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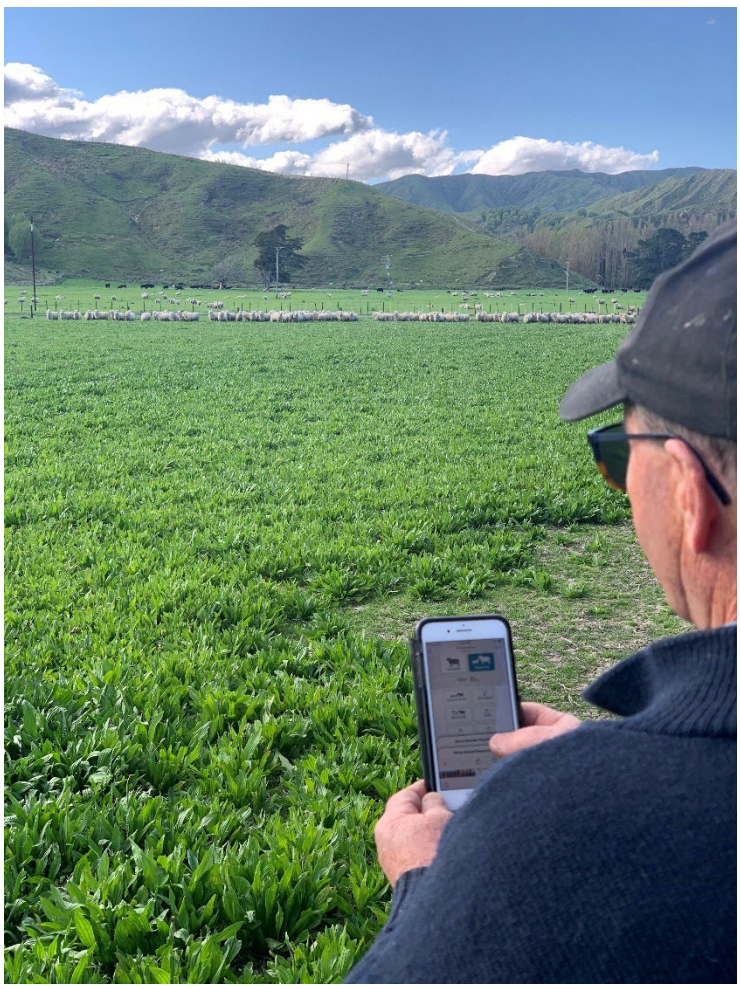

BARRIERS TO GENETIC POTENTIAL THROUGH SIRE SELECTION IN NEW ZEALAND SHEEP FARMS

Kellogg Rural Leadership Programme

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I wish to thank the Kellogg Programme Investing Partners for their continued support.

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1. Contents

2. Executive Summary

Agriculture contributes to 50% of New Zealand's gross greenhouse gas emissions, an industry that is largely dominated by ruminants producing methane (Ministry for the Environment, 2022).

The Climate Change Response Act 2002 has set a target to reduce biogenic methane emissions to 24–47 per cent below 2017 levels by 2050. Therefore, the reduction of methane emissions from livestock is of significant environmental and economic importance.

It has been demonstrated that there is repeatable, individual variation in the methane emissions of sheep and that part of that variation is genetically heritable. There is now a breeding value that allows commercial farmers to rank, select and purchase lower methane emitting sires. This is currently the only tangible and proven mitigation farmers can start implementing on their farms right now.

In a time where our consumers are more discerning than ever before about how their food is produced, it is vital that commercial farmers utilise resources and technologies wherever possible to further our competitive advantage through sustainable practices.

However – regardless of personal views on climate change or political policies – do commercial farmers have the capacity and capability to understand the opportunity that these low methane-emitting genetics bring?

This research focuses on understanding the barriers to genetic potential through sire selection on New Zealand sheep farms.

To gather information on the barriers for farmers in relation to breeding decisions a literature review was undertaken to understand the gap in knowledge of farmers with regards to genetics, along with establishing factors in commercial farmer behavioural change and understanding of complex decision-making in relation to animal breeding decisions.

This was followed by an unstructured interview process with four farmers from three different farming enterprises, to establish a journey map to understand each farmer's experiences, by creating a map of their interactions with sire selection. Farmers were selected to represent different types of farming enterprises and perspectives within the sector.

This process also helped to establish a picture of their current level of understanding, perceptions and preferences in genetic decision-making and identification of barriers to genetic potential through sire selection within the farm systems.

i. Key Findings

Given the significant advances in genetic and recording technologies over the past 20-30 years, it could be assumed that sire selection decisions should have become simpler. However, though these technological advances may provide more information, the complexity and scope of the information may also overwhelm farmers.

Martin-Collado, et al. (2018) describes that when people are faced with complex decisions and/or are exposed to information overload, this leads to either impulsive often suboptimal decision-making or they use simplification strategies (i.e. heuristics).

In terms of effecting meaningful change through genetic decision-making, the ability to effectively compare a farmer's system with that of others appears to be an instigator to change.

There is a significant educational role to fill with regard to sire selection and genetic decision-making. Whilst we have sheep which are genetically lower methane emitting or significantly more tolerant to facial eczema available for purchase now, there is much to be done to assist the commercial farmer to realise the opportunities available to them when it comes to genetics.

ii. Recommendations

Beef + Lamb NZ should aim to develop a number of tools and resources aimed towards genetics education and extension for both commercial farmers and breeders.

The development of these tools and resources should:

- consider the individualism of farmers and their systems, the behaviour of change and complex decision heuristics,
- be developed in collaboration with subject matter experts and farmers to be relatable for the intended audience,
- share the success stories of farmers who have successfully harnessed the opportunity of genetics
- be created for a range of delivery mechanisms to cover a range of learning styles.
    - These should be developed in collaboration with industry partners to facilitate the uptake of these resources by these parties to assist in the dissemination and delivery of the resources.

3. Acknowledgments

First and foremost, I'd like to acknowledge and thank Beef + Lamb New Zealand for allowing me this opportunity, by selecting me to fulfil their 2022 placement in the Kellogg Rural Leadership Programme. The support of B+LNZ to complete this programme has been greatly appreciated and I endeavour to bring my learnings and leadership skills developed through this programme, back to my role within B+LNZ Genetics to further benefit our industry.

To the everyday inspiring industry, I am lucky enough to work in, thank you. Every day there is a new challenge, a new perspective, a new story. This gets me out of bed every day and drives my enthusiasm to do better for our industry's future. This programme has helped me identify just how fantastic our country's food and fibre sector is, and how many incredibly passionate and capable people we are lucky to have in it. I will continue to strive to be one of them.

To all the farmers, breeders, colleagues, friends and family linked to this industry; thank you for being my sounding board, for sharing your stories and for giving up your time in my quest to better all things sheep genetics! I am incredibly grateful to be supported and challenged by you all.

I'd like to thank my fellow cohort-47 members. A small but passionate group of individuals from many different corners of the industry has enabled some great discussions and perspectives and I look forward to continuing these beyond the completion of this programme.

Finally, I'd sincerely like to thank the Rural Leaders team; Phil Morrison, Annie Chant, Lisa Rogers, Dr Patrick Aldwell and Chris Parsons. You have each individually added to what is already an incredibly diverse, thought-provoking and inspiring programme. It has been a privilege to learn from and work with you all throughout this programme.

4. Introduction

The world we live in today is experiencing a time of unprecedented volatility, uncertainty, complexity and ambiguity, referred to as VUCA (KPMG, 2021 Agribusiness Agenda, 2021). However, New Zealand's Food and Fibre sector continues to produce high-quality exports.

Despite the many Covid-19-related supply-chain disruptions, a record high of $52.2 billion in export revenue was forecast in the year to 30 June 2022, a 9% increase from the previous year (Ministry for Primary Industries, 2022).

The Covid-19 pandemic the world over saw many supply-chain disruptions, and as a result, has seen a consumer trend toward locally or domestically produced products. This consumer behaviour can be attributed to one or more of the following factors: unreliable or lack of supply of imported products due to supply-chain disruptions, a more acute awareness of "food miles" associated with imported products, or a desire to support local businesses in times of uncertainty.

As our food and fibre sector is heavily reliant on exporting our products, this trend brings significant risk. Now more than ever, the need to clearly understand our consumer's expectations and articulate the value proposition of our products is of critical importance.

The 2022 Agribusiness Agenda (KPMG, 2022) suggests that previously our competitive advantage had been more production focussed, but now should focus more on what we can do in Aotearoa that is distinct, unique, and sustainable. Therefore, our competitive advantage to consumers will likely come from environmentally positive brand stories and products.

In 2016, New Zealand formalised its commitment to an emissions reduction target by ratifying the Paris Agreement – the global agreement on climate change (Ministry for the Environment, 2020).

This signified New Zealand's intention to reduce greenhouse gas emissions.

New Zealand's agricultural industry is largely dominated by ruminants which produce methane. Methane is an end product of the fermentation process of ingested feed before absorption of nutrients in ruminant animals, it is produced as a way to dispose of hydrogen from the gut (Swainson et al., 2018).

Figure 1 demonstrates that Agriculture contributes to 50% of New Zealand's gross greenhouse gas emissions, including the majority production of methane and nitrous oxide.

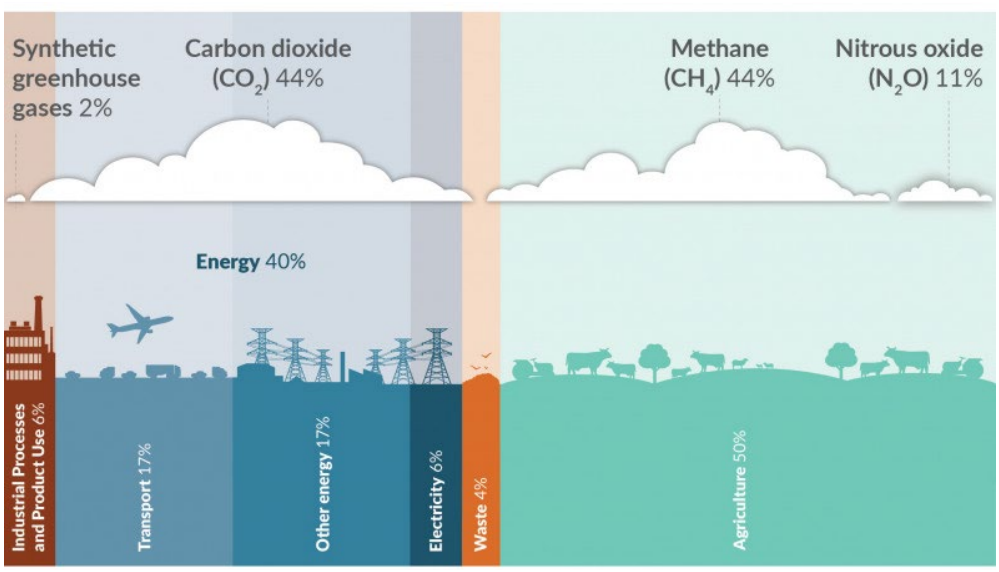

Figure 1. *Breakdown of New Zealand's gross greenhouse gas emissions by sector and gas type in 2020. (Ministry for the Environment, 2022)*

The Climate Change Response Act 2002 has set a target to reduce biogenic methane emissions to 24–47 per cent below 2017 levels by 2050 and 10 per cent below by 2030. Therefore, the reduction of methane emissions from livestock is of significant environmental and economic importance.

In the last 30 years, we have seen a drop of 55% in sheep numbers from roughly 58 million to 26 million head, while lamb production has only dropped 10% (a difference of 40,000 tonnes of hot carcass weight) over the same period (Beef + Lamb New Zealand Economic Service, 2021). In part, this is due to

improved management and pastoral farming advances but is also due in part to advancing genetics for livestock improvement.

Due to the efficiency at which New Zealand farming businesses utilise resources for production outputs, the overall emissions intensity (emissions per unit of product) of New Zealand agriculture has on average, decreased by roughly 1% per year since 1990 (PGgRc & NZAGRC, 2016). This means that the gasses generated per unit of meat or milk produced on farm has on average, been gradually decreasing for the last 30 years. This is thanks to several advances in things such as genetics, stock management, grazing management, and feeding practices.

It has been demonstrated that there is repeatable, individual variation in the methane emissions of sheep and that part of that variation is genetically heritable (Pinares-Patino, et al., 2013). There is a breeding value (BV) (Beef + Lamb New Zealand, 2020) that allows commercial farmers to purchase low methane rams. Currently, breeding for low methane sheep is the only tangible and proven mitigation farmers can start implementing on their farms right now.

However – regardless of personal views on climate change or political policies – do our commercial farmers understand the opportunity that these low methane-emitting genetics bring?

Alongside the animal's own emissions, climate change predictions also present the potential for the increased occurrence of significant animal health challenges such as internal parasites, facial eczema, flystrike and pneumonia (Johnson, et al., 2021). Genetic improvements in tolerance and resilience to these health challenges represent an opportunity for commercial farmers to reduce on-farm inputs and improve animal welfare.

In a time where consumers are more discerning than ever before about how their food is produced, it is of vital importance that wherever possible, resources and technologies are utilised by commercial farmers to further our competitive advantage through sustainable practices.

5. Aims & Objectives

This report seeks to identify and understand the barriers for farmers to making better use of the low-hanging fruit that is genetic or animal breeding decision-making through sire selection.

This research aims to better understand:

- What "genetics" means to farmers
- Farmers' experience with sire selection within different farming systems
- Barriers to effective utilisation of genetics within different farming systems

Thus, the research question is what are the barriers to genetic potential through sire selection on New Zealand sheep farms?

6. Methodology

To gather information on the barriers for farmers in relation to breeding decisions, both primary and secondary sources of information were critically analysed.

A literature review was undertaken to understand the gap in knowledge of farmers with regards to genetics, along with establishing factors in commercial farmer behavioural change and understanding of complex decision-making in relation to animal breeding decisions.

This was followed by an unstructured interview process with four farmers from three different farming enterprises, to analyse the experiences and perspectives of New Zealand sheep farmers.

Farmers were selected to represent different types of farming enterprises and perspectives within the sector, including a family-owned and operated commercial farm and stud ram breeder, a large progressive farming enterprise and a corporate farming entity.

The unstructured interview process with each farmer aimed to establish a journey map to understand each farmer's experiences, by creating a map of their interactions with sire selection.

This process also helped to establish a picture of their current level of understanding, perceptions and preferences in genetic decision-making and identification of barriers to genetic potential through sire selection within the farm systems.

From the interview process, key themes were identified and analysed in section 8 Discussion.

Comparisons and contrasts were made with the key themes resulting from the farmer interviews, alongside the information gathered in the literature review.

7. Literature Review

i. Behavioural change

Decisions are informed by attitudes and behaviours, therefore before we delve into effective animal breeding decisions, it is important to understand the factors influencing behavioural change. This is critical to appreciate when looking to influence change.

Thompson, et al. (2021) lists and describes four key factors found to influence behavioural change and adoption of practices in farmers:

a. Personal factors – general attitude, including risks (openness to change or innovation), values (e.g. to the environment) and knowledge.
b. Institutional factors
    i. *Informal* – social context, includes networks and connectivity, norms (what is right or normal), the influence of peers.
    ii. *Formal* – economic, legal and political context, includes rules and regulations, incentives (e.g. subsidies) and markets, supply chains and consumer preference.
c. Farm structure factors – farm characteristics, for example, spatial area, herd/flock size, farm type (e.g. livestock, arable, mixed), income and geographical and biophysical conditions.
d. Socio-demographic factors – farmer characteristics, for example, age and education.

Farmers will adopt varying combinations and intensities of the above factors in their behaviour based on their individual situations.

It is important to remember these drivers of individuality when attempting to influence change.

ii. Complex decision-making

Sire selection is often a balance between visual appraisal and data-driven decision-making. These could also be described as objective versus subjective decision-making factors and the balance of these two factors, in reality, varies based on the individual.

Martin-Collado, et al. (2018) outlines that fields such as psychology, economics and marketing have extensively researched the complexities behind people's decision-making behaviours. It also described the work of Uzaea (1959) where it is thought that people are rational-decision makers, who select the option that gives them the highest value after a logical assessment of the options available. However, this assumes that people have the required information and the capacity to analyse said information, before making the decision (Todd & Gigerenzer, 2000).

In reality, this may not necessarily be the case. Within the field of genetics or sire selection more specifically, this is likely related to the capacity to understand or analyse all available information.

Given the significant advances in genetic and recording technologies over the past few decades, there could be an assumption made that sire selection decisions should have become simpler for farmers. However, though these technological advances may provide more detailed information to inform the decision-maker, the complexity and scope of information may also overwhelm them.

Martin-Collado, et al. (2018) describes that when people are faced with complex decisions and/or are exposed to information overload, this leads to either impulsive often suboptimal decision making or they use simplification strategies called heuristics – either consciously or unconsciously, see **Figure 2**.

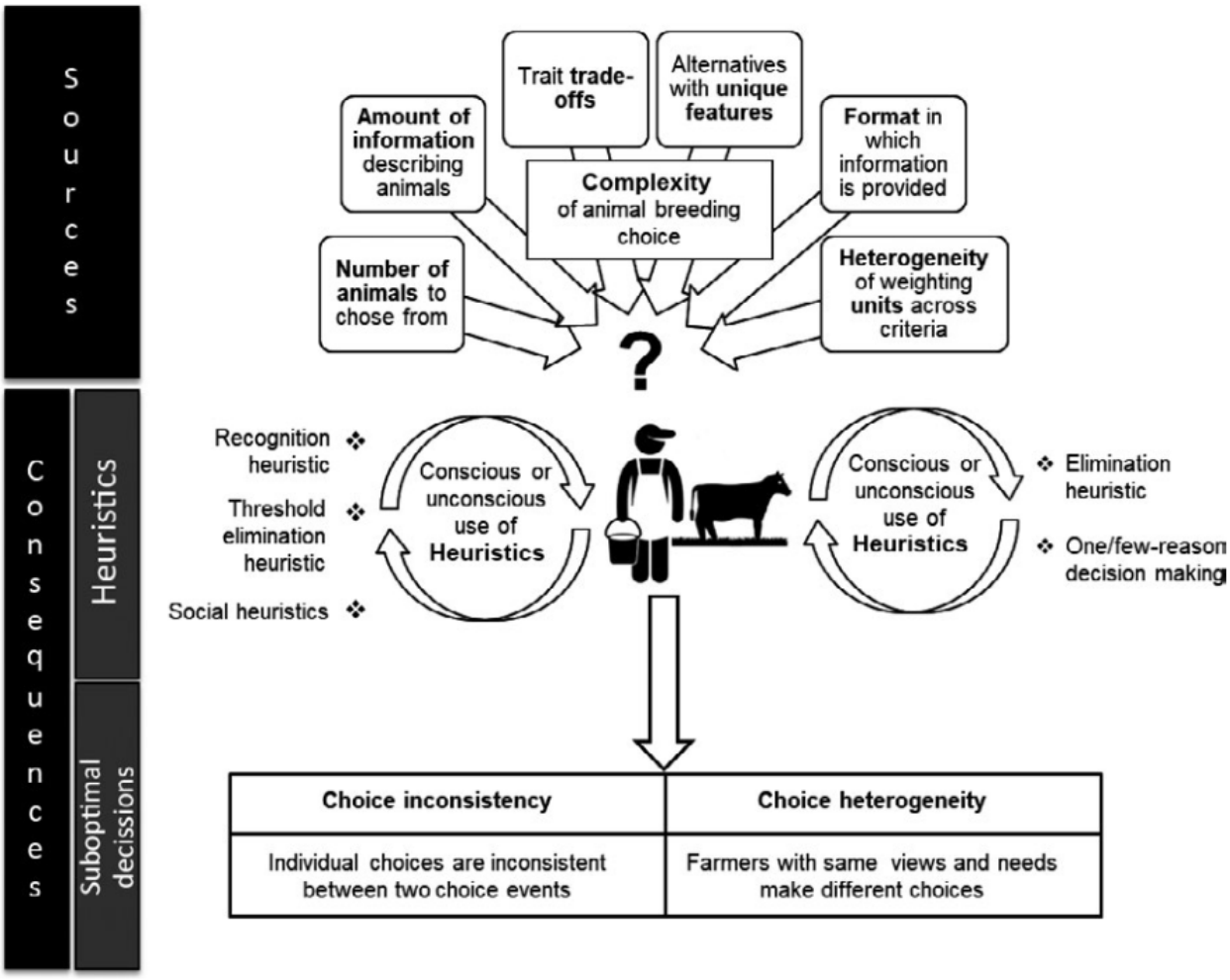

Figure 2. *Description of how complexity might be affecting animal breeding choices made by individual farmers according to the theoretical principles of complex decisions. Key sources of complexity, potential heuristics used by farmers to simplify the decisions, and types of suboptimal decisions which may occur due to that complexity (Martin-Collado, et al., 2018).*

Within this research, heuristics are described as simple rules which are implemented by people making complex decisions or when they lack the adequate information required to make an informed decision. An example of this is to ignore significant chunks of information provided, relating to the animals they are selecting.

Table 1 from Martin-Collado, et al. (2018) outlines key sources of decision complexity of relevance to animal breeding choice-making.

This outline is a helpful summary to bear in mind when developing resources to assist in commercial farmer education around animal breeding decisions. It identifies the sources influencing complexity in decision making and their application to animal breeding or the sire selection process.

Table 1. *Key sources of decision complexity of relevance to animal breeding choice making (Martin-Collado, et al. 2018)*

Theoretical principle (*concept name*)	**Applied to animal breeding**	**Example**
Too many choice alternatives (*Choice overload*)	Number of animals to choose from	The number of breeding animals available could be considered unlimited
Too many attributes used to describe alternatives (*Information overload*)	Number of traits and other pieces of information used to describe breeding animals	Traits, index merit predictions and any other piece of information used to describe breeding animals
Existence of trade-offs between attributes of alternatives	Trade-off between traits of interest, particularly when there are antagonistic associations among traits	Existing trade-off (unfavourable correlations) between production and functional traits. There is no perfect animal for all traits, and even if there was, there would not be enough of these animals
Existence of alternatives with unique features	The existence of limiting attributes or unique features of some specific animals or breeds	Genetic disorders or polled animals are easy targets for decision-makers; the animal has discrete levels, carrier or non-carrier, and so there tends to be a bias towards selecting for these when they are available
Heterogeneity of weighting units across criteria	Animal traits have different units and not all of them are easily translated into economic terms. Also, attributes can be measured in either categorical or continuous terms	Some traits are easily expressed in monetary terms while for others the transformation is not as easy. Farmers have economic and non-economic motives in making breeding decisions
Format in which information is provided	The format in which breeding animals' characteristics are provided to farmers	Breeding animal cards provided by breeding companies are usually designed to highlight some animal features and include different systems to simplify information
Decision-maker ability to cope with complexity (*Competence-Difficulty gap*)	The perception of the complexity level of selection decision is farmer dependent	Age, education level, and experience in breeding are very likely influencing farmers' ability of cope with complex breeding decision

iii. Understanding the knowledge gap

Fellow Kellogger Johanna Scott investigated the knowledge gap in farmer understanding when it came to genetics (Scott, 2016). From her research, she concluded that yes there was a gap in understanding, however, this varied from farmer to farmer. Several reasons for this gap were documented in her report including the following:

- "You can't see genetics" – It is hard to prioritise and invest in compared with for example fertiliser.
- It's a complex subject to understand and explain – "Even stud breeders find it hard to understand, let alone explain it to their clients".
- Genetics is a long-term game – once you purchase a sire, it might not be til 3-4years down the track that you see the maternal performance of his daughters.
- There is limited information being shared with commercial farmers and no obvious pathway for the transfer of information to commercial farmers.
- Advisors to commercial farmers on genetics vary but may include breeders, scientists, consultants, stock agents, vets and levy bodies such as B+LNZ Genetics. Not all of these are created equal and have varying knowledge and biases depending on their role.

There were also themes identified by Scott (2016) around the desire from commercial farmers for more authentic information to empower their decision-making.

Since the publication of this report (Scott, 2016), there has been industry change. For example, in relation to the point made by Scott (2016) around the lack of information transfer to inform commercial farmer decision-making, there is now a new tool nProve, that has been developed to allow farmers to "Discover genetics fit for your purpose" (B+LNZ Genetics, 2020). It has been developed, in collaboration with commercial farmers, to be intuitive to use and the transparency of data invites users to really understand what their current breeder is offering and compare them with other options on an even playing field.

8. Discussion

As described previously, this research aims to better understand three aspects of animal breeding decisions in commercial farmers, through discussion and creation of a journey map around the experience of sire selection with selected farmers.

- What "genetics" means to farmers
- Farmers' experience with sire selection within different farming systems
- Barriers to effective utilisation of genetics within different farming systems

To understand the experiences and perspectives of New Zealand sheep farmers and their barriers to genetic progress on-farm, an unstructured interview process with four farmers from three different farming enterprises was undertaken,

Farmers were selected to represent different types of farming enterprises and perspectives within the sector, including:

- a family-owned and operated commercial farm and stud ram breeder (two farmers interviewed),
- a large progressive farming enterprise and
- a corporate farming entity.

The unstructured interview process with each farmer aimed to establish a journey map to understand each farmer's experiences, by creating a map of their interactions with sire selection. A Journey Map key questions asked through this process can be found in Appendix section 12 i.

The following describes the key themes which emerged from the unstructured interview process.

The four farmers representing the three farming systems are quoted in the discussion below and can be identified as described in the footnote below[1234]:

i. What does "genetics" mean to farmers?

As described by (Thompson, et al., 2021), there are four factors that will influence behavioural change and the adoption of practices in farmers. This suggests that each individual and operation will have different views on the proposed question.

"Opportunity, genetics presents opportunity" [1]

"Data is what I'm paying for, the ram or bull is just the transfer mechanism, it's just a vessel for the genetics" [3]

"Objective way to make decisions, takes the noise out of it" [4]

Genetics or sire selection utilising genetic information tends to have a stigma around it in terms of being complicated and this influences decision-making behaviour. Martin-Collado, et al. (2018) described, that when people are faced with complex decisions and/or are exposed to information overload, this leads to either impulsive often suboptimal decision-making, or they use simplification strategies called heuristics – either consciously or unconsciously.

However, genetics doesn't need to be complicated. The process described in the Sheep Genetic Learning Module (Beef + Lamb New Zealand, 2020) breaks down how to make sire selection easier, one step at a time:

a. Establishing goals – what the current level is now and where it needs to be

Understanding what in the farm system makes money and costs money is a simple way of thinking about goals. For example, one farmer interviewed described the following:

"Our initial focus was heavily on reproduction, more lambs on the ground means more dollars in the bank, until it didn't. What we realised was that worms and dags across more lambs was

[1]family-owned and operated commercial farm and stud ram breeder (1)
[2] family-owned and operated commercial farm and stud ram breeder (2)
[3] large progressive farming enterprise
[4] corporate farming entity

costly both in terms of labour and input, so we needed to up our focus in terms of genetic selection in these areas to realise the benefit of those additional lambs." [3]

b. Finding a breeder that can help achieve those goals

B+LNZ's tool nProve makes it easier for farmers to find the best rams for their farming operation by using a series of buttons and slider scales to define exactly what is needed from a ram team. The end result is a list of breeders whose rams tick those same boxes (B+LNZ Genetics, 2020). nProve allows an anonymous even playing field to compare breeders objectively with each other, without the *"white noise"* of sales pitches and marketing plugs, as alluded to by the below quote.

"It's amazing come sale season just how many breeders claim they're the top 10% in the country for something!" [2]

Once a short list of breeders has been narrowed down, it is of the utmost importance to then talk with these breeders directly. Firstly, to get a feel for their programme philosophies and direction to see if it aligns with the farmer's system, secondly to get a feel for the business relationship the farmer may be entering into, will they be able to provide a level of service they're comfortable with, and finally to understand the process of purchasing their animals, described in the following steps.

c. Research animals available

nProve not only shows resulting breeders based on the farmer's selection criteria but also animals that fit the criteria. However, as there is no "buy now" button on the tool, sires still need to be purchased from the breeder. As above, discussion with the breeder regarding the availability of animals available to purchase but also importantly, discuss with the breeder what animals have piqued interest in the process and why so that they can help the farmer find what they're looking for. If the breeder enables the farmer to make an effective and informed purchase, it's more likely that the farmer will be back to them for more, so if the farmer wins, the breeder wins.

d. Understand the sales process

Understanding what the process will be on sale day is one of the most critical steps in relation to whether or not a farmer will choose to stay where they are or change breeders – according to all four of the farmers interviewed. The following quote helps to qualify this sentiment.

"If I'm looking at changing to another breeder, but they tell me I'm going to be the last draw after everyone else has picked the eyes out of the rams available, I would find it hard to move" [4]

The sale day process varies, some breeders hold auctions, and many hold private selections. Along with the process, the "pecking order" or priority list detailing the order of client selection can be a major factor to be considered. Breeders often prioritise loyal customers, however, many will also be sure not to let all clients see all rams so there is still an opportunity for those later down the list to get what they need – again this is where it is important for the farmer to let the breeder know what they are looking for.

How rams are priced on sale day is another thing for farmers to ask ahead of time. Generally, the prices will be linked to the merit of the animal, whether that be genetic information or physical attributes will depend on the breeder's preference.

The genetic information available to farmers on sale day is another critical component to understand prior to sale day. One of the farmers interviewed described the process they've gone through with their breeder in the quote below.

"I've worked with my breeder to establish a line in the sand of what I am willing to compromise on genetically and what I'm not. It's taken time but I'm now able to

shortlist rams based on their genetic information prior to the sale and then all I have to do is select on structure and phenotype when I get there" [3]

Not all breeders have the capacity to present animals this way to all clients, however, it is the prerogative of the client/farmer to ask for information beforehand to enable them to make informed decisions on the day.

e. Select and purchase individual rams

Farmers by this point have effectively "done the hard yards" so to speak. Much of the homework, including the establishing of goals, breeder research, discussions and establishing of boundaries with genetic information is done prior to looking at animals.

Sire selection is often a balance between visual appraisal and data-driven decision-making. These could also be described as objective versus subjective decision-making factors and the balance of these two factors, in reality, varies based on the individual.
Phenotypic selection or selection based purely on the physical appearance of an animal, allows unconscious bias to influence the decision. For example, the biggest roundest ram may draw the eye, however, his individual performance is not always indicative of the potential performance he could pass on as a parent. Therefore, it is best to balance visual assessment with that of objective genetic information.

However, it is important to factor in structural integrity. If a ram is not able to serve a ewe, then the best genetics in the world won't help any farmer.
Finally, once the ram is taken home by the farmer, it is important to look after him as he's an investment in the flock's future. If the farmer looks after him, he'll look after them.

ii. Farmers' experience with sire selection within different farming systems

Throughout the process of journey mapping with the four farmers interviewed, the following key themes emerged while discussing their sire selection experiences:

a. The instigation for change aligned with comparison or benchmarking with others.

"The ability to step back and look at your performance in comparison with others gives you the perspective to change." [2]

This highlighted a need to establish easy and accessible performance benchmarking tools for commercial farmers so that they can gain perspective of their system without necessarily engaging a consultant or joining a discussion group.

b. Trial and error is the best way to find out what works in your system.

"You don't have to change everything all at once, just try a little each year, to see what works." [1]

"Sometimes you need to spend a dollar to make a dollar" [3]

Farmers who trialled and tested changes within their systems, measured the differences, and compared them to their current systems, found it easier to effect change. They had confidence in changing after seeing tangible results of comparison from within their own system. Changes can be incremental, just trying it on a small scale initially was a common occurrence among those interviewed, and if it worked, they kept expanding. If it didn't, they would stop, reflect and adapt.

"Investing in this process may be the best money you could ever spend, as it will qualify your potential going forward" [3]

c. Engaging and comparing performance outside of your own operation gives valuable perspective.

"It's ok not to be an expert and to ask for guidance" [4]

A different perspective can be all that is needed to change the thinking around the same old problem. Enabling other people, tools and services to help farmers understand their system will

make farmers more aware of the opportunities and mitigate the risks within it. This may include but not be limited to the following: discussion groups with fellow farmers, consultants, and subject matter experts.

iii. Barriers to effective utilisation of genetics within different farming systems

Even with a varying appreciation and understanding of genetic information (e.g. breeding values and indexes), animal breeding decisions are made annually in terms of what animals are to be mated.

Below describes some of the themes identified by the farmers interviewed as barriers to more effective genetic decision-making.

"It's where Grandad bought rams from" [1]

Historical relationship pressure was one of the most commonly described barriers to change in those farmers interviewed.
This describes a very common restriction in many farming operations, where a relationship with a breeder has been established generations before the current decision maker and there is pressure to keep this relationship, despite what their sires offer.
According to the farmers interviewed, there was an observation that younger generations seem to feel less pressure in terms of loyalty than previous generations, however, many of the younger generations are not farming autonomously so do not have sole decision-making power. Therefore, there is still pressure to maintain historical relationships.

"No one likes change." [2]

In the VUCA world we currently live in, change is the only constant so adding something else to the pile can be the last thing on anyone's mind. Establishing that it's "broke" before you try to "fix it" is likely why we see benchmarking and comparison with others as an instigator for change.

"I trust my breeder, I don't need to understand what they're doing" [1]

This is a common "too-hard-basket" type mindset for many commercial farmers. However, as a decision with the potential to make such a significant and long-lasting impact within a farm system, it is hard to understand why farmers often hand this over to the person profiting from this decision, the breeder. Of course, not all breeders are created equal.

9. Conclusions

Decisions are informed by attitudes and behaviours. Thompson, et al. (2021) listed four key factors found to influence behavioural change and adoption of practices in farmers: personal, institutional (both formal and informal), farm structural and socio-demographic.

Farmers adopt varying combinations and intensities of these factors in their behaviour based on their individual situations. This individualism was demonstrated through the farmer interviews, where each system saw genetics slightly differently, for example as an opportunity for change with regard to specific issues or more directly as a production tool.

This individuality is important for a diverse industry but is also an important factor to recognise when attempting to influence change.

Understanding the human behaviour behind complex decision-making gives a new perspective on how information may be perceived (or ignored) with respect to sire selection and animal breeding decisions.

The work of Uzaea (1959) described people as rational-decision makers, who select the option that gives them the highest value after a logical assessment of options available – assuming that people have the required information and the capacity to analyse said information, before making the decision (Todd & Gigerenzer, 2000).

In reality, this may not necessarily be the case. Within the field of genetics or sire selection more specifically, this can be seen through the capacity of a farmer to understand or analyse all available genetic information.

Despite all good intentions from breeders to inform their farmer clients with as much information as is available, this may be making the decision-making process harder for farmers through overwhelm.

When people are faced with complex decisions and/or are exposed to information overload, this can often lead to poor selection decisions when heuristics are engaged to make a decision. Martin-Collado, et al. (2018) described heuristics as the simplification strategies people either consciously or unconsciously engage when they experience decision complexity. This can lead to either wrong or inconsistent decision-making.

This effect, if not considered in the process of sire selection, can severely influence (bias) the resulting decision. If an incorrect (dependent on the farm system) or inconsistent sire selection decision is made, this will severely limit the potential genetic progress for the farmer in their system. This inconsistency and/or lack of progress may also lead to frustration and doubt around the reliability of genetics as a means of on-farm progress. This in itself can create a barrier to future genetic potential.

Through farmer interviews, a theme emerged around the value of comparison or benchmarking of current farm performance with that of others. The instigator for changes within a farming system in relation to genetics or sire selection in all three of the farming enterprises represented by those farmers interviewed had been the comparison or benchmarking of their current system. The method for this comparison varied. For example, one farmer's experience was through their discussion group where members shared their production and financial information with each other and discussed amongst the group. Where another carried out on-farm trials with different genetic lines of stock and measured and compared them against their existing system. Both of these methods appeared effective in effecting permanent changes in the sire selection and animal breeding decisions within their respective systems. Therefore, enabling farmers to effectively compare their systems may be the instigator they need to effect change.

However, in the VUCA world we live in, where change is the only constant, prioritising a potential for change is often difficult for farmers. Establishing that it's "broke" before they try to "fix it" is likely why we see benchmarking and comparison with others as an instigator for change.

Historical relationship pressure was identified, through farmer interviews, as a significant barrier to genetic potential. Where there is pressure from an older generation to maintain the existing breeder relationship, rather than compare and contrast the existing breeder with others who may be better suited to help the farmer achieve their on-farm goals.

However, this restriction imposed by the older generation may also be the support mechanism allowing or assisting younger generations to enter this industry through farm succession or equity partnerships. Therefore, it is important to maintain a level of balance between the two often opposing views.

This research has further exposed the significant educational role in relation to genetics and animal breeding decision-making. Whilst we currently have sheep that are genetically lower methane emitting or more tolerant to disease available, there is much to be done to assist the commercial farmer to realise the opportunities available to them when it comes to genetics. This needs to account for a number of the factors listed here including but not limited to; the behaviour of change, complex decision-making heuristics, instigation of change through comparison mechanisms and existing relationship restrictions.

10. Recommendations

The following recommendations are predominately directed towards Beef + Lamb NZ. They are to:

- Develop of tools and genetics educational and extension resources to assist commercial farmers in genetic decision-making.
    - These resources should take into account the individualism of farmers and their systems, the behaviour of change and complex decision heuristics.
    - These resources should be developed in collaboration with not only subject matter experts but also farmers so that they are relatable to the perspective of the intended audience.
    - Farmers should be recruited as the predominant storytellers within these resources, with regard to how they have achieved change and success through genetics.

        - Profiling of farmers who have successfully harnessed the opportunity of genetics within their farm system should not only be “top 10%” farmers but should predominately include the relatable “everyday” farmer story.
    - There should be a range of delivery mechanisms for this information to be disseminated including but not limited to face-to-face workshops, online learning modules and fact sheets to cover a range of learning styles.
        - This should be in line with RMPP recommended extension design, alongside work currently being undertaken by B+LNZ Genetics in the Informing New Zealand Beef programme.
    - These delivery mechanisms should be developed in collaboration with industry partners such as vets, consultants and tertiary education providers, to facilitate the uptake of these resources by these parties to assist in the dissemination and delivery of the resources.
- Development of tools and templates to assist sheep breeders deliver their genetic information to commercial farmers in a consistent, clear and comparable format.
    - These resources should also take into account the individualism of farmers and their systems, the behaviour of change and complex decision heuristics.

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12. Appendix

i. Journey Map and Informal Interview Template

Key factors identified in establishing the journey map for each farmer interviewed are listed below. The informal interview process included questions along these key points:

- the journey maker — who completed the task
- their goal or task — what they wanted to do
- their touch points — how they interacted with people, technology or resources
- what they saw, thought and felt — what they noticed, what they were thinking and how they felt while carrying out the task
- the instigator – who or what prompted the need or desire to change
- the highlights — things that enabled them to complete the task successfully
- the pain points — things that made it hard to complete the task