



NEW ZEALAND
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TRUST

The use of mobile technology in the red meat sector



Email



FarmHelp



Alarm & clock



Earth



BNZ Mobile



Chrome



Data Collect



4R

“Decision making makes the farmer but the information they use to make the decision makes the profit”



FULL REPORT

Table of Contents

About the Author	3
Background	3
Weaver Declaration	4
Contact Details	4
Acknowledgements	5
Executive Summary	6-8
Introduction	9-10
The Red Meat Industry	10-11
The Changing Market	12-14
The Farming Ecosystem	14
The Current State of Mobile Technology	15
On-Farm Technology	16-17
Emerging Technologies Relevant to the Red Meat Sector	18-19
Adoption of On-Farm Technology	20-22
Value Chain	23-24
Industry Change	25
Transparent Supply Chain	26-27
Conclusions	28
Recommendations	29
References	30
Glossary	30

About the Author

Dan Shand is a 36 year old farmer married to Mandy Shand. Together with their two children, Amalia (8) and Hugh (5), they farm sheep and beef on their 7,000 hectare Island Hills Station at Culverden in North Canterbury. They also run a beekeeping and tourism operation known as Everything NZ Ltd.



Background

I grew up at Island Hills and spent most holidays helping on the farm. After attending boarding school in Christchurch I completed a diploma in business management before moving to Dunedin to study design and marketing at the University of Otago.

While at Otago I met my wife, Mandy. We later moved to Australia where I continued my I.T. study at the Kent Institute in Sydney before working for Objective Group, a market strategy company. My wife and I then returned in 2001 to Island Hills Station to start our tourism and honey company, Everything NZ Ltd. I started farming in 2007 and in 2012 we won the Canterbury Ballance Farm Environment Supreme award. I soon realised that I would need to understand New Zealand markets in a global context should I want to contribute to helping improve the industry. This was instrumental in my decision when applying for a Nuffield Scholarship.

Having farmed for a number of years with the inability to identify productivity gains using the current technologies, I decided to research the use of mobile technology and how we are able to use it to return value to farmers. Having completed my study, I am now more convinced than ever that technology will revolutionise the way we farm for a number of reasons, as I go on to describe in the following report. To collect the research required to compile this report I travelled to Africa, Kenya, Russia, Poland, Czech Republic, Germany, England, Northern Ireland, the Republic of Ireland, Wales, China, Australia, Canada and 11 states in the US. I have visited and spoken to researchers, software companies, processing plants, cold storage companies, agricultural consultants, supermarket agricultural managers, industry good organisations, government departments, over one-hundred retail outlets and most importantly conducted interviews with **farmers and consumers**.

I have always considered myself primarily a sheep and beef farmer with a land and honey business to support it. However, it is now critical with the world market volatility, variety of food consumed and the complexity of our land businesses due to nutrient and water issues, that all farmers remember we are food producers that fit well within the definition of rural entrepreneurs.

Entrepreneur¹

A person who organizes and operates a business venture and assumes much of the associated risk.

A person who organizes a risky activity of any kind and acts substantially in the manner of a business entrepreneur.

Waiver Declaration

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Acknowledgements

It is impossible when awarded a Nuffield Scholarship to comprehend the huge number of family, friends, colleagues and strangers who are willing to sacrifice so much of their time and effort to ensure that you are able to gain the most from the opportunity.

I would firstly like to thank the many sponsors for their investment in me and the industry that I am so passionate about. I hope you continue to support Nuffield; an organisation that carries such a positive influence to change throughout the world.

To The New Zealand Nuffield Farming Scholarship Trust, thank you for giving me the opportunity to complete a Nuffield scholarship. I hope that my future endeavours are able to help New Zealand Inc. as much as so many of the Nuffield alumni before me.

I would also like to thank Nuffield Australia for the opportunity to attend the Contemporary Scholar's Conference and Global Focus Program. They were instrumental in making sure that I had a truly global perspective and also enabled me to fully utilise the knowledge gained during my personal study travel.

To my incredible support team, my parents, children, neighbours and friends. Thank you for making it possible to be away for so long during a single year.

Lastly to my wife Mandy, without the support and self-sacrifice, determination and sheer hard work that you started more than a decade ago none of our achievements would have been possible.



Executive summary

The research in this report was gathered in order to determine how mobile technology can deliver improved on-farm and industry productivity gains now and in the future and also to understand technology adoption and how mobile could deliver positive outcomes. The scope was limited specifically to New Zealand sheep and beef farming and focused on opportunities that can give a genuine return on investment. The information was collected both in New Zealand and in a number of their largest trading partners around the world including China, Northern Ireland, the Republic of Ireland, England, Wales and the US.

The initial research found that low numbers of farmers record data on-farm using mobile technology for simple day to day decision making. This in turn means that the level of data that is then attached to

the animals electronically as they move through the supply or value chain is also low. The only data that remains with the animals is related to animal health declarations. The main reason that farmers gave for not carrying out more data collection was due to the time available to collect the data in relation to the perceived cost:benefit ratio. Further to this, almost all farmers felt current available mobile data collection equipment was not suitable to use to a level that will have a significant lift to their individual farm performance, nor is it able to create industry change that will provide enough financial benefit to them directly.

A further significant observation was the performance of those who were measuring their key performance indicators compared to those who were not. It was noted that there are individuals with a natural farming ability who are able to perform extremely well with little or no technology, often with higher on-farm performance than the innovators or early adopters. These individuals are able to monitor grass levels, stock condition and market conditions with little technology. However, the fact that 80% of farmers believe that they are in the top 20%⁹ would indicate there are far more farmers thinking they are able to do this successfully than actually can. This leads to the question: “how much could farmers improve if they increased the monitoring they undertook on farm?”

“There is nothing amazing about collecting data. Collecting data is just the basics” Eric Reid, Ex production director Moy Park

Research has shown that the adoption of mobile technology has not only changed the buyer behaviour of consumers, but also their decision making process. The improvement in logistics systems for perishable goods is enabling smaller retailers to compete with larger retailers for premium markets by shortening the supply chain. This in turn provides opportunities for more niche markets to be opened up for high end products, the likes of which New Zealand creates.

The red meat sector in New Zealand continues to underperform due to the huge variation in on-farm performance and supply/value chain inefficiencies, rather than change in demand or the product’s ability to attract a price premium over other proteins. Some of these inadequacies are small and could be reconciled relatively easily, while others are far more

Mobile technology is the technology used for cellular or wireless

complex and would require the cooperation of processors, industry good and government organisations, both here and abroad. Individually incremental changes would not reform the industry but collectively they would have the ability to increase the overall performance to a level that would have a satisfactory return and may enable new opportunities to open up.

Mobile Technology has the potential to change farming as we know it by providing a platform that enables a more transparent value chain. In conjunction with a behavioural change, mobile technology can provide an easy, affordable, convenient data collection and delivery platform at all points of the supply chain.

This may create disruption by bypassing agents as businesses up and down the supply chain could communicate information directly relating to products made transparent to them. This matching of specific products or product attributes between the seller and buyer at all levels is a way of turning the red meat sector into a more transparent value chain and deriving premiums for all stakeholders.

Before adoption of technology can take place, industry extension must look at what can be done to engage with different types of farmers. Once identified it may be possible to develop strategies that target the individual groups and enable them to achieve their desired outcomes. Moving to this more structured holistic model would provide an ongoing cycle of improvement.

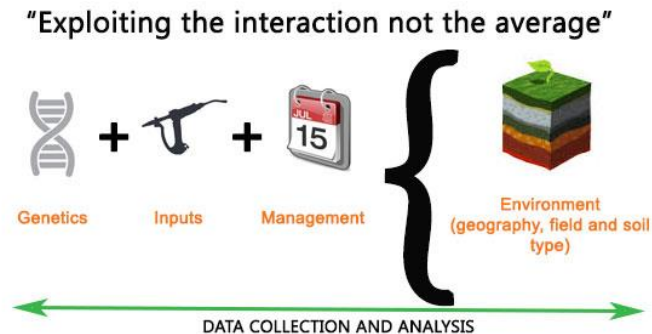
“We need a market where quality attributes are rewarded” -Tina Mackintosh White
Rock Mains

Conclusions

- Although some farmers use mobile technology very few have it as an integrated part of their farm decision making system, but instead use the information in isolation.
- Many of the mobile applications are emerging but not in a commercially viable form because they are unable to satisfy farmers’ seven principles of the adoption matrix.
- Technology will be responsible for the next doubling of farm productivity throughout the world - red meat is no exception.
- The red meat industry is underperforming which, if it continues, will cause declines in stock numbers, exacerbating the problem.
- Reforming the industry must start at both ends of the value chain.
On-Farm – Developing Premium Markets
- There is more gain to be made in the industry by concentrating on moving the middle rather than moving the top.
- Cellular coverage in New Zealand is poor compared with many third world countries. Our future relies on it improving.
- Using average as a measure of performance averages out potential value.
- New farm data tools are required focusing on automation and user experience (UX)
- Farmers who want to continue must collect key metrics otherwise they will eventually be swallowed up by those that have created their own certainty.
- Transfer of information between industry stakeholders is currently poor. Good research is not being utilised and a lot of the extension is confusing and unsuitable for the farmers it is intended for.

Recommendations

- Information systems that provide positive productivity outcomes and enable a transparent value chain should be developed and implemented.
- Investment in increasing the broadband coverage in rural areas is crucial.
- Marketing should be focussed on product attributes that are inimitable to New Zealand as much as possible.
- Farmers must monitor key performance indicators to aid decision making.
- Accurate, clear Return on Investment (ROI) models focused on farmers must be created by industry that simplify the decision making process of adopting technology.
- New technology should focus on simple problems first instead of trying to fix all problems at once.
- Extension should be accompanied by personal service that is focused on thought leadership and enables the individual farmer to identify and achieve their individual outcomes (enabling).
- We must not focus on farm productivity in isolation of the consumer.
- Industry good extension needs to be clear, concise, modernised and include ROI modelling.
- Integrated Farming Systems should be used to enable farmers to exploit the interaction not the average.



Introduction

New Zealand is in a unique situation due to its geographic location. It has an extensive quantity of low to mid altitude land that is categorised as cool temperate or warm temperate. This, combined with a low population density allows New Zealand to have one of the few true grass fed grazing systems in the world.

IF YOU HAVE DATA MINE IT
IF YOU DON'T COLLECT IT
ABARES 2014

In order to maximize the opportunity that this creates, New Zealand farmers must ensure that the product is produced in the most efficient way possible, while still being able to provide assurance to consumers by recording various quantitative values. Previously data has been recorded using paper based systems but mobile may provide an alternative.

Mobile technology has in a very short space of time become part of daily life around the globe. Many societies have even bypassed other technologies such as personal computers to embrace mobile technology due to its fundamental attributes - low price, convenience and ease of use as well as their ability to extract value.

As we consider this technology for farming we must also consider these and some other fundamentals, some of which are currently being widely overlooked:

Agriculture: Latin combination of the word **field + culture**.¹

Farm culture needs to remain at the heart of any software application or device for farmers.

In the field considering the culture of those that are using it.

Technology: A specific device used to solve practical problems.¹

What is the technology for and what problem does it solve?

Mobile technology is about enabling people and is no longer limited to phones or tablets but includes anything that has the ability to be connected either by cellular or wirelessly.

Aims of research:

- To understand how mobile technology can deliver improved on-farm and industry productivity gains now and in the future
- Analyse farmer technology adoption, gaps and how mobile technology could deliver outcomes

The use of mobile technology to extract value

Mobile technology could become the single most important farm technology in the future as farmers find it more and more difficult to make the productivity gains required to remain profitable. It may also provide opportunities to identify and then make improvements on-farm that directly affect total productivity. Mobile technology is the first platform that directly links all industry stakeholders, including farmers and consumers.

If we can deliver practical solutions to farmers that provide a tangible productivity gain through the collection of key data, then the adoption that is required will be more likely. This would create more opportunities in the value chain by providing procurement predictability in conjunction with unique product outcomes.

There will always be farmers that are “not ready to change”², nevertheless, if the industry delivers consistent positive financial outcomes through influential farmer feedback that do not require a huge change in farming practice, change will naturally occur. An example of this happening is the huge farmer initiated change to cross-breed sheep; a move that was motivated by necessity, instigated by farmers and adopted by those that could see it as a solution to their individual situation to increase on farm productivity.

The red meat industry

The world is changing at unprecedented rates as globalisation continues to escalate. The red meat sector in New Zealand is extremely complex due to the huge variety of products that are produced and then distributed to a large number of countries across the world. Trade barriers, government importation and retail requirements all add to the complexity.



The first shipment of frozen meat in 1882 was the defining moment for the red meat industry in New Zealand and was instrumental in making it remain a dominating force until 1987, when dairy took over to become the nation’s biggest export earner. The increase in dairy has continued as new international markets have opened and demand for dairy protein has increased. This in turn has also led to more dairy conversions and an increase in land being used for dairy support. Combined with the increased demand for synthetics and the low price of other proteins such as pork and poultry this has left the red meat sector in New Zealand with declining stock numbers, over-capacity and less finishing land. This combination of factors has prompted some within the industry to look at what can be done to increase total productivity on sheep and beef farms.

The Red Meat Profit Partnership (RMPP) is one of those initiatives. It is a primary growth partnership (collaboration of a number of industry stakeholders and government) aimed at identifying “what good looks like” and assisting with the development of farms to increase on farm productivity. This has been created as the difference between the top performing 20% and bottom 20% continues to grow. The RMPP has a definitive plan with well-defined outcomes: if they are successful the gains are estimated at \$284 million p.a. by 2025 in pre-tax on-farm profit which represents an additional \$117 per hectare.³

TECHNOLOGY OFFERS POTENTIAL TO ALLEVIATE DISTANCE AND BECOME A LOCAL SUPPLIER, GLOBALLY.

- KPMG AGRIBUSINESS AGEND 2014

Meat Industry Excellence (MIE) has also been established by farmers frustrated with the industry and is focused on the two largest cooperative processors. MIE believe that the

merging of these two companies and further rationalisation in the processing capacity would help return better prices for stock at the farm gate.

Both have yet to prove they are able to drive meaningful change, however, with MIE getting some of their candidates voted onto the CO-OP boards and the RMPP being approved by farmers to become one of the first collaborations of industry players, all indications are that many in the industry are at least in support of change.

Positive progress and positive impact of dairying

The high global dairy price in the past few years has provided an opportunity for land owners, farmers and investors to look at dairying as an attractive investment option that provides a return separate from the land capital gains. Due to the large amount of capital that is invested and diverse range of stakeholders, including banks, there has been a requirement and continued drive for improving productivity using factual data driven decision making.

Dairy farmers have the ability to more accurately measure inputs and outputs through daily feed intake and milk output which has meant that their understanding of returns from pasture and soil inputs has been far greater than that of many sheep and beef operations. Many of the principles learned have now been transferred either by proximity or due to the practice of grazing dairy cattle by sheep and beef farmers. This transfer of principles and the increase in land price requiring farmers to look at greater returns has been the biggest single driver of productivity gains on sheep and beef farms in recent times.

The requirement by dairy farmers for cellular, internet and technology services has also helped speed up the infrastructure required to provide broadband to many sheep and beef properties.

BY THE NUMBERS

2x	more sheep and beef farms than dairy in New Zealand (2012)
68 PER CENT	of New Zealand pasture land is primarily for sheep & beef or deer farms (2012)
98 PER CENT	of New Zealand's lamb crop available for export (2013)
\$5.5 BILLION	annual value of red meat exports (2013)
12 PER CENT	of New Zealand's merchandise exports are meat (2013)
41 PER CENT	fewer sheep in New Zealand 1993 to 2013
30 PER CENT	less pasture land used for sheep & beef farming 1993-2013
35 PER CENT	increase in kg/ha of meat produced by New Zealand sheep and beef farms 1993-2013

Source: Beef & Lamb New Zealand Economic Service

65 PER CENT	red meat farmers plan to increase production in next 3-5 years
84 PER CENT	plan to invest in pasture
69 PER CENT	plan to invest in animal genetics
53 PER CENT	see benefit in getting expert help in improving farm productivity
63 PER CENT	say succession is about passing the farm to family or whānau
34 PER CENT	say the purchaser's ability to finance is the key barrier to succession

Source: ANZ Privately-Owned Business Barometer

The changing market

China

China has now become New Zealand's biggest trading partner. Red meat is no exception: they are the largest export market of sheep meat and second largest market for beef. Sheep meat exports to North Asia have increased from 52,969 tonnes worth \$292 million in 2010-2011 to 101,805 tonnes worth \$605m in 2013-2014.⁴

The issue of been overexposed to one market is very real as the Chinese government may be using grey channels to influence prices. This, in combination with only frozen meat being allowed to be exported to China at present, limits the opportunity to establish the premium created by chilled products. For New Zealand to derive a premium from prime cuts in the future we must try and establish a chilled market that is centred around our food safety reputation and other New Zealand inimitable marketing.



The China market should continue to be developed as part of a balanced strategy maximising the opportunity to move fifth quarter products that are only suitable for a selected number of global markets but one that helps maintain profitability. Grass-fed beef is not considered a premium product here and the money that would need to be invested to change this makes the premium market for beef in China a challenge.

United Kingdom

Price is the biggest influence on sales in Europe with buy local, cooking time and freshness making up the other primary attributes



when it comes to deciding what product to purchase. This combined with own labelling of product by all of the major retailers makes the premium market in the UK a hard sell for New Zealand produce. Most of the other suppliers to the UK market have similar product to New Zealand which removes our point of difference in the

2012 US LOCAL FARMING TRENDS

Technology unlocks the ability for producers located anywhere in the world to build close relationships with potential customers. The web can enable a company to tell the story of its product in an interactive way, and far more comprehensively than could be done at a farmers market. Social media tools mean that the producer can maintain a comprehensive dialogue with its customers; telling them about operations, products and advice on how to use a product. They can also give consumers technical specifications and integrity information.

Clever use of technology, backed by an effective supply chain, can enable a producer to be 'local' to a consumer anywhere in the world. For all but the most dedicated of locavores, we suggest this opportunity is open to all growers and producers of differentiated, high-quality products which are proven to be ethical and sustainable. They will be able to build a loyal, engaged customer base around the world that considers them part of their local supplier group. Over time this may create opportunities for agri-tourism, enabling these consumers to visit the source of the product and build even closer connections with the producer.

2012 US local farming trends

Source: US Department of Agriculture; 2012 Census of Agriculture; May 2014

market. Adding to this, the majority of farmers receive an uncoupled (separate from productivity) Common Agricultural Policy (CAP) subsidy payment for the land they own. This has been factored into the price by buyers making it possible for farmers to sell product below the cost of production. New Zealand is extremely fortunate that UK producers are not pushing productivity, because if they were the requirement for off season lamb product may change dramatically. The two major advantages New Zealand has in the UK market is our out of season supply and consistency although both of which are difficult to demand a premium for. There are some other niche markets throughout Europe, but currently not a sufficient enough number to take the amount of product New Zealand produces.

United States

The buying habits of consumers in the US are changing as the “whole foods” lobby successfully penetrates the educated consumers. The move to grass-fed as a perceived healthier alternative is prevalent as many consumers question the sustainability of the industrial farming practices associated with the US corn-fed system.



The US is New Zealand’s largest market for beef, mainly for grinding and blending with higher fat content feed-lot beef for the fast food industry. However, with dropping sheep numbers and consumers’ growing desire for high quality, safe, GM-free, hormone-free, grass-fed product, there is a large opportunity for New Zealand’s beef and lamb to increase volumes while still extracting a premium.

Rapidly changing world

Buyer behaviour is rapidly changing as demographics around the globe alter significantly. This is creating risk and opportunity as age, income, food safety, religion, health and the way people buy influence supply and demand for different proteins. ***This represents an opportunity for New Zealand.***



MEATY FIGURES: New Zealand's meat exports to China have skyrocketed over the past 12 months, according to the Meat Industry Association.

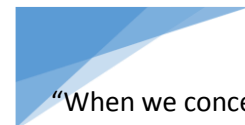
Problem?

The three fundamental issues the New Zealand red meat sector faces are:

1. The on-farm productivity difference between our top and bottom performing farmers.
2. Limited premiums for New Zealand products.
3. Overcapacity is limiting farm gate prices.

These issues are not unique to New Zealand. In fact sheep and beef farmers around the world appear to have very similar issues with many finding it difficult to return a reasonable profit or one at all. A large number of farmers rely on other forms of income including subsidies and partners' wages to supplement on-farm income.

In New Zealand the difference between the top and bottom is increasing as the top performers reinvest profits for further productivity gains while the bottom end producers are struggling to defend the status quo.



“When we concentrate
on average we average
out a lot of value”

Monsanto

How do we get out of this situation?

Liebig's law of the minimum⁶ has been used in recent times when considering plant nutrition, however, if we take the concept and apply it to the entire business the results will be far more effective. One of the reasons this has not happened by natural attrition is that the necessary technology to identify the most limiting factor has either not previously existed or still does not exist.

By monitoring and identifying what the most limiting factor is and removing unknown variables, the farmer's opportunity to make more certain productivity gains would become tangible, encouraging reinvestment.

The farming ecosystem

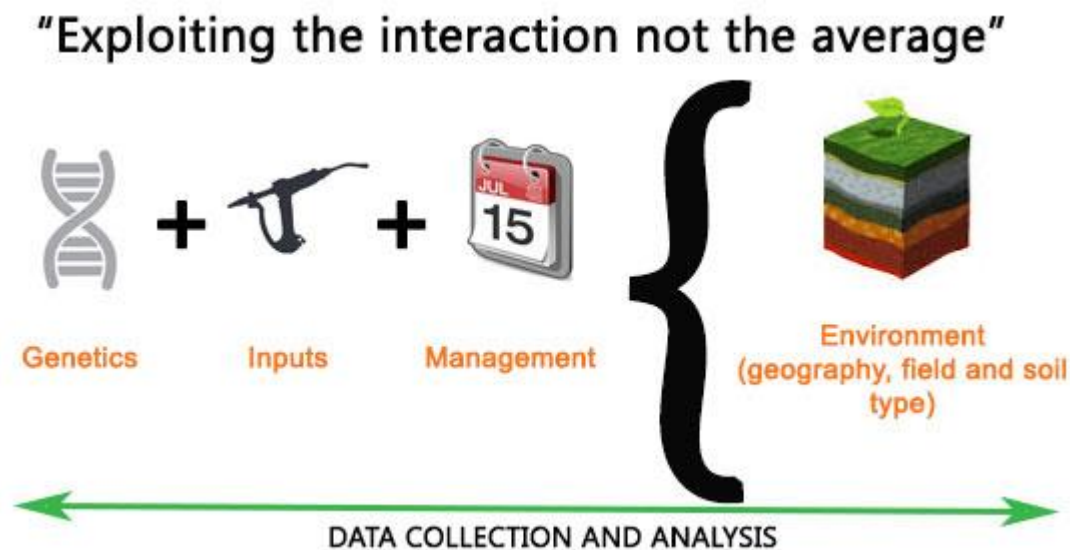
The farm ecosystem is very complex with many of the key variables out of the farmer's control. However, the fewer variables or more predictable outcomes that exist, the more chance red meat has of competing with predictable prescription farming models like dairy. It also allows farmers to invest with more certainty that there will be a return on investment or value proposition.

The farm is made up of some key components: if a farm system is broken into metrics to determine the most limiting factor(s) it is possible to start the process toward the higher performing farming operations.

If current technology exists and a value proposition exists for using it, measuring the key metrics will ensure that a more informed and accurate decision is made, making more predictable outcomes possible (e.g. crop or animal yield). This also provides the opportunity for more advanced correlation reporting in the future.

Integrated Farm System

The idea of an integrated farm system⁵ comes from the arable sector, however, the idea suits the red meat sector well as it is designed to match genetics, inputs (e.g. animal health, feed) and management to a particular environment (geography, field and soil type).



Often, using current methodology we try to transfer a system that works on one farm to another, expecting a similar result. This is the major issue with using return per hectare as a direct comparison benchmarking tool. It does not take into account the individual geography, field and soil type when looking at the value proposition.

As a general rule the use of benchmarking should be used more as an opportunity to identify variations within systems and consider cause and effect of applying them to another, rather than as a direct comparison.

Current state of Mobile technology.

Mobile technology is now one of the most used technologies in the world due to the huge variety of applications and low price of entry. A smartphone replaces hundreds of single purpose devices leaving it at the top of the adoption ranking for mobile technology. This trend is set to continue to accelerate for the foreseeable future as 3G becomes 4G and devices and plans become even more affordable. There is not only opportunity for businesses and individuals to communicate using cellular, but also to interact with almost anything. This is known as 'ubiquitous computing'.

The use of mobile technology in New Zealand agriculture has been slower than in other industries due to telecommunication companies' unwillingness to invest in rural areas due to the low population density and other demographic factors. This has limited the rural coverage, a factor that continues to plague the industry as although you do not require mobile coverage to use devices it is essential in creating enough incentive to entice users to adopt. Especially as until recently the main use for mobile devices has been communication.



On Farm technology

Currently the main devices that farmers use for collecting data about their farms and general administration purposes include:

Weigh scales: These are more widely used by finishers than suppliers of store stock as there are deductions made for animals that are not within the required weight specifications of the processors. There has also been a recent shift from weight to condition score when evaluating stock due to the variation in mature weights. However growth rates are still considered most important in determining the feed requirements of young stock to ensure they reach targets (weight at date required for mating).

Electronic Identification Tags (EID): With the introduction of compulsory EID in cattle adoption has increased greatly. Many sheep and beef farmers are now grazing dairy stock with contracts that require weight targets to be met making EID readers and scales the most practical solution for monitoring. However, the value proposition that EID generates has not been clearly obvious to farmers and is one of the major reasons for limited adoption of EID as a daily decision making tool by farmers.

Ultra sound or pregnancy testing: Carried out by specialist contractors or vets. The ability to identify pregnancy status so that farmers can retain, preferentially feed or sell animals is one of the technologies most adopted by farmers as it has a tangible benefit that is easily quantified.

Personal Computers (PC) are now found in almost all farming households in New Zealand, although the primary reason for having the computer is not always for business. Many farmers do not use the computer themselves but instead leave their partner to use it for accounting software, internet services or personal use. It is normally a family computer rather than a farm business computer. Those who do use it for the farm predominantly use

it for accounting software and use Microsoft Excel to manipulate or analyse data about their farm. Few farmers currently use a farm management system such as Farmax or FarmIQ.

The telephone is the most used technology. As coverage has increased so has the use of mobile phones. The phones are used predominantly for administration purposes, not data collection. Smartphone use by farmers is growing significantly although adoption has so far been greatest in the dairy industry.

Hard copy/note books are still the most used way for recording data. Understandably the note book still counters a number of challenges that technology currently cannot overcome, these include:

- Suitable in most weather
- Does not run out of batteries
- Fits in your pocket
- Inexpensive or free
- Difficult to damage

The issue with the note book is it requires you to manually analyse the data or re-enter it into a computer to get additional value from it.

Farm Management Systems (FMS) have been introduced to try and address the issues of extracting value from farm information. They have, however, failed to gain wide spread adoption due to the time that is required to learn how to use them, enter data from multiple locations and then manipulate data to find value in it once it has been input/entered.

Every farm management system or FMS that was observed by the author throughout the world has struggled, and continues to struggle with adoption. From those questioned it was commonly thought that farmers do not see enough value given the time that is required to collect the data so give up using it at all.

Other Mobile Technologies which are being used on sheep and beef farms to collect data or aid decision making.

- Apps are being used for a wide range of applications including weather, area calculating, feed requirements, pasture record keeping, EID recording, banking, maps etc.
- Radio frequency tags to determine cow movements to understand when a cow is cycling for artificial insemination (AI).
- Tag temperature sensors to understand the health status of stock for treatments.
- Blois for pH and temperature to optimise rumen balance and identify feeding requirements.
- GPS and gyro sensors to understand stock grazing patterns and eating times.

THE RAPID ADOPTION OF NEW TECHNOLOGY IS CREATING NEW MARKETS (FOR INSTANCE THE APP ECONOMY IS EXPECTED TO GROW TO OVER US\$150 BILLION BY 2017), WHILE DISRUPTING TRADITIONAL ONES.

KPMG AGRIBUSINESS AGENDA



- Soil temperature moisture sensors to maximise forage yield and utilisation.
- Weather recording to understand the effects on stock performance.
- Automatic stock weighing for daily live weight gain data.

At present there are a wide range of mobile technologies being used on numerous farms around the world, although the majority of these are currently either in the developmental stage or merely being trialled, and therefore not suitable for commercial use. Some will require a number of years of recording before the true value proposition can be established, while others will offer much faster solutions to specific problems.

Emerging technologies relevant to farmers in the red meat sector

As data collection has evolved so has the amount of data. Not long ago data collection was dominated by manual entry, however, it has quickly moved on to user entered data such as business login accounts to Machine to Machine (M2M) and the Internet of Things (IoT). These new technologies collect a huge volume of data at high speeds and in many different varieties from GPS locations and weather data to high definition video. This mass of data is where the concept of 'big data' eventuated from.

In combination, these technologies could change farming as we know it. Using sensors (IoT) and other data collection devices (M2M) mobile will be able to connect directly to the cloud where the huge amount of data (big data) can be processed into a meaningful form that enables a much higher level of accuracy and predictability than has ever been possible before. An example of this is weather forecast accuracy: due to the huge amount of area specific data, weather forecasting will improve significantly. Dry matter and metabolic energy sensors will be able to accurately tell a farmer how much daily feed is required to maximise growth rates while also maximising pasture utilisation. Grazing patterns and automated weighing of stock coupled with pregnancy scanning, may establish why animals are dry. As this combination of automated technologies progresses it may provide the opportunity for a true decision support system (DSS) that can provide valuable decision making data to farmers which may even reduce labour. For example, one would still be required to look at the analytics to decide what on-farm activity is needed (i.e. moving stock, health treatment) but actions would only be carried out if they were definitively required.

Machine to Machine (M2M) refers to technologies that allow both wireless and wired systems to communicate with each other.¹

Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure.¹

Cloud is the centralised data storage and online access to computer services or resources.¹

Big data is a catch-phrase used to describe a massive volume of both structured and unstructured data¹

“What gets measured gets done” Eric Reid, Ex production director Moy Park

Sensor technology is increasing in use around the world enabling farmers to monitor from their mobile device just about anything that a sensor exists for (e.g. fuel usage, rain fall). There are multiple ways that this will be able to return value to sheep and beef farmers. The most relevant examples currently in use are soil temperature and moisture sensors to help with timing of planting, and grazing to maximise yield potential. In the near future areas like the Hurunui catchment may require nitrogen sensors in rivers to ensure farm development is able to continue without having a negative impact on the water quality.

Soon M2M may even refer to mammal to mammal using bolus or tag technology to provide individual animal weight, feed intake, pH, temperature and GPS location so that health treatments and feed budgeting can all be optimised.

Unmanned Aerial Vehicles (UAVs): Although UAVs are thought to be one of agriculture’s most encouraging breakthroughs for measuring yields and field input requirements, the real value they will create for sheep and beef farmers will be spraying. In combination with new hyperspectral cameras UAVs will be able to, without any interaction, fly around the farm and identify any targeted weed and then spray it before returning to base. There may be many other farm specific uses for UAVs but using them for mustering, checking the farm etc. can all be overcome by cheaper, more effective technologies.

Global Positioning Systems (GPS): In the not so distant future individual animal GPS will be a reality in the form of a bolus or tag. This in combination with Big Data processing will create a huge jump in the understanding that is required to increase productivity significantly. Progeny matching, sire identification and eating habits are examples of the incredible data set that will be available. Price and ROI will determine the uptake but all indications would suggest that this would have huge value behind the farm gate.

DNA testing: portable DNA testers are now available and the price has come down significantly. Before long farmers will affordably be able to do their own DNA testing of animals.

Ultrasound is now more readily available and it will enable farmers to do their own pregnancy testing.

The automated technologies that are emerging can change the way that farmers operate without changing why they farm. It will enable farmers to exploit the interaction and not settle for the average.⁵



Adoption of on farm technology

Adoption of technology in businesses around the world happens relatively fast, on sheep and beef farms however, adoption can only be described as poor. Depending on where you are in the world the reasons for this are somewhat different. EU producers for example are slow to change largely due to Common Agricultural Policy (CAP). This uncoupled (detached from productivity) subsidy payment ensures that it is not as important for a European farm to become more efficient as it is in New Zealand and Australia. In Kenya and other parts of Africa adoption rates are predominantly influenced by the tradition of subsistence farming, extension and their current position on Maslow's hierarchy⁷. Kenya does however have one

of the most advanced and extensive mobile payment networks in the world: M-Pesa is mobile driven and now deals with 20% of the total GDP of the country. The significance of this highlights the fact that if developers get the technology right then adoption is fast. New Zealand has some examples of fast adoption including pregnancy testing, electric fences and more recently the reinvention of lucerne based farm systems in dryer areas.



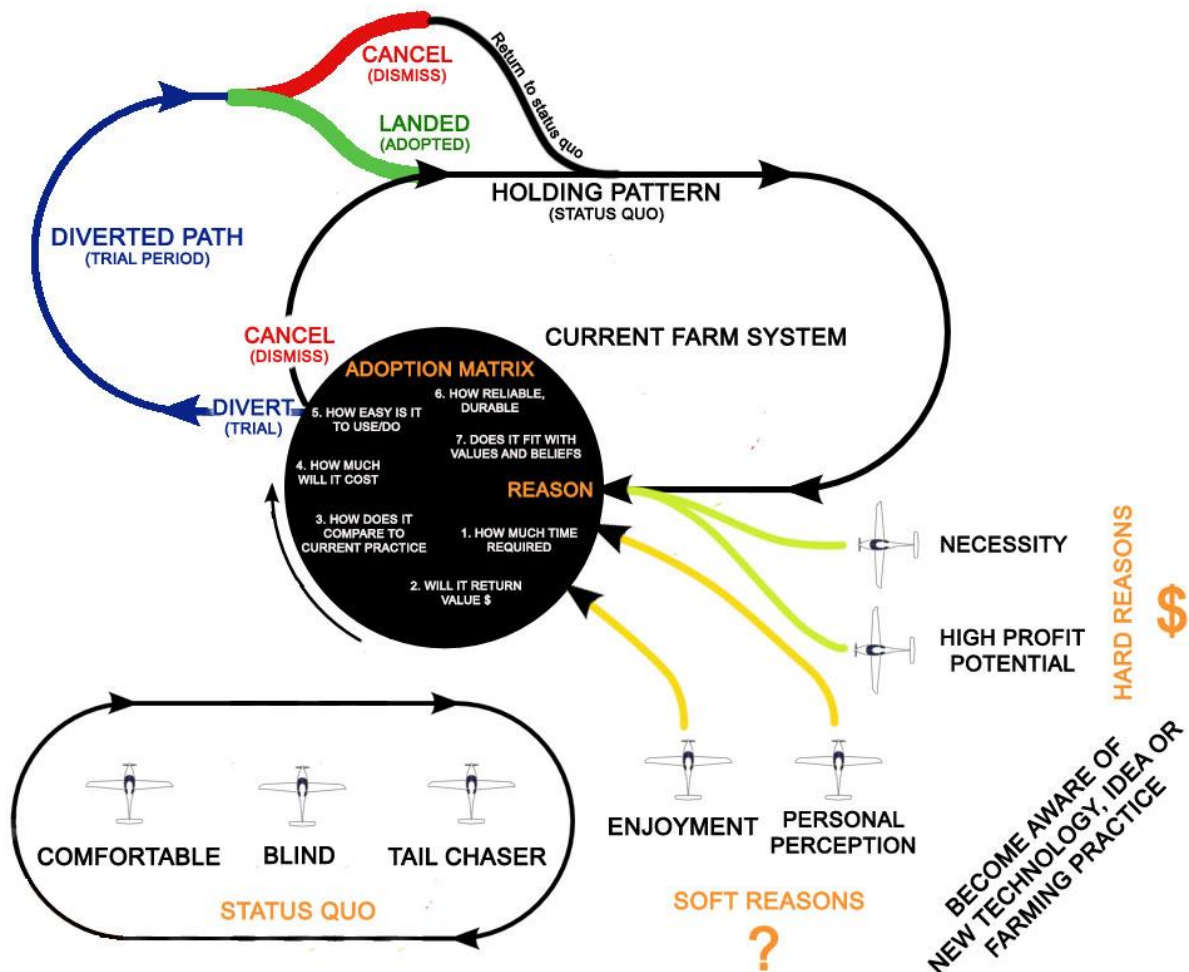
The farm adoption flight plan

From the research that has been gathered through surveying farmers, talking with experts and most importantly farmer interviews the author has recognized a number of different types of farmers. From this the farm adoption flight plan has been designed to represent the current thought patterns of many farmers to seek to distinguish the areas that could be worked on to improve industry-wide productivity gains.

Once identified it may be possible to work on a strategy and extension programmes that are more suited to each group instead of the field-day approach that ends up helping the same group of farmers each time, further extending the gap between top and bottom performers.

Following on from this is the Enabling Flight Plan which is aimed to highlight the need for a more holistic approach to farmer adoption. This focuses on the farmer evaluating and improving their systems continuously during the year to improve the opportunity to deliver their desired outcomes.

FARM ADOPTION FLIGHT PLAN



Necessity -When someone is forced to try and find an alternative way to achieve an outcome, otherwise risking losing or not achieving something they require.

High Profit Potential (Risk/Return ratio) -The internal or written evaluation of a change or practice to decide if the risks, either financially or to lifestyle, are worth invoking the change.

Personal Perception - Adoption because they believe that it is what “good farmers do” or because they want to appear a certain way, i.e. that they are at the forefront of farming practices. Although elements of the adoption matrix are important they will be less concerned about return than others.

Enjoyment - Farmers that simply enjoy trying new things and finding out more about their farms. They are less concerned about the adoption matrix also.

Tail Chaser - Farmers so busy with the status quo that there is no time to work on researching or implementing improvement.

Comfortable - This farmer, although possibly unhappy with the industry, is happy and content with their financial position, lifestyle or the contribution that they make to other

areas of the community. They may be competent farmers who choose not to change rather than poor farmers.

Blind - A farmer who cannot see the benefits of practice change even if it is right in front of them.

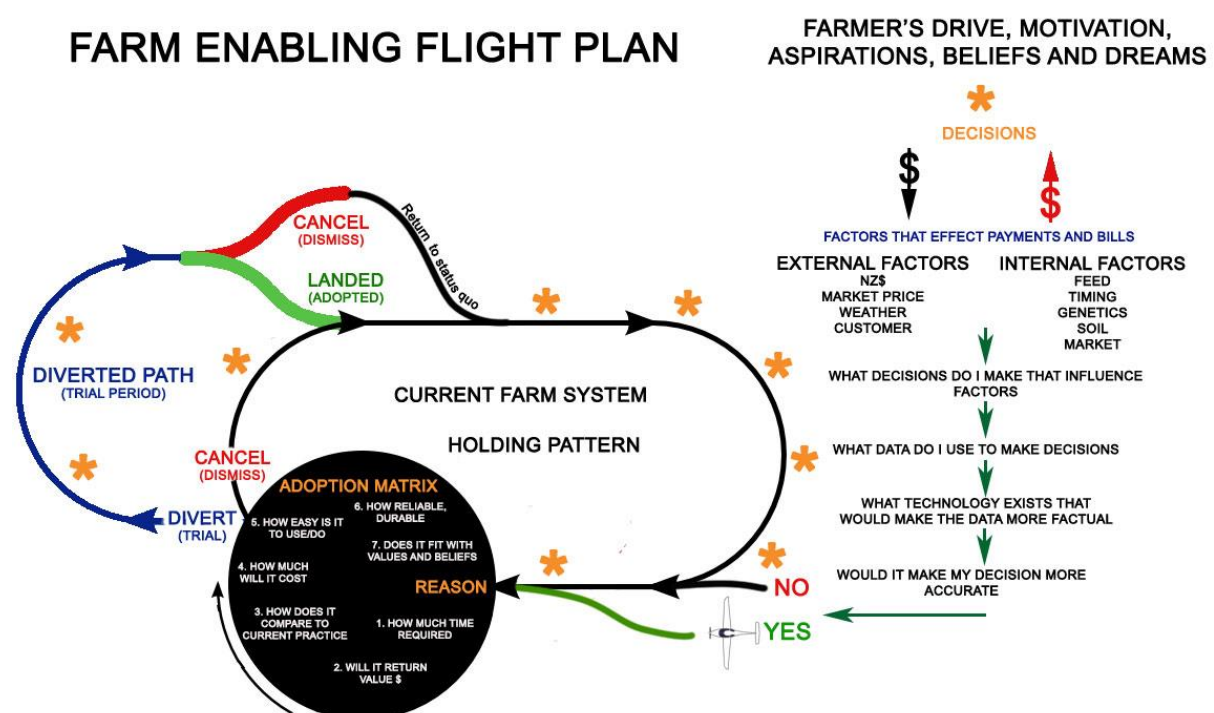
Farm Enabling Flight Plan

If we can first understand what type of farmer someone is and what they want to achieve then it is easier to establish a suitable extension method to encourage a change in practice therefore enabling the farmer's desired outcome.

Moving to this more structured holistic model would provide an ongoing cycle of

Concentrate on what the productivity gain enables and not the productivity gain itself.

improvement. This would be a cycle which constantly evaluates each decision that is made and the metrics that would help improve the quality of that decision, improving decision making and as a result providing more certainty for reinvestment.



Value Chain

Nearly all red meat produced in New Zealand is suitable for a niche market* due to its unique attributes (e.g. quality assured, totally grass-fed, hormone free, GM free, raised entirely outdoors). However, until farmers can provide evidence of these qualities and processors have matched them to specific consumers, thus establishing demand, any point of difference has little or no value resulting in the product remaining a commodity at the mercy of the global market price.

One must remember that consumers around the world have a different idea of what a premium product is depending on their values, beliefs and the perception that has been created in the market.

Some product attributes are the deciding factor when purchasing a product (e.g. organic) while others are a secondary reason if two products are otherwise similar (e.g. provenance). Each country around the world has different factors that affect the decision making process relating to the perceived value of a certain quality. Due to the high cost associated with creating original premium markets, New Zealand must look to identify established premium attributes for produce, and then use them as a starting point to create additional unique qualities and brands.

The UK, China, US and the Middle East all have very different perceptions of what attributes make premium products. This means people must be careful not to confuse the demand for one characteristic (e.g. farm assurance) in one market from those in another (e.g. religious beliefs). It is all too often that people talk about “what the market demands” when actually they are talking about only one individual market.

Premium markets are expensive and take many years to become established, so unless processors and farmers work together to create positive outcomes nothing will change. Examples of this working successfully are Silere and Kumanu; two brands working together with processors to provide premium meat products. Although volumes may currently be low it is a positive illustration of what can be achieved.

New Zealand must ensure that as premium markets are developed they are scalable and inimitable where possible. However, in some markets collaboration with other countries to provide in season product may provide the highest premium, as consistency of supply is a major factor when considering premium brand marketing.

For a scalable premium market to be established it must focus on transparency as a total productivity outcome at all levels of the supply chain:

Breeder to Finishing Farmer <> Farmer to Processor <> Processor to Retailer <> Retailer to Consumer

There are now many commercial store producers collecting data from birth although very few are offering data other than what is required on declarations at point of sale. By attaching performance metrics and other static data to animals they have more known variables than other animals so for example have a more predictable finishing. This has

additional value to finishers if they are able to calculate how many days are required for finishing given the available feed.

If animals at market (e.g. calves at sale) had performance metrics, their potential could be analysed, thus creating the beginning of the value chain. If this became popular it would also reward those that invested in improved performance through things such as feeding and genetics. This reward will encourage farmers to increase their investment in improvement.

New Zealand needs to create a market where being able to prove quality attributes is rewarded at all points along the value chain.

Why do contracts not currently work?

1. Loyal farmers contract or agree to supply a particular company at a set market price. Some contracts include an adjustment if the market price goes up.
2. This in turn drops the remaining total number of available stock in the market.
3. The price of the remaining available stock then rises (supply/demand) causing the processor to pay more for the remaining stock and those that contracted or remained loyal either end up worse off than those that hunted for top dollar or the processor is forced to adjust the price and pay more to equal the increase in market price.

The exceptions:

- Scale - large suppliers who are critical to the maintaining of processors' low operational costs
- A drop in the international commodity price
- When the contracted stock have a point of difference (e.g. Organic, Silere Merino).
- Major weather event (e.g. drought)



With procurement contracts for stock with farmers, processors push up the market price and get forced to pay their contracted suppliers an adjustment to retain them in the future or choose not to and risk losing loyal farmers and shareholders.

Industry change

The New Market

Disruption* is happening in many industries in the world, for example: Uber which provide not only a taxi service but also lunches; eBay shortens the supply chain removing retailers; Tesla is challenging the way we drive with their electric cars and is currently fighting laws that prevent them selling directly to the public and Whole Foods Market, one of the most well-known high end supermarkets in the US, has teamed up with Instacart to provide delivery of groceries within one hour.

In the UK the move to online grocery shopping has meant that retailers like Tesco are struggling to justify their huge superstores so are opting for more metro stores⁸. This has meant that the local butcher shop, its future once facing uncertainty, is back on the rise as convenience shopping during the week complements the weekly online super shop.

China's online retailing continues to grow, leading to retailers offering groceries through web based shops such as T-mall, [Taobao](#) or even social media platforms such as WeChat whilst online market disruption continues around the world.

There is no reason why these trends cannot and will not hit the meat industry in New Zealand. With a greater emphasis on food security, food safety and food perception market disruption is primed for the New Zealand market.

The collection of data in one place could provide the opportunity for this new market. Just as internet shopping has provided a way of bypassing retailers there is potential that the future market could look very different.

In combination with processors or toll processing, data collection could provide the opportunity to auction animals on specific attributes to processors, wholesalers, food service or even retail companies around the world or alternatively create long term relationships that are able to provide a premium due to the guaranteed food supply of a certain quality - Supplier Relationship Management (SRM).



Transparent supply chain

The reasons for establishing a transparent supply chain go far beyond food safety and marketing. It may be possible to use transparent supply chain principles to shorten the value chain and create a market where those that invest in quality are rewarded.

In China food safety is one of the largest considerations for consumers when making purchasing decisions. The UK has also had issues when horse meat was found in many of the large retailer's beef products. Consumers have become more aware of what they are purchasing and the provenance of their food. Often they rely on retailers to do this for them which the retailer then uses to differentiate themselves.



Retailers implement farm assurance programmes that in turn puts more costs on the farmer with little or no increase in price. New Zealand has an incredibly good reputation globally, however, a huge amount is based on the trust of farmers and farm workers as there is little or no perceived benefit to the farmer for the work that is required. The fact is that there is a huge risk being placed on our industry by using the declaration system that we currently have. For example it only takes a few animals to push under the fence from another mob for the entire line to be contaminated with animals within a withholding period and the farmer could easily not even know he is making a false declaration.

Although data collection will not completely eliminate the risk of contamination in combination with EID it would provide a safeguard that increases the certainty that markets would remain open.

The consumer is the most important person in the value chain, but in order for assurance systems to be adopted they must be focused on farmer productivity first then regulation second. Data provides value up and down the supply chain by eliminating variables while also creating product quality guarantees.

Currently when farmers purchase stock through agents or sale yards, very little data is attached to them and often even the location is only found out after the sale making it impossible to know phenotype or genotype information about the product they are buying. This means those farmers who invest in quality genetics or animal selection are not rewarded. Buyers are also limited to available stock due to the geographic spread of a particular company. If farmers were to collect data on farm (e.g. birth weight, growth rate) then when they wanted to sell them make it transparent through the Cloud to all those they choose (e.g. finishing farmers, agents, processors) they would provide opportunity for them to maximise price depending on quality. Once the system was established it would be providing premiums for higher quality stock. This would in turn mean underperforming farmers would be either forced to change or suffer lower prices. Once this data is collected it can then be used further down the supply chain by others that are wanting to benefit

from the quality of the data available. This does not mean individual animal traceability or that all meat will remain within the system, because until premium markets open up it may be cost prohibitive. But the reality is that unless value is created and extracted behind the farm gate the status quo will continue.

Guaranteeing supply to a certain company has not meant that they are able to pay a premium for it. There are some exceptions such as large scale producers or specific product attributes (e.g. organic) but generally market price has prevailed. Although they may have processing efficiency and are able to extract additional value for the product by signing long term supply contracts with customers, they are still selling the same commodity product as those that do not guarantee supply to any one company.

A transparent supply chain system is required to ensure the perpetuity of our industry.



Conclusions

- New technology will not be adopted throughout the red meat industry in its current form using the current delivery. Although some farmers use some technology few have it as an integrated part of their farm decision making system but instead use the information in isolation.
- Many of the mobile applications are emerging but not in a commercially viable form because they are unable to satisfy farmers' seven principles of the adoption matrix.
- Technology will be responsible for the next doubling of farm productivity throughout the world. Red meat is no exception. Red meat markets around the world are fighting to have a competitive advantage. New Zealand must not let its past dictate the rate at which it adapts in the future.
- The red meat industry is underperforming which, if it continues, will cause further declines in stock numbers, exacerbating the problem.
- Reforming the industry must start at both ends of the value chain.

On-Farm – Developing Premium Markets

- The top performing farmers are extremely important in establishing potential. However, it is important to remember that all farmers make up the industry and not just the top 20%. The law of diminishing returns may mean there is more gain to be made by concentrating on moving the middle than moving the top.
- The cellular coverage in New Zealand is poor compared with many third world countries. It is required for industry growth and improvement will only occur if pressure is applied continuously. This affects the industry's ability to communicate and automate data collection. Our future relies on it improving.
- Using average as a measure of performance averages out potential value. This is where the opportunity in the red meat sector currently lies.
- New farm data tools are required, focusing on:
 - Automation
 - User Experience (UX)
- Farmers who want to continue must collect and analyse key metrics, otherwise they will eventually be swallowed up by those who have created their own certainty. This may be dairy farmers, cooperates or it may be rural entrepreneurs that have moved to the sharing economy that information technology can create.
- The transfer of information between industry stakeholders is currently poor. There is a lot of very good research that is not well communicated to farmers.

If the pace of change outside your farm gate is greater than the pace of change inside the gate, then there is a problem. ~ Pita Alexander

Recommendations

- Marketing should be based on the attributes that makes New Zealand products inimitable as much as possible.
- The creation of information systems that enables a transparent value chain should be implemented allowing producers of quality stock to be rewarded.
- Investment in increasing the broadband coverage to rural areas is crucial to increase the technology adoption which is required to double New Zealand agriculture export value by 2025.
- Farmers wanting to increase their profitability must accurately monitor key performance indicators in their farm system in order to make informed decisions.
- Accurate, clear return on investment (ROI) models must be created by industry that simplify the decision making process of new technology relative to the specific key performance indicators:
 - Genetic potential
 - Considered growth
 - Conception
 - Survivability
 - Eating quality
 - Environment
- New technology should focus on simple problems first instead of trying to fix all problems at once as adoption will only occur if these seven principles are strongly considered.
 - ✓ Does not require excessive time
 - ✓ Provides a return
 - ✓ Simple, easy to use functionality
 - ✓ Convenient
 - ✓ Reliable
 - ✓ Affordable
 - ✓ Fits with values and beliefs
- Extension of new technology should be accompanied by personal service that is focused on thought leadership which in turn enables the individual farmer to identify and achieve their specific KPI outcomes. These may not necessarily be related directly to their farm productivity.
- We must not focus on farm productivity in isolation of the consumer as it may result in produce that the premium consumer does not desire.
- Benchmarking should be used more as an opportunity to identify variations within systems and consider cause and effect of applying them to another rather than as a direct comparison.
- Industry good extension needs to be clear, concise, modernised and include ROI modelling.
- Integrated farming models should be adopted instead of a one size fits all approach. “Exploiting the interaction not the average”.

Genetics + Inputs + Management } Environment
 <-----Data and Analysis----->

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Glossary

NEW ECONOMY A buzzword describing new, high-growth industries that are on the cutting edge of technology and are the driving force of economic growth.

Sharing economy These systems take a variety of forms, often leveraging information technology to empower individuals, corporations, non-profits and government with information that enables distribution, sharing and reuse of excess capacity in goods and services. A common premise is that when information about goods is shared, the value of those goods may increase, for the business, for individuals, and for the community.

Correlation and dependence In statistics, dependence is any statistical relationship between two random variables or two sets of data. Correlation refers to any of a broad class of statistical relationships involving dependence.

A **niche market** is the subset of the market on which a specific product is focused. The market niche defines the product features aimed at satisfying specific market needs, as well as the price range, production quality and the demographics that is intended to impact. It is also a small market segment

A **value chain** is a chain of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market.

Disruption in the context of radical change due to the introduction of a new idea driving a different way of doing things