BEEF + LAMB NEW ZEALAND GENETICS RESEARCH + DEVELOPMENT

beef+lamb new zealand GENETICS

SUPPORT

Research and development initiatives are funded by sheep and beef levy payers and the Ministry of Business, Innovation and Employment, with support from meat processors, breed societies and commercial entities with an interest in sheep and beef genetics.

CONTENTS

UNDERPINNING PROFITABLE BREEDING DECISIONS

Beef + Lamb New Zealand (B+LNZ) Genetics is the government-backed subsidiary of Beef + Lamb New Zealand (B+LNZ) which brings together New Zealand's sheep and beef genetics research and innovation into a single entity.

Established in 2014, our driving theme is building stronger genetics by focusing on industry-relevant outcomes and adoption. We strive to enable farmers to make the most of new and existing genetic technologies for sheep and beef cattle breeding, to breed the animals New Zealand needs for the future.

Our programme works to introduce new traits into breeding stock to boost farm profits and efficiency, and enhance the product qualities that consumers find desirable.

We're investing in R&D to deliver a 'new norm' based on the transparent genetic potential of animals.

Research Partners

- AgResearch
- AbacusBio
- University of Otago
- Massey University
- Meat & Livestock Australia
- Veterinary groups
- Rezare Systems
- University of Adelaide
- University of New England's Animal Genetics & Breeding Unit

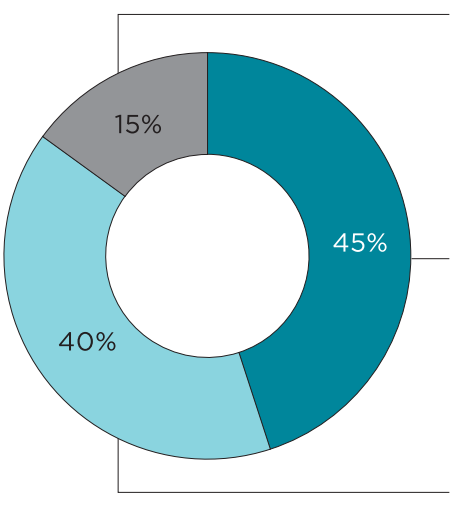
Collaborators

- Breed societies
- Sheep & Beef breeders
- Progeny test farms
- New Zealand meat processors
- Industry service providers
- Corporate farms
- Shepherd Cadet Training Schools
- PGP's and Partnerships (RMPP, FIQ, PGGRC)

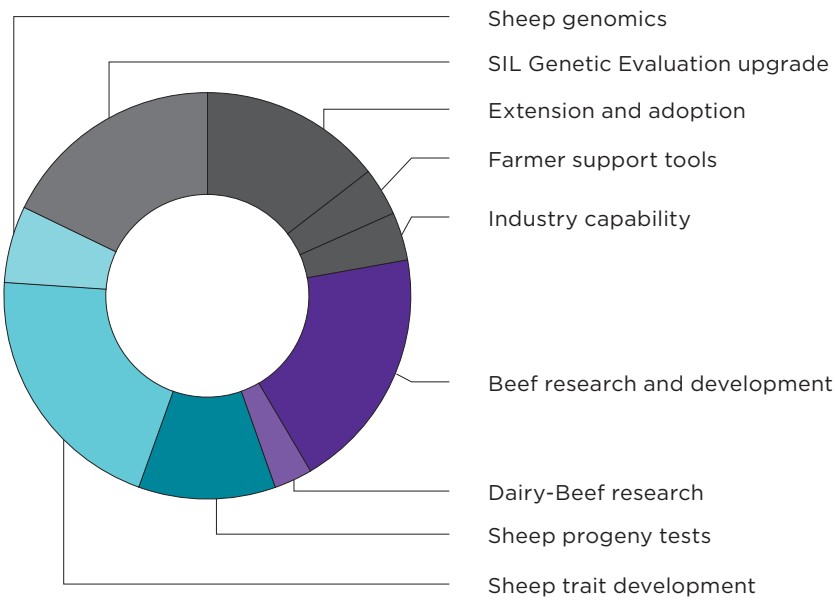
HOW B+LNZ GENETICS IS FUNDED

As a subsidiary of B+LNZ, we are funded by sheep and beef levy payers and the New Zealand Government. We are supported by investment from third parties, including meat processors, breed societies and commercial entities interested in sheep and beef genetics and genomics.

Sources of funding



Investment by portfolio area



INDUSTRY SNAPSHOT

27.5 million
SHEEP

50% NORTH ISLAND

50% SOUTH ISLAND

3.5 million
BEEF

71% NORTH ISLAND

29% SOUTH ISLAND

Total sheep numbers at 30 June 2016 were 27.5 million, a decrease of 31% compared with 2006. Of the 27.5 million sheep, 18.1 million were breeding ewes and 9.4 million were classified as ewe hoggets, dry ewes, wethers and rams. Beef cattle numbers were provisionally 3.5 million, of which 1.0 million were beef breeding cows and heifers.

18.1
MILLION BREEDING EWES

1.0
MILLION BEEF BREEDING COWS AND HEIFERS

6.6
MILLION DAIRY CATTLE

The red meat sector has change radically in the past 25 years. Research and innovation has contributed to building a sustainable future for New Zealand sheep and beef farmers.

1990	On average 0.9 lambs were born per ewe
2015	**Today on average 1.3 lambs are born**
1990	The average weight of a lamb carcase was 14.3kg
2015	**Today the average weight of a lamb carcase is 18.3kg**
1990	Breeding ewe lamb production (kg of lamb produced/ewe) = 9.8kg
2015	**Breeding ewe lamb production (kg lamb produced/ewe) = 19.5kg**
1990	The volume of meat exported per worker was 23 tonnes
2015	**The volume was 43 tonnes: a productivity gain of at least 88%**
1990	There were on average 49 beef cows and heifers per farm
2015	**There are on average 70 beef cows and heifers per farm (+61%)**
1990	Farm profit before tax = $44,800
2015	**Farm profit before tax = $86,500***

*estimated forecast using exchange rate USD 0.63

Figures have been sourced from **Beef + Lamb New Zealand Economic Service 2017**

SHEEP IMPROVEMENT LIMITED (SIL)

SIL is the world-renowned New Zealand sheep industry's performance recording and genetic evaluation database.

SIL is part of B+LNZ Genetics and is funded by sheep meat levies and fees charged to breeders. It provides tools and information for ram breeders and commercial farmers – with the goal of improving the profitability of sheep farming in New Zealand.

Goal trait group measured	Flocks
DNA parentage	33
Lamb survival	312
Reproduction	328
Lamb growth	326
Wool	229
Meat yield	191
Worm resistance (WormFEC)	38
Facial eczema tolerance	52
Resilience	7
Bareness	4
Dags	33
Body condition score	67

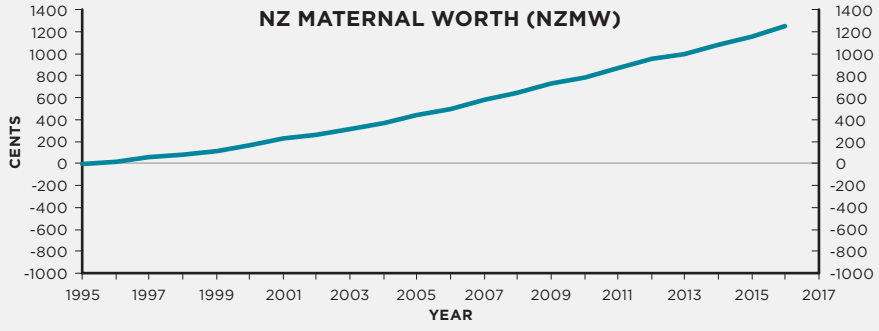
What maternal flocks measure
Almost all flocks measure Reproduction, Lamb Survival and Lamb Growth. The majority are measuring two or more of Adult Size, Meat Yield or Wool Production. Health traits are measured by a minority of maternal ram breeders.

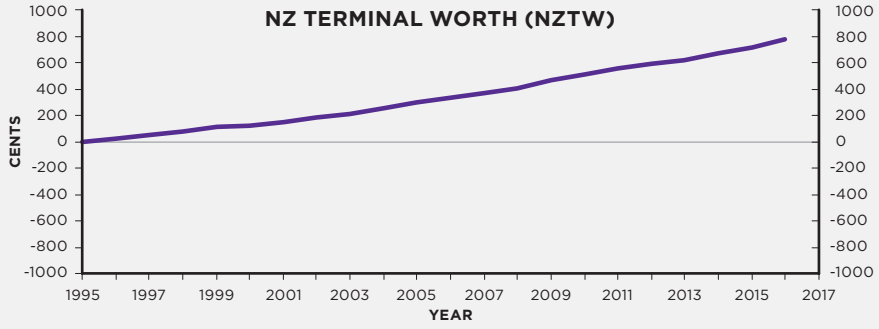
Goal trait group measured	Flocks
DNA parentage	15
Lamb survival	220
Reproduction	212
Lamb growth	220
Meat yield	195
Worm resistance (WormFEC)	2
Facial eczema tolerance	2
Dags	5

What terminal flocks measure
Most terminal (or meat) flocks are measuring Lamb Growth, Lamb Survival and Meat Yield. Health traits are measured by just a few flocks.

Genetic improvement of NZ's sheep flock

Figures: genetic trend graphs depicting gains made by NZ sheep breeders since 1995.





R&D Initiatives

On-farm

Providing the information infrastructure for breeders and farmers to make valued breeding decisions.

Progeny Tests

Strengthening genetic comparisons

The Sheep Central Progeny Test is a long-standing and critical component of New Zealand's sheep genetics system, while the Beef Progeny Test (launched 2014) compares bulls under commercial farming conditions. They provide the necessary connections that underpin genetic evaluations and help breeders and farmers identify top genetics that will perform best in their environment.

Initiatives:

- Sheep Central Progeny Test
- Beef Progeny Test
- Dairy-Beef Progeny Test

Traits impacting farm profit

Evaluating finishing and/or maternal performance

Research in this space is focused on; evaluating and refining existing traits that are important to farm performance, as well as introducing new traits. E.g. maternal longevity, body condition score, and refining the breeding goals for carcass merit.

Initiatives:

- Maternal Beef project
- Maternal Ewe project
- Trans-Tasman Beef Cow Profitability programme
- Feed efficiency in sheep
- New traits
- Genetics by Environment (GxE) effects

Genetic Decision Tools

By accelerating genetic gain, farmers will be able to buy animals with greater genetic merit.

Investing in technology

Access to better genetic information

B+LNZ Genetics are investing in a new genetic evaluation system that will incorporate genomics, as well as delivering user-friendly decision support tools to breeders and commercial farmers.

Initiatives are aimed at providing access to better genetic information to help breeders and farmers make the most profitable breeding choices for their particular farm management system.

Initiatives:

- SIL upgrade
- New Zealand Genetic Evaluation
- Easy to use industry standard indexes (NZMW & NZTW)
- Sheep and Beef genomics

Capturing value on-farm

Linking genetics to farm goals

Informing future ram and bull buying decisions for farmers, by matching genetic merit of the ewe flock or beef cow herd to performance metrics and business objectives. This includes developing breeding objectives and selection indexes to better describe farm profit in hard country.

Research focuses on:

- redefining indexes to include traits with an intermediate optimum
- bringing new traits into indexes - e.g. body condition score and stayability
- improving the farm business model from which the economic indexes are based.

Initiatives:

- New breeding objectives

Processing

Facilitating connectedness within the value chain, between processors, breeders and farmers.

Carcass Merit

Targeting more valuable animals

Initiatives focus on: **i)** Redeveloping the genetic evaluation system for meat production, making it relevant to the measurement technologies and breeds of sheep used in New Zealand. **ii)** Collect ultrasound, CT scan and VIAscan grading data in the same group of animals sourced from breeders and the CPT flocks. **iii)** Incorporate meat processor grading systems in the genetic evaluation system. This will improve the accuracy of breeding values for meat traits and allow breeders to use any mixture of measurement technologies, but get one set of breeding values. Initiatives will also provide breeding values relevant to breeders and meat processors to target genetics that add value throughout the value chain.

Initiatives:

- Central Progeny Test
- Next Generation sheep progeny test sites
- Beef Progeny Test
- Dairy-Beef Progeny Test
- SIL Meat Module

People

Investing in initiatives that build capability within the industry to ensure animal breeding continues to advance sheep and beef production.

Meat Quality

Delivering consistent quality for the market

This project investigates the feasibility for prediction of meat quality attributes at processing plants. Initiatives include:

- testing the suitability of rapid, objective technologies in developing meat-quality based decision support systems
- establishing the current status of IMF in New Zealand lamb
- low-cost, objective phenotyping for lamb meat quality (IMF and pH)
- beef progeny test offspring are assessed on carcass attributes and ultimately, eating quality.

The ability to grade carcases based on meat quality parameter(s) sought by the consumer would allow the industry to inform the value chain of the impacts of management and breeding decisions on product quality for continual improvement.

Initiatives:

- Hyperspectral imaging
- Beef Progeny Test

Communicating knowledge

Implementation of proven on-farm practices

B+LNZ Genetics provides the information and tools farmers need to lift their profits via genetics. We invest in initiatives to increase the uptake of proven on-farm practices and promote best practice in the management of breeding flocks and collection of performance data. Initiatives include;

- delivering online support tools to aid ram or bull purchases
- developing cloud-based data collection software for breeders that will save time and improve accuracy
- direct engagement with breeders and farmers through regular genetics workshops, forums and field days
- using progeny test farms as a platform to demonstrate genetic tools and how they can be used in real-farm situations.

Initiatives:

- Cloud-based smart analytics
- Breeder forums
- Ram & bull buying workshops
- Progeny test field days

Building Capability

Investing in New Zealand's genetic capability

Supporting academic resources and teaching to encourage and train future genetic specialists. This includes the establishment of a two-year Master of Applied Sciences in Quantitative Genetics at the University of Otago. Quantitative genetics is central to most B+LNZ Genetics research activities and underpins its world-leading sheep genetics system. Skills in quantitative genetics underpin genomic technologies in all New Zealand's primary industries.

On farm, two beef progeny test properties also operate as training farms, exposing young cadets to breeding and genetics technology in real-life commercial farming situations.

Initiatives:

- Quantitative Genetics Masters programme
- Taratahi, Smedley and Otiwhiti cadet training farms

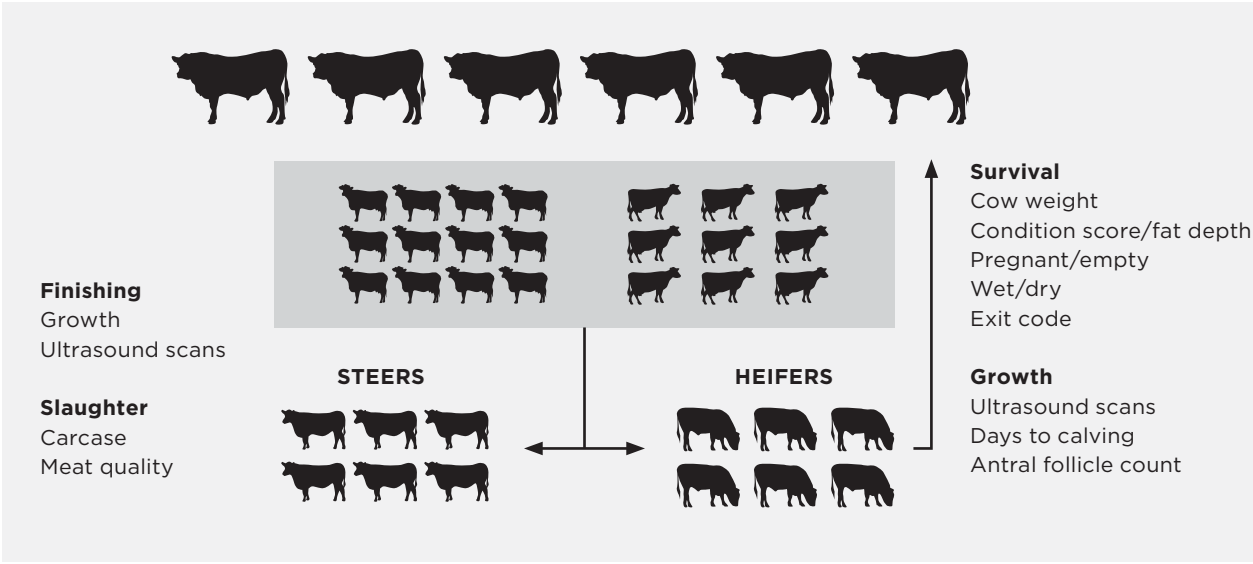
R&D ON-FARM

On-farm

Providing the information infrastructure for breeders and farmers to make valued breeding decisions.

THE BEEF PROGENY TEST

Evaluating finishing and/or maternal performance



The Beef Progeny Test (BPT) compares bulls under New Zealand commercial farming conditions. The test was established in 2014 and involves about 2200 cows and heifers on five large properties across New Zealand. Steers are assessed on their finishing performance and carcase traits, while replacement heifers are tracked for their maternal characteristics.

A mix of both internationally-sourced and New Zealand semen is being used. The breeds include Angus, Hereford, Stabilizer, Simmental and Charolais. Some bulls are specifically included to provide genetic links to international programmes, where carcase data is being collected (e.g. the Australian Angus Sire Benchmark Programme, Hereford Progeny Test and Angus Sire Alliance).

Over time, the test will:

- Evaluate maternal performance and survival for different cow types in commercial conditions.
- Generate potential new eBVs for cow performance – e.g. antral follicle counts (measured in heifers to predict cow fertility); cow condition score; and cow stayability.
- Evaluate the relationship between maternal performance, finishing performance and carcase quality/market attributes.
- Evaluate across breeds.

Whangara Farms

Whangara Farms manager Richard Scholefield believes strongly in the use of EBVs when selecting bulls. He is keen to show how beef cattle performance can be boosted by selecting higher EBVs for certain characteristics.

Whangara Farms is a partnership between two Maori incorporations, based 30 kilometres north of Gisborne. It totals 7100 hectares, supporting 70,000 stock units, and is managed by Richard Scholefield.

Beef policy: The 1600-cow herd is run as two mobs of 800: an "A herd" made up of the top cows, which are mated to Angus bulls to produce maternal genetics for the future; and a "B herd" which is mated to Simmental bulls as terminal sires. Male Angus progeny are all castrated and finished as 18-20-month-old cattle – at an average carcase weight of 270 kilograms. About 15 per cent are carried over to finish a year later. The Simmental male progeny are kept entire and finished as bulls.

Heifer selection: About 300 of the top rising-one-year-old Angus heifers are mated to low birth weight Angus bulls. Replacements into both the A and B herds must be Angus and must have reared a calf as a heifer. Whangara also scans the heifers for back fat and eye muscle area and uses those measurements as part of its selection process.

Bull selection: "The first thing is EBVs – looking at fertility, 400 and 600-day growth rates and in the past three of four years I've also been looking closely at EBVs for eye muscle area and intramuscular fat."

Beef progeny test: Involves 400 cows in the A herd. The focus is on selecting bull genetics with carcase characteristics that match Silver Fern Farms' BeefEQ criteria.

Breeding philosophy: Richard is a believer in EBVs. "I operate in a very traditional East Coast area, where EBVs are frowned upon. For me, I'd like to show farmers that you can increase your beef cattle performance by selecting higher EBVs for certain characteristics." He is also curious about the viability of artificially inseminating cows on a commercial scale.

Read the full profile at ***blnzgenetics.com/progeny-tests***

Rangitaiki Station

"From this test, I want to know whether more money spent on decent genetics pays off. Also – long term – observing whether the heifer replacements coming through make a difference."

- Rangitaiki Station manager Sam Bunny

Rangitaiki Station is a Landcorp Farming property, situated on the Napier-Taupo Road, and managed by Sam Bunny. The station's 8350 effective hectares are nearly all flat and carry 83,000 stock units. At 700 metres above sea level, cold hard winters dictate much of the farm's policy.

Beef policy: The cow herd is made up of 1400 head of Angus mixed-age cows and 380 rising-one-year-old heifers. The herd's role is to maintain feed quality. Steers are finished as two-year-olds, at a target carcase weight of 310 kilograms.

Heifer selection: The 380 replacement heifers are selected based on weaning weight, with the remainder sold store. Both heifers and cows are mated to Angus bulls.

Bull selection: As a Landcorp property, bulls come from Focus Genetics, specifically Rotamahana Station near Reporoa. Sam requests bulls that will leave cows of medium frame and also has an emphasis on calving ease.

Beef progeny test: A range of Angus bulls are being used, in line with the station's breeding cow policy. In addition, some were mated to Hereford and Stabiliser bulls, as alternative maternal breeds, and some cows were mated to Simmental bulls, as a terminal sire option.

Breeding philosophy: Sam has reservations around the value of expensive bulls. "With calving percentage limited by the fact a cow generally only has one calf, you're really only looking at growth and cow efficiency, and may be yield. Sires costs in commercial operations are quite expensive for beef. You normally mate cows at a rate of one bull to 40 cows. If you have a 95% in-calf rate and a 90% calving, that might be only 30 to 35 live calves annually.

Assuming a bull is used for four or five years, the sire cost per calf is quite different for a $3000 bull, compared to a $10,000 bull. I'm interested to see the value genetic performance makes to offset that cost. The use of AI for the project is something Sam is observing with interest. "If we could get more calves out of bulls through AI – from our own bulls or outside genetics – that changes the equation."

Read the full profile at ***blnzgenetics.com/progeny-tests***

Mendip Hills

Mendip Hills' Simon Lee believes quality genetics represent good value for money.

Mendip Hills is a 6130 hectare property, near Cheviot. The rolling to high country property is supported by two irrigated blocks and winters nearly 40,000 sheep, deer and beef stock units. It is owned by the Black family and managed by Simon Lee.

Beef policy: Runs 1150 breeding cows and 180 rising-one-year-old heifers. The herd is a mix of Hereford, Angus and crossbreds. Male progeny and excess heifers are finished as rising two year olds with a target carcase weight of 310 kilograms and 230 kilograms respectively. Replacement heifers are Hereford and crossbred animals.

Heifer selection: Must work on the property's harder hill country, which is summer dry and winter cold. Simon wants cows that are not too large or rangey, have an easy temperament, and have the constitution and confirmation to handle the property's sometimes trying conditions.

Bull selection: Simon "does and does not" look at EBVs. "I pick on type – a good barrelly, easy-doing animal – then look at EBVs, particularly mature cow weight. He peruses the catalogue of his favoured studs, then works with his stud stock agent to short list the specific bulls to view, before visiting the studs about three weeks out from their sales.

Beef progeny test: Hereford bulls were selected to give a range of types, but making sure they fitted with Mendip Hills' commercial goals. It also included bulls with high IMF EBVs, and both horned and polled Herefords.

Breeding philosophy: Simon says there is no compromise for good breeding. "It's good value for money. You need good females, because they're the backbone of your business." He is as curious as the next farmer about what the test will reveal. "I believe there's value in good genetics. But is there? We'll find out."

Read the full profile at ***blnzgenetics.com/progeny-tests***

Tautane Station

Tautane Station says accommodating the Beef Progeny Test serves an educational role, by exposing the young agricultural trainees to a large-scale genetics trial.

Ngati Kahungunu owned Tautane Station sits on the North Island's East Coast near Pongaroa and is leased by the Taratahi Agricultural Training Centre. The 3700-hectare station and its 29,500 stock are also a training ground for agricultural students.

Beef policy: The property runs 600 mixed-age Angus cows, 180 rising-two-year-old and 200 rising-one-year-old heifers. The cattle are there to support and complement the sheep operation. The cattle policy is flexible and largely dictated by the season. Currently, all weaners are sold on farm, except for the 200 heifer replacements.

Heifer selection: cows are big – about 600 kilograms. Tautane concentrate on a slightly smaller framed animal focusing on efficiency. "They can do it a bit hard at times, so they need to be an animal that can handle that and the hills. We also want quiet animals with good growth rates."

Bull selection: We want a cattle beast that's sound, a good type but one that performs - has good conformation, gets in calf as a yearling, produces a live calf to weaning every year and that can bounce back quickly from a tough season. We are focused on the maternal side of things, as that drives our production system. We want a good meaty bull, with good feet and good bone, then we look at the EBVs concentrating on 200-day weight, milk and self replacing index. We are careful not to focus solely on these traits, as the carcase traits are also important.

Beef progeny test: Involves 383 mixed-age cows. Bull genetics were selected to represent a broad range of types, from quite moderate bulls, through to bulls which have strong emphasis on carcass attributes.

Breeding philosophy: Bulls are first selected on type, before their EBVs are reviewed. "A lot of people are in one camp or the other – EBVs or type – when it comes to bull selection. We see room for both approaches and that's why Taratahi was keen to get involved in the Beef Progeny Test."

Read the full profile at ***blnzgenetics.com/progeny-tests***

Caberfeidh

Caberfeidh are looking forward to clarifying the role genetics plays in the property's overall performance improvements. The programme involves artificially inseminating only the heifers - with both internationally and New Zealand-sourced semen.

Caberfeidh is one of six properties operated by Lone Star Farms. It covers 6000 hectares in the Hakataramea Valley of South Canterbury and is mostly flat to rolling, with 1350 hectares oversown hill country.

Beef policy: The cow herd is made up of 360 mixed-age Angus breeding cows and 102 in-calf rising-one-year-old heifers. Cull heifers and male calves are kept one winter, before being either processed or going to Anzco's Five Star Beef feedlot.

Heifer selection: Caberfeidh wanted a medium-framed animal, with higher fertility and higher grow rates. They started keeping the heifers and now add 60-85 heifers into the herd annually. All heifer calves are retained and about 120 head are mated to the newest bulls – being the bulls on the property with the best genetics – for 2.5 cycles. They are then cycle scanned and Caberfeidh usually manages to retain only those which get in calf during the first cycle.

Bull selection: Lone Star Farms is part of Focus Genetics' embryo transplant programme and selects the exact cow and bull they want to produce their bulls. The selection criteria favours maternal traits and takes into account low birthweight and easy calving, high growth rates – including weaning and 300-day growth rates – and high eye muscle area.

Beef progeny test: Involves only Caberfeidh's heifers. Bulls were firstly selected, based on being safe options for mating to heifers. They were then selected against Caberfeidh's goals, which included good growth rates (600 day weight EBVs) and moderate cow size.

Breeding philosophy: "It will be interesting to know how much of a role genetics play in the improvements we have made – and the improvements we will make over the course of the programme. Management has changed a lot, so it's about learning how much is genetics versus feeding versus management."

Read the full profile at ***blnzgenetics.com/progeny-tests***

DAIRY-BEEF PROGENY TEST

The dairy-beef progeny test aims to put a dollar value on the extra profit that can be added to the dairy-beef supply chain by using good genetics.

Alongside the core Beef Progeny Test, a dairy-beef test is being carried out at **Limestone Downs**.

Its goal is to calculate the additional value that can be added by using high-genetic-merit beef bulls, versus the unrecorded bulls traditionally used as "follow-on bulls" in most New Zealand dairy systems. A 2015 analysis indicated there is up to $61 million worth of economic potential annually for the beef sector, if better quality beef bulls are used over dairy cows.

Limestone Downs near Port Waikato is a high-profile trust-owned property, covering 3,200 ha and wintering about 27,000 stock units. The operation converted 350ha to a dairy milking platform two years ago and runs 610 Friesian cows and 190 heifers.

It has a long-standing relationship with Massey University and is often used to trial research projects in a commercial setting.

While this is a stand-alone progeny test, it will be genetically linked to the beef progeny test by using selected sires across operations. This will provide comparisons around how the bulls perform in two different systems.

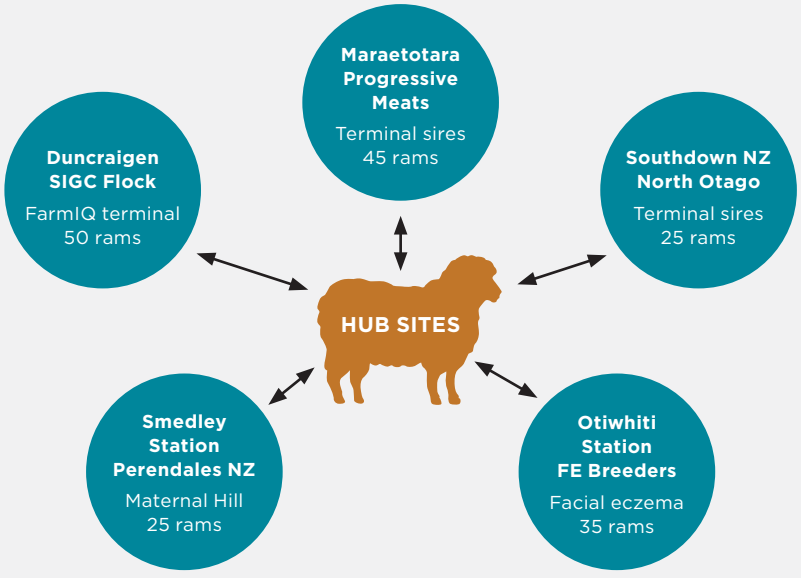
One of the project's objectives is to introduce a dairy-beef genetic index, that clearly quantifies the economic benefit of recorded bulls.

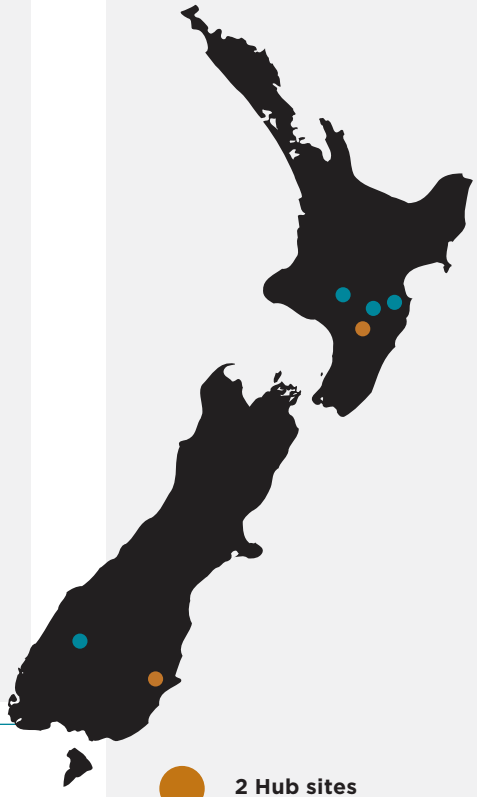
Read the full profile at
blnzgenetics.com/progeny-tests

SHEEP CENTRAL PROGENY TEST

Helping breeders and commercial farmers identify top genetics that will perform best in their environment

The benchmarks created by this test underpin NZGE - the weekly large-scale across-flock and across-breed evaluation.





In 2017, B+LNZ Genetics **Central Progeny Test** (CPT) involves 186 rams, across seven sites, including six commercial properties, of which three are cadet-training bases. The test's focus has been adjusted further towards more commercial hill country environments and in partnership with industry, "Next Generation" flocks have been introduced.

These changes allowed:

- Testing of more rams of a younger age
- Rams of high genetic merit to be identified in time to be used more widely, while still alive
- The test to be carried out under more commercially-relevant environments
- Partnership with industry

2 Hub sites focus on flock connectedness betweeen the Next Generation flocks.

5 Next Generation sites build stronger connections with ram breeding flocks in the industry.

Hub sites

Hub sites focus on flock connectedness between the Next Generation flocks. This connectedness underpins across-industry genetic evaluation. Hub flocks also provide a resource for add-on innovative projects.

The two CPT Hub sites are:

- **AgResearch's Invermay Farm** (Otago)
- **Taratahi's Mangarata Farm** (Wairarapa)

Annually, 25-30 rams produced progeny at both sites (via AI). Many research traits are measured at these sites, including Reproduction, Growth, Meat, Wool, WormFec, Facial Eczema, Stayability, DagScore and Hogget Fertility.

With AI and dam + sire parentage, lamb survival is also captured. Entry of rams by expression of interest are called for in late November.

Maraetotara

"None of us expect to get a different result by doing things the same way. The Central Progeny Test is our chance to work together to show leadership."

- Stuart Ellingham, Horizon Farming

Progressive Meats, Horizon Farming and B+LNZ Genetics have established a next generation site to compare the performance of various terminal rams' offspring under commercial farming conditions.

The 400ha Hawkes Bay farm is one of Horizon Farming's six properties and as a terminal-only operation is deemed ideal for this study. 45 sires are brought to the farm from terminal ram breeders, including 2 link sires that are also artificially mated with ewes at the HUB CPT sites. Lambs born on the property in 2016, have sires from 11 different breeds.

The resulting data will help increase the rate of genetic gain, allowing Progressive Meats to target more valuable animals with its farmer clients, help farmers choose the best terminal rams for their management system and provide breeders with direct feedback on their rams' performance.

Progeny are monitored for growth rate, before being processed and measured for eating quality and yield through Progressive Meats' grading system.

Once the meat module is fully implemented, results will feed into the New Zealand Genetic Evaluation (NZGE).

Read the full profile at ***blnzgenetics.com/progeny-tests***

Duncraigen

"To be working alongside cutting edge science is an opportunity that needs to be grabbed with both hands. Creating points of difference are going to be the game changers."

- Matt Holden, Kelso

While still part of the progeny test family, the Landcorp Duncraigen arrangement is slightly different. The Te Anau property is home to the **South Island Genomic Calibration (SIGC) flock**.

A genomic calibration is about testing how closely an animal's DNA profile matches its performance in real life. Information gleaned from calibration flock lambs is immediately used to refine the genomic predictability behind eating quality measures – specifically, meat tenderness, pH, marbling and colour. The actual carcase merit performance of lambs is compared to what the genetic data predicted.

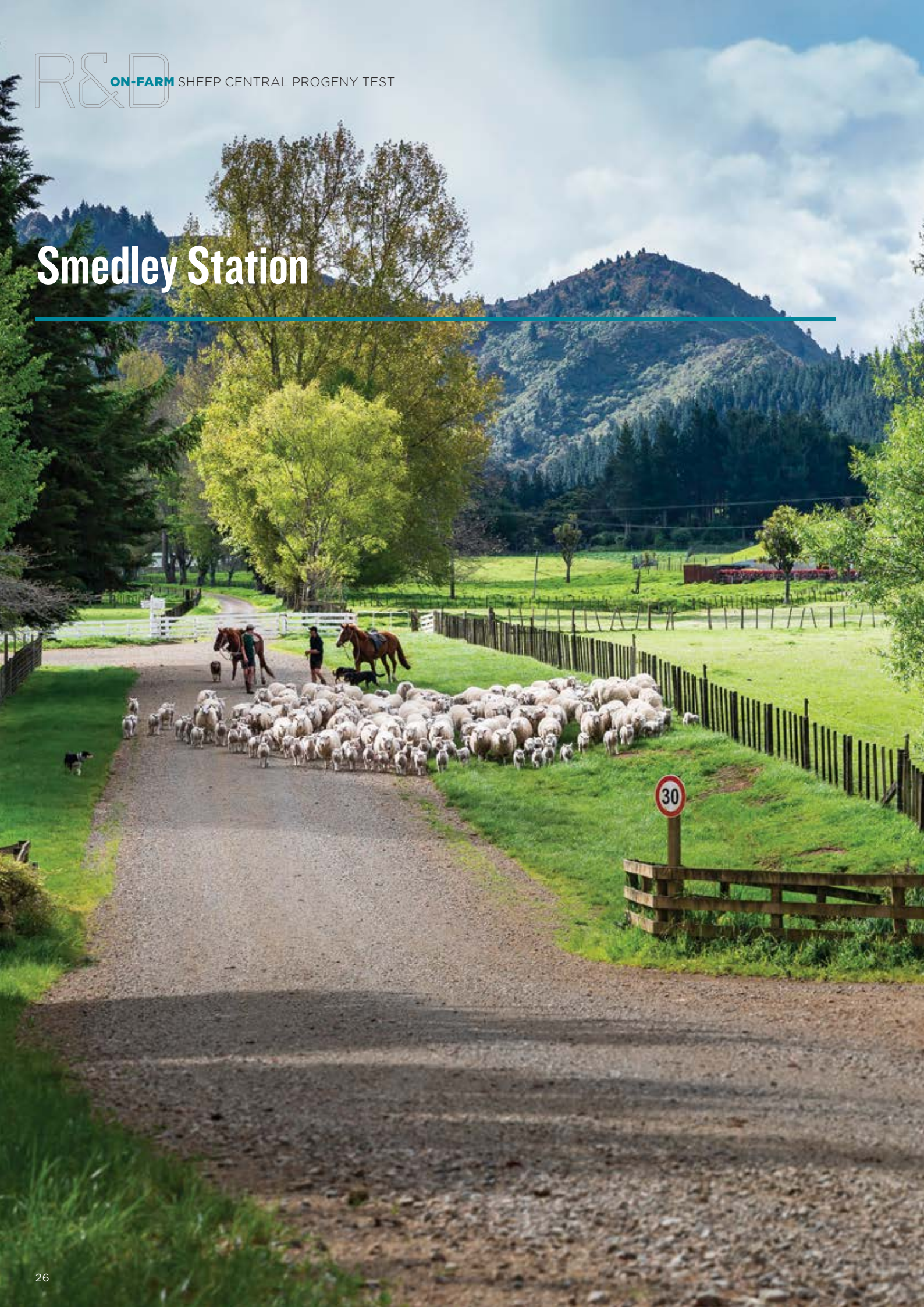
SNP tests can be developed that allow a ram lamb to be assessed as soon as he is born – the results immediately revealing how he will perform as a sire (rather than waiting for him to mature and sire live lambs for assessment). The more tests/comparisons done, and the closer these animals are to the lamb in question, the more accurate the SNP tool.

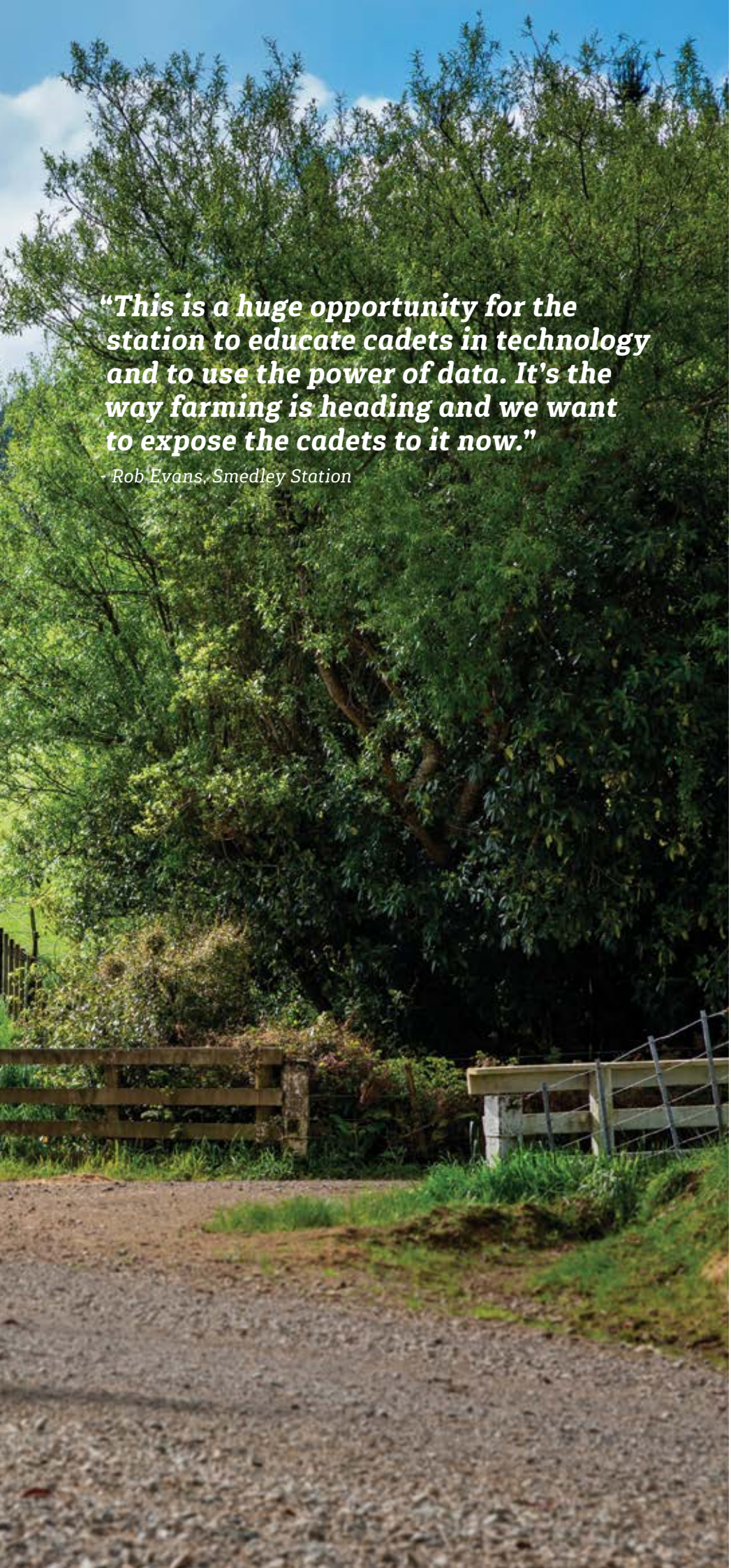
The calibration flock was established in 2011, as part of FarmIQ, a Primary Growth Partnership (PGP) programme investigating genetic selection for eating quality in sheep. Today, 800 mixed-age Romney ewes are mated to 40 mixed-age and hogget rams from 14 breeding flocks.

With a focus on evaluating composite terminal breed rams, the flock currently incorporates Suftex, Suffolk, ANZCO, Kelso and Focus Genetics (FocusPrime and Texel) sires.

Read the full profile at ***blnzgenetics.com/progeny-tests***

Smedley Station





Since March 2016, the Hawkes Bay training farm has been working with B+LNZ Genetics and the Perendale Society of New Zealand to test the genetic potential of 25 up-and-coming Perendale rams across 1000 of its young ewes.

In late October 2016, the progeny was EID tagged and DNA tested. The lambs' performance is now being monitored and assessed across a range of production and health traits.

Smedley manager Rob Evans says the CPT ewes are run with Smedley's commercial flock, except at mating and lambing.

"They're exposed to exactly the same conditions – there is no favouritism on the ground."

Arriving at the same time was an autodrafter, scales and data management system. Previously, Smedley only weighed cattle and, periodically, lambs.

Smedley plans to use its new technology more widely. "We plan to tag (non CPT) lambs and use the data in some of the theory work in class. It'll also help us do things like understand if plantain and lucerne are outperforming grass and put a bit more power behind our thinking."

Read the full profile at
blnzgenetics.com/progeny-tests

Otiwhiti Station

Facial Eczema (FE) challenge can decimate farm production and profitability. With the spread of warmer conditions that favour the fungal spore, greater commercial use of FE-tolerant rams are needed for at-risk farms.

Otiwhiti Station is large-scale sheep and cattle breeding property in the Hunterville district, Rangitikei. It also operates a cadet-training farm.

In partnership with Facial Eczema (FE) Breeders, the progeny test site focuses on best practice use of existing genomic and RamGuard™ tools to identify rams that produce FE-tolerant progeny.

In 2017, the site will use ewe hoggets as dams, so prior use of submitted rams at the home stud farm can occur for best practice connectedness.

Annually, 40 FE-tolerant rams will be assessed for their ability to produce FE-tolerant progeny.

This will be determined through genomic testing of parents and progeny as well as FE dosing of progeny.

Southdown New Zealand

In a new partnership with the Southdown Sheep Society, this Next Generation site is based at a commercial sheep farm near Palmerston, North Otago. The site activities are managed by Southdown breeder Dave Robertson, from The Vetinerary Centre, Oamaru.

Each year, 25 terminal rams will be assessed for growth and meat production/quality (measured by VIAscan). With natural mating and sire only parentage, lamb survival is not measured at this site. Entry of rams is negotiated by the Southdown Society.

TRANS-TASMAN BEEF COW PROFITABILITY PROGRAMME

The Trans-Tasman collaboration means every $1 of New Zealand farmer levy investment translates to $3.50 of research funding.

B+LNZ Genetics and Meat and Livestock Australia (MLA) are committing a total of $5.2m over three years towards major joint beef research projects.

All projects within the collaboration – regardless of which side of the Tasman they fall on – will be overseen by B+LNZ Genetics.

The partnership centres around the Trans-Tasman Beef Cow Profitability Program, which aims to balance desirable maternal traits in beef cows, with the finishing performance of the calves and their ability to meet quality carcase specifications.

The program will develop genetic measures for better describing the important physical attributes of the cow (such as size, body condition and her ability to handle fluctuations in feed availability), fertility indicators in heifers, and selection tools for easy decision-making.

It will investigate how different environments and farm systems in both countries impact on the balance of traits required to produce an economically efficient cow. Research will also help underpin advancements in genomic technology.

MATERNAL BEEF

Research aims to collect maternal productivity traits in both commercial and stud environments. Data will be combined with complementary data from dams in the Beef Progeny Test to yield 10,000 females with phenotypes and DNA. Trait Measures include cow weight and body condition scores, and calf weaning weights.

This project has become part of the trans-Tasman initiative and focuses on improving maternal productivity in temperate beef cattle. Combining resources and science expertise from New Zealand and Australia will improve the tools available to breeders to select the best cattle for local commercial conditions.

Farms involved
Cows are measured pre-calving, mating and weaning

Longspur, Innes Family
(Hereford)

Orari Gorge Station
(Hereford)

Haldon Station
(Angus and Hereford)

Mount Linton
(Angus)

FEED EFFICIENCY IN SHEEP

Can we breed sheep that require less feed to achieve productive outputs?

Feed efficiency – the measure of how much feed an animal actually eats, versus what it should need to eat for maintenance and growth – is being integrated into many worldwide breeding schemes for both beef and dairy cattle and has been shown to be moderately heritable. Given its importance in these species it is likely to also be important in sheep too.

The trial aims to collect sufficient data to provide first estimates of the heritability of the trait and genetic correlations between it and other important production traits.

Such data will be able to inform decisions about its integration into maternal breeding programmes.

The Feed Intake Facility was established in July 2015, near Invermay. Results to date:

- 600 young animals have been measured through the facility
- 24% difference in feed intake between low & high-efficiency extremes
- First estimate of heritability is significant and high, but needs more data to improve estimate
- Variation in frequency, duration and rate of feeding events – nibblers and gorgers
- Relationship with fatness exists – but it needs further investigation
- First cohort have been measured both as hoggets and now as adults

EWE LONGEVITY (STAYABILITY)

Breeders with suitable data have access to research breeding values for ewe stayability

Research breeding values can be calculated and reported from SIL for stayability (STAY). Work undertaken in 2017 will focus on completing the analysis that provide estimates of breeding value for STAY.

The reason animals have left the flock - e.g Commercial reasons (C), or performance knowledge reasons (K) are recorded.

Additional detail about the specific reason animals have left, can also recorded – e.g. died during lambing (D2), culled for udder problem (H7), or culled when sold for commercial use (S4).

ENVIRONMENTAL EVALUATION (GxE)

Preliminary CPT data shows small levels of genetics by environment (GxE) in growth (LW8) between flocks

This project focuses on recording performance on hill country commercial farms for the development of maternal traits.

About 5,000 ewes from three commercial farms have been EID tagged and sampled for DNA. They are being recorded for body condition score, number of lambs scanned, live-weight and stayability.

This will allow us to understand re-ranking of rams between environments (e.g. stud and commercial farm).

Additionally, the data collected on commercial farms will be included in the generation of genomic breeding values for stud animals.

>> Does performance on stud farms fully translate to performance on commercial farms?

NEW ECONOMIC VALUES

Develop breeding objectives and selection indexes to better describe farm profit in hard country

Changes in industry pricing and structure, as well as genetic trends have driven changes in the value of traits within the breeding objective.

Overall, the value of genetic improvement has increased by 20-30%, driven largely by increases in lamb price and farm costs from higher feed value. These changes have shifted relative trait emphasis.

For the maternal index NZMW, emphasis has shifted from growth to controlling ewe size and increasing direct and maternal survival, and to a lesser extent, increasing wool weight and reproductive performance.

For the terminal index NZTW, there were only very small changes in relative emphasis on growth, meat yield and survival.

FARM RECORDS TO ECONOMIC INDEXES

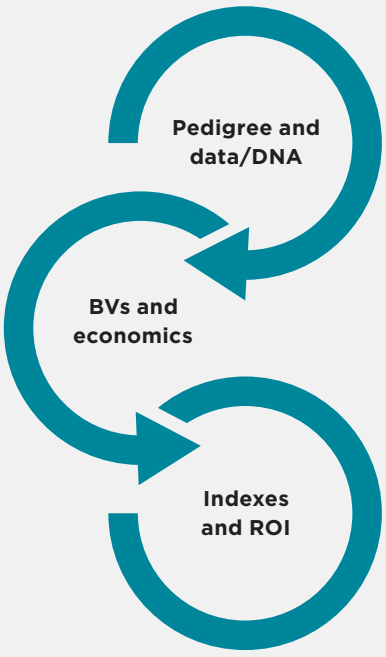
Pedigree is based on parentage recording and DNA information. Performance data is collected and can be informed by DNA information

Breeding values are calculated from pedigree, performance data and DNA information using mathematical models and statistical parameters (e.g. heritability). To weight BVs based on their relative economic importance we need economic weights. These are calculated for each trait.

Relevant traits are included in sub-indexes and an overall index. Index values combine EBVs with economic weights and are a measure of the profit from the ram per ewe mated

Research focuses on:

- Re-defining indexes to include traits with an intermediate optimum
- Bringing new traits into indexes e.g. BCS and ewe stayability
- Improving the farm business model from which the economic indexes are based.



- **Ram breeders record a range of data which is required for genetic evaluation. This data feeds into the NZGE**
- **BVs are a way of identifying genetically superior animals for a range of traits**
- **Selection indexes convert BVs into economic terms and represent profit potential of a ram**
- **Simple calculations can be done to calculate ROI**

METHANE SELECTION FLOCK

Every NZ breeder of maternal breeds has some of their flock's genes shared with the selection lines

PGgRc-NZAGRC are partnering with B+LNZ Genetics to understand the relationship to feed efficiency and bring this breeding opportunity to New Zealand sheep farmers.

SIL Flock #3633

Since 2009 we have screened sheep from the Central Progeny Test through respiratory chambers and Portable Accumulation Chambers (PAC) to identify the extremes in methane production and create this selection line.

Our study of this shows that:

- Methane yield has a heritability of 0.13
- Low methane sheep have smaller rumen
- Sheep that differ in methane also have distinctive rumen microbial communities

Thank you to the following flocks for their contribution to this work:

90	630	1983	2774
94	696	2054	3001
158	712	2415	3007
233	904	2529	3827
391	1023	2629	4474
454	1094	2638	4479
489	1138	2687	4480
591	1194	2695	4669
603	1446	2744	

RAM HEALTH & LONGEVITY

Genetics and husbandry

This trial aimed to gain greater understanding of the health and husbandry of commercial rams and in particular, looking at the changes in body condition in rams throughout a year and the main reasons why rams exit the farm system.

Research included:

- A survey of 22 farmers on the topic of ram health
- A follow-up study conducted on 9 farms with approx 500 commercial rams from a range of breeds.
- Each farm was visited 3 times within a year: pre-mating, 1 month post-mating and 6 months post-mating.

Key findings from commercial study

The amount of **weight and body condition loss** of rams over mating:

13%
Average

22% - 6%
Mob range

-44% - +8%
Individual range

More on-farm variables than breed

No difference between maternal vs terminal sires

Average drop-out rate:
Deaths • culls • missing

7%
over mating

23%
over the year

Main noted causes of culling and loss:

- Excessive condition loss in mob and individuals
- Lameness
- Teeth
- Age

Other conditions noted:

Parasitism: High egg counts pre-mating in good condition rams -> then they lose 10-20% of body weight over mating.

Less than 40% given annual clostridial booster.

Fly strike on head, injuries, green mouth, abscesses, testicular lesions, respiratory conditions.

Watch a video of Dave Robertson's presentation at ***B+LNZ Genetics 2017 Sheep Breeder Forum*** in Napier on our YouTube channel

Genetic Decision Tools

By accelerating genetic gain, farmers will be able to buy animals with greater genetic merit.

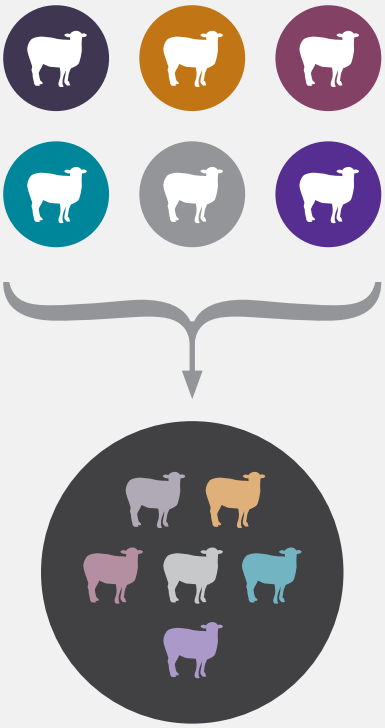
NEW ZEALAND GENETIC EVALUATION

Eliminate variation in breeding values and increase power and speed to run a single, weekly evaluation that includes all flocks

In line with our commitment to provide breeders and farmers with the best genetic information possible, we have upgraded the SIL genetic evaluation. At the core of the upgrade is the move to a single weekly New Zealand Genetic Evaluation (NZGE) that includes all SIL flocks.

As a result, ram breeders and farmers will have access to better genetic information when making breeding decisions.

From multiple evaluations and estimates of merit - to a single evaluation with one estimate of merit



- **All flocks**
- **All information included**
- **Best estimate of genetic merit**
- **Ability to benchmark rams**

STANDARD INDEXES (NZMW & NZTW)

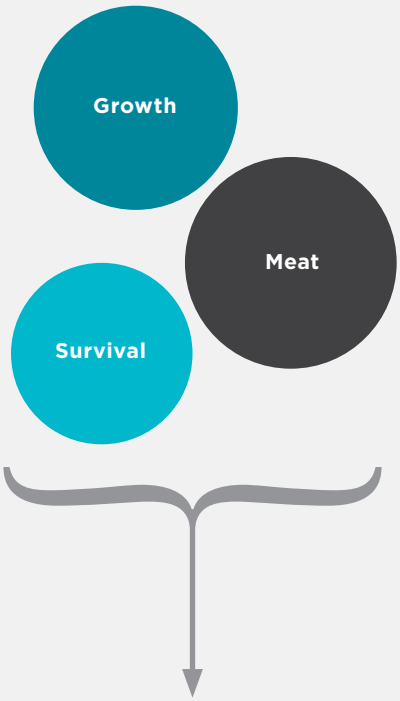
Two new indexes designed to make ram buying information much clearer for commercial farmers

To simplify selecting rams, B+LNZ Genetics have introduced two standard indexes. They summarise a ram's merit for core maternal and terminal traits. The dollar values are presented in a uniform way, allowing farmers to directly compare rams. In a nutshell, the higher the index, the better the ram. An individual ram will have either a Maternal Worth (NZMW) or Terminal Worth (NZTW) index, depending on its purpose. Terminal rams have lower values than maternal rams, which reflects that the NZTW value is drawn from a smaller number of traits.

Core traits

NZ Maternal Worth (NZMW)
formerly dual purpose

Core traits



NZ Terminal Worth (NZTW)
formerly terminal sire

These indexes can be tailored for additional traits of interest. For example:

NZMW + Meat (M)

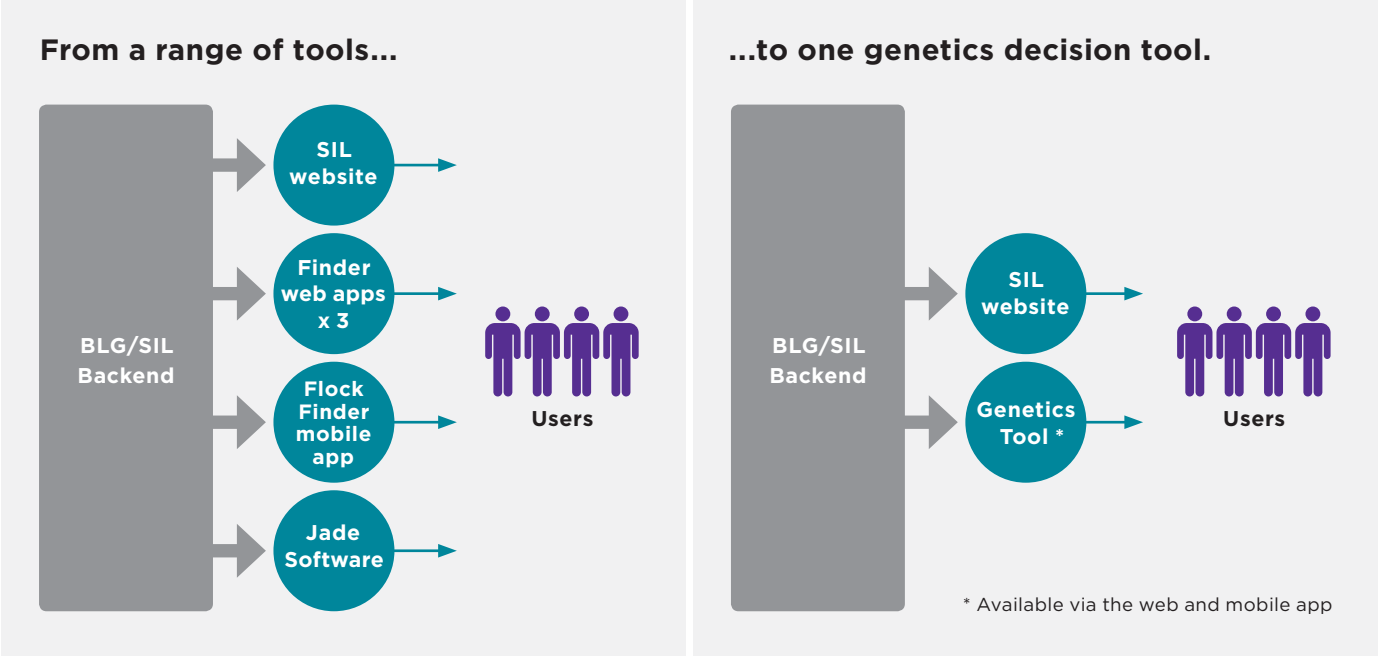
NZMW + Facial Eczema (X)

NZTW + Worm FEC (F)

B+LNZ GENETICS NEW DECISION SUPPORT TOOL

B+LNZ Genetics program of redeveloping the SIL genetic evaluation system includes replacing the exiting myriad of tools with one new decision support genetics tool.

It will help drive on-farm adoption of best practice by delivering a user-friendly experience which encapsulates SIL data to empower breeders, commercial farmers, and consultants to more efficiently make better selection decisions to advance genetic gain. The tool will be accessible via PCs/laptops, tablets and smartphones with some offline functionality.



ON-FARM RECORDING

On-farm data collection with your smartphone saves time and improves accuracy

There are several decision support tools being developed in conjunction with B+LNZ Genetics.

On-farm recording is a joint venture between Rezare Systems and B+LNZ Genetics.

Accurate recording is critical to achieve reliable breeding values and support decision making.

pureFarming software connects to the SIL database and can be used on your Android smartphone or iPhone with your Gallagher, Tru-Test or Te Pari scales and EID reader to speed up data collection and avoid data entry mistakes.

pureFarming also brings growth rate and carcass data together, improving management as well as breeding decisions.

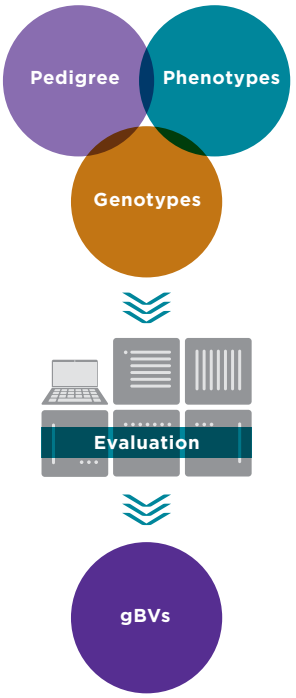
SINGLE STEP EVALUATION

Farmers can have more confidence when buying rams from breeders who are using genomics and single step evaluation

Single Step is a new genetic evaluation method that incorporates genomic information from DNA testing. Previously, genomic-enhanced breeding values have involved a multi-step process.

Single Step is faster and more accurate, because it processes all genotype, pedigree, performance and progeny data simultaneously.

Single Step evaluation continues to provide breeding values, whether an animal is DNA tested or not. If an animal is DNA tested, this information will enhance the animal's breeding values and increase breeding value accuracy, especially when the animal is young.



SHEEP 5K

Improve your flocks performance and profitability by making better selection decisions, more often.

Sheep5K in combination with Sheep50K can be used as part of a genomic strategy to enhance eBVs and ensure sheep breeders have the most accurate information available when selecting or culling young stock.

In the latest calibration, the molecular breeding values (mBVs) from Sheep5K are blended with eBVs in the NZGE analysis. With the input of phenotypes and genotypes from ram breeders, FarmIQ, NZAGRC and PGgRC, Sheep5K can be now delivered with more traits, more breeds and more accuracy.

Sheep5K can be used on:

- Young rams to select only the best to go forward as sires.
- Replacement ewes to ensure the best producers are retained in the flock
- Young candidates before phenotype recording such as RamGuard®.

What's new with Sheep5K?

More traits	Up to 13 new traits will be added to the 22 traits already delivered. The amount of traits available will differ per breed.	New traits for: • Hogget fertility/ NLB • Body Condition Score • Carcass measurements • Wool traits • Health Traits
More breeds	New breeds have been added to the prediction.	Highlander and Texel
More accuracy	The accuracy you get from Sheep5K is comparable to already having direct progeny on the ground. Progeny equivalents will vary according to breed and trait.	As an example, the accuracy you get from the NLB mBV for Romney is equivalent to having 16 daughters on the ground lambing. More accuracies in the table below.
Evaluation	mBVs will now be blended within the NZGE.	This aligns the reporting of all breeding values and indexes.
Reports	gBVs will be reported through SearchPoint. Hard copies will still be available.	SearchPoint is an online genetic information management system designed to enable breeders to access their data and turn it into information that drives better decisions.

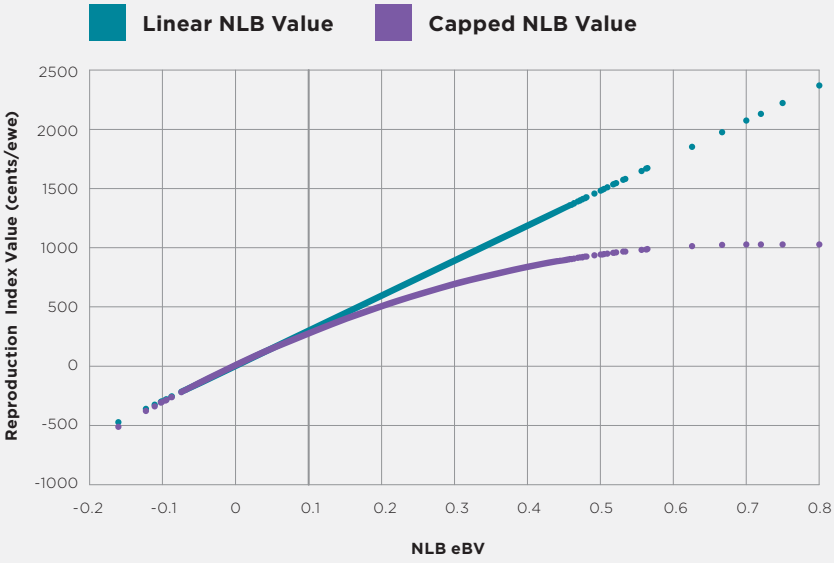
Trait	CWT	WWT	NLB	BCS	SURV	EMA	FW12	GGT21	FEC1	ADAG
Progeny equivalents	3	14	13	12	70	6	6	5	38	3

CAPPED REPRODUCTION

Excessive prolificacy no longer drives high-index ranking

A new capped economic value for number of lambs born (NLB) has been developed for implementation in the breeding objective. In practice, marginal profit per lamb per ewe decreases with increasing NLB and there is an optimum NLB above which production becomes unprofitable.

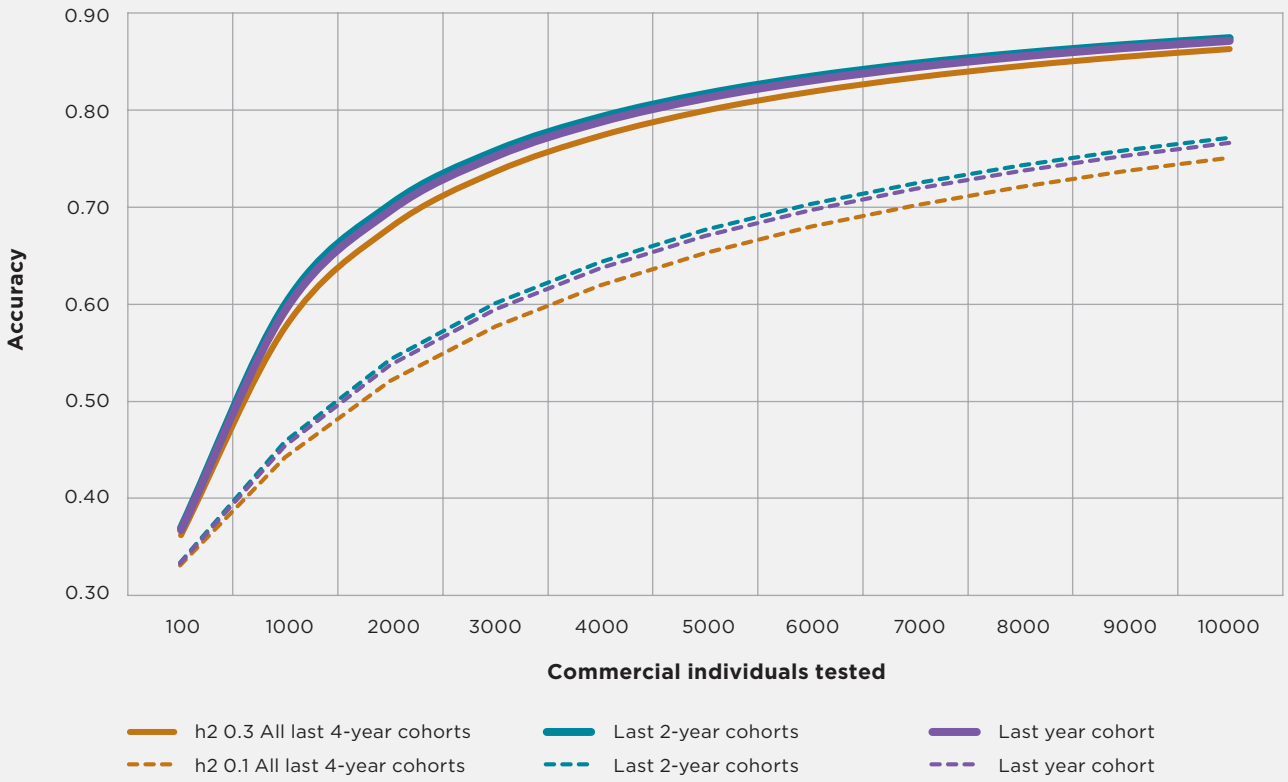
Economic analyses for 2016 have found the commercial optimum NLB is approx 2.13 lambs/ewe. When incorporated into the New Zealand Maternal Worth (NZMW) index, the capped reproduction economic value mitigates the risk of very prolific genetics driving an individuals' total index value.



Ram reproduction indexes when calculated with linear NLB economic value, or capped NLB economic value.

COMMERCIAL EWE SELECTION

Accuracy of genomic prediction by combination of populations



The accuracy increase depends on:

- The number of commercial animals tested, heritability and relationships between and within populations.
- The genetic correlation between commercial and nucleus populations.
- The baseline accuracy of genomic prediction within the industry reference population.

Using commercial data records and genotypes to increase accuracy of genomic prediction

There is opportunity to use commercial data records to accelerate the rate of genetic progress in the New Zealand sheep industry.

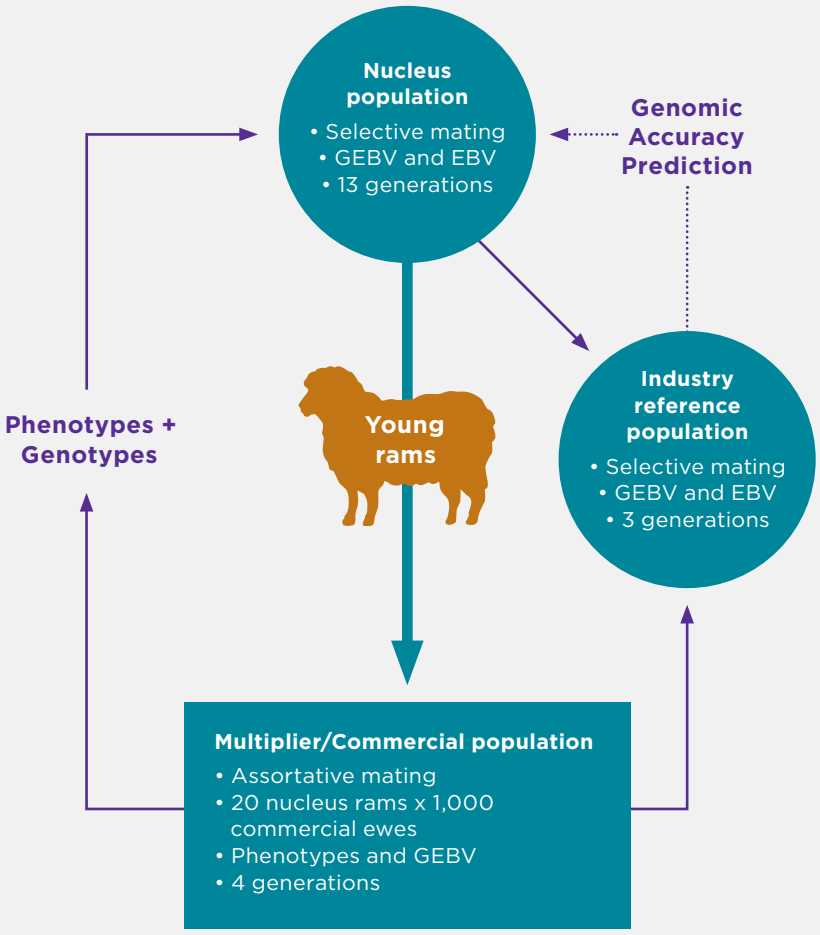
Data can be used:

- As part of the reference population to improve genomic selection accuracy of stud animals.
- To explore expression of traits in a nucleus flock that might not be fully transmitted to the commercial tier (GxE) to utilise commercial information for genomic prediction.

Outcomes of research:

Data from multiplier/commercial animals was found to be useful to increase the accuracy of prediction in the nucleus (stud) flock..

Representation of the breeding scheme



Processing

Facilitating connectedness within the value chain, between processors, breeders and farmers.

SIL MEAT MODULE

Provide direction for the genetic improvement of carcass merit and allow breeders to integrate processing data into their breeding programme

This project aims to improve the accuracy of breeding values for meat traits.

All meat data collected and stored in SIL will be used to better predict breeding values. It will allow breeders to use any mixture of measurement technologies, but get one set of breeding values.

Research involves:

- Redeveloping the genetic evaluation system for meat production, to make it relevant to the technologies used and breeds of sheep in New Zealand today
- Collecting ultrasound, CT scan and VIAscan data of animals sourced from breeders and CPT flocks
- Incorporating other meat processor grading systems in the genetic evaluation system

HYPERSPECTRAL IMAGING

Developing a suitable tool to capture value from superior quality lamb and improve product consistency

This project investigates the feasibility for real-time, non-destructive prediction of meat quality attributes in lamb across three processing plants. The ability to grade lamb carcasses based on meat quality parameter(s) sought by the consumer would allow the industry to:

- Target carcasses for specific market requirements
- Market lamb based on measurable quality parameters for increased product differentiation
- Inform the value chain of the impacts of management and breeding decisions on lamb product quality for continual improvement.

People

Investing in initiatives that build capability within the industry to ensure animal breeding continues to advance sheep and beef production.

QUANTITATIVE GENETICS MASTERS PROGRAMME

"It's about ensuring New Zealand has a ready supply of appropriate capability – talent that is highly relevant to our primary sector's productivity. And continued genetic improvement is a key part of sustaining our nation's GDP."

- Dr Phillip Wilcox, University of Otago

B+LNZ Genetics has appointed Dr Phillip Wilcox as its inaugural senior lecturer in quantitative genetics at the University of Otago.

Dr Wilcox has a background in molecular and quantitative genetics and comes from the forestry-focused Crown Research Institute, Scion, where he was a senior scientist. He was also a part-time senior research fellow with the University of Otago's Department of Biochemistry, working in the field of human genetics.

Dr Wilcox's main focus in the B+LNZ Genetics funded role will be establishing a two-year Master of Applied Sciences in Quantitative Genetics at the university. Quantitative genetics is central to most B+LNZ Genetics research activities and underpins its sheep genetics evaluation system. "For the past 20 years, to get people with these skills in New Zealand, we've tended to recruit people with PhDs or advanced Master's from overseas.

The Master's programme is an opportunity to begin filling such roles with homegrown talent.

B+LNZ Genetics chairman Dr Chris Kelly says quantitative genetics is a critical discipline in animal and plant breeding and key to B+LNZ Genetics' ability to drive continued genetic gain for commercial sheep and beef farmers.

"It is, however, a specialist discipline and there are very few practitioners trained to an advanced level in New Zealand. The Master's programme will link with other genetics programmes in New Zealand and make extensive use of primary industry scientists. This will help facilitate a pathway for Master's students to transition into work positions."

The new position sits within the University of Otago's Department of Mathematics and Statistics and Dr Wilcox will work alongside other scientists from the university who also contribute to B+LNZ Genetics research.

COMMUNICATING KNOWLEDGE: FORUMS, WORKSHOPS & FIELD DAYS

Increasing the uptake of proven on-farm practices

B+LNZ Genetics provides the information and tools farmers need to lift their profits via genetics. We invest in initiatives to increase the uptake of proven on-farm practices and promote best practice in the management of breeding.

Several progeny test properties also operate as training farms, exposing young cadets to breeding and genetics technology in real-life farming situations

Initiatives include:

- Engagement with industry through regular genetics workshops, forums and field days
- Using progeny test farms as a platform to demonstrate genetic tools and how they can be used in real-farm situations
- Delivering online support tools to aid ram or bull purchases.

SIL-ITAG ADVISORY GROUP

SIL Industry Technical Advisory Group (SIL-ITAG)

SIL-ITAG was formed to help guide development of the SIL performance recording and genetic evaluation system. The group meet 1-2 times per year to provide feedback to B+LNZ Genetics on its programme of services and developments related to SIL, and to provide industry with a route to table ideas or issues relating to SIL with B+LNZ Genetics.

SIL-ITAG members

Richard Lee (Chairman)

Sharon McIntyre (SIL Senior Advisor)

North Island representatives:

Will Jackson, Matt Holden, Rob Forsythe, Barbara Beckett, Cameron Heggie and Brent Campbell

South Island representatives:

Robert Peacock, Andrew Tripp, Hamish Bielski, Hamish Craw, Julia Aspinall, Graham Sidey and Annabel Tripp

B+LNZ Genetics and SIL advisory team:

Graham Alder, Eleanor Linscott, Max Tweedie and Annie O'Connell

If you have any topics that you would like to put forward for discussion at SIL-ITAG meetings, please email these through to: *info@blnzgenetics.com*

BEEF + LAMB NEW ZEALAND GENETICS

Beef + Lamb
New Zealand Genetics

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