable Business Council enables collaboration with business leaders from a diverse range of sectors collaborating on workable solutions that can be presented to government. It has also enabled discussion by a subgroup of agri-businesses, focused on impacts and contribution of farming specifically. Where possible through this process, we seek input from farmers, directly and through our agri managers.

Policy advocacy into the future

Ravensdown is entrusted by its shareholders to ensure that new policy is appropriate and fit for purpose and we take that role very seriously. We anticipate an ongoing role both at central and local government levels, and we are currently reviewing the latest Freshwater Farm Plan regulations. Our involvement visibly extends to submissions on plan changes and plan reviews, the presentation of evidence to hearing panels, and in some cases participation in Environment Court appeals. Less well known perhaps is our involvement in primary industry stakeholder groups that work with the regulator as policy documents are being prepared, providing feedback on drafts and assisting with interpretation and implementation of newly released plans and plan changes.

The regulations are inevitably complex and we see part of the role of the co-operative is to translate the regulations once set and to help farmers adapt to the new regulatory regime. The ongoing focus of our role in defining the future direction of agriculture is on solving problems collaboratively and being part of the solution. Our contributions to policy processes are valued by regional councils as we seek to strike a rational balance between agricultural production and environmental protection.

Source Code

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Page 11

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The Last Word

We hope you enjoyed the spring edition of Ravensdown's Ground Effect®, which is all about enabling smarter farming for a better New Zealand.

Got an idea? We'd love to hear from you! For other comments, thoughts and general chat about Ground Effect, get in touch via the details below.

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On behalf of Ravensdown, we'd like to thank you, our shareholders, for your contribution to New Zealand and our food and fibre industry. We continue to invest in and develop our agri-science, technology and innovations for the good of your business and the country. Keep up the good work of Smarter Farming for a Better New Zealand

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Victoria O'Sullivan Editor

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