


Stories and articles from Hill Country Futures

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beef+lamb new zealand

HILL COUNTRY FUTURES







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Farmer stories

Sound accessible information is critical to the changes hill country farmers need to make

Gisborne farmer George Mcildowie sees the availability of sound accessible information such as that being produced through the *Hill Country Futures Partnership* programme as critical to the changes hill country farmers need to make to ensure the sector is sustainable into the future.

“I think the main opportunity is through increased revenue from under-productive farmland under current farming practices,” he says.

“The Hill Country Futures Partnership programme is producing a bank of good data to help back up good practice. It’s collecting data on a variety of farms over a wide area for the better of our industry.”

The $8.1m programme is focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities. It differs from most pastoral-based research in that it considers the whole-farm system and, critically, the wider communities these systems exist within.

It incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

George is the fifth generation of his family to farm the 2250 Ha Totangi Farms - 2000 Ha effective - at *Ngātapa*. The breeding and finishing business lambs around 8000 ewes and calves 500 cows. They winter around 20,000 units with a cattle to sheep ration of 50:50.

Having studied applied sciences at Auckland University of Technology, worked on super yachts in the US and farmed and worked in agricultural construction in the UK, George returned to the family farm at the end of 2015 to begin his professional farming career.

He says a key outcome he’d like to see from the Hill Country Futures Partnership programme is hill country land remaining in meat and fibre production.

Totangi Farms has undergone a number of changes to ensure efficient use of the farm’s topography, allowing for reduced staff input. There is a focus on pasture renewal of flat land with the use of summer brassica crops.

Significant subdivision is planned in conjunction with a reticulated water system throughout an area of flat land. The water source is via two large springs, tapped two years ago. A refined breeding programme has also seen Totangi lift its lambing percentage from 115 per cent to 140 per cent.

George sees policy change as the major challenge facing hill country farmers and welcomes the Hill Country Futures Partnership's focus on interviewing hundreds of people involved in the sector, to gain their views and to also share the real stories of hill country farming.

"Hill country farming plays a massive role in the success of rural communities. Provincial success can be attributed to hill country farming and it's important for those communities that they remain sustainable and productive. It's these connections along with other custodial stories that must be shared so they can be understood."

George and partner Emma were pleased to be part of the original focus group that contributed to the development of the programme. While the focus group was initially brought together to help shape the development of a farmer wellbeing assessment tool, known as FarmSalus, members have continued to catch up and share ideas and mutual support.

"We see the programme as important because it will provide critical insight into the changes and willingness of new generational farmers to adapt to current environments," says George.

"Being involved was a relaxed but formal process and was made easy by the fact all the farmers involved were of the same generation. In continuing as members of the group, we've also found the shared passion for our industry and any knowledge gained is of benefit to our business."

Ange McFetridge, Design and Capability lead for B+LNZ, said members of the focus group played an important role.

"We wanted to interview a group who were representative of people living in hill country to help us to future proof our work," said Ange.

"We put out a request to the farming community and got the group together. We had a face-to-face meeting with them and got a whole lot of insights about their frustrations and their aspirations for the future for their farms."

Ange and the team (led by Katherine Dixon – Nature Positive) also held a second meeting with the group.

"What has also been very good is that they have continued as a group and they are very free and frank with one another. They all know about working through succession and the environment, stewardship and business health are all very important for them.

"We wanted to show them what we had done with their insights and to test some of the conceptual work and deliverables to gain their feedback on the utility of that. It was important to us to validate that we were on the right track and ensure hill country farmers had an active voice in what we were doing."

Supporting initiatives to help point farmers in the right direction

Hill country farmers Ted and Becca Jefferd are keen to support initiatives to help point farmers in the right direction. The couple, who farm sheep and beef on 570 hectares north-west of Gisborne, are part of a farmer focus group which provided input into the Hill Country Futures Partnership Programme.

“We all know farming is great a lot of the time,” says Ted. “But it can be really tough too.”

Ange McFetridge, Design and Capability Lead for Beef + Lamb New Zealand, says the focus group played an important part in development of the programme.

“We wanted to interview a group who were representative of people living in hill country to help us to future proof our work.

“We held a face-to-face meeting with them and got a tremendous amount of insights, about their aspirations for their farms and hill country farming for the future, and also their frustrations.

“They all know about working through succession and the stewardship role they have and they really care about what they are doing for future generations. They are all thinking about the world differently and the things that are important to them, the environment and business health.”

Ange and her team later held a second meeting with the focus group.

“We wanted to show them what we had done with their insights and to test some of the conceptual work and deliverables to gain their feedback on the utility of that. It was important to us to validate that we were on the right track and ensure hill country farmers had an active voice in what we were doing.”

Ted’s parents moved to their farm in 1995 and he always knew that he wanted to follow them into farming. He went to Smedley Cadet Training Farm in the Hawke’s Bay, followed by gaining a diploma in farm management from Lincoln University.

A ‘split’ OE of several years followed spending NZ summers shearing here before heading to the UK to do the same during summers there. He returned to the farm in 2015 where he’s made a number of “small changes but nothing major”.

He sees education as vital to the future of hill country farming.

“We have so much to learn from one another – farming is probably the one industry where everyone is happy to share their secrets.

“I think there are opportunities to further promote our red meat product overseas and the messages about how it is sustainably produced.”

As part of that, Ted sees the importance of ‘real farming stories’ being shared – one of the key areas of the *Hill Country Futures Partnership* programme.

“Most people who come into farming do so from a rural background. High numbers of sheep and beef farmers in New Zealand are over 50 years of age. It’s critical to keep young people coming through.

“The wider public can have very strong views on farming. I feel very strongly about getting the real facts out there - that most hill country farmers have relatively few livestock compared to the very large areas they are grazing, so our footprint on the land is minimal and our red meat and wool are very naturally produced.”

While Ted feels the Gisborne area hasn’t yet been overly impacted by regulations addressing climate change, he is very aware of the effects that they are having elsewhere.

“Certainly, for hill country farmers in Southland, the regulations are having a severe impact. We need to get more knowledge about hill country farming out there and get our stories told.

“Hill country farmers are important to New Zealand. In terms of land mass, hill country makes up the bulk of farms here. Prices for beef and lamb have held pretty steady throughout the pandemic and it is important for the New Zealand economy to have that overseas revenue coming in.

“I see conscious consumers as a major opportunity for the sector, along with the potential for a resurgence in demand for wool.”

Knowledge is key

Tararua farmer Dean Wardle sees “knowledge as key” for hill country farming to flourish into the future.

“That and opening our minds a wee bit to change,” he says.

“I try to keep an open mind. Things aren’t easy for hill farmers, dealing with issues like drought, but we are making changes on our farm.

“While it’s a long-term journey and things won’t get better overnight, we are seeing enough positive signs to stay excited.”

Dean gained a lot of support to make change through being part of a Red Meat Profit Partnership (RMPP) action group and he welcomes the work of the *Hill Country Futures*

Partnership programme to provide further resources to support farmers to make the best decisions for their land.

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Dean farms 3,200 Romney ewes and 100 beef cattle and their progeny over 1,000 Ha at Pongaroa, north east of Masterton. The farm has been in his family for almost 90 years, with his father's parents taking on the first block in 1936.

Having grown up helping on the farm, he trained at the prestigious Smedley Station and cadet training operation in Hawke's Bay before completing a diploma in agriculture at Lincoln University.

He worked at an outback station in Australia and then travelled for a few years, working on overseas farms during the New Zealand winter while heading back to work on the family farm in summer. He returned for good in 2018.

"Every farm is different," he says. "For us, we're trying to head down the soil health/regen' path so our biggest challenge is carrying the shoulders through, getting through winter without too much supplemental feed.

"That isn't easy when you're getting droughts, but we are trying to be flexible to the seasons and take feed through the year to minimise the risks We are focusing on our grazing and trying to get a longer recovery period at certain times of the year and having the sheep go onto longer grass to protect the soil.

"When growing is slow, we aim to be at least 60 days before returning to grazing but in spring, it's 20 to 25 days because it goes to seed so quickly. Having expert information to back up what you are doing is really valuable - we got a lot of advice from our facilitator on the RMPP programme.

"It's also about learning to celebrate your failures. We do get failures, but we are getting a lot of positives too and seeing different species showing up - like red clover which we've never had before. We are seeing opportunity here, working with nature more and we aren't sending all our money to town on fertilisers."

Dean says having access to really good information - such as that now being made available through *Hill Country Futures,* has been critical to driving the changes they want to make on their farm and he sees that as the key opportunity for hill country communities to flourish.

"We have been lucky to have access to really good information and I think that's the real opportunity for hill country communities - we need to make sure we open our minds to the really good information that is available to us - and talk among ourselves and share ideas about what is working well for us and what isn't."

Gaining input from farmers

Gaining input from farmers was critical to the development of the *Hill Country Futures Partnership* programme - and Gisborne farmers Henry and Sofie Gaddum were glad to be able to help.

The couple, who farm sheep, beef and deer at Kotare Station at Matawai, acted as connectors to draw together a focus group to support work on the programme's design.

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It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities.

Ange McFetridge, Design and Capability Lead for B+LNZ, said the support of Henry, Sofie and their farmer group had been invaluable.

"We wanted to interview a group who were representative of people living in hill country, to help us to future proof our farmers. We were given Henry and Sofie's names and it was so good to get them on board.

"They put out a request and brought a group of hill country farmers together. We held a face-to-face meeting with them and got a tremendous amount of insights about their aspirations for their farms and hill country farming for the future and also their frustrations.

"The great thing is they have also continued together as a farmer group. They are very free and frank with one another; they are all peers who have 'come home to farm', they know about working through succession and the stewardship role they have and really care about what they are doing for future generations."

Ange and the Nature Positive team then held a second meeting with the group to test plans for the programme.

"By then, the group's numbers had grown too. We wanted to show them what we had done with their insights and to test some of the conceptual work and deliverables to gain their feedback on the utility of that. It was important to us to validate that we were on the right track and ensure hill country farmers had an active voice in what we were doing."

Henry said it was great to be part of a partnership that has a clear focus and is forward thinking about building resilience into the future of farming.

Holistic focus on supporting hill country farmers

“It is great to see a holistic focus on supporting hill country farmers with initiatives like the *Hill Country Futures Partnership Programme,”* says Gisborne farmer Matt Humphreys.

Matt and Wife Megan farm 420 hectares – 390 effective - at Ngatapa and were part of a farmer focus group which provided insights that helped shape the development of a farmer wellbeing assessment tool, known as FarmSalus.

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It incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

Ange McFetridge, Design and Capability Lead for B+LNZ, said members of the focus group played an important part in the development of FarmSalus.

“We wanted to interview a group who were representative of people living in hill country, to help us to future proof our work,” said Ange.

“We put out a request to the farming community and got the group together. We had a face-to-face meeting with them and got a whole lot of insights about their frustrations and their aspirations for the future for their farms.

“What has also been very good is that they have continued as a group and they are very free and frank with one another. They all know about working through succession and the environment, stewardship and business health are all very important for them.”

Ange and the team (led by Katherine Dixon – Nature Positive) later held a second meeting with the focus group.

“We wanted to show them what we had done with their insights and to test some of the conceptual work and deliverables to gain their feedback on the utility of that. It was important to us to validate that we were on the right track and ensure hill country farmers had an active voice in what we were doing.”

The Humphreys family's roots run deep in the region. Matt is the fifth generation to farm Herefords and the fourth generation at their Wilencote stud - his ancestors started out at Strahallan Station in Gisborne. Wilencote is New Zealand's oldest Polled Hereford stud – and the family introduced the hornless Hereford breed to New Zealand in the 1920s.

Megan has an environmental consultancy background and Matt has wide-ranging experience in hill country farming. He spent 13 years shepherding on a number of sheep and beef stations in Gisborne and Taihape before moving back to Wilencote in 2021. The couple are proud of the farm's history and passionate about the future of the sector.

Wilencote has 300 registered Hereford breeding cows, including heifers. Some trading lambs have recently been introduced into the system but the stud is the key focus for the farm. The Humphreys sell around 30 bulls each year, many to local farmers. Their programme is focussed on breeding bulls that have good structure, temperament, mobility and a certain 'athleticism', ensuring progeny have quality carcass traits.

"Our breeding philosophy is about small, steady and incremental improvement – optimising and balancing traits within the herd," says Matt.

"We have been working away at implementing a new stud recording system, are rolling out DNA testing across the herd and have some ambitious environmental goals, including natural bush regeneration and wetland enhancement projects."

Alongside scientific research, the *Hill Country Futures Partnership Programme* includes a focus on telling the real stories about hill country farming – and the couple see that as a key factor.

"It is so important to distinguish between hill country farming versus dairy and how hill country red meat is produced in New Zealand compared to the rest of the world," says Megan.

"The industry needs to be better understood and future proofed. Objective research detailing how red meat is produced can feed into policy decision making and marketing, ensuring the media are told accurate information around hill country farming – and hopefully our products receive a premium to reflect the way it has been grown.

"It is so much more relatable and tangible when people can see the positive work farmers are doing environmentally as well as the way stock are looked after. One of the outcomes we'd like to see from the programme is hill country farming to be seen in a more positive light – showing how we are producing premium products in a sustainable way."

Good opportunity to express shared problems and concerns

Being part of a focus group for the *Hill Country Futures Partnership* programme was a good opportunity to express shared problems and concerns, says farmer Fraser Tombleson.

Insights gained from farmers involved in these focus groups has helped shape the development of a farmer wellbeing assessment tool, known as FarmSalus.

Fraser and wife Jaime farm almost 1000Ha near Mātāwai, about an hour north of Gisborne, and Fraser says they are keenly aware of how some hill country communities are struggling.

“It was really good to be in a group of farmers that are on the same page, with concerns about issues like carbon farming and communities disappearing.

“It was a good way to get feedback from farmers to express our problems and concerns and get our side of the story out there at a high level.”

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Ange McFetridge, Design and Capability lead for Beef+ Lamb New Zealand, which is supporting Hill Country Futures, said members of the focus group played an important part in the development of the programme.

“We wanted to interview a group who were representative of people living in hill country to help us to future proof our work,” said Ange.

“We put out a request to the farming community and got the group together. We had a face-to-face meeting with them and got a whole lot of insights about their frustrations and their aspirations for the future for their farms.

“What has also been very good is that they have continued as a group and they are very free and frank with one another. They all know about working through succession and the environment and stewardship and business health are very important to them.”

Fraser’s parents bought the farm in 1973. The terrain is challenging - rising from 300 metres above sea level to 1000 metres.

Fraser knew from a young age that he wanted to follow his parents into hill country farming. He gained a Diploma of Agriculture and a Diploma of Farming from Lincoln University and worked on several other farms, including the large Papanui Station at Taihape, before leasing most of his family’s farm in 2015.

He and Jaime bought 726 hectares in 2019 and lease a further 250 from his parents - 900 Ha is effective. They run a breeding and finishing operation with 3700 ewes to ram, 1000 hoggets, 150 in calf cows, 200 steers and 150 bulls.

Fraser sees the major challenges to hill country farming as staying viable in the face of increasing costs and a wave of regulations - and hopes the programme will result in more solutions for farmers.

“Land going into forestry is a big concern too, along with the change in consumer trends and rise of ‘synthetic alternatives’.

“Being young and just coming into all this change is difficult but for older farmers having to deal with all of it, it can be really bad for their mental health.

“Many of us are young and have big debt and there are a lot more things we’d like to do in terms of environmental stuff but we also have to stick to a budget. For instance, we have land we would be happy to forgo for planting into natives if we could afford to.

“My mother did a lot of planting, but mainly exotics as natives are pricier and harder to establish. I’m currently focusing on fencing off the rivers and the planted areas. We are keen to do wetlands too, once we can afford it. That will be very important going forward.”

Virtually no spraying is carried out on the farm. Work to “go down the biological path” and reduce use of super phosphate has however proved challenging in the face of cold winters and hard ground.

Fraser says that there are real opportunities for hill country farmers to play an even more vital part in the New Zealand economy - if they are given the support they need to make required changes.

“I see the opportunities as ensuring we are recognised for the most efficient farming in the world, combined with biodiversity and a high quality product targeted to high end markets.

“I’m optimistic that consumers will see the health benefits of high quality red meat over non meat alternatives. I’m also optimistic about the future of wool. It’s an amazing product as an alternative to micro plastics. A lot of work is being done around wool and I think it’s time will come again.

“I also hope the programme will help address the rural urban divide, by getting the real stories out there - so people start to realise the really good work we are doing.”

Best pastures for lifting performance

Participating in the *Hill Country Futures* Partnership programme has helped John Chapman identify and quantify the best pastures for lifting the performance at his 4,250 ha Inverary Station in Mid Canterbury.

Lincoln University got in touch with John after learning he was conducting his own pasture production research as part of an in-depth review of the property and livestock, looking at ways to drive productivity and profitability.

“Professor Derrick Moot was keen to work with us and provide technical support – as part of the *Hill Country Futures* programmes research projects that he leads, working with farms and farmers across New Zealand,” says John.

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John and his wife Anne farm the 4,250 Ha sheep and beef hill and high country property near Mt. Somers, with managers Bert and Kate Oliver who are joining them in an equity partnership

The farm runs to 1500m altitude and carries 5500 ewes, 1600 hoggets (half mated), 700 breeding cows and 400 yearling cattle wintered.

Around half of the property is higher and harder hill country with limited useful grazing. The lower hill country is a mixture of improved and unimproved blocks with better soils. The remainder is in a variety of terrains from cultivated river flats to higher glacial terraces.

The rolling or flat country with good cultivatable soils consistently grows large quantities of high-quality dry matter, however the hill blocks, largely browntop-based, are slow growing when needed in the spring but generate large surpluses of poor quality feed in the summer and autumn.

“About ten years ago, we began a substantial development stage on the property but we were still struggling to use much of our hill country pastures efficiently,” says John.

“We didn’t really understand the seasonal contributions from the hill country although we knew it didn’t fit our feed demand too well. On the other hand, the legume pastures we had established were providing some exciting results. I set out a network of over 30 pasture cages throughout the property and measured the growth on a six-weekly basis providing a comparison between a variety of hill blocks and existing and developing pasture elsewhere.

“This fitted nicely with the work Derrick Moot was doing around legumes in hill country and he provided a lot of technical support in weighing and analysing the pasture samples.”

The measurements have been maintained for five years and have accurately determined the relative advantage of the legume based pastures over conventional grass based pasture.

The differences have been quite substantial. The traditional ryegrass based pastures have averaged 11400 kg dry matter annually while the lucerne (on lighter soils) produced 15300 kg dry matter. Red clover based pastures have provided spectacular results – on average, 17500 kg dry matter.

Of particular note was the spring performance of the legume or legume dominant paddocks in the spring. Consistently these have provided double the spring production of their conventional ryegrass paddocks and at a time of the year when every farm needs the maximum production.

John says that, as expected, the hill country pastures were substantially less productive - 6700 kg dry matter on oversown and topdressed blocks and 3700 kg of dry matter on the unimproved hill.

“What it did highlight however was how tragic the early spring and autumn production levels were compared to the annual pasture growth.”

The production records enabled John to develop a pasture growth profile for the entire property and supported identifying and developing measures to address the imbalance. This includes developing pioneering a ‘spray and delay’ technique using soil residual sprays to completely remove existing pasture and weed strikes on steeper hill faces and establish high performing legume pasture.

These are then ‘rested’ for 12 to 18 months with the fallow spell allowing development of an open seed bed and suitable soil moisture levels for growing red, white and Caucasian clovers.

“These hill blocks that previously produced 4-5000 kg of poor quality feed are now providing over 16000 kg dry matter of exceptional quality. Where a few ewes once made a difficult living, we are now finishing lambs. This in turn creates high nitrogen levels, enabling sowing of high fertility grass species in subsequent years.”

Monitoring sensor networks have also been established on the farm as part of an experiment to map micro-indicators, such as soil temperature and moisture. The goal is to help farmers quantify key soil and terrain features to enable robust decision-making around the most suitable locations and potential benefits of introducing forage legumes.

“Working with Derrick and his field technician Malcolm Smith has been invaluable for us,” says John. “I was cutting representative pieces of pasture and drying them in the oven – and that wasn’t a recipe for a good marriage. Malcolm is multi-skilled and provides discipline, precision and accuracy and the samples go to Lincoln to be analysed and recorded for pasture composition and ME.”

The impact on productivity has been significant. Ewes scanning is up from 152 per cent to 175 per cent and sales of lambs have grown from 31.7 to 44.8kg per ewe mated.

John says he’s cautiously optimistic about the future of hill farming and sees science as key to that.

“The *Hill Country Futures Partnership* and programmes like it are absolutely critical – because hill country is where all the potential in New Zealand lies. Most of the flat arable land is spoken for but there is a huge amount of potential in using legumes in hill country. This is on-farm work demonstrating to a wider farmer audience that it is possible.

“Farmers are apprehensive about their obligations under the environmental legislation but they can see some of the potential too, such as the work being done here.”

Pasture trial results ‘Interesting’

“Taking part in trials for the *Hill Country Futures* Partnership Programme has already been really valuable for us,” says Matt Iremonger, general manager of Willesden Farm on the Banks Peninsula.

“We have had some early results from the experiments on the development we have done on our hills and total dry matter and it was very interesting. We took that data to our bank when we applied for additional funding to undertake further capital improvements – which are now underway.”

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Willesden Farm is a 5,500 Ha sheep and beef property. About 1,200 Ha is flat and cultivatable while the remainder is mostly moderate to steep hill country. Rainfall and altitude can vary significantly within a short distance on this property. Annual rainfall ranges from 550 to 1,100 mm while altitude goes from sea level to above 850m above sea level.

Two projects within the *Hill Country Future Partnership* programme are underway on the farm. One, led by Lincoln University's Professor Derrick Moot, is undertaking measurements of pasture growth at two locations, one an improved area with lucerne and the other an unimproved pasture of mainly weed grasses with a little ryegrass and white clover.

The other, led by Dr Nathan Odgers, of Manaaki Whenua Landcare Research, is mapping micro-indicators, such as soil temperature and moisture, in the hill country landscapes. The goal is to help farmers quantify key soil and terrain features to enable robust decision-making around the most suitable locations and potential benefits of introducing forage legumes.

"Derrick Moot asked if we would like to be involved," says Matt. "He had done previous trials on the property and given us advice around some of the legume work we have done in the past.

"I think the challenges for hill country farmers are the same as they are for farmers whatever the land type in that there is an increasing focus on more efficient use of the resources we have and the need to use all inputs, fertiliser, chemicals and feed more efficiently.

"However, it is not easy for hill country farmers to show how efficient we are because of the topography and difficulty of measuring. That is where the challenge is and I see that as one of the major opportunities of the *Hill Country Futures* programme.

"It will show the opportunities we have to actually evolve science around this and the more we have science and advice from experts, the better informed we will be in the decisions we make."

The pasture measurements at Willesden Farm are being taken at two altitudes 20 or 175 metres above sea level. At each altitude, there are paired enclosure cages on improved and unimproved pasture. The cages are monitored by field technician Malcolm Smith from Lincoln's Dryland Pasture team.

Harvests were taken in May, September and December 2019 and January 2020. Over this period, the improved lucerne pasture had accumulated 14 tDM/Ha – more than twice the 5.4 tDM/ha for the unimproved pasture.

“Data from the trial was critical in enabling us to make our case to the bank,” says Matt. “It is all very well to say you can do something, but being able to prove that from a scientific point of view is far more powerful, because science is irrefutable. Having the trials on farm has created no issues – we just provide access and the technician comes on and does the measuring.”

Matt says he is extremely positive about the future of hill country farming.

“As technology increases, there will be more resources available to use to improve our performance and the outcomes of this work will be among them.

“As techniques of capturing data and information become more readily available, that will help to develop skill sets and information and data sets and support the ability to measure ourselves around best practice and returns on investment.

“Having this work underway on the farm has been interesting, a pleasure and exceptional value for us and it will continue to be valuable to us in any of our projects.”

Paparata Station

“Climate change and how quickly it’s happening is the biggest challenge for us,” says Trevor Johnson, owner of Paparata Station owner, 50km west of Taumarunui.

“We have less water and higher temperatures. We have had to change our farming systems and it’s important for us to know which legumes will grow where. We are interested to know what species might grow on our hills without the fertilisers we are using.”

So when Trevor was approached about the 7,100 Ha station becoming a trial site for the *Hill Country Futures* Partnership programme*,* he was keen to get involved.

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Within the programme, there are four research areas – all contributing towards the overall objective of future-proofing New Zealand's hill country farms and rural communities.

Paparata Station is one of the trial sites for the research led by Dr Nathan Odgers, of Manaaki Whenua Landcare Research.

The study involves mapping micro-indicators such as soil temperature and moisture in the hill country landscapes. The goal is to help farmers quantify key soil and terrain features to enable robust decision-making around the most suitable locations and potential benefits of introducing forage legumes.

Paparata Station is farmed in four blocks, overseen by managers. It carries 65,000 stock units, including an elite Romney stud and around 6,000 Hereford and Angus cross cattle.

"We have had to change our farming systems and supply stock with water from other sources," says Trevor. "We can't rely any more on the natural water which are streams in the hills. They are not lasting the 12-months. It's got warmer from late spring through summer and into autumn, so we have less feed for autumn.

"Farmers try to manage production so that feed demand fits in with feed supply. We've moved to finishing and selling stock earlier and we now have reticulated water. Finishing stock earlier means we can build grass covers in the autumn. We see the trials as very useful as the species we are currently growing are very dependent on water."

Cattle and sheep numbers are carefully balanced to complement one another. "Getting the right ratio of cattle to sheep is important. You can't harvest all the grass when the feed quality is at its maximum.

"Adult cattle have the ability to maintain live weight on pasture that has lost feed value. Cows, especially after weaning, can go on to lesser quality pastures. However, cows can damage the soils especially if paddocks are stocked with high numbers per hectare. We try and avoid this damage by lowering the stocking rate per hectare. The present practice is to calve cows on the hills with sheep and the cows stocked at one cow to two hectares. This limits damage to soils."

Trevor says participation in the programme has been very easy.

"We haven't really had to do anything. The researchers have fenced off some small 2m x 2m areas where they have probes in place and they have put a monitor on top of a hill that sends the information to the research team. We are very much looking forward to getting feedback on the outcomes."

The *Hill Country Futures Partnership* programme is also focused on identifying a clear vision for a resilient hill country future and developing guidance for farmers on how to work towards this vision at a farm and/or catchment scale. This is based directly on stakeholder consultation delivered through in-depth interviews with over 300 farmers and key stakeholders.

A major component is the development of a trustworthy hill country farming story of continual improvement in the environment, animals and people. It will showcase through case studies, articles, podcasts or videos how hill country farmers are

demonstrating resilient and sustainable farming practices and stewardship of the land, animals and people.

Trevor is also strongly supportive of the ‘telling the farmers’ story’ approach.

“It is important to us to be sustainable. I’m a third-generation farmer and in my book you have to be sustainable for the next generation in the hills – and we need to tell that story.

“There are challenges but I’m positive about the future and we want to be here forever. One of our managers has been with us 33 years, one 25 years, one 15 and one seven. My objective is not just to have a profitable sheep and beef operation but to make sure everyone here is happy and enjoying what they are doing. You could say if the farm team is happy and they are enjoying what they are doing, you will have a profitable farm.”

Hill Country Futures Steering Committee

Love for the land and livestock

Jenni Vernon’s love for the land and for livestock was forged as a small child, helping her grandfather feed out mangels on farm. Today, after more than four decades in farming and public sector leadership, she remains passionate about giving back to the industry.

So, she saw taking on the role of independent chair of the steering committee for the *Hill Country Futures Partnership* programme, as a “golden opportunity to do that”.

It’s a task she combines with her job as a Principal Adviser for the Ministry for Primary Industries and other governance positions including with the Agri-Women’s Development Trust (AWDT) and the National Fieldays Society. Jenni was also New Zealand’s first female Nuffield Scholar and the first woman chair of Environment Waikato.

With research work undertaken for the five year, $8.1m *Hill Country Futures Partnership* programme now drawing to a close, Jenni is looking forward to seeing the long-term outcomes for hill country farmers.

“This is only the beginning of the journey and that’s why I find it so exciting,” she says. “We have study sites all over New Zealand and people have been very keen to engage with the programme. The next step is to put all this science and research into tangible tools.

“A big part of it has been about recognising how valuable hill country farming is to New Zealand society and ultimately the work that has been done will also add value to our markets.”

The five-year programme is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand. It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities.

It incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

“I see the project as important because hill country farming in the New Zealand scheme of things is often neglected,” says Jenni.

“When I was growing up, following my grandfather around in the Ruahine Hills, sheep and beef farming was front-of-mind when New Zealand agriculture was mentioned. Today, you hear more about dairy and kiwi fruit. But there is still a huge acreage of hill country farming that is very valuable to our economy and has some of the most unique rural communities.

“New Zealand needs hill country farming and we need future hill country farmers. *The Hill Country Futures Partnership* is about how we still have those rural communities and how we help the sector to remain profitable and resilient in the face of many challenges.”

Jenni originally trained as a teacher in Christchurch, where she also joined New Zealand Young Farmers, providing her first step into leadership and public speaking. In 1977, she was awarded a NZ Young Farmers Exchange trip to America to learn about US agricultural methods. She went on to become president of Young Farmers, where she “got to learn about farming from a national perspective”.

Jenni and husband Gordon have been farming together for 42 years – originally in dairy farming but now sheep and beef on a dry stock property in the Western hills of Waikato.

Being “hill country ourselves, although not steep hill country”, Jenni recognises the challenges that farmers face and the passion and values that drive them – and the tough decisions that sometimes need to be made.

“Being a hill country farmer isn’t easy. As a child I remember plucking wool off the barbed wire and even from a dead sheep because wool was 50 per cent of our income back then and every piece counted. Hill country farmers will be familiar with those conversations around the kitchen table about who is best to earn the ‘off farm’ income and who is best to stay on farm.”

It was “one of those kitchen table conversations” that led to Jenni taking an off-farm role with the National Party. She spent eight years as a divisional director, learning a lot about leadership, policy, politics and central government.

After returning to university in 1993, gaining a Masters degree in environmental management – she also has a post graduate diploma in environmental law - she took up the Nuffield scholarship.

“I had already done the Kellogg Rural Leadership programme and Nuffield was an amazing opportunity to represent New Zealand agriculture overseas – something I have now done on a number of occasions – and also to understand our place in the world and what a competitive world it is.

“I was a scholar alongside some amazing people, including a woman from Zimbabwe who was studying the Dutch flower industry. It made me really understand the fickleness of the consumer. How some countries and industries put great effort into producing a product but by the time it gets to market, interest has waned.”

Back in New Zealand and seeking a new leadership opportunity, she ran successfully for Waikato Regional Council.

“Regional councils are very important in farming and it seemed a good opportunity for me to stand for the rural community, as a farmer and continue to provide a rural voice at the table. I did that for 12 years, until 2007, including as chair of Environment Waikato. I loved it. It was an amazing opportunity and, in particular, the opportunity to work with Māori was a great privilege for me.”

Jenni went on to work in resource planning for the Waikato District Council, leading a district plan review and private plan changes. In 2017, she finally “took a gap year and went overseas to reconnect with Nuffield friends” before returning to the fray, taking on her AWDT role, joining MPI and agreeing to head the *Hill Country Futures Partnership* steering committee.

“Because I’m hill country, I understand the background,” she says. “One of my skills is that I like to work with everyone. I’m not a ‘consensus by veto’ type of person. I like to listen to people and work with them.

“I have also been very fortunate to work with an amazing team and steering committee.

Jenni is now looking forward to seeing results of the programme over the coming years.

“I’m excited about the opportunities around biodiversity and the forage landscape, including the potential to integrate natives shrubs as grazing fodder as part of integrated farming systems.

“We now have a national database, which will expand, and can be accessed to find if a plant will grow in a particular location. I think that will be of great value alongside the land classification tools and understanding what legumes and crops can be grown on hill country.

“It will support hill country farmers to become more versatile. As our most beautiful soils get gobbled up for urban living, hill country can become even more valuable and important in the scheme of the New Zealand primary sector. Opportunities may come from markets you don’t expect.”

Jenni also sees the social research undertaken as critical to the success of the programme.

“That included in-person interviews with over 300 stakeholders of which 169 were farmers, to actually ask them what they really need. What is the future of hill country, what is important to you, what support do you need, how are we going to encourage the next generation to be shepherds and equity owners and come back and work in partnership with their parents, how will Māori farming trusts inspire young Māori to continue to manage their land?

“A lot of that is intrinsic. It is about values and the passion hill country farmers have and the hard work they are prepared to put in. My passion and focus is for good governance and representing the rural voice – and it is vital to give a voice to those unique communities living out in the back of beyond.”

Passion is really the biggest resource we have in terms of the long-term future of the industry

Rita Batley from Moawhango in the Rangitikei district had been involved with several research programmes but says being part of the steering committee for the *Hill Country Futures Partnership* programme was a very different experience.

“I was initially sceptical about what I could contribute to the programme,” says Rita, whose husband Peter is a fourth generation sheep and beef farmer.

“I think I was asked to join because I have always been outspoken about hill country farming and promoting it - it has been my life for 37 years.”

“I have loved being on the committee. I have been involved with other research programmes but this has been different. It has a much broader scope to other programmes I have taken part in. It is multi-stranded and I find each strand interesting and compelling.

“At the start I was worried they would be disparate but now I see how all the projects tie together, it has become cohesive.”

The $8.1m *Hill Country Futures Partnership* programme is co-funded by Beef+Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand.

It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities. Research has been undertaken across 18 study sites.

Rita gained a degree in agricultural science and in her early career during the 1980s was involved as a field rep on the programme to get the first organic insecticide registered in New Zealand. She also taught maths and science at the local college but is currently focusing on establishing a small garlic growing enterprise.

Rita and Peter are fairly unusual in that they have never lived on farm, opting instead for life in the village about 19km from Taihape.

“It used to be the case that most people lived in the village here,” she says. “All the sheep would come through here to the woolsheds, but gradually people have built on farms. Our farm is twice as far to town, on metalled roads. We made the decision to stay here as we are nearer to facilities and it was easier for the children to walk to school when they were small.”

That is just one of many changes the Batleys have seen in hill country life.

“There are a lot of challenges for hill country farmers. A few years ago, my main concern was the threat of alternative proteins to sheep and beef farming. I’m still concerned about that but it has been overshadowed by carbon forestry and government policies.

“That is not to say I don’t agree with the need to change but trying to achieve carbon zero and remain financially viable will be impossible for farmers without a lot more tools in the toolbox. You can’t just keep taxing an industry because it hasn’t changed – farmers want to change but they don’t have the technology to do it.

“Our land is very challenging, we have virtually no flats. We are now Hawke’s Bay dry, we can’t farm the way we used to because the drop in rainfall means we are no longer summer safe, and we can’t crop, so what do you do?

“I was very interested in the Hill Country Futures programme around natives being grown on hills and assessing their forage values for grazing and their drought resistance. I would like to see further research around that.

“The advance of carbon farming and conversion of hill country for permanent forests is very worrying.

“It is frightening to see what is happening in large tracts of traditional hill country. Hill country farmers certainly aren’t in farming for the money. If they were, there would be no farms left, they would all be in carbon forestry.

“It’s a real passion that keeps people going and a long-term association with the land. I think that passion is really the biggest resource we have in terms of the long-term future of the industry.”

Four years ago, Rita became involved in a fledgling garlic growing enterprise, inspired by fellow local farmers Jacqui Cottrell and Sarah Wells.

Jacqui, also a member of the *Hill Country Futures Partnership* programme steering committee, and husband Dan farm sheep and beef on their land on the Napier-Taihape road. They have successfully established a quinoa-growing operation. Former TV reporter Sarah runs a sheep and beef farm with her husband Tom and is a founder of Hinterland Foods.

“They are two young women with great ideas, driving change in the community,” says Rita. “They said, ‘what can we do to diversify?’ I suggested garlic, which I’d grown for years and knew you didn’t need to irrigate, so Sarah bought 5,000 bulbs and we started growing it, initially in a patch on Sarah’s land.

With Jacqui and Sarah increasingly busy with their businesses, Rita took over the garlic operation, which has moved to a riverside area on the Batley's farm. Friend and permaculturist Vanessa Witt is now driving the venture forward.

"It's the fourth year now and it's been a steep learning curve," says Rita. "It's still in the establishment phase. We are doing it all organically. The first year I had to fight California Thistle and I'm hand weeding couch now. The growing area is a hugely infertile spot and garlic is a gross feeder but it's unbelievable what can be achieved. We rely heavily on cover crops and add humates and we use woolly dags on the pathways to suppress weeds and feed the soil.

"Vanessa is a powerhouse. She does all the bookwork and organises the sales and marketing and I do the donkey work. I really enjoy it. I was starting to think we should move away, to get away from the cluster flies and to somewhere that I could grow a lemon tree – we can't do that here, we get snow in winter. But the garlic has provided a new and interesting challenge.

"It's currently grown as 14 beds, 1.5m wide and 60 metres long. There's no money in it at the moment but we grew 25,000 bulbs in our most recent season and it sold out very quickly."

Garlic is now part of Rita's hill country story. One of the focuses of the *Hill Country Futures Partnership* programme is on telling the real stories around hill country farming. 170 interviews have been undertaken, talking to about 300 people, including 169 farmers.

"When I first joined the steering committee, I did think that strand of research was a bit 'pie in the sky,' says Rita.

"But I have come to realise, especially in this environment that has come from COVID-19, that there is real value in us telling our good stories. I recognise that as much more significant and worthwhile than I would have realised three years ago."

Programme looks to gather data to future-proof a traditional Kiwi way of life

Farmer Jacqui Cottrell has a background in agricultural science but she says the *Hill Country Futures* programme is "science like I've never seen it before in agriculture – a real focus on the glue that makes up agriculture – our people".

Jacqui and husband Dan's 600Ha sheep and beef farm 25 minutes from Taihape is a trial site for *Hill Country Futures*, a long-term $8.1m partnership programme, co-funded by Beef + Lamb New Zealand, the Ministry of Business,

Innovation and Employment (MBIE), Seed Force New Zealand and PGG Wrightson Seeds.

Hill Country Futures is focused on future-proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities. The programme differs from most pastoral-based research in that it considers the whole-farm system and, critically, the wider communities these systems exist within.

The programme incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

As part of the *Hill Country Futures* project, sensors have been installed on the Cottrell farm – and some neighbouring properties to map micro-indicators soil temperature and moisture in the hill country landscape.

As hill country farms typically have diverse landscapes within individual farms, there is a need to help farmers quantify key soil and terrain features of these landscapes to enable robust decision-making around the most suitable locations and potential benefits of introducing forage legumes into their hill country landscapes.

"This particular research project is very exciting," says Jacqui, who is a member of the *Hill Country Futures* steering group.

"Obviously there is a strong focus on the greater good of hill country farming, around further sustainability, productivity and profitability but what is even more exciting for me is the focus on human resource to help us as farmers identify our strengths and weaknesses and areas that we might improve."

Innovation is integral to the Cottrell's approach to farming. Jacqui is originally from Australia and she and Dan returned to New Zealand and Dan's parents' farm in 2015.

The farm is high altitude, with cold winters and short summers. It's 80 per cent sheep and 20 per cent cattle, plus a flourishing quinoa growing operation.

"The idea is to capture extensive data over the long term that will give us information to make decisions about the suitability of different cultivars and where to plant.

"Legumes are an efficient way to finish animals and get high quality dry matter, so you want to grow as much as you can. If we can identify the best areas to grow good legumes, why would you not be doing that?"

With three sons, aged six, four and one, Jacqui recognises that a challenge for farmers may be finding the time to grasp the benefits offered through research and innovation.

"I think that can be the biggest limitation, when you are on the ground, finding time to make use of all the information that's out there. We need good leadership – I think Beef + Lamb NZ is doing a good job of providing that – and to make use of the resources being made available.

"New Zealand has a great growing climate. I'm from Australia and summers are so hot but the climate here is incredible to grow things. We need to keep growing and

innovating and I'm really enjoying being part of a project that can help to shape the future of hill country farming.

"We are all for looking after the environment. We have put in a wetland, fenced our waterways and extended native planting. We have 26Ha of forestry but only on very steep slopes that were not performing.

"Higher prices are being paid for land for forestry than for sheep and beef and good undulating productive country being converted into trees is very worrying. *Hill Country Futures* can give farmers a boost in terms of performance and productivity and resilience."

Hill Country Futures Research Team

Keeping the hills alive

Who am I? Katherine Dixon is the co-founder of Nature Positive, a provider of research and advisory services for integrated nature and climate solutions, and a lead researcher for the Hill Country Futures Partnership Programme.

A thriving hill country farming sector is critical to New Zealand's economy and to our regional communities.

Hill country farms make up 70% of our pastoral area and farmers are making productive use of approximately 5.6 million hectares of land.

These farmers are producing the world's most sustainable beef and lamb with an environmental footprint far lower than many of our competitors.

However, hill country farming is also facing a series of unprecedented challenges.

Climate change, extreme weather events such as droughts and flooding, erosion and the growing threat of afforestation mean in many cases farmers are being forced to do more with less.

That's why it's more important than ever that our sector works hard to future proof the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities.

The $8.1m, five-year Hill Country Futures Partnership programme, co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand, is a research programme that is aiming to help us do exactly that.

Importantly, farmers themselves are at the heart of the programme and a core part of the research has been a series of 170 in-person interviews, asking farmers about the challenges and opportunities they face and their vision for the future.

Farmers' biggest concerns for the future were afforestation/carbon farming, rising costs and land prices and loss of communities.

They fear this will impact retirement plans, deter the next generation from farming and create decline in rural communities such as falling school rolls, social and sporting opportunities and farmer support networks.

One farmer told us his retirement plan had been to sell his farm but the only offers he had received were from pine companies.

He was delaying his retirement because he couldn't bear to see all his work destroyed.

Numerous farmers told us they wanted to be good environmental stewards.

They felt a strong responsibility to future generations and saw benefits for livestock, climate resilience, profitability, market access and personal enjoyment.

At the same time, we heard that there are obstacles in the way of best environmental practice.

Many farmers told us that they were struggling to keep up with requirements due to needing more time, funding and, in some cases, knowledge.

Some of the new regulations were perceived as impractical and there was a lot of uncertainty about environmental investment, with many farmers wanting more local examples to follow.

Farm ownership and the next generation of farmers was a common point of discussion.

The average age of hill country farmers is increasing and, at the same time, family succession is becoming more complex and difficult.

Inheritance and splitting the value of property between siblings can be challenging.

Farmers told us how succession planning is now compounded by rising land prices, land-use competition, high debt levels, lowering profitability and increasing regulatory costs, which are all making farming "less appealing".

A common opinion in the hill country farming sector is that diversifying businesses and land use may provide a pathway to reducing some of this uncertainty and building a more stable future.

We sought farmers' views on this and found a mixed bag.

Many farmers are attracted to the idea of economic diversification, seeing it as a way to spread risk, enable more ecologically-sustainable land use and benefit communities and create employment.

However, there are barriers to putting this into practice ranging from concerns about time required, geographic constraints, market difficulties, access to labour and a lack support to take such steps.

More than a quarter of the farmers interviewed raised the topic of regenerative agriculture unprompted.

There was a sense that it could align with personal values, create new market opportunities and fit with new regulatory requirements.

Peer to peer learning was cited as an attraction of regenerative agriculture, with a community already building and knowledge being shared through grassroots farmer-led workshops, field days and online discussions.

However, many also had reservations and wanted to see more scientific evidence that it would work in the New Zealand setting.

Overall, the key hopes for the future were to achieve sustainable environmental stewardship, to achieve ownership and financial goals and to enable rural communities to be able to thrive.

Farmers see “rural and urban” working together as important to achieving these goals.

They are seeking opportunities to share the stories of the good work being done; they want to have a direct input into decisions about their future and to help develop a feasible roadmap for the future of sheep and beef farming.

Pasture planning tools available soon

Innovative tools to support farmers and farm consultants in pasture planning are expected to become available this year as part of the *Hill Country Futures* Programme.

Lincoln University’s Professor Derrick Moot, who is leading several of the research areas that make up the programme, said findings from a number of projects are now being written up.

These include a simple model to help farmers forecast potential yields of lucerne for their properties, a national database of pasture growth data, and legume production data to help farmers assess the difference in productivity they could achieve by replacing resident pasture with improved pasture.

Hill Country Futures is a long-term $8.1m partnership programme, co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment (MBIE), Seed Force New Zealand and PGG Wrightson Seeds.

It's focused on future-proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities. The programme differs from most pastoral-based research in that it considers the whole-farm system and, critically, the wider communities these systems exist within.

The programme incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

"The programme is made up of a number of separate workstreams but they are all interconnected and working towards the same goals," says Derrick.

"The goals are to help answer the common questions *"what plant, where and why?"* – because choosing the optimal forage can improve animal productivity, animal welfare, biodiversity and soil health, while also mitigating soil erosion and climate change."

Modelling Legume Yield

The Modelling Legume Yield project draws on 20 years of lucerne, soil and water data from Lincoln University, along with on-farm experiments.

It aims to answer questions around legume forages' impact on production, environment, climate change, nutrient leaching and carbon sequestration. Two models are being developed, one for use by agribusiness professionals, policy-makers and researchers and the second for use by farmers.

"When you develop a model, you can develop a sophisticated one to work out how much a crop grows in a day," says Derrick.

"To do that, you need to know everything about the plant, such as how much sun it captures, how much water is available and nitrogen used and so on.

"You need that sort of model to do scenario testing. Part of our research, in collaboration with Plant & Food Research Ltd, has been taking the Lincoln data and putting it into a sophisticated model. This model can provide answers to big questions with great precision and accuracy. It will mainly be used by the science community and agricultural consultants to answer questions around agriculture and the environment.

"However, we are also doing a test between this model and a simpler model that could be used by farmers for predicting lucerne yield on their farms. The simple model based on mean air temperatures has been published and the comparison of results of the sophisticated model will be submitted for publication by the end of the year."

National AgYields Database

For any model to work you need good data. A spin-off from the model development has been the creation of the National AgYields Database. This project, co-funded by

the T.R. Ellett Agricultural Trust, aims to collate all existing pasture data information for New Zealand into a national database, which anyone can access to source information or upload pasture data into.

“New Zealand has collected a lot of pasture production data from all over the country over the past 50 years,” says Derrick.

“However, it is scattered – some is in notebooks, some in records on people’s bookshelves, some people have retired and taken that information with them.

“We thought, as a public good exercise, we should develop a readily available open database of pasture and crop yields from throughout New Zealand, where anyone can put in pasture growth rates data they have measured.”

The database has already gone live at www.agyields.co.nz/home

“It is likely to be used by consultants and people planning feed budgets,” says Derrick. “Initially, it is expected most of the data uploaded will be already published material. We will be encouraging the Ministry for Primary Industries, the science community and seed companies to add their data. But we expect it to build over time and become steadily more useful as more information is added.

“I have been talking to farmers for many years about growing red clover, lucerne and so on. They often say ‘we’d like to but don’t know how much it would grow or when in my environment’. Ultimately, the AgYields tool will enable them to see how it has grown in a location close to their farm.”

Legume Production Map

The third project is quantifying Legume Production Data, which aims to inform decision-making on farms, including around legumes, by alerting farmers to their options, as well as the risks associated with using different pasture species.

New Zealand’s diverse landscapes, climatic conditions and farm systems can make it difficult to decide which legume to grow where, including when considering nitrogen-fixing properties. The aim of the project is to help farmers match their property’s different land management units with the appropriate legume.

The data will complement the AgYields database, by providing legume production curves for different regions. Farmers will be able to match their property’s different land management units with the appropriate legume.

“We are comparing production from legume dominant pastures such as lucerne, or red clover with chicory or plantain to resident or unimproved pasture on the same farms,” says Derrick.

“The aim is to see the size difference you can get from using an improved pasture in a system. For instance, we have data for a pasture where lucerne produced 14 tonnes of dry matter, compared to five tonnes from the resident pasture. Another, in spring drought conditions in Banks Peninsula, saw lucerne produce 10 tonnes of dry matter, compared to 3.4 tonnes from resident pasture.

“We are gathering the kind of evidence needed to help answer that common question from farmers, ‘how much will that pasture grow here?’ We will write the data up for formal publication but also upload it all to the AgYields database, so anyone can access it.

“This data will be immediately useful for farmers to compare resident and new pastures. This is an exciting area for future development so we are also producing videos of “How to” for farmers who may want to measure their own pasture growth rate data and load it into the National Database.

Mapping hill country

New tools being developed through one of the Hill Country Futures programme aim to help farmers better manage sustainability and production across diverse landscapes within their farms.

The micro-scale indicators project, led by Dr Nathan Odgers of Manaaki Whenua – Landcare Research, is running trials across two South Island and four North Island farms, measuring scale indicators – soil temperature and moisture.

This project recognises that hill country farms consist of diverse landscapes. It is designed to enable farmers to use farm scale mapping to assess which forage mixes are likely to do well in specific areas of their farm.

Hill Country Futures is a long-term $8.1m partnership programme focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities.

It is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment (MBIE), Seed Force New Zealand and PGG Wrightson Seeds.

“Ultimately, it is hoped the project will support farmers to monitor soil temperature and moisture, to make more effective decisions, leading to improved economic, environmental and social outcomes,” says Nathan.

“It is known that soil conditions vary across landscapes and across farms, and therefore plant conditions vary.

“We are aiming to better quantify that. For instance, if we can say, ‘this north facing slope at the back of this farm will perform differently to its south facing slope,’ then you can use different management approaches to measure your sustainability and production.

“It’s all about producing evidence to help farmers farm more sustainably and precisely than they could if they did not have farm scale mapping.”

The project has been underway for two years and includes setting up wireless sensor networks on the farms, each with 20 sensors. For the past 12 months, these have been monitoring the soil temperature and moisture hourly.

“We are using that data to see how it relates to things like the aspect of a slope to see if we can map those soil properties across the farm and link that farm scale information to a crop growth model.

“We are trying to predict growth of legumes over time. If we can do that at farm scale, we can provide farmers with useful information around growth rates and how they differ, depending on landscape characteristics, and model a map that provides information to help them to manage production more effectively within their farm.”

The project is now at the modelling stage, with results expected by spring 2022.

“We hope that in 12 months’ time we will have a portal to share this data in real time,” says Nathan. “We are looking at what tools we can build to enable farmers to access and interpret the data we are collecting.”

Multiple benefits of native planting on farms

Multiple potential benefits from planting native shrubs for use as sheep fodder are being researched as part of the *Hill Country Futures* Programme.

The project, led by Dr James Millner, Academic Dean – Agriculture, at Massey University, was launched in 2019. It currently has three trial sites for a range of native shrubs, looking at palatability, digestibility, protein content and other nutritional characteristics as well as the Mātauranga Māori (Māori knowledge) for a range of species.

Hill Country Futures is a long-term $8.1m programme focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities.

Overall research focuses include improving animal productivity, animal welfare, biodiversity and soil health, while mitigating soil erosion and climate change.

Dr Millner says the programme is assessing the productivity and seasonal growth patterns of indigenous species potentially useful as occasional ‘browse species’.

These are Houhere (*Hoheria populnea*), Pāpāuma (*Griselinia littoralis*), Karo (*Pittosporum crassifolium*), Karamū (*Coprosma robusta*), Whauwhaupaku (*Pseudopanax arboreus*), Māhoe (*Melicytus ramiflorus*) and Taupata (*Coprosma repens*).

The non-native *Salix kinuyanagi*, a browse willow, has also been included and can be compared with the natives.

“Culturally, native shrub species have long histories and the team is building that knowledge into this project.

“We are interested in giving hill country farmers as many options as possible and are specifically looking at the potential of native shrubs as forage in hill country.

“Farmers with steep erosion-prone land may be interested in getting it into woody vegetation. *Pinus radiata* is one option commonly used but not everyone wants to be a forester. Transport and harvesting in steep areas is also expensive so it may not be economically feasible.

“There are potential economic benefits to planting native shrubs, along with enhanced diversity, improved water quality and reduced erosion. We are looking at the additional potential benefits for forage and for grazing sheep around the shrubs.”

The native shrubs selected are known to be heavily browsed in areas where there are deer and goats, suggesting they would be palatable to sheep.

“We are also looking into nutritional traits,” says James.

“For instance, the protein content and any tannins that can affect how protein is digested, and if there are any anthelmintic - natural anti-parasite – qualities, as there is evidence some shrubs have that effect.

“We are also looking at what happens during *in vitro* digestion to see how much methane and CO_2 is produced in the rumen.”

Currently, the project has three hill country trial sites on farms, two in the Manawatu and one on the Mahia Peninsula.

“We have discovered that the foliage of the shrubs is pretty digestible and we don’t think there will be any problem with sheep browsing on it,” says James.

“It is a bit low in protein, so not good for long-term feed or for young animals that farmers are needing to grow quickly but there would be no problem at all with short term maintenance feeding.

“In summer, it could provide a short-term food resource to fall back on when dry and shelter, particularly after shearing – alongside the environmental and economic benefits.”

Research into anthelmintic work is due to start soon. Food preference trials are due to get started in the autumn and full feeding trials in spring 2022. That will be followed by feeding trials.

“The sheep food preference trials will involve us offering standard feeds like lucerne chaff as well as leaves from the shrubs to see if the sheep will voluntarily eat them,” says James.

“We’ll take data from that as the basis for a proper feeding trial and measure dry matter in and dry matter out.

“Ultimately, we want to grow some shrubs in paddocks with sheep, however this will be subject to approval by an animal ethics committee.”

James says the main disincentive to planting hill country with native shrubs would be the cost – at $3-$5 per shrub, plus the cost of planting out and initial weed control. This would need to be weighed against the potential benefits, including income carbon credits.

“The initial outlay can be > $10,000/ha limiting widespread uptake unless assistance from central or regional government was available.

“Our aim is to provide robust information that can give farmers, their bankers and others the information they need to have confidence that it is a good thing to do, so they can weigh up the cost and the benefits.”

Research programme identifying best areas for growing lucerne

Research undertaken through the *Hill Country Futures Partnership* programme has led to the development of national suitability maps showing where lucerne crops can be grown.

The research involved a collaboration between scientists from Plant & Food Research (PFR), Lincoln University, Manaaki Whenua-Landcare (MW-LC) and NIWA.

The maps, developed by a team led by senior scientist Dr Edmar Teixeira of Plant & Food Research, also provide an estimate of potential yields for lucerne crops across different regions.

Lucerne was used in the study with the aim of developing a method to identify other suitable legumes and growing areas in New Zealand, and factors that could affect yield. The goal now is to extend the programme to other legumes.

The $8.1m Hill Country Futures Partnership programme is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand.

The programme is focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities.

Dr Teixeira’s main research focus is biophysical processes in cropping systems. He uses biophysical modelling to simulate crop performance across different locations and time periods. The goal is to provide new insights to help manage cropping systems.

For this project, the team has been spatially simulating lucerne growth across climates and soils in New Zealand to map its suitability as a forage crop.

The research used historical daily weather data from NIWA and soil types from Manaaki Whenua-Landcare (MW-LC) using the Agricultural Production Systems

sIMulator (APSIM), co-developed by Plant & Food Research (PFR), to simulate crop growth.

“Forage legumes are important resources in New Zealand hill country and agricultural areas in general,” says Dr Teixeira. “They fix nitrogen from the atmosphere and provide a high quality feed for livestock – a combination of positive environmental and economic outcomes.”

“For farmers, it is important to know the potential of production of different legume crop options within a given region and understand how yields change under different climate, soil and management combinations.

“Our programme aimed to develop new methods to simulate yield potentials of legumes across New Zealand at large – landscape – scale. This knowledge creates benchmarks and helps identify main limiting factors and causes of yield gaps. Also, yield variability across many years can be assessed across environments with this method, which is a measure of risk of production.”

Lucerne crops were used as the team’s proof of concept because of the more abundant data for the crop available in New Zealand. This included developing the models and also running APSIM-lucerne within a spatial framework called ATLAS, developed at Plant & Food Research in a high performance computing environment.

“The method enables the team to link the agricultural models with long-term NIWA climate data at five kilometre resolution across NZ and also represent different soils, such as from the S-map digital soil database developed at MW-LC.

“In this specific application, we created a first set of national suitability and yield maps for lucerne, which show where lucerne crops can grow and provide an estimate of their potential productivity across different regions.”

The prototype created in the programme can now be used to ask specific questions through virtual experiments, such as the effects of changing defoliation management in different regions.

It also enables the team to explore crop responses to new climates – for instance, using NIWA climate change projections instead of historical climate – and it can also be expanded to represent other legume species.

Work is ongoing to test and improve the models.

“It is important to note that such models are simplified representations of reality and results must be interpreted accordingly, within the scope where they were developed,” said Dr Teixeira.

“Fit-for-purpose models can be seen as useful resources to extend our understanding beyond what empirical data provides. They are built upon field datasets which have to continue to be collected with high quality to help testing and improving models in the future.”

Producing outcomes for farmers

"I'm very excited about the *Hill Country Futures Partnership* Programme because it is fully directed at producing outcomes for farmers," says PhD student Laura Keenan. "For me as a farmer, that is incredibly important, particularly the key link between science and practical application in the field."

The five year $8.1m *Hill Country Futures Partnership* programme is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand. It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities.

Ms Keenan is undertaking research for the programme for her full-time PhD studies through Lincoln University, looking at *Farm systems impacts of satellite farming with improved forages in New Zealand sheep and beef.*

She combines her research with doing environmental consultancy work and working with her partner on his family's mixed cropping and lamb trading farm in the Manawatu.

"I learned about the programme through Professor Derrick Moot, who I have known since my undergraduate days at Lincoln," she says.

"I'm investigating how red and white clover and plantain can change the feed supply of sheep and beef farms. The focus is very farmer oriented and aimed at providing lots of context for farmers around alternative forages, particularly legumes and the fit that they can have in individual farm environments."

Ms Keenan worked for a seed company for over five years, before starting her PhD studies. She is on the board of the NZ Institute of Primary Industry Management and the executive of the NZ Grassland Association and aims to publish her research outcomes through the association's journal.

A key aspect of her research is assessing the opportunities of increasing and improving forage growth on unimproved land. If successful, this would enable growth of an extra 7.15 tonnes of dry matter on five per cent of New Zealand's sheep and beef farmland – a total of 440,000 hectares. If that could be achieved, it would have the potential to add an extra $312m to the NZ economy.

"My project is using a combination of field-collected and historical data to develop equations to predict the growth of these species in response to temperature and moisture," she says.

“The aim is to provide robust information that can be used on-farm for feed planning in the sheep and beef sector. The emphasis is on determining how specialist pastures can aid the overall production and profitability of sheep and beef farms.”

Decades of weather data could support better farm planning

Twenty-five years of weather data from a central Otago farm is being analysed to see if it could help farmers plan better around temperature and moisture variations across different altitudes and aspects.

The pilot programme, led by Professor Derrick Moot of Lincoln University, is one of multiple work strands underway as part of the *Hill Country Futures Partnership* programme, a five-year programme co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand.

The $8.1m programme is focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities. It differs from most pastoral-based research in that it considers the whole-farm system and, critically, the wider communities these systems exist within.

Professor Moot said the decades of data from Lincoln’s Mt Grand station, near *Lake Hāwea,* will be compared to that from NIWA’s Virtual Climate Network.

“Lincoln has had weather stations at Mt Grand for 25 years, recording temperature and rainfall at three different altitudes. It is easy to predict what is happening on flat land but most of New Zealand is hill country and there is lots of local change, through aspect and altitude or north or south facing slopes.

“NIWA gets its information from weather stations but also has a virtual network with the climate for the whole of New Zealand. What we want to see is how well the predictions from that match the data from our weather stations.

“Stations at the bottom of the valley do not pick up the difference between sunny and shady slopes so we are trying to quantify the difference in temperature and moisture across different altitudes and aspects and ultimately to help farmers plan better.”

NIWA’s Virtual Climate Station Network (VCSN) data are estimates of rainfall, air and vapour pressure, relative humidity, solar radiator, wind speed, soil moisture and evapotranspiration – the processes by which water moves from the Earth’s surface into the atmosphere. These are set out on a regular 5km grid covering the whole of

New Zealand. The estimates are produced daily based on spatial analysis of data observations from NIWA's nationwide network of climate stations.

"We are looking to see how big the difference is and how much of a difference it makes, and whether we could use NIWA's virtual network," says Professor Moot. "This is just a pilot, not a solution, but we have the opportunity to do this with the dataset we have available."

Many of the *Hill Country Futures Partnership* programmes overlap and complement one another and Professor Moot said the Mt Grand data pilot will feed into research being led by Dr Nathan Odgers of Manaaki Whenua Landcare Research, to map micro-indicators - soil temperature and moisture - in the hill country landscape and use this data to support and link to the forage models being developed in other parts of the programme.

As hill country farms typically have diverse landscapes within individual farms, there is a need to help farmers quantify key soil and terrain features of these landscapes, such as soil temperature and moisture dynamics. This work will enable robust decision-making for farmers around the most suitable locations and potential benefits of introducing forage legumes into their hill country landscapes. Data acquisition of micro-indicators from six farm test sites is ongoing and is being monitored in near real time.

Native shrubs in the hill country

"There is currently little scientific research into the potential for using native shrubs on erosion-prone pastoral land," says Massey University PhD student Joan Ropiha.

"The work being undertaken at Massey, as part of the Hill Country Futures Partnership programme, looks at the potential of native shrubs to contribute to environmental and biodiversity enhancement and also as supplementary fodder for sheep and cattle."

The five year $8.1m Hill Country Futures Partnership programme is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand. It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities.

Joan is one of two PhD students and two Masters students from Massey University undertaking research for the programme.

This includes assessing the potential of specific native shrubs and trees – Papauma (Griselinia littoralis), Taupata (Coprosoma repens) and Māhoe (whiteywood) - for

planting in steep erosion-prone hill country. Approximately 4,000 of these have been planted at the university's Tuapaka hill country farm.

A kaupapa Māori approach to methodology recognises the intrinsic interests of Māori and provides for the cultural and scientific aspirations of the study.

Joan, who is based in Mahia, already has Masters degrees in both Environmental Studies and Māori Studies and has knowledge in the practice of rongoā (traditional Māori medicine) and horticulture within the wider field of Māori cultural and environmental heritage.

Her role in the programme includes clarifying the mātauranga (knowledge) about the native shrub species in the study and the associated tikanga (customs and values) of their use, particularly kaitiakitanga (guardianship of the land).

"Currently, the main alternative to erosion-prone pastoral land is pine forests or manuka plantations for honey," says Joan.

"The research looks at the potential alternatives of planting native shrubs on steep erosion-prone land. That would enable the land to continue in pastoral use, with the possibility of farmers also being able to claim carbon credits.

"However, there is a gap in the literature around this. We know of native shrubs that are palatable for feral deer and that plantations and closed canopies of tall woody trees reduce landslips in storms by 70-90 per cent, and that certain native shrubs have potential for environmental and biodiversity values. But we do not have enough robust information on the impact of native shrubs on erosion of pastoral land.

"It is very costly to plant native plants in hill country – so farmers need very robust scientific evidence to inform their decisions around planting."

Joan's research includes interviewing Wairoa hill country farmers about their views on the use of native shrubs on erosion-prone pastoral land, developing a case study and running wānanga for marae communities about mātauranga around the shrubs and hill country vegetation. She is also monitoring the nutritive value of mature Papauma, Taupata and Māhoe as a potential supplementary fodder.

"Massey's research is around these native shrubs in hill country and I bring the traditional Māori aspect of that to the table.

"Hill country is also ancestral landscapes. About seventy per cent of Māori titled land is in hill country farming but there is still little data of Māori in farming - so I am also interested in traditional Māori knowledge of these native plants.

"The lakes and rivers in the community I live in are affected by farming. I have worked with local hapū around their concerns about silt coming down the waterways from hill country farms.

"Northern Hawke's Bay and the East Coast have the worst erosion in the country and I realised we didn't have that scientific bridge between what communities know about the impact of hill country farming on the landscape and the decision-making behind it."

Using science to identify forage value

A scientific method already used widely across medicine and forensic science could provide a fast and cost effective way for New Zealand farmers to identify the nutritional value of native forage and exotic forage.

Massey University Masters student Gregory Coleman is researching the effectiveness of Attenuated Total Reflectance Fourier Transform Infrared (ATR-FT-IR) spectroscopy to enable farmers to accurately analyse nutrients in shrubs and trees.

His research is one of the many trials and studies underway through the *Hill Country Futures Partnership programme (HCF).*

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It incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

One aspect of the research is to gather robust scientific evidence on the potential of native shrubs and trees in steep erosion-prone hill country. This will help inform farmers' decisions around planting.

Potentially, native shrubs could be used to help retain erosion-prone land, enable farmers to claim carbon credits while still also using the land for grazing, and provide a complementary forage for sheep and cattle. Feral deer are known to graze on certain native shrubs and the research will assess the suitability of these for livestock.

Gregory's role in the programme is to help identify a faster and more cost-effective process for farmers to test nutritive qualities of the native shrubs.

"There are two other methods which are commonly used to analyse the nutritive content of plants but these can cost up to $200 per sample," he said. "ATR-FT-IR chemometrics method is much cheaper and faster. It has already been used to

analyse pasture species in New Zealand, but this is the first time it has been applied to native New Zealand plants, so it's a chemistry first."

Griselinia, Coprosma, Pittosporum, Horeria, Mahoe and Pseudopanax are being used in the trial. Samples are freeze dried and then ground up, with only a tiny amount needed for analysis.

The samples are first analysed for their nutrient content in the lab by wet chemistry, then they are scanned with the ATR-FT-IR equipment. Both the wet chemistry data and the scanned are then used to develop calibration equation for the different nutrients.

"This has the potential to be a faster, cheaper and better predictive method for farmers than the alternatives previously used," says Gregory.

"Farmers could send a sample of their crop to the lab to be freeze-dried, ground up and then run through the ATR-FT-IR equipment. Based on the calibration equations developed in this project a table with the nutrient content of the sample will be provided to the farmer.

"We have a good system in place and we now need to explore more analysis methods to ensure we have the most accurate calibration to use for the predictions.

"If it proves as reliable as the other two methods, the benefit for farmers will be a cheaper, faster method of analysing forage crops on their land. At a later stage of the project we will be trialling using fresh samples, rather than freeze-dried, which will mean farmers could get results even faster."

Gregory was born in the UK – where he developed an interest in agriculture through visits to a family farm – before moving to New Zealand in 2014. He graduated from Massey in 2021 with a BSc, major in chemistry and minor in earth science. He is due to complete his Masters research in June this year.

"I'm finding it really interesting applying chemistry to potentially help hill country farmers," he says. "It's very satisfying. There's the biodiversity side, getting natives back on slopes and using New Zealand shrubs and trees as an alternative to imported plants like pines; There's the potential to help address erosion and also provide an alternative forage. All that could be very good for hill country farms."

Articles

Legumes under the spotlight for Hill Country Futures Programme

Take home messages

- Legumes have the potential to transform hill country farming businesses while protecting vulnerable landscapes.
- Address nutrient deficiencies to allow legumes to photosynthesize and fix nitrogen.
- Correct management of sub clover is critical to maximise its productive potential in early spring.
- Talk to seed agents about the cultivars most suited to individual farm environments and systems.
- Satellite farms within hill country can have significant production and environmental advantages.
- Rotationally graze as soon as possible after lambing to help drive pre-weaning growth rates.

Legumes are the powerhouse of pastoral farming systems, and with the correct management, have the potential to transform farm businesses while protecting fragile hill country landscapes.

Capturing the power of legumes was the subject of a recent *Hill Country Futures*' and Luisetti Seeds' field day, which shone a spotlight on how legumes can be used both on hill country and finishing country to drive economic and environmental efficiencies.

The *Hill Country Futures Partnership* programme is a five-year project co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand. The programme is focused on future-proofing the profitability, sustainability and well-being of New Zealand's hill country farmers, farm systems and rural communities.

Within the programme, there are four research areas – all contributing towards the overall objective of future proofing New Zealand's hill country farms and rural communities.

Mt Benger, a 2810ha hill country farm in North Canterbury's Hurunui District hosted the field day and is typical of many east coast commercial breeding operations where the focus is on maximising the number of lambs sold prime at the weaning draft.

This not only has financial benefits, but it also reduces the amount of methane produced by the lamb crop, takes pressure off hill country landscapes and allows summer feed to be partitioned back into the ewes so they are at optimum body condition going into mating.

Mt Benger, like much of this country's hill country, has subterranean clover as an endemic pasture species within the sward. This is a legacy of the 1950s and 60s when sub clover (usually Mt Barker) was flown onto hill country in the early days of aerial topdressing.

What was lacking was an understanding of how to manage this clover so that it would create a bank of feed in early spring to drive lactation and maximise pre-weaning growth rates.

Ten years ago, the management team on Mt Benger looked to augment existing sub clover with new varieties in a 25ha block known as Alice's block.

Sub-divided from a larger 236ha block, Alice's block was thick with matagouri and growing Danthonia and browntop. Small amounts of native suckling and striated clovers hinted at this block's ability to grow legumes.

In 2011/12, the woody vegetation was cleared and lime was applied. A mix of rape (at 3kg/ha) and Woogenellup (3kg/ha) sub clover was flown on along with 150kg/ha of Sulphur Super in the first week of February. The area was then harrowed.

Steers grazed the block over winter and in spring it was shut up to allow the clover to set-seed. In January 2013 it was grazed by cattle to open up the sward before being lightly disced to chop up re-growth rape. The following month, Porto Cocksfoot (5kg/ha), Ruanui ryegrass (10kg/ha), Antas sub clover (5kg/ha), Monti sub clover (5kg/ha), Huia white clover (3kg/ha) and plantain (1.5kg/ha) was flown on.

The results were and continue to be impressive.

In that year, the block was grazed by 500 ewe lambs from early May to early June and set-stocked with 100 twin-bearing ewes from the end of July.

Alice's block is now rotationally grazed by ewes and lambs post-tailing to try and maximise pre-weaning growth rates and the weaning draft. It is typically shut up in autumn to allow pasture covers to build for spring.

Speaking at the field day, Lincoln University-based plant scientist Professor Derrick Moot described the mix of sub clover and cocksfoot as an ideal dryland pasture mix.

The space between the drought-tolerant cocksfoot allows the clover to flourish without competition, while the clover supplies the cocksfoot with nitrogen, keeping the plant growing and palatable.

The success of sub clover on this block has highlighted the potential of legumes in the hill country and now, under a new management team, the focus is on applying the same principles to other parts of the farm.

Nutrients needed for nitrogen fixation.

Professor Derrick Moot says for sheep and beef farmers to continue to drive production efficiencies and continue to reduce their environmental footprint, they need to recognise the resources they have on their farms and utilise them to grow animals quickly.

To do this, they need to get nitrogen into their system to address the perennial issue of nitrogen deficiency. Legumes do this in the most efficient, cheapest and environmentally sustainable way possible.

In order to fix nitrogen, legumes need moderate levels of sulphur and phosphorous – the latter for photosynthesis and nitrogen fixation – along with pH levels of around 5.7.

Molybdenum is also needed for nitrogen fixation.

Speaking at the field day, soil scientist Jeff Moreton, says some soils, especially those in lower rainfall areas, rolling downs or hills lack molybdenum. He recommends testing every four or five years and correcting deficiencies with 50gm/ha.

Testing for molybdenum deficiency is difficult and is the subject of a trial being carried out at 21 test sites on dryland east coast hill country.

Introducing sub clover to hill country pastures

Lincoln University's plant scientist Dick Lucas says September is the best time to assess the presence of sub clover in pastures by looking out for sub clover's idiosyncratic white flowers.

Striding up a hill, Dick told farmers that if they step on a clover patch every second step (about every two metres) then, with the correct management, there is enough clover to drive livestock production.

Any less than this and he recommends either over-sowing or drilling with more than one cultivar of sub clover, the following autumn. A mix of large and smaller leaf varieties is ideal – along with a mix of flowering dates.

Cultivar suitability also depends on the environment, so Dick suggests that farmers talk to their seed agents and order the seed early.

To increase sub clover populations, the area identified should be spelled from mid-September or grazed with cattle to keep grass under control for up to eight weeks. This will allow seed-set.

Once the sub clovers runners have "pegged" their seed (test by giving the runner a gentle tug) the area can be grazed down by cattle only. Sheep will target the sub clover runners and eat the seeds.

Over summer, the block can be grazed to reduce pasture mass. Autumn rain of more than 20mm will trigger germination after which the area should be spelled to allow the seedlings to reach the 3-4 trifoliate leaf stage. The block can then be lightly grazed, preferably by cattle to control grass competition. In winter, it is recommended that the area is grazed to 1200kg DM/ha and in spring, the sub clover will produce a bank of high-quality feed for lactating ewes and lambs.

Satellite farming

Alice's block on Mt Benger is a good example of the potential of "satellite farming" on hill country. These are intensively managed smaller farmlets within larger, more extensive blocks.

Appropriate areas are identified for more intensive development and once fenced off, these are typically used for maximising pre-weaning growth rates in lambs or for growing out cattle.

These satellite farms take pressure off the hill country landscapes and allow these areas to recover and build pasture covers during spring and early summer which can then be used to increase the body condition of breeding stock over summer and autumn.

By giving livestock the opportunity to realise their genetic potential, these satellite areas drive profitability and the cost of the development is then disseminated over the whole area. Professor Moot commented that this concept is an extension of successful satellite areas of lucerne and red clover being used on small cultivatable areas that then support the hill areas around them.

Further sub-division of Mt Benger's hill country is planned along with the development of 500-600ha hill country pastures. Manager Stuart Fraser intends developing around 100ha annually, into sub clover and improved grass pastures.

Peter Anderson

Former StockCare vet Pete Anderson enthuses about legumes.

"I'm a great fan of legumes because farmers who are using legumes, are getting the best results."

When analysing stock performance through StockCare programmes, they found lambs on dryland properties in Marlborough and North Canterbury were growing faster than anywhere else in the country. The reason was the sub clover in their pastures.

"I have since been a convert."

He says the only true measure of sheep production is the kilograms of lambs weaned per kilogram of ewes mated. This figure is driven by the lambing percentage and weaning weight.

Weaning weight is driven by age and lamb growth rates and lamb growth rates are driven by the availability of high-quality forage, particularly legumes.

"Since we started to learn how to manage sub clover, we have seen some huge changes on hill country properties, simply by changing management."

Peter cited examples of four hill or high-country farms, Tempello near Blenheim, Bonavaree near Seddon, Dumgree in Marlborough and Bog Roy in Omarama whose businesses have been transformed by harnessing the power of legumes.

Within four years of learning how to manage sub clover, the lambing percentage in Tempello's Corriedale ewes increased by 33% to close to 150% and lamb growth rates lifted by 142g/day to just under 400gms/day.

As well as learning how to manage sub clover to harness, Tempello's owners got their ewes and lambs on a rotation as soon as possible before tailing, and this has been critical to driving pre-weaning growth rates,

Bog Roy started using grazing lucerne, rather than just using it as a supplementary feed, and this has proved transformative.

Peter says the main change on Bog Roy was the lift in ewe condition. This has pushed lambing percentages to over 140% in their Merino ewes and allowed them to mate their hoggets. It has also taken pressure of the hill country while allowing them to carry an extra 900 ewes.

He says the three key principles to utilizing legumes is resting lambing blocks to allow sub clovers to build prior to set-stocking, to start rotational grazing as soon as possible after lambing and sub-division to enable better pasture management.

Capturing the power of legumes

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In 2011/12, the block went through a transformation process cumulating in the establishment of a cocksfoot and sub clover pasture in the autumn of 2013. The sub clovers included Antas and Monti to give a range of leaf sizes and flowering dates.

The results were and continue to be impressive.

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The success of sub clover on this block has highlighted the potential of legumes in the hill country and now, under a new management team, the focus is on applying the same principals to other parts of the farm.

Satellite farming

Alice's block on Mt Benger is a good example of the potential of "satellite farming" on hill country. These are intensively managed smaller farmlets within larger, more extensive blocks.

Appropriate areas are identified for more intensive development and once fenced off, these are typically used for maximising pre-weaning growth rates in lambs or for growing out cattle.

These satellite farms take pressure off the hill country landscapes and allow these areas to recover and build pasture covers during spring and early summer which can then be used to increase the body condition of breeding stock over summer and autumn.

By giving livestock the opportunity to realise their genetic potential, these satellite areas drive profitability and the cost of the development is then disseminated over the whole area. Professor Moot commented that this concept is an extension of successful satellite areas of lucerne and red clover being used on small cultivatable areas that then support the hill areas around them.

Further sub-division of Mt Benger's hill country is planned along with the development of 500-600ha hill country pastures. Manager Stuart Fraser intends developing around 100ha annually, into sub clover and improved grass pastures.

Addressing the issue of over grazing pasture

'Over-grazing' is a problem for farmers, but "rescuing" pasture through deferred grazing isn't the answer, according to research for the *Hill Country Futures* Partnership programme.

Professor Derrick Moot of Lincoln University, who is leading several of the research projects for Hill *Country Futures*, is recommending farmers move to rotational grazing as soon as practical and minimise set-stocking to ensure pasture doesn't become depleted in the first place.

The *Hill Country Futures* project is focused on the benefits of using legumes such as lucerne to overcome nitrogen deficiency in hill country farming. Researchers are measuring the response of pasture species and legumes to their environment with the aim of giving farmers confidence to invest in appropriate legume-base pastures for hill country areas – boosting yield.

The $8.1m *Hill Country Futures Partnership* programme is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand. It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities.

"I recognised that we will be telling hill country farmers about the best forages to use in particular places," said Professor Moot. "That will see five to ten per cent of a property being put into specialist crops but to really see benefits you also need to be getting the other 90 per cent right.

"Farmers will also often say the new cultivars are not persistent but a major part of pasture persistence is grazing management."

Professor Moot saw that a review of grazing management would fit with a key research theme of the programme, looking at biodiversity in forage landscapes. He presented his review paper on this at the Resilient Pastures Symposium in 2021.

“We are seeing a lot of people now advocating for deferred grazing and leaving pasture to get long to allow roots to recover.

“They are getting successes – that is because pastures have previously been overgrazed and by doing so, they are not as resilient and so vulnerable to drought and pests.

“When a plant is grazed, you remove the green leaf, just like when you mow a lawn. To replace that leaf, the plant has to use its reserves, from above ground and from its roots. If we graze a plant too frequently, we reduce its reserves.

“The answer is for farmers to move to a rotational graze as soon as they can in the year, to give the pasture plants a chance to recover root reserves between grazing events and also to grow more feed. If you manage pasture appropriately, then there is no need to go to that state of deferring grazing or letting grass grow long and producing low quality tag.”

To achieve healthy sustainable pastures, Professor Moot says it is also critical to understand the biology of the plant you are using.

“For instance, if using ryegrass, you need to know that it needs to have three green leaves before you graze it. If you don’t do that, you deplete the reserves and if you do it more than once, the problem is compounded. Ryegrass is the most sensitive of our pastures grasses to mismanagement.”

Professor Moot says the leaf is the ‘solar panel of the plant’.

“It’s how the plant obtains carbon from the atmosphere, and if a plant is short of carbon, it tries to grow more leaves and doesn’t put carbon into its roots so the roots get weaker. If you keep grazing or cutting, it is constantly trying to catch up and grow new leaf and its root biomass will decline.

“The opposite happens if the plant is short of nitrogen or water. It reduces its leaf areas and puts more of the carbon into its roots. So as soon as you get a dry pasture, the plant grows more roots and stops growing leaves.

“These are the two stress responses and if you still keep grazing it, you put more and more pressure on the plants. It’s a double whammy of reduced leaf area and weakened roots. Set stocking results in constantly removing leaves and depletes the plant’s reserves.

“A golf course is a very good example of the most intensive grazing management possible – it is cut every few days. It has to be continually provided with nitrogen and water because the plants have got such weak root systems they can no longer forage for it.

“Take the example of St Andrew’s in Scotland, the oldest golf course in the world. The grass there is dominated by Browntop, which is also our most common grass in hill country. The reason it is dominant in both is that it copes with intensive defoliation either by a mower with an engine or a mouth and four legs, but Browntop is not a productive pasture plant.

“If we want to get rid of Browntop and introduce other forages, we have to recognise that we need to maximise rotational grazing and minimise set-stocking as much as possible.”

New national AgYields forage database launched

A new national forage database has been launched to help farmers and rural professionals make informed decisions around pasture planning.

AgYields is a central repository for all pasture and crop yield data and growth rate information collected in New Zealand. It allows farmers to see which pastures and crops have been grown in their districts and how much they grew so they can select more resilient pasture and crop systems.

Built by Professor Derrick Moot of Lincoln University, the software development of AgYields was funded by T R Ellett Trust and the populating of data by the *Hill Country Futures Partnership* programme.

Professor Moot said that AgYields will help farmers, rural professionals, students and scientists make key decisions around pasture planning.

“Measuring yield and growth rates for pastures and crops is vital for the prosperity of New Zealand’s agricultural sector.

“Currently, much of this data can be expensive to collect and it is stored across a range of electronic and physical platforms, making it difficult to access easily. For the first time, the AgYields website consolidates this data into a publicly accessible resource.

“In time, AgYields will also provide guidelines for standardising future data collection and enhancing New Zealand’s livestock and crop production systems.”

Mhairi Sutherland, programme leader for *Hill Country Futures*, an $8.1m programme co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand, says AgYields will be an important tool for hill country farmers.

“*Hill Country Futures* is focused on future proofing the profitability, sustainability and wellbeing of New Zealand’s hill country farmers, their farm systems, the environment and rural communities and AgYields will play an important role in helping us meet this goal.

“Individual farms need local data on different species to inform feed budgeting programmes and make appropriate species selections for different environments.

“Accessing data about a range of species will help farmers select appropriate species to address climate change challenges and work within environmental regulations.”

Dr Suzi Keeling, sector science strategy manager at Beef + Lamb New Zealand, says AgYields provides a valuable resource for farmers, researchers, and rural professionals.

“All too often, data is lost or forgotten. Having a central repository means better decisions and smarter use of future investments.”

The database includes both peer-reviewed published data, as well as unpublished data. It references data source, location, soil type, basic management practices and dominant species.

Scientists can link yield and flowering data with meteorological information. This will generate information for pasture growth forecasting and predicting the impacts of drought on growth and development to inform regional decision making.

Data is being collected from a number of research and farm locations and will be entered into the database.

Individuals and organisations are also being invited to contribute their data to enhance the utility of the repository.

Dr David Chapman and Dr Wendy Griffiths of DairyNZ and Dr Mike Dodd of AgResearch, have all been involved in the development of AgYields. It is among a range of new tools to support farmers and consultants that will be among the outcomes of the *Hill Country Futures Partnership.*

See www.agyields.co.nz

Network of study sites unearthing valuable information for hill country farmers

A network of study sites on hill country farms around New Zealand is now providing a wealth of information and research findings to help guide farmers around pasture forage decisions.

The 18 study sites, ranging from Lake Hawea in Central Otago to Waiakaia near Gisborne, were established through the *Hill Country Futures Partnership Programme*.

The $8.1m programme is co-funded by Beef + Lamb New Zealand, the Ministry of Business, Innovation and Employment, PGG Wrightson Seeds and Seed Force New Zealand. It is focused on future proofing the profitability, sustainability and wellbeing of New Zealand's hill country farmers, their farm systems, the environment and rural communities.

It incorporates traditional science research, farmer knowledge, social research and citizen science and has a strong emphasis on forages and providing decision-making tools to help farmers select the best forage option for different land management units.

Dr Suzi Keeling, Sector Science Strategy Manager for B+LNZ, provides scientific oversight for the programme and says a key focus has been resilient forages for the future. Researchers undertaking the work are from Lincoln University, Manaaki Whenua – Landcare Research and Massey University.

"The programme provided an opportunity to test different forage combinations in a number of research and commercial farms around New Zealand.

"Being able to do this in a range of different locations has ensured we have accommodated what farmers are really interested in, while also answering important science questions."

The 18 locations include 12 forage trial sites evaluating different combinations of forages. There are six sites capturing soil temperature and moisture data (some overlap with forage trial sites) and three focused on assessing native plants as potential forage.

"Through the forage trials, we are looking at how we support farmers to have resilient forages into the future.

"It is capturing real data on farms to make it tangible for farmers to see how forages perform in different locations. We are also building a large dataset to develop tools that farmers can use to help them select which forages are most ideal for their situation."

A further outcome of the programme has been the AgYields national forage database, a central repository for all pasture and crop yield data collected in New Zealand to help farmers and farm consultants with decision-making around pasture planning. Planned videos will include showing how farmers can set up their own monitoring on farm and then add their data to AgYields.

The soil temperature and moisture micro-scale indicator projects recognise that hill country farms are diverse landscapes. They are designed to enable farmers to use farm scale mapping to assess which forage mixes are likely to do well in specific areas of their farm.

Research around native shrubs looks at the potential of natives for sheep fodder, in terms of palatability, digestibility and protein characteristics. The focus is on improving animal productivity, animal welfare, biodiversity and soil health while mitigating soil erosion and climate change

“An important aspect of the programme is ensuring our investment is informed by good information,” says Suzi.

“That means farmers know what forages suit what soil types and environments, when to sow forages and what they need to be thinking about in terms of sowing rates and fertiliser applications.

“It means that when they are planning to establish pasture to feed their animals, they have the best information available to do that as efficiently as possible. It removes the risk of ‘taking a stab in the dark’.

“If you are producing forage of better quality and yield that integrates well into your farm system, it allows you to make smart decisions around pasture management and hopefully get a longer lifetime out of your forages. That means less frequent need for forage renewal of pasture, which also has good benefits for soil health.”

Findings from the trials have been made available as factsheets through the Beef + Lamb New Zealand (B+LNZ) Knowledge Hub. Plans are also underway to create a series of ‘how to’ videos providing guidance on pasture management.

There have been many positive outputs from the research, says Suzi.

“Many of the outputs are also now in scientific literature, so they have been through a peer review process. That gives us real confidence around the level of rigour associated with the work and that the information in the B+LNZ factsheets is robust and useful for farmers.”