



KELLOGG
RURAL LEADERSHIP
PROGRAMME

“What a Waste! - My Story”

Improve Farm Waste & Journey Towards a Circular Economy



Course 39 2019: **Patricia Rankin**

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To my fellow Cohort #39 - for the challenge of being as awesome as you all!

Executive Summary

Doing better with my farm waste was the initial driver for this Kellogg project. I did not like the amount of rubbish I produced, set out to find out more about what I produced and the options I had to do better. Conducting farmer surveys, a Farmsource workshop, interviews, research, discussions with local councils and chats with rural professionals provided a picture for me about my waste.

I discovered we are in a 'Linear' - take, make and dispose economy. A system where we take from natural resources to make items we need and then often just throwaway the end by-products.

There is another option. Where I could reduce my waste but also strive towards a "circular economy". Where we;

1. Regenerate natural systems
2. Design out waste and pollution
3. Keep products and materials in use

During the research, I have discovered options for good practice around waste management. We have the ability to return and recycle many items used on farm that create bulk waste like containers, silage wrap and plastics. However, just less than half of the farmers surveyed used recycling or returning as a way of dealing with waste.

What is not evident that is happening in our sector yet, is the movement towards the circular economy. A goal around the world and with our own Ministry for the Environment on how their countries should or plan to evolve.

However, even bigger than moving to a circular economy is the opportunity to really know 'our' numbers in regards to our farming system. Can 'us - the farmer' doing better with our use of items and striving towards a circular economy, also result in improving our overall farming system? If we buy better, sell better and make better decisions, can we improve and move towards circularity faster with added benefits like a reduction in emissions? If we develop the concept of Life Cycle Assessment on our farms, can that help us move towards a circular economy?

My recommendations are that;

1. Farmers get better educated about the waste hierarchy model with emphasis on the first 4 stages of the 6 stages being reduce/rethink use, keep in use (robust designed to not break/wear out), manufacturer to design out waste or take back waste and reuse/repurpose (stage 5 is to recycle and stage 6 is to dispose e.g. landfill).
2. Farmers get better educated about the 6 Rs of waste decision making; Refuse, Reduce, Reuse/Repair, Recycle, Rehome and Rot (or compost).

3. Conversations within the industry start to focus on the Ministry for the Environment's vision to move towards circularity.
4. The Waste providers better educate their clients (aka farmers throwing rubbish out) about waste and recycling. Tell us the true stories about the 'why' we should change our behaviour or use best practice.
5. The Waste Minimisation Fund targets innovation in the sector (as the number one contributor to the economy) to help deal with waste solutions and support manufacturers to better design products.
6. Enforce no burning and burying of items. Almost 40% of farmers surveyed still burn or bury. This might possibly affect our social license to farm. Make it part of on farm plans for farmers to acknowledge their rubbish disposal methods to ensure compliance/reflecting best practice within current limitations.
7. To turn an agriculture system into a more circular economy we'd need to;
 - a. Identify our own farms equivalent of the "Agrocycle" to identify our systems.
 - b. Use a minimal amount of external inputs (from the Agrocycle diagram this includes fuels, feeds, chemicals, fertilisers etc (everything around the outside of the green centre)
 - c. Close the nutrient (biological and technical) loops.
 - d. Reduce negative discharges to the environment (in the form of wastes and emissions).
8. In addition, there is a real opportunity to put 'numbers' on the products we use to help with decision making and behaviour. The development of more work in Life Cycle Assessment modeling of agriculture use and the production of materials is a big opportunity. This model, *"which is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling"* could be a game changer for farmers where we assign real numbers to our impacts, can measure these and strive to reduce these.

The overarching theme to improve in each of the recommendations is to Calculate & Educate.

My project title - 'What a Waste' ends with me knowing that if farmers don't get credit for all their numbers and measure the improvement in their behaviours and practices - that would be a waste.



It's my plan to ensure that doesn't happen by establishing a new business CircularAg.Com

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Introduction: Rubbish on my farm concerns me.

That we take from natural resources, make, use and throw away broken items, use packaging and farming supplies which result in rubbish to landfill concerns me. It got me thinking. How can I improve my farm waste? Would improving waste gain favour with the public (improve our social license) and avoid an issue before it becomes one?



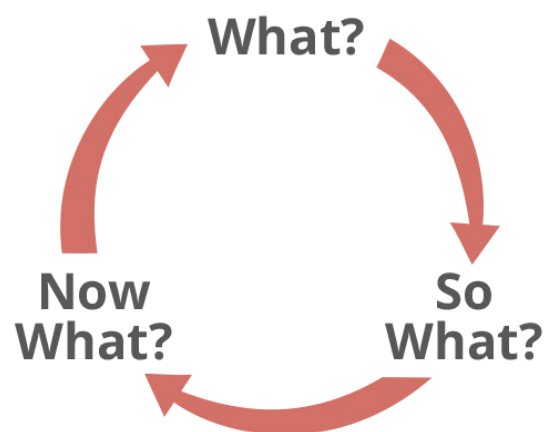
Photo 1. The farm we sharemilk on - 143 ha, 450 cows in South Taranaki

Source: Trish Rankin

This is my story of my journey to find out more.

This is my story of my journey to do better. This is my story of how to help us ALL to do better. It is my story broken into four key sections;

1. The "What"
2. The "So What"
3. The "Now What"
4. The "What Next?"



Part 1: The "What"

1.1 Waste

A dairy farm waste stream is complex.

Waste: of a material, substance, or by-product eliminated or discarded as no longer useful or required after the completion of a process. (Oxford Definition)

The New Zealand Ministry for the Environment provides a list of agricultural waste coded as 02 01 and includes:

Table 1: Types of waste generated from Agriculture, Aquaculture, Forestry, Hunting and Fishing

Code	Waste
02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing
02 01 01	sludges from washing and cleaning
02 01 02	animal-tissue waste
02 01 03	plant-tissue waste
02 01 04	waste plastics (except packaging)
02 01 06	animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site
02 01 07	wastes from forestry
02 01 08*	agrichemical waste containing hazardous substances
02 01 09	agrichemical waste other than those mentioned in 02 01 08
02 01 10	waste metal
02 01 99	wastes not otherwise specified

Excerpt taken from <https://www.mfe.govt.nz/waste/waste-list/02-%E2%80%94-wastes-agriculture>

This waste list is the 'official' way of classifying our industry's waste streams. Packaging is classified differently. Lots of effort in our industry is set to deal with organic/biological waste.

1.2 This project set out to...

This project reports on my waste that went into my skippy bin and went to landfill. That is the primary focus of the first "What" and "So What" sections. It then looks at options, trends and methods into the future to deal with waste and journey towards a circular economy. During my report, other opportunities arose that are explored too. Terms like waste stream, waste flow, waste systems are used in the report. These are all similar terms, all meaning the journey the waste takes to move through my farm and to its final destination whether that is landfill or recycled.

1.3 The technical term for our current rubbish system

The Linear Economy

Linear being a line approach to our current use where we take (natural resources, raw materials etc), make them and use them for a specific purpose and then dispose of anything left over.

Linear Economy



Figure 1: A Linear Economy

Image taken from

<http://www.gabi-software.com/solutions/circular-economy/>

1.4 How can we 'disrupt' the Linear Economy?

DISRUPTING THE SYSTEM

The linear economy has to change.

We must transform all the elements of the take-make-waste system: how we manage resources, how we make and use products, and what we do with the materials afterwards. Only then can we create a thriving economy that can benefit everyone within the limits of our planet.

Figure 2: Disrupting the System

Image taken from <https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy>

1.5 The New Zealand Position.

The NZ Ministry for the Environment explains the current waste systems and plans for the future - [click here](#) on their website. The concepts of being able to 'unmake everything we make' and design out waste and pollution is the way forward they say, and that it's time to 'redesign our thinking' about how we use products. An excerpt from the website below started me thinking - how can this be applied on a farm?

We need to transition to a circular economy approach

The essential concept at the heart of a circular economy *ōhanga āmiomio* is to ensure we can unmake everything we make.

A circular economy is based on three principles.

- Design out waste and pollution.
- Keep products and materials in use.
- Regenerate natural systems.

When a product is designed for the longest use possible and can be easily repaired, remanufactured or recycled (or used, composted and nutrients returned) we consider it to have a circular life cycle...[Read more](#)

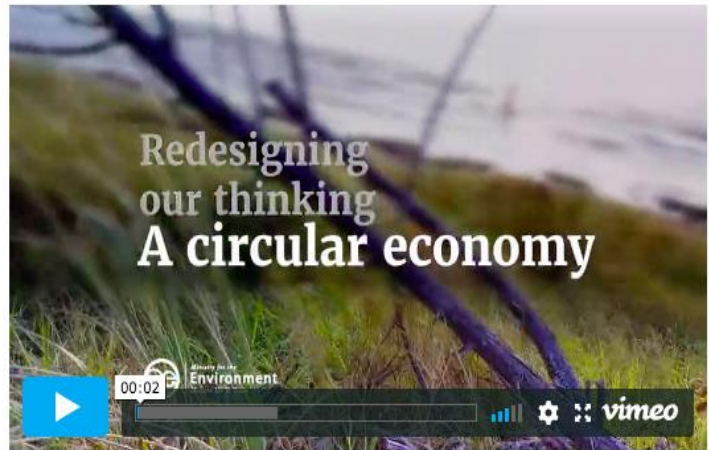


Figure 3 - Ministry of Education Webpage
Taken from <https://www.mfe.govt.nz/waste/circular-economy>

1.6 Introduction to a Circular Economy

Dating back to the 1960s, is the concept of an open and closed economy (Boulding, 1966) where economies could be open/unlimited in resources or closed/limited in resources. This was expanded on further in the 1980s by Pearce and Turner (1989) who reflected that the open economy placed little importance on the recycling of resources.

The report '*Towards the Circular Economy: Economic and business rationale for an accelerated transition*' (November, 2015), commissioned by the Ellen MacArthur Foundation and developed by McKinsey & Company, was the initial report that set out to consider the economic and business opportunity for the transition to a restorative, circular model.

The concept of circular economy is now used by many countries around the world as a model to move towards in the future and one that should help drive decision making for long term sustainability.

1.7 What is a Circular Economy?

An 'economy' that is 'circular' in nature has 3 main goals. These goals help both identify and design a system that can move towards circularity. It is more than just ending in zero waste. It is the whole system focusing on three main aspects.

The goal of the 'circular economy' is to;

1. Regenerate Natural Systems
2. Design out waste and pollution
3. Keep products and materials in use



The overall idea of circular economy is to 'close loops'. Oldfield, Ward, White, Holden (2016) define circular economy in livestock farming as '*that is (an economy) producing no waste and pollution, and in which material flows are of two types: biological nutrients, designed to re-enter the biosphere safely, and 'technical' nutrients, which are designed to circulate at high quality in the production system without entering the biosphere as well as being restorative and regenerative by design*'.

This definition deals with biological and technical nutrients. One key phrase in this definition is that "nutrients are designed to circulate at high quality" and are "restorative or regenerative"

Figure 4: A Circular Economy
taken from <https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy>

Regenerative and restorative are central concepts underlying the circular economy and are often under emphasised concepts of a circular economy. As well as closing the loops of production and use, designing out waste etc, restoring or regenerating the natural capital, the economy and the sector using a circular approach is an important aspect.

Many countries around the world are moving towards this model. The Netherlands and the United Kingdom are two leading countries. New Zealand has begun some work in this area. The Sustainable Business Council and Sustainable Business Network are two of the main organisations working on circular economy here. Both have not done any/or very little work in the Agriculture sector.

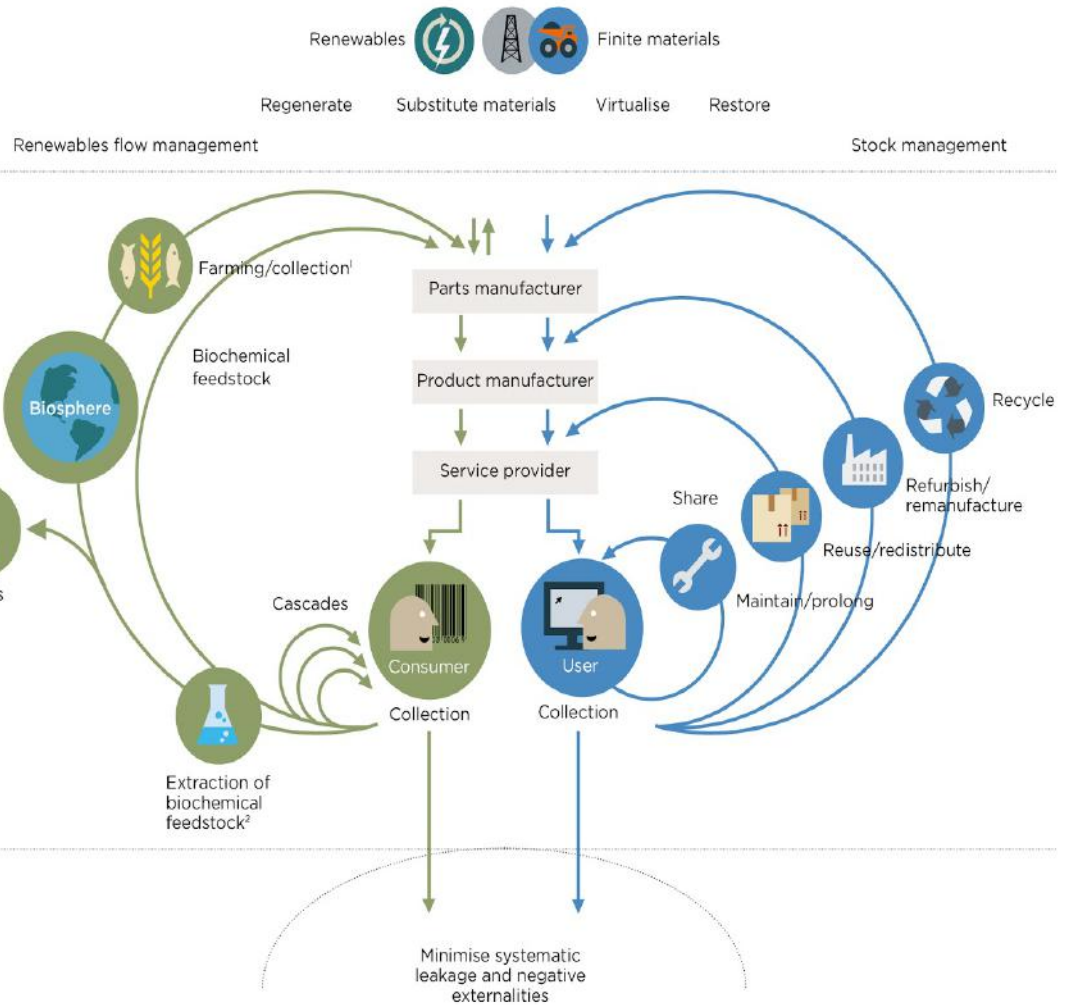
1.8 How does a Circular Economy Work?

OUTLINE OF A CIRCULAR ECONOMY

PRINCIPLE

1

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows
ReSOLVE levers: regenerate, virtualise, exchange



PRINCIPLE

2

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles
ReSOLVE levers: regenerate, share, optimise, loop

Figure 5 - A Circular Economy

Image taken from <https://www.ellenmacarthurfoundation.org/circular-economy/infographic>

The above figure is the closed loop circuit depicting a circular economy. Where we design out waste, design in restorative behaviour/action/business and keep our resources in use at their highest / quality use at all times.

1.9 Questions Asked...

The questions that this report sets out to answer are as follows;

1. Who in the world is studying circular design in Agriculture? What does it look like in the Dairy Sector? (Section 2.1)
2. What is the actual scale of my problem? Do I actually have a problem? Do I create much landfill? (Section 2.2)
3. What are the options for my rubbish now? (Section 2.3)
4. How can I leverage my on farm knowledge with other rural professional knowledge on what is happening with rubbish and waste minimisation? (Section 2.4)
5. How do others in Taranaki deal with their waste? How do others around NZ deal with theirs? (Section 2.5)
6. What is the role of our local and regional councils? What opportunities do they have? (Section 2.6)
7. Who in NZ is working on agricultural waste? How can / should I partner with them? (Section 2.7)
8. What is the NZ and the global view of the rubbish we make? (Section 2.8)
9. What do our rural farm professionals think? What part can they play in helping me do better? (Section 2.9)
10. What opportunities exist for manufacturers - How can I do better with what I buy and use? (Section 2.10)
11. What is the bigger picture - does doing better with my waste and moving towards circularity help me/my business/our sector/our country in other ways too? (Section 2.11)

1.10 How did I research the Answers?

With the questions above in mind, I set out to;

- Do a 30 Day waste Audit on farm
- Conduct conversations with the local/regional council
- Hold a Fonterra workshop with Fonterra retail and sustainability staff
- Interview the CEO of Fonterra
- Conduct a conversation with the Sustainable Business Network
- Have conversations with rural professionals (both NZ and International) including Agrecovery, Ballance and Advisors.
- Complete a Survey Monkey on 5 key questions for both Taranaki and NZ Dairy Farmers
- Research parallel solutions - (non industry based but similarly themed)

This research was carried out between February and June 2019. 'How could I (on my farm) move towards a circular economy?' was the overarching theme that each phase of research revolved around. Research participants were asked to think bravely and not be limited by current technologies in possible solution design.

Part 2: "So What? What Did I find?"

2.1 Who in the world is studying circular design in Agriculture? What does it look like in the Dairy Sector?

Very little work exists on how a dairy farm (pastoral) could implement a circular economy. Oldfield et al (2016) introduces the idea around the opportunities for an agricultural system to be moved circular though, this is European based.

'Circular economy' in agriculture centres on the production of agricultural commodities using a minimal amount of external inputs, closing nutrient loops and reducing negative discharges to the environment (in the form of wastes and emissions). Examining the entire agri-food system from the 'circular economy' perspective can reveal opportunities at all stages, from primary production using precision agriculture techniques, to the recycling and utilisation of agricultural wastes.' (Oldfield et al, 2016)

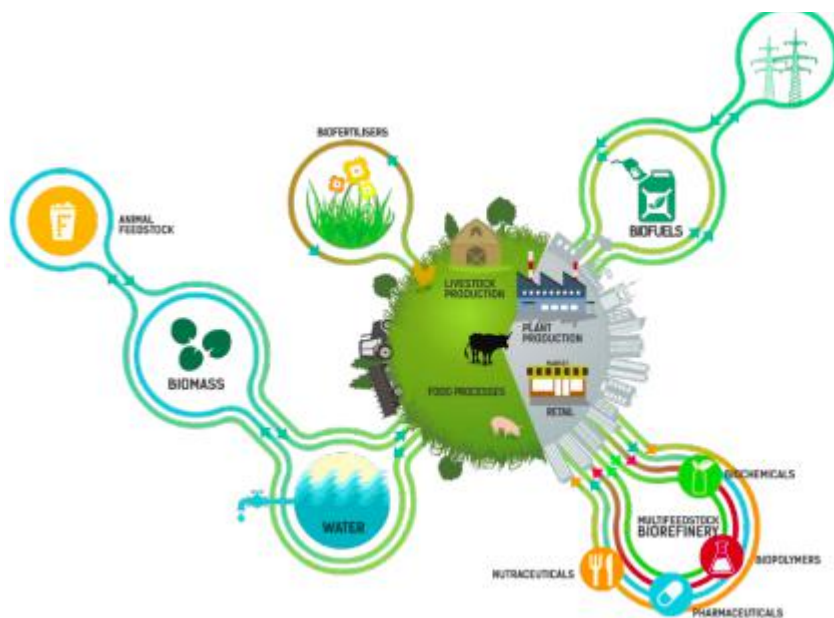


Figure 6 - Agrocycle Diagram

Toop, Ward, Oldfield, Hull, Kirby, Theodorou (2017) have developed an 'AgroCycle' to pictorially reflect an agricultural system.

This is limited in its application to NZ farming, being pastoral based however is a good starting point to consider all the elements of an agriculture system.

The above two references both identify the complexity to move towards a circular economy. We aren't a 'factory' making the same thing in the same way everyday.

To turn an agriculture system into a circular economy using the above ideas, we'd therefore need to;

- Identify our own farms equivalent of the above "Agrocycle" to identify our system input/outputs.
- Use a minimal amount of external inputs (from the Agrocycle diagram this includes fuels, feeds, chemicals, fertilisers etc (everything around the outside of the green centre)
- Close the nutrient loops (technical and biological)
- Reduce the negative discharges to the environment (in the form of wastes and emissions).

To date, a lot of effort and energy, education and funding sits in (d) the reducing of negative discharges to the environment. Farmers are already seeking better practice and better information to enable them to do this off the back of both public sentiment but also as a goal to be good kaitiakitanga (guardians of the land) that most farmers behave like everyday. We are ensuring we use feed, nitrogen, fertiliser, water and energy efficiently and reports show nationally that farmers are improving water quality, nitrogen leaching and animal welfare year on year.

There is little evidence of work done in the first 3 (a,b and c). Very little conversation has been had and is an enormous opportunity for industry bodies to explore more into, particularly seeing item c. closing the nutrient loops will be vital moving forward in a carbon neutral / methane reducing political and global climate.

2.2 What is the actual scale of my problem? Do I actually have a problem? Do I create much landfill?

No rubbish is buried or burnt on farm. We work for a Māori incorporation with strong kaitiakitanga beliefs - nothing gets buried in/on the whenua (the land) - land is tapu (sacred). The 1.5m³ skip bin on our farm is used to collect all farm and two times households rubbish. It is emptied eight times per year. Straight maths then shows 'to landfill' we send 12m³ of rubbish using a rubbish collection service. On top of that we generate scrap metal waste, reused/repurposed rubbish and recyclable rubbish.

The farm this year has filled two times 20ft containers with scrap metal that has been generated on this farm over a long period of time, but we have now collected and returned to scrap metal dealers.

We have recyclable silage wrap stored for collection on farm as well as containers triple rinsed to return to our local Agrecovery depot periodically. We have recyclable plastics (e.g. 200l drums) but these are repurposed.

What I have not done to date is to consider purchasing patterns, bulk purchases, deliveries, product type. E.g. the farm needed zinc bullets (animal health supplement for youngstock) - I went to the local vet to purchase. These came wrapped in cardboard, plastic and sitting in polystyrene. If I'd purchased the same product from a different manufacturer from the local farm store, I could have got these just packaged in cardboard.

This farm has no council rubbish collection. Some farms in our area on specific roads have access to council rubbish and recycling collection service. I drive all my recyclables off farm to the various depot - Farmlands Opunake for Agricover items or Manaia Transfer Station for glass, paper, cardboard, tins, plastics. Cumulatively this will take approximately 3 hours per month to do my recycling.

The Taranaki Regional Council's Waste Management and Minimisation Plan (WMMP) 2016, sets out its vision for the region. While it doesn't specifically list the concept of circular economy, the sentiment behind much of the plan does. The plan does tend to focus on more domestic rubbish, not farming rubbish.

'Identifying practice, methods for reducing waste and improving resource efficiency' sits alongside nicely the concept of circular economy.

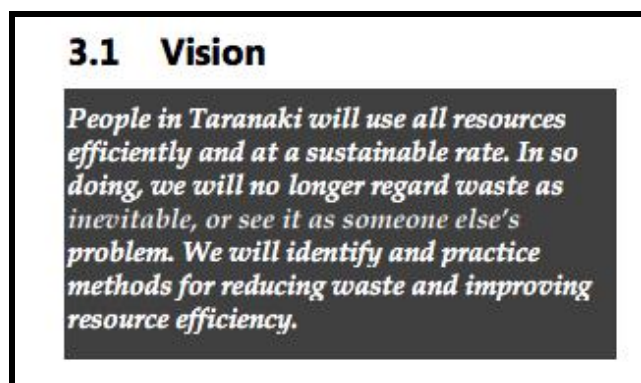










Figure 7 - Vision Excerpt (Taranaki WMMP)

I conducted an audit of the waste produced for 40 days. I went weekly to our rubbish and recorded what was in our bin. This was during Feb to March 2019. This is a 'quiet' time in our farming calendar. The main activity at this time is based just on milking the cows. Very little specialty product is used like it is during the months of July to December when it is calving and mating.

Table 2: 40 Day Audit - 20 Feb to 30 March 2019

			
8 Cans of Spray Mixed Colours	2 per person every 3rd day	Filter Sock Packet Wrapper (plastic)	Each milking - filter sock
			
100 bales of silage wrap	100 bales of silage netting	Vet Minerals 5 bags - sack 20kg	Zinc 1 bag per day Plastic 20kg

			
Boxed packets - came in polystyrene boxes	Detergent Acid Aquaklenz HV 20	Detergent Acid Aquaklenz HV 200	Drugs from the vet - one bottle Engemycin
			
Drug from Vet - plastic bottle	8 Boxes of leptoshaield with 8 plastic 800ml bottles inside	Needles for drench gun for lepto administration	Drug treatment for mastitis for cows - 16 tubes
			
Silage Wagon Broken Bearing - scrap metal	10l plastic container	Bucket 20l we reuse	Bucket 20l we reuse
			
Cardboard boxes with plastic 200ml plastic bottle	Magnesium Chloride Flake C/Mile 25kg - 1 bag per 2nd day	Chicken Food - 1 bag per fortnight - plastic coated	1 bag per 20 days

The waste audit showed the variety of rubbish generated over 40 of the 365 days of the year, however not the total volume. Added to this, are the 'tons' of product used over the course of the year. Six ton of calf

meal in 40 x 25kg bags. All bags are plastic/woven based - needed for both feed longevity and ease of packaging. These are sent to landfill.

What is evident is that a lot of what we buy is in single use (not able to stay in the farm system at its highest quality use). It is very 'linear' where we take it, use it and throw it away. Similarly in the photo, the rubber based milking liners we use comes packaged in packs of 4, but we need 200 at a time. Immediately looking at the waste audit I can see opportunities for buying in e.g. bulk (200 milk liners in a box of 200 instead of 50 packs of 4) or buy items in more bulk than in smaller sizes.



Photo 2 - Milk Liners waste and packaging - used 3 times per year

2.3 What are the options for my rubbish I use currently?

I have options on how to deal with my waste now. One thing I have discovered through this project is that whether or not these are well known or advertised to farmers is the likely cause of some less than desirable behaviour. What I can do now is;

- To recycle what I can at Manaia transfer station or Agrecovery depot
- To landfill what I can't reuse or recycle
- To reuse or repurpose the item
- To compost, burn or bury (not on current farm)

These options are reflected in the Waste Triangle (see Figure 8 overpage). However, often we are told or under the impression that recycling is a high priority. In order or preference of the waste triangle, recycling is preferred number 5 of the 6 options.

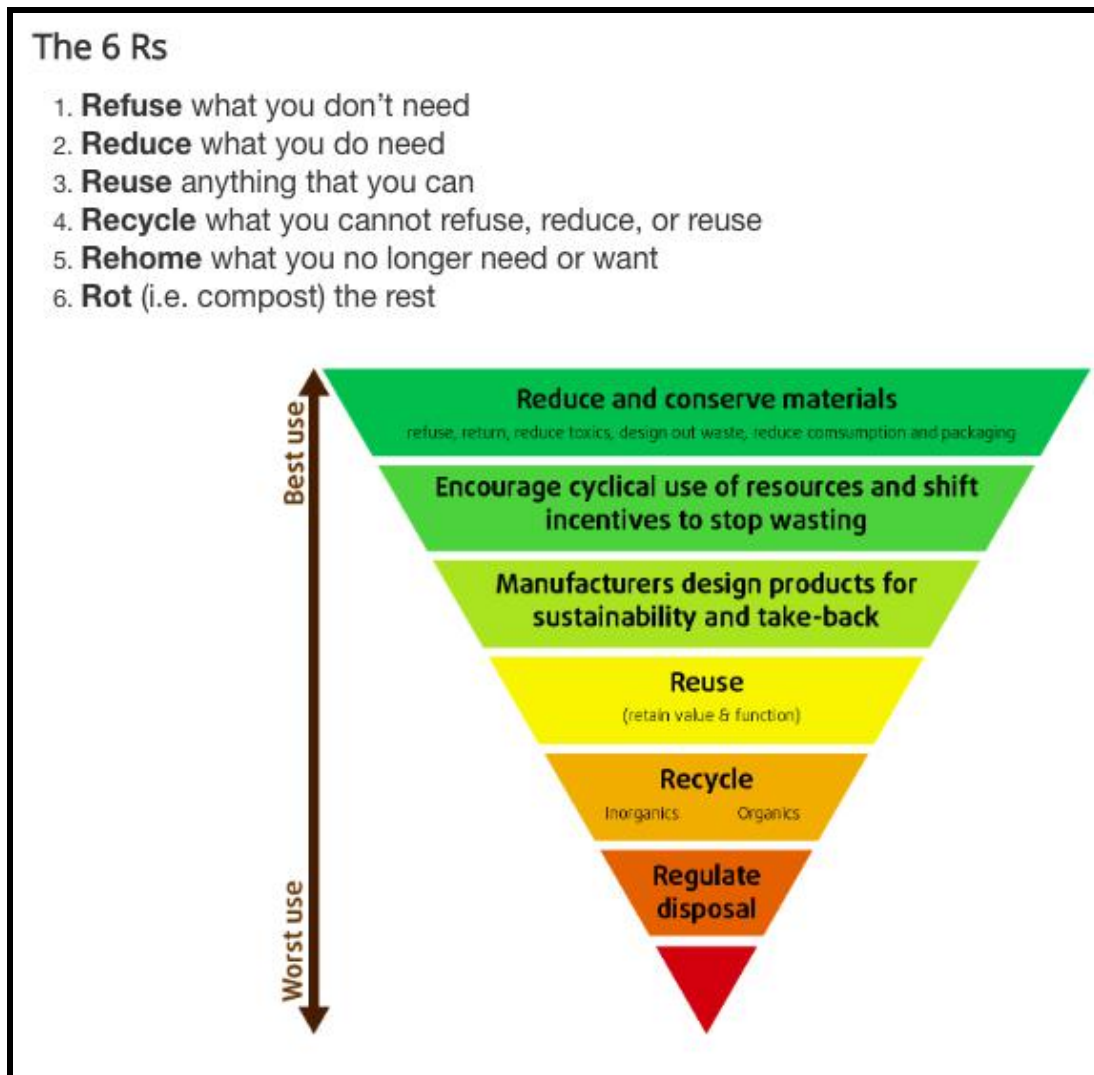


Figure 8 - Waste Hierarchy Triangle
taken from <http://www.halswellcommunity.net.nz/index.php/info/environment/waste>

2.4 What do our rural farm professionals think? What part can they play in me improving?

As part of the Farmsource workshop, retail staff brainstormed how we could all do better.

Opportunities exist from everything from only stocking 'good' products (where the manufacturers are part of current or newly created to demand stewardship schemes), to providing advice/services for waste management.

During the Farmsource hosted workshop in Pukekohe, retail store managers were very interested in what they could do to help farmers do better. Suggestions were made to upskill store staff in being able to not only sell the product to the farmer, but to advise how to deal with the waste created from it. This could be

as easily as saying - "see this is packaged in cardboard, you can take this to the (e.g.) Manaia recycle centre when it's finished". Or additionally, offer alternatives to similar products that are packaged better (less waste to landfill).

Table 3: Workshop Question 5: What are the opportunities in our sector?


<p>Educating the people producing products to make it easy(easier) for farmers to reuse, reduce, waste etc. (a number of comments along these lines).</p> <p>Working with manufacturers, suppliers and retailers more to see what best practice is and what technology is out there to be tapped into.</p> <p>Reward good practice.</p> <p>Make it part of farm plans that look like they'll be required in the future for all farms.</p> <p>Community collection service - raise funds for groups.</p>	<p>Create demand for better solutions.</p> <p>Legislate change.</p> <p>World leading chance to change.</p> <p>Replace plastics with better options (paper, card, wood).</p> <p>Supplier responsible for collecting their own company's waste.</p> <p>Bulk storage on farm instead of smaller storage containers.</p> <p>Bulk delivery - shed dispenser for chemical instead of all sheds having to have 200 litre drums</p> <p>Milk companies put waste as a requirement in handbook.</p>	<p>Find a demand for our waste - other sectors that could utilise our packaging etc.</p> <p>Educate the younger generations.</p> <p>No single use anything.</p> <p>Product stewardship - increase in requirements.</p> 
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Table 4: Q6: How do you feel (red hat thinking) about Farm Waste, Circular Economy or in General?

Farm Waste	Circular Economy	In General
<p>Don't appreciate it</p> <p>Feel disappointed in it</p> <p>Consume, consume, consume model</p> <p>Need to be more diligent</p> <p>Disappointed to be part of the problem</p> <p>Its ugly</p> <p>Time consuming to deal with</p>	<p>Should happen</p> <p>Not a level playing field</p> <p>Opportunity to Improve Behaviour and philosophical change is required</p> <p>Make it easy</p> <p>Start at consumption</p> <p>Interesting</p> <p>Full of opportunities</p>	<p>When should companies be held accountable for their waste?</p> <p>"Life Cycle" is being thought of but little action.</p> <p>Growing awareness of current rubbish system not being sustainable.</p>

2.5 How do others in Taranaki deal with their waste? How do others around NZ deal with theirs?

A survey was undertaken on 100 dairy farmers in NZ of which 30 are Taranaki farmers. The full survey results can be found as Appendix 2.

Question 3 and 4 was based on farmers main behaviour when dealing with rubbish.

Q3: Your on farm rubbish (non-biological/non-organic) is MAINLY (select ONE - what you would MAINLY do with rubbish)... Note: rubbish from farm can be thought of as everything from silage wrap to rubberware to spray paint, latex gloves to meal bags - all the things we would consider rubbish.

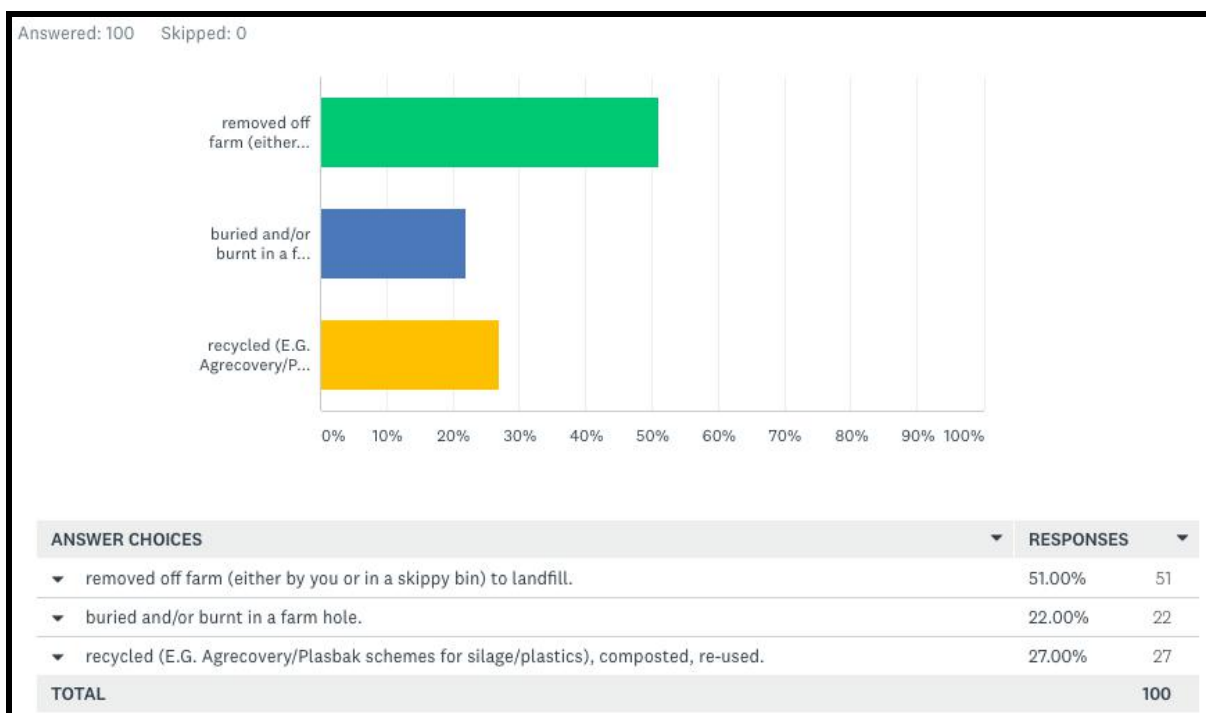


Figure 9 - Q3 Survey Result

51% of dairy farmers (NZ) mainly send rubbish to landfill. Of the 30 Taranaki respondents the figure is 18/30 or 60%.

The follow up question on - list the other ways farmers manage rubbish had the results;
50% of farmers in Taranaki also recycled their rubbish compared to 48% of NZ wide sample.
43% of farmers in Taranaki burnt or buried their rubbish compared to 48% of NZ wide sample.
20% of farmers in Taranaki also sent rubbish to landfill compared to 40% of NZ wide sample.

On a Taranaki level, 60% of the 30 farmers (18 farmers) send rubbish to landfill as main choice however recycling and burning/burying also had 50% (15 farmers) and 43% (13 farmers) respectfully. The burning of rubbish is a concern. If 60% of farmers send the approximate same amount of rubbish as me at 12m³ then this is a substantial amount of rubbish.

2.6 What is the role of our local and regional councils? What opportunities do they have?

The Taranaki's WMMP (Waste Management and Minimisation Plan) has 3 main targets of which the first one - reducing total waste going to landfill is an opportunity for both the farmers and the council to work closely together.

In the survey undertaken, Question 5 asked;

Q5: What would help you improve how you deal with rubbish on farm? Rank these 1-7 - where 1 is the option that would help you best and 7 being the option that would help you least...

3.3 Targets

3.3.1 Strategy targets

Over the life of the Strategy, the following targets are anticipated:

1. To reduce total waste volume going to landfill measured on a per capita basis.
2. To reduce residential wastes collected through kerbside collection for disposal to landfill on a per capita basis.
3. To ensure any increases in waste volumes to landfill remain below any increase in regional economic performance.

Figure 10 - Taranaki WMMP Targets

	1	2	3	4	5	6	7	TOTAL	SCORE
▼ The council rubbish services offered (at the gate pick up, easier recycling options etc).	38.04% 35	15.22% 14	11.96% 11	8.70% 8	6.52% 6	6.52% 6	13.04% 12	92	4.98
▼ More information about how to improve how you can deal with farm rubbish in YOUR region.	3.26% 3	16.30% 15	10.87% 10	19.57% 18	21.74% 20	17.39% 16	10.87% 10	92	3.64
▼ At point of purchase - clear information on the products that can be e.g. recycled, composted etc	1.12% 1	10.11% 9	29.21% 26	14.61% 13	22.47% 20	11.24% 10	11.24% 10	89	3.74
▼ At point of manufacture - make item /packaging that don't end up as 'waste' at end of life	27.17% 25	18.48% 17	10.87% 10	22.83% 21	8.70% 8	4.35% 4	7.61% 7	92	4.89
▼ At end of life of the product - clear information from manufacturer (on label perhaps?) as to how to 'dispose' of it in the best way available.	7.61% 7	6.52% 6	14.13% 13	15.22% 14	33.70% 31	14.13% 13	8.70% 8	92	3.62
▼ An on phone information 'App' - take a pic of a product/packaging and it will tell you how to dispose of 'it'.	2.17% 2	7.61% 7	9.78% 9	11.96% 11	5.43% 5	30.43% 28	32.61% 30	92	2.67
▼ More investment/technology into the sector to be more innovative with types of products required e.g. silage	24.74% 24	25.77% 25	14.43% 14	7.22% 7	3.09% 3	13.40% 13	11.34% 11	97	4.76

Figure 11 - Q5 Survey Results

The highest scoring preferred option to help farmers better deal with their rubbish was 1. "that the Council make rubbish and recycling options easier for farmers", followed by point 4. "point of manufacture - product redesigned to not result in waste at end of use".

The 'Waste Minimisation Act' (2008) the overarching national policy driving the council's WMMP.

What the Act does

The Waste Minimisation Act 2008 Act (the Act) encourages a reduction in the amount of waste we generate and dispose of in New Zealand. The aim is to reduce the environmental harm of waste and provide economic, social and cultural benefits for New Zealand.

Figure 12 -Excerpt Waste Minimisation Fund

The Act has 5 main provisions;

Provisions of the Act

Provisions of the Act are outlined in the following pages on our website:

- **Waste disposal levy**
What the waste disposal levy is and why we have one, information for waste disposal facility operators and findings from the three-yearly reviews of the effectiveness of the levy.
- **Product stewardship**
What product stewardship is, and how schemes are implemented and managed.
- **Waste Minimisation Fund**
What the fund is, eligibility and assessment criteria and guidance on how to apply.
- **Role of territorial authorities**
Obligations under the Act.
- **The Waste Advisory Board**
An overview of the Waste Advisory Board which provides independent advice to the Minister for the Environment on matters relating to the Act and waste minimisation.

Figure 13 -Excerpt Waste Minimisation Fund

Farmers (and everyone) who send rubbish to landfill subsequently pay a waste disposal levy. Farmers may not see this charge as when getting billed by subcontractors collecting skip bins, this levy may not be visible on the invoice. The levy is \$10 per tonne and goes into the Waste Minimisation fund (centrally) and then half of the levy gets redistributed to the council to spend on *"promoting or achieving waste minimisation activities set out in their waste management and minimisation plans (WMMPs)"*.

If farmers send rubbish to landfill, as we see 60% of Taranaki farmers surveyed did as their main way of dealing with rubbish, then should we expect some targeted return and solutions to the dairy sector to improve the rubbish created in the sector? What could that look like? On our farm we get no rubbish collection and for me to participate in recycling is at my time/cost. Farmers cited better council services as a preferred way to help deal with waste. However, would this actually be of real benefit? Or is it the ambulance at the bottom of the cliff? Perhaps it is better to design out the need for council waste services?

2.7 Who in NZ is working on agricultural waste? How can / should I partner with them?

There are 2 main 'players' in the agricultural waste space. Plasback and Agrecovery. Plasback attended my workshop with Farmsource and Agrecovery has supported my project financially and with expertise. Both

deal with agricultural waste from all sectors. Both are accredited product steward scheme providers that all chemical manufacturers have to belong to under the Waste Minimisation Act 2008.

Agrecovery has launched a rural waste minimisation project in 2018 which has been trialled out in some regions. All of this work is important in solving today's problems of waste. The idea of circular economy is to design waste out of our system. Is 'dealing' with waste where we should be putting our effort?

The Waste Minimisation Fund, funded by the waste disposal levy people pay when sending rubbish to landfill is another avenue to deal with agricultural waste.

Allocation of funding

Fifty per cent of the revenue earned from the waste levy, minus administration costs, is allocated to waste minimisation projects through the Waste Minimisation Fund.

Approximately \$10-12 million is collected through the levy per year to support waste minimisation projects. The majority of funding available for projects is allocated through an annual contestable funding round.

Figure 14 -Excerpt Waste Minimisation Fund

The project profiles funded to date include

<ul style="list-style-type: none"> > Flight Plastics Limited > Alpine community recycling stations > Soft plastic recycling scheme > Food waste collection service > Marae waste minimisation project > Milk bottle reincarnation > Packaging awards > Recycling centre 	<ul style="list-style-type: none"> > Residential red-zone household hazardous waste management > Resource recovery centre > Vermicomposting trial > Wood waste processing > Accreditation scheme for hospitality sector > Tackling the problem of used tyres in New Zealand
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Figure 15 -Excerpt Waste Minimisation Fund

Reading through the names of projects funded to date, no projects focus on enabling the agricultural sector to research and investigate how to become more circular - a focus of the Ministry for the Environment - an opportunity perhaps for the Dairy sector to get ahead and make movement towards understanding what circular economy in dairy could look like?

The (NZ based) Sustainable Business Network (SBN) is a membership based organisation. I am a member. I met with the SBN. They had done little work



in the Ag sector. Their website has a plethora of successful stories based in NZ businesses movement

toward Circular Economy. They have a specialist branch called the 'Circular Economy Accelerator'. There are no farmer's stories or Ag stories here. What an opportunity to see how parallel industries are moving towards circularity! For example - packaging is not an 'agriculture sector' problem in isolation. All sectors have similar problems.

The challenge for me as a new member is to work with SBN to encourage work and emphasis to be done in the Ag sector on helping this sector take on principles of circular economy.



Figures 16(pg 22) and 17 - Sustainable Business Network

'New Zealand's dairy export revenue is forecast to rise 5.5 percent to \$17.6 billion for the year ending June 2019' states the Situation and Outlook for Primary Industries (SOPI) Report (2019) which in turn makes up 35% of all our exports for 2019. As such a large part of our country's economy, it is important that the Dairy sector is part of our country's move towards circularity and has a provision in both SBN's future plans and the Ministry for the Environment's plan's utilisation of the 'Waste Minimisation Fund'.

2.8 What is the NZ and the global view of the rubbish we make?

We, as farmers tend to live in a NZ bubble. We are in fact a part of a bigger global picture and lead the way in many aspects of our farming environmental practice.

Because our predominant industry in NZ is based around agriculture, we are as a nation reliant on our good practice and reputation. We have seen the effects when something in our dairy industry doesn't go well. Whether it is the 2008 China Melamine event or the 2013 Botulism Scare recalling products, all farmers felt the cost directly through social license and/or Fonterra share dividend when something goes wrong.

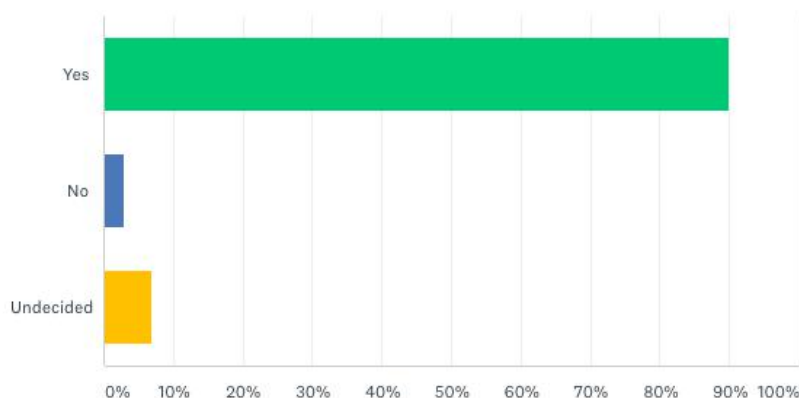
We are often reactive though. When social and community pressure was placed on bobby calf welfare, farming behaviour was regulated to change. We are always facing challenges whether it is environment or social license to farm.

What if there was an opportunity to build resilience and pride in our industry in ways that are other than reactive to people or social pressures? What if we could get ahead of an issue before it becomes an issue? The transition to a circular economy could be another way to gain both favour in the local setting but also in the global setting. And perhaps even more so is the ability to use circularity to help our businesses be both environmentally and financially more sustainable.

Farmers in the Survey Monkey Survey conducted were asked the question;

Q2: Opinion Question - Do you think the NZ Dairy Industry needs to improve the amount of 'rubbish' produced on farm, how we deal with it and options for recycling/reusing/composting etc?

Answered: 100 Skipped: 0



ANSWER CHOICES	RESPONSES	
▼ Yes	90.00%	90
▼ No	3.00%	3
▼ Undecided	7.00%	7
TOTAL		100

Figure 18 - Q2 Survey Question

90% of the 100 farmers (90 farmers) surveyed believe that the NZ Dairy Industry needs to improve (reduce) the amount of rubbish produced on farm with 7% undecided. Just 3% of people surveyed didn't believe we needed to improve our rubbish behaviours.

I interviewed the CEO of NZ largest milk company (and 5th largest milk company in the World) Miles Hurrell about circularity and rubbish. I was interested to hear what global pressure there might be on circularity.



Photo 3 - CEO Miles Hurrell Fonterra

An Interview with CEO of Fonterra - Miles Hurrell

Miles sat down for 40 minutes with me and over a coffee we talked about my project. Miles had personally sponsored some of my course fee. I was lucky to be sitting down with NZ's largest company's CEO, and all because I sent him a direct message on Saturday morning April 13th on twitter and asked if he was free for a coffee on the 15th. He replied 10mins later and said "sure - come to HQ at 8.30am".

He cares. He cares about our company. He cares about our product, but most importantly he cares about the people. I explained that I care about my rubbish. We discussed what he saw overseas. He knows that

NZ are some of the best producers of Dairy products in the world. Certainly there is evidence that we are the most efficient per kgMS for measures such as GreenHouse Gas (GHG)

emissions. There is no measure for 'rubbish'. There is in fact very little discussion about it. He said no one he talked to or dealt with at this stage were wanting our farmers to prioritise rubbish mitigation. GHG emissions like carbon, methane, PKE (palm kernel expeller) and animal welfare were higher up the list.

A group of successful NZ business people have formed 'Pure Advantage' to help drive improved environmental behaviour based on economic principles. Here is what they say about Circular Economy



Figure 19- Excerpt taken from <https://pureadvantage.org/news/ftf/section-3/>

What this group also discusses is the need to stay economically viable and have sound business performance to enable the move towards circularity. This raises the important idea that business viability is vital to enable change, so how to make sure our primary industry of farming stays viable is key to moving towards a circular economy.

2.9 How can I leverage my on farm knowledge with other rural professional's knowledge on waste minimisation?

Farmsource supported me by hosting a workshop with 18 rural professionals ranging from local Farmsource store managers, sustainability advisors, rural merchant/manufacturers and Plasback. The full results of the questions and brainstorming undertaken can be found as Appendix 1.

The five main ideas that came out of the day were;

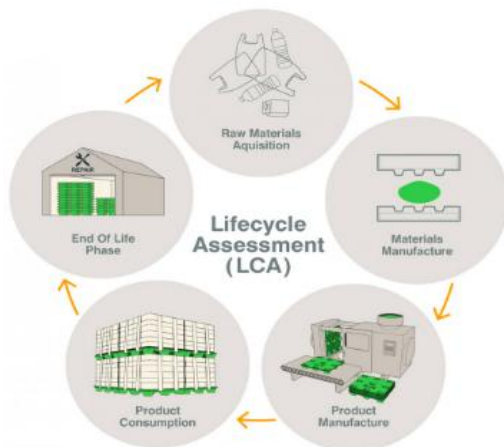
- **The concept of circular economy was a new concept to many.** That even though the Ministry for the Environment are driving business towards the concept, it had not been established as a concept or actions at farm or farm service industry level.
- **The opportunity for the retailer in the manufacturer - retailer - consumer flow was immense.** The retailer could feed information up to the manufacturer and down to the consumer about how to improve product and behaviour.
- **Communication with farmers is a challenge.** Getting information to farmers to e.g. inform behaviour is difficult. Farmsource report even with direct email, internet posts, social media posts, direct text message or print copy, the uptake of information by farmers is limited.
- **Products aren't all equal and there are ways to improve them** - how can we encourage the purchasing of the 'better' ones? Better could be because they are locally made (less transport/handling/energy/carbon miles), better packaging, less 'leftover waste' or better for people/handling. Design thinking can produce some achievable product transformation.

- **Education is an enormous opportunity.** Educating manufacturers that farmers don't want to buy waste as part of products. Educating retailers to encourage the sale of 'better' items or even only stock and sell better ones. Educating farmers on the waste triangle of preferred behaviours. Educating our entire sector that to 'say no' or rethink use is a powerful tool.
- **Start having conversations now** - within businesses, with clients, with manufacturers, start asking questions of people in your circle of influence about what they are doing towards circularity.



Photo 4 -Farmsource workshop held April 17th 2019 in Pukekohe

But even bigger than these immediate solutions were the suggestions around helping farmers to make good decisions. This could include purchases where products could be assessed for variables like carbon miles, raw product ingredient/is it a finite resource, circularity, ease of breakdown/recycling etc and 'actual' numbers attributed to this. E.g a product that comes from the South Island to the North Island versus a product made in the North Island and used by a North Island farmer would have less 'kilometer', 'energy', 'human resources' etc all expended on it. It would have a lower number. There is a term developed to describe this - Life Cycle Assessment. The retailer could be part of an investigation into Life Cycle Assessment (LCA) of a product.



LCA "is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Designers use this process to help critique their products." (Wikipedia)

https://en.wikipedia.org/wiki/Life-cycle_assessment

The study of LCA is limited. Engelbrecht, Ladenika, MacGregor, Maepa, Bodunrin, Nicholas. Burman, Croft, Goga & Harding (2018) conducted a study into the 'Availability of Life Cycle

Assessment Studies of NZ.' They concluded that only 35 document existed on Life Cycle Assessment relevant to NZ of which just over half were publicly available.

Chobtang, Ledgard, McLaren, Zonderland-Thomassen & Donaghy (2015) in their report state *"the present study indicates that, when the LCA is expanded to consider a wide range of impact categories, more attention should be given to improvement options related to off-farm activities (i.e. production and transport of agrichemicals and animal feeds, and rearing of replacement animals). This is because these off-farm activities contribute a higher proportion of the result for all other impact indicators than is observed for the CC (Climate Change) indicator."*

Is this another opportunity. What if LCA including waste could help farmers meet their obligations under the newly proposed conditions in the draft Carbon Zero Bill? The opportunities for retailers working as the middle person for farmers between manufacturers and consumers is a real opportunity to help drive buying behaviour, waste behaviour and LCA information gathering.

2.10 What opportunities exist for manufacturers? How can I do better with what I buy and use?

Manufacturers have a number of considerations when 'making' a product. These range from minimum order required at manufacturing, specialist equipment required to manufacture through to packaging and storage. The obvious concern is packaging, however consideration must be given to the alternatives.

Plastic packaging for example allows extended shelf life, safe transport of chemicals, durability of items for distance. It is light, hygienic and versatile. It is claimed that to not use plastic (and use other materials) would increase GHG emissions of the packaging.

(<https://www.bpf.co.uk/packaging/why-do-we-need-plastic-packaging.aspx>)

However, there are opportunities for manufacturers to rethink the waste their items they produce. Without the limits of current technologies the 'design thinking process' is a good model to use. At the Farmsource workshop I held, we spent an afternoon using the design thinking process to deal with the big waste on farm. Edible or biodegradable silage wrap was one item discussed which has been being developed around the world for the last 10 years. Milk bottles recycled into fence posts was another item discussed.



Photo 5: Recycled Milk Bottle Fence Posts

However, again, all these solutions are to deal with the waste AFTER it has occurred. Little action has been implemented into the redesign of the (a) requirement for the product in the first place (e.g. silage wrap: making silage is a result of too much grass growing at a particular time of the year not matching the stocking rate) and (b) initial product design (e.g. plastic milk bottles). What if we just went back to glass then we wouldn't have to have solutions to plastic bottles!

The opportunities I believe are in the entire sector looking at all our 'ins' and 'outs' of the (in my case) dairy farm and seeing what can be designed out or redesigned in its logistics, ingredients or use model. For

example - do I need to 'own' items, or could I lease the service? Do I need to own the rubberware used in the shed, or just require the service of milk liners which the company could install and replace when required, with the company still owning the actual product and take it away to remake the item.

Innovative products are being developed everyday. Dairyflo (NZ) have created a plastic 'rubberware' dairy shed liner. Now while no one likes the sound of 'plastic', when you have done 5000 milkings with them, you



send the product back to the manufacturer in Napier (so local NZ location), who breaks the product down and reuses 40% in another batch and the rest is made into plastic matting (like playground mats etc). Their product is designed and made in NZ - so no overseas carbon miles for travel and they do twice as many milkings as traditional rubber milk liners that are only destined for landfill.

Photo 6: 100% Recyclable Milk Liners



Figure 20 - Milk Liner Attributes

Other innovative products that can help on farm to reduce waste and inefficiencies include electric motorbikes, cow tag/collar management systems, meters (fuel, milk, water) that send alerts to your phone and feeding systems like in shed or per cow systems that deliver feed to cow in the most efficient way reducing wastage. These products are all available now, are increasing in uptake, though many are costly and the upskilling of farmer behaviour is a challenge to overcome.

How to get a message to manufacturers that we care about our wastage is our first step. If we as farmers stop buying products that create landfill in favour of better products then, that is a good first step.

2.11 What is the bigger picture? Does doing better with my waste and moving towards circularity help me/my business/our sector/our country in other ways too?

I started out my project thinking it would be good to do better with my waste. Not from a scientific or economic viewpoint - just so that I was being more environmentally friendly. I believe the opportunities for better waste management when seen as a part of the bigger picture of the total on farm environment behaviour is vital moving forward.

To think of the information in terms of circular economy, I believe that when my farm is viewed as a total unit, I could be achieving all three goals to;

1. Regenerate Natural Systems
2. Design out waste and pollution
3. Keep products and materials in use

To improve my waste and move towards circularity I could help my business close my loops, reduce my emissions (contribute positively to the Carbon Zero Bill on farm requirements) and improve the social license to farm within our community. If farmers used the '6R' approach to decision making of Refuse, Reduce, Reuse, Recycle, Rehome and Rot (or compost) they could not only reduce their waste but increase their financial and environmental sustainability.

On top of the on farm benefits, if farm businesses in general worked towards circularity, it could be World leading. This could add value to our product and could result in our newly generated technologies to enable this to happen to be sold overseas too.

Farmers are always challenged to do better. While this doesn't often result in a better bottom financial result, other benefits can be found. The connection to improvement in farming practices to the improvement in the public perception of farming is felt by all farmers. We have opportunities to have better on farm practices around circularity, but at the moment we don't seem to have much support to.

Part 3: The "Now What"

Now that I have established what my waste is, and who are the people involved in my 'waste', then finding solutions is my "Now What"...

The overarching theme to improve in each of the sections is **Calculate & Educate**.

Numbers attributed to better behaviour around farming could be calculated. Numbers that can and should be attributed to my business. The concept of Life Cycle Assessment should be explored more. If I send less rubbish to landfill, how can I get that improvement 'number' as part of my farming system? The circular economy is a numbers game. Economy is based on economic principles which foundation is in numbers. What goes in should match what comes out, and everything used stays in play for as long as it can.

Revisiting the Agrocycle Diagram by Toop et.al (2017) which shows how complex and wide spreading the relationships are in my farming system is key to being able to start identifying our own agrocycle for our own farms. This would need to be adapted slightly for a NZ setting. To close the loops on each of these components like feed, water, fuel, electricity, fertiliser usage, chemicals, animal health, plant production, retail etc, is what needs careful consideration and planning moving forward and is an opportunity for a place to start. If I am able to calculate my 'ins' and my 'outs' even for just one small sections e.g. fuels, is a start to finding my numbers and measuring improvements.

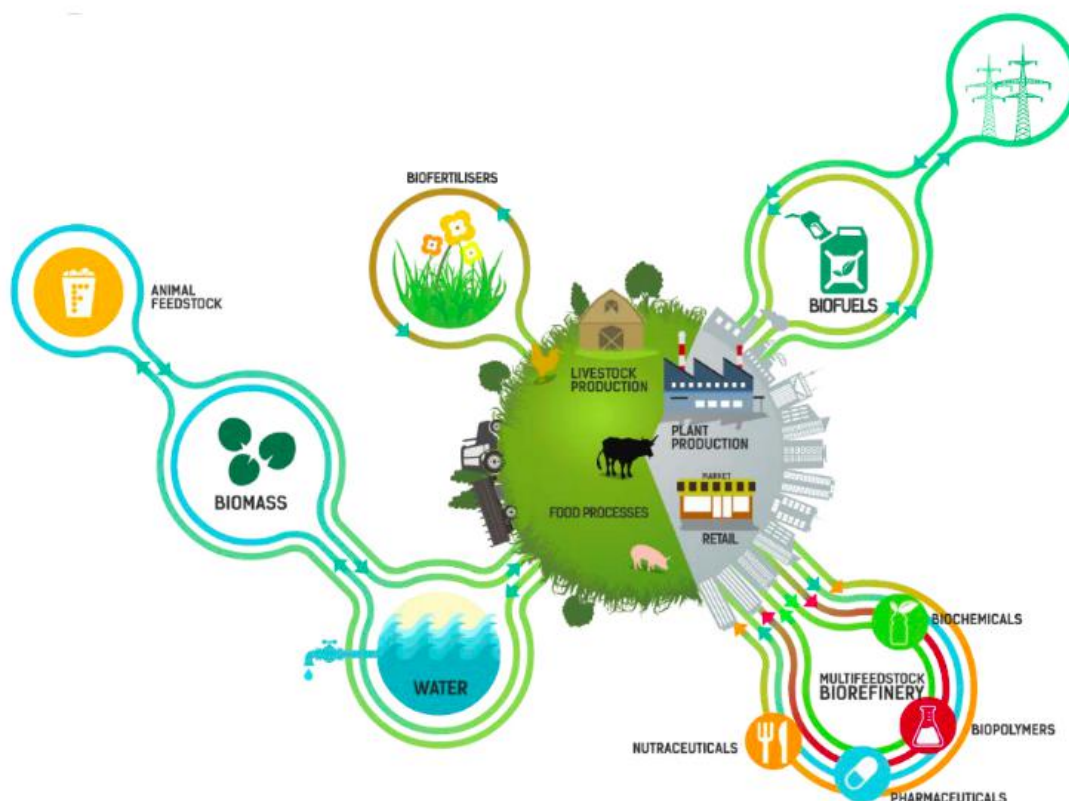


Figure 21 - Agrocycle Diagram

How does 'my farm' get to claim my improvements? If 'my farm' used less energy e.g. electricity, or bought locally made goods with locally made packaging, how could that better behaviour and action be part of 'my numbers'? At the moment the electricity sector would get the better number attributed to them. The transport sector would get the better number for less transport attributed to them. The Agricultural sector is the biggest economic generator of business in our country, but farmers don't get to use 'their' numbers in many of the components of their system.

We get told to know our numbers for leaching nitrates or water quality or greenhouse gases. But if we improve our farming practice we could know our numbers for all parts of our business and use those numbers to become more circular. Could a waste calculator 'App' be developed? Where I can put in where my product was made (therefore thinking carbon miles), the type of packaging (therefore how easy it is to break down), the type of product (did it use fossil/natural resources to be made), longevity (can it be reused, repurposed etc) and give me a score out of 10 for the product. Then I could compare products based on their number that do the same purpose. Compare apples with apples scenario.

This section will be broken into four sections with subsections 'Start Here' and 'The Future'.

- 3.1 On My Farm
- 3.2 In Taranaki
- 3.3 For the Sector
- 3.4 But the Real Opportunity is...

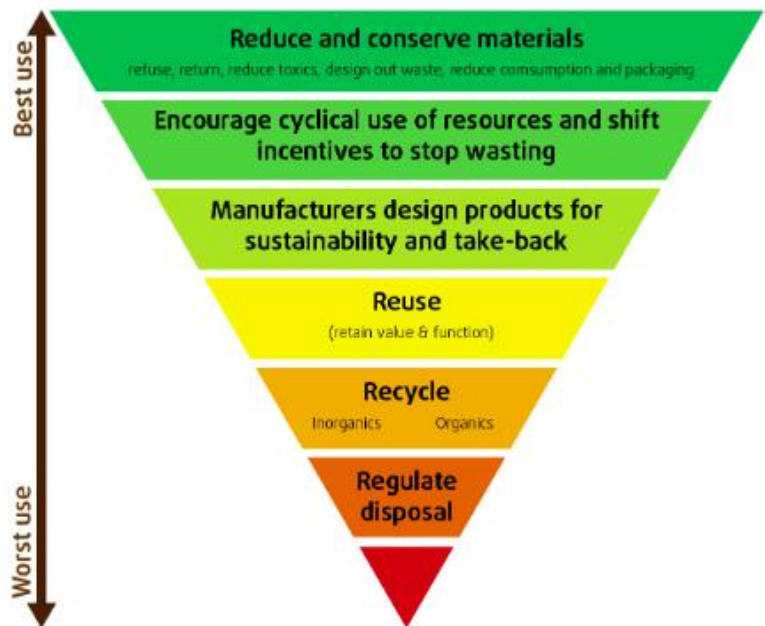
3.1 Improve farm waste? On My Farm.



With the current linear system in place, and using the waste hierarchy triangle, I believe I have 5 things I can do on farm to improve my waste right now. For me right now, improvement is based on my **own on farm behaviour**.

Changing behaviour is always easier when you have good education. Only through this project have I come across the Waste Hierarchy Triangle.

Education around this would be beneficial to all people in my farming business but to the wider farming community.



1. Reduce Use Can I buy a half tonne bag of meal instead of 20 plastic coated bags?

2. Reuse the item/repurpose it for other uses after initial use has finished. What else can I reuse - we already use all buckets and plastic 200l drums. Or can I rethink my purchase and buy a larger quantity so

therefore less likely to have an item left over I don't want - instead of buying a 100 l container which is of little use etc, buy 2x as much (e.g. 200litre) to have a more usable item.

3. Recycle what I can - make sure I understand what Agrecovery and Plasback can recycle.

It is more than just chemical containers and silage wrap. Get educated on this.

4. Part Recycle - Recover energy or part of the product for further use. When I use items, is there a part that can be recovered to be used, recycled etc. Or are there technologies to e.g. incinerate at high temperature to generate energy? There may not be these options in NZ at the moment, but with demand there may be?

5. Disposal in ways other than landfill. What treatment can I use on farm? Can I compost my filter socks? Can I use a worm farm to break down organic based products.



If I set myself the goal to be circular (in waste but also in all aspects of my farm), I need to know what that looks like in real life. What are my inputs, outputs and streams coming in and out of product, services etc and what does improving these look like?

All providers of goods I use/need would have to be able to provide me with knowledge and numbers. If I need e.g. fertiliser - I need to know the better product to use defined by circular concepts. Is there a fertiliser that would regenerate my system? Is there one that can be used to end with zero waste?

I need the sellers of my inputs and the buyers of my outputs to work with me so that I know the whole circular economy system individualised to my farm. The AgroCycle diagram (Toop et.al 2017) included the inputs into the farm but also through the processing and retailing of the product. Instead of looking just at my farm inputs, should we be looking from the pound of butter or glass of milk backwards? Is there a benefit of being part of a larger circular economic picture? Reverse logistics (working backwards from my glass of milk) with measurements/identifiable/quantifiable numbers could be a way of doing this.

To develop this idea further, if I know where my farm's actual raw milk goes when picked up from tanker (not just a general idea that it might go to Factory A or B) but the actual destination of my raw milk, then I can identify in that first transaction of product ways to improve. Perhaps I could choose to supply a closer milk factory that produces product that ends up locally. This versus the product that might get collected by tanker, loaded onto a train (after a longer truck ride), trained to a milk factory which then sends the products overseas, would have a 'worse' number of e.g. carbon miles, energy, fuel, processing time etc. To make better decisions, I need to be able to measure. To measure means I am in a better position to reduce waste.

3.2 Improve farm waste? In Taranaki

60% of Taranaki farmers surveyed send rubbish to landfill, 50% recycle their rubbish and 37% of Taranaki farmers burn or bury rubbish as their 'first' ranked option for dealing with their rubbish. How could we reduce requirement for landfill? How do we get the recycling to 100%? Do we even want to have to recycle? Shouldn't we try and skip this and just design products to have no wastage? How do we in Taranaki change and improve farmer behaviour?



Calculate and Educate

- Calculate and educate farmers around the benefit(s) of recycling for Taranaki. Calculate the benefit of 'not' burning rubbish. Calculate the space farmers could save at landfill by focusing on recycling or reusing items. Tell us the story of how we can improve and why we want to.
- Educate farmers on what can be recycled, recovered or treated and why we should bother. What is the value proposition for a farmer taking the time to drive their recycling to a depot and drop off a triple rinsed container? Why is it/Is it better for a farmer to take cardboard collected during the season from their packaging (stored so you get decent amount), drive to a transfer station and drop this off? Does it get recycled? Is the energy used in making the cardboard, putting it on something as packaging, transporting the packaged item, then on farm collecting, storing, driving, then council storing again, collecting and transporting to wherever it is recycled worth it? Should we just

compost it on farm? How can we design out that waste in the first place? Again, tell us the facts and the story.

- Develop solutions and education on how to start doing the 'waste triangle' steps better. The solution that is most emphasised at the moment is 'recycling' through Agrecovery and Plasback. Where is the education around the more preferred steps of reduction and reusing? There are some examples of the reusing after recycling coming into play now. The fence posts made from old milk bottles from Anchor. The plastic made into underground cable from Agrecovery. Where on farm can we celebrate the reusing we do? How can reusing my 200 litre drum over time be part of good farm behaviour?
- Education around what to burn or not to burn. We get 'told' burning rubbish is bad, is it? Is it worse than sending to landfill where it can emit methane or cause leachates. More education for farmers is required by the council as to the do's and don't's and most importantly, the why.

DairyNZ in their advice to farmers on waste management state that it is illegal to burn some plastics. Farmers do not have an understanding of what is allowed/what shouldn't be burnt/buried and what isn't allowed to be burnt/buried by Taranaki Regional Council and I'd suggest a number of farmers would be surprised by this information. Burning of 'industrial waste' is banned in Taranaki. It is a grey area as to whether what is being burnt is classified as industrial waste.

Why is burning and burying a problem?

It is now illegal to burn certain materials such as tyres and some plastics. Burning releases harmful chemicals and contaminants into the atmosphere.

Many farm plastics are not biodegradable and if they are buried, can be disturbed and eaten by stock. Burying waste can cause chemicals to leach into soil. Burial pits can also create future problems if they are disturbed by farm activities.

Figure 22 Excerpt taken from <https://www.dairynz.co.nz/media/4209679/waste-management-solutions-technote.pdf>

- Recycling - by and large the biggest reason that farmers I spoke to don't recycle is, that they believe nothing happens to it. That it gets stockpiled somewhere or sent to landfill as contaminated items (not cleaned properly). Tell the story of where my recycling goes might help inspire farmers.
- Solutions for waste minimisation - actual figures for farmers on environmental and economic returns to change use/decision making e.g. what if replaced my e.g. 1 tonne (40) bags of calf meal with 2x half tonne slings of returnable bags. I save 'x' amount of landfill etc.



Funding for better council services.

The number 1 strategy on how to help farmers improve waste management according to the survey I conducted was 'better council services'. If 50% of the waste minimisation levy paid to central government per tonne of waste sent to landfill is returned to the regional/local councils to help improve waste, then proportionally

how is that invested in agriculture specific solutions. Solutions don't have to be 'come pick up my

rubbish at my gate' as you'd initially think, but in our region's whole approach to waste. Support the farmers by helping get better information to them about their waste. This could be a farm waste specialist role - where the education of farmers on improving waste is paramount. This role could liaise with manufacturers locally to encourage farmers to buy local which results in improved 'circular economy' or LSA numbers. We've led NZ in our riparian planting - how can we do the same in circular economy and waste?

- What about a local initiative where retailers have a system to 'score' items on their ability to be reused, recycled or recovered? What if that included a score on how much carbon was produced in the making/transporting of the item? Then as a consumer I could purchase 'better' items. Think 'heart tick' type accredited products, but 'Taranaki Tick' for products that have over e.g. 50% of the product staying at his highest quality of use or 100% recyclable.
- If I was to view my waste in terms of the bigger picture - what if I was encouraged to buy fresh and buy local. So instead of having to buy e.g. 40 bags of calf meal made further afield than Taranaki, shipped or trucked here, capable of being stored in pest/disease resistant bags, I could buy local, fresh, made to order smaller quantities more frequently (not requiring such long lasting packaging). What if we really got in behind our local manufacturers because we knew the 'footprint' of that purchase to be better.
- The big idea - what else could we do with waste? In Stockholm they incinerate rubbish to make electricity for heating and with by product methane, create biogas to fuel buses. While there are philosophical issues around whether this is actually a better solution - i.e. shouldn't we focus on decreasing rubbish to landfill instead, this is actually a solution to be considered to use the current and perhaps historical landfill. What if we (Taranaki) built an incineration plant in e.g. South Taranaki that could be a collection point for all of the lower North Island's rubbish (current and historical)?
- Innovation Energy and Waste 'brand' developed for Taranaki. An article around using hydrogen gas to fuel vehicles (see [Could Hydrogen Turn Taranaki into Norway of the Pacific](#)) and how a couple in Taranaki have received a grant to work on their concept is just the tip of the iceberg on how inventive and creative we could help make Taranaki. Or the recently published article around (see [New Plymouth trials putting Recycled Plastics into Roading](#)) being made with plastics here in Taranaki. What if we made our region the one region to focus on giving circularity a go?

3.3 Improve farm waste? For the Sector

How can we as a sector improve our demand and use of products? What if we refused to buy anything with a certain 'score or rating' for its packaging/use of fossil fuels/waste left behind after use etc?

The story of how McDonalds created sector change is a parallel one. Early in the business, McDonalds asked that the meat patties they purchased off a supplier come in a square box, instead of a round container. The supplier said no - that, that would require them to change their plant, systems and processes. Within a short time, McDonalds became a large part of that supplier's business and they asked again, this time with the added 'change or we will take our business elsewhere' mindset. They challenged

the status quo, were a large part of a suppliers business and got the change they wanted. Why did they want the patties in a square box? Because they fit better into transport vehicles and in storage in the shop freezers/shelves.

How can we as a Dairy / Ag sector get the same change. What if we said to companies as a sector - do better with the waste your product produces? Would they say no? Or would we have the critical mass to affect change?

Supply and demand is the key economic principle, if we demand less of the 'poor' products, then they won't last long in the supply.

How can we make these decisions about products - we need to calculate. We need to assign numbers to our behaviours.

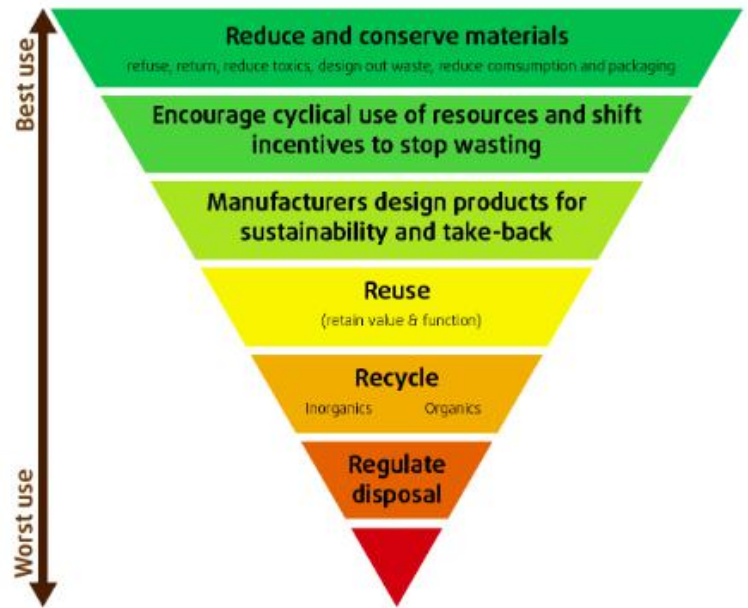


Figure 23 - Waste Hierarchy Triangle



How could the sector put pressure on manufacturers and suppliers to design out waste and pollution from their products? Can we come up with a system to 'score' products?

- Start the conversation about circularity. As a sector we need to signal change to the entire system where we are moving circular. At my workshop held for Farmsource, only 3/18 people knew about the concept of circular economy.
- Emphasise the waste triangle/hierarchy. The sector can right now start discussions on improving the uptake of the first three tiers as a sector.
- Emphasise the 6Rs of decision making Refuse, Reduce, Reuse/Repair, Recycle, Rehome and Rot (or compost).
- Discuss farm waste at events and discussion groups. Have events where people can learn about it. Start putting the concept of being better with farm waste into farmer communications.
- Train rural professionals to ask the questions about waste and on farm waste practices.



Can we calculate soil type, stocking rate, fertiliser use, effluent loading, feed fed onto that land, transport/carbon of that feed, milk produced off that land, emissions from the land as a formula to then be able to calculate how we can regenerate that system? How does my riparian planting count towards my 'regeneration' of my system?

How can we encourage research and development into the items we use to keep products and materials in use? Where does the model of purchase vs leasing come into play? What if I just purchased the use of an item - the acid inside the 200 litre drum - not the drum itself? As a sector with 10000 farmers alongside it, we could pressure the status quo that we have to landfill items like shed rubberware and make the manufacturer take the item back.

3.4 But the real opportunity is...



The big picture.

As farmers we are challenged to do better in every aspect of our farming behaviours and practices. This isn't always driven by pressure from the actual bulk of our consumers (overseas), it is the pressure from the people we live next to, shop, go to school with and live alongside of.

Water quality, animal health and welfare, human resources, fertiliser use, methane, nitrous oxide and carbon emissions, nitrogen leaching, palm kernel use...the list is endless. How does it all tie in together into one system?

How could improving our behaviour in each of those areas and adding in better use of resources/inputs/outputs improve our farming practices and our farming performance and 'footprint'?

Life Cycle Analysis (LCA) - a 'know your numbers approach' to decision making could benefit not just the farmer, but also the sector. Could a farmer who reduces what they send to landfill reduce their methane and therefore be a step closer to meeting the newly proposed Carbon Zero Bill requirements to reduce their methane by 10% by 2030? What if instead of just focussing on animal reducing methane strategies - we analysed our whole system and we got to use our whole farming system to back 'our' numbers. If we buy better products, made in better ways, locally, with less carbon attached to their production, how do we get 'credit' for it?

At the moment other sectors 'get' to claim our numbers. There is little value in us e.g reducing waste, transport (buying local), electricity, energy use etc except for the occasional financial gain for farmers. We don't get any other form credit for better behaviours moving forward into a political and global climate where we have to measure emissions and likely pay for them.

DairyNZ in their information about the Carbon Zero Bill and its implications for farmers, suggests;

What does this mean for farmers?

Each farm will need to estimate its current emissions and, over time, develop a farm-specific plan to manage and reduce these emissions through farm management improvements. Although any level of emissions reduction represents a challenge for our sector, we think it needs to be managed alongside the broader environmental issues, like water quality, biodiversity and erosion control.

Changes won't come into effect immediately, but there are steps farmers can start taking now to prepare.

1. Know your numbers – calculate your on-farm emissions. Overseer can do this.
2. Think about what farm management changes you could make to reduce your emissions.

Here are two to consider:

- Improve feed efficiency – this is the best way to reduce methane emissions. Research shows there's a direct correlation between feed intake and methane produced.
- Reduce and improve your use of nitrogen fertiliser – this is the best way to reduce nitrous oxide emissions.

Figure 24 - Excerpt taken from <https://www.dairynz.co.nz/environment/climate-change/zero-carbon-bill/>

However, I think there is an opportunity to review our system and be able to account for our own improvement in emission and farming behaviour too by looking at our product use, waste, develop LCA and reverse calculate from the 'glass of milk to the cow' and look at ways to improve each and every step. If we reduced waste (carbon, methane, rubbish, etc) every step along the way, what does this look like for our sector.

So while I started out thinking that reducing my farm waste and exploring how a circular economy model could be developed on my dairy farm would be a 'good' (for environment, public perception) thing to do for our industry, I now believe there is a massive opportunity, greater than just using the 'overseer' programme to **find our numbers and improve farming as a system.**

If I reduce the energy (electricity) used to produce my milk - that is worth something to the total food system. If I improve the efficiency of the infrastructure - that is worth something. If I reduce the 'carbon miles' my system uses by buying local or selling local - that is worth something. If I reduce the use of fossil fuel based energy or mined phosphate - that is worth something.

Currently we have no popular measure of these improvements. We have *Overseer* that can calculate in a limited basis my emissions, leaching and loss of N and P, but nothing in day to day use to calculate the improvement to my farming system by making 'better' choices. This is the opportunity, to actually be able to see results by improving the farming system because you 'know your numbers'.

Part 4: The 'What Next?'

The final 'What' is 'What Next?' - What are my recommendations as a result of my project?

My recommendations are that;

1. Farmers get better educated about the waste hierarchy model with emphasis on the first 4 stages of the 6 stages being reduce/rethink use, keep in use (robust designed to not break/wear out), manufacturer to design out waste or take back waste and reuse/repurpose (stage 5 is to recycle and stage 6 is to dispose e.g. landfill).
2. Farmers are better educated about the 6 Rs of waste decision making; Refuse, Reduce, Reuse/Repair, Recycle, Rehome and Rot (or compost).
3. Conversations within the industry start to focus on the Ministry for the Environment's vision to move towards circularity.
4. Waste providers better educate their clients (aka farmers throwing rubbish out) about waste and recycling. Tell us the true stories about the 'why' we should change our behaviour or use best practice.
5. Waste Minimisation Fund targets innovation in the sector (as the number one contributor to the economy) to help deal with waste solutions and support manufacturers to better design products.
6. Enforce no burning and burying of items. Almost 40% of farmers surveyed still burn or bury. This might possibly affect our social license to farm. Make it part of on farm plans for farmers to acknowledge their rubbish disposal methods to ensure compliance as reflecting best practice within current limitations.
7. To turn an agriculture system into a more circular economy we'd need to;
 - a. Identify our own farms equivalent of the "Agrocycle" to identify our systems.
 - b. Use a minimal amount of external inputs (from the Agrocycle diagram this includes fuels, feeds, chemicals, fertilisers etc (everything around the outside of the green centre)
 - c. Close the nutrient loops.
 - d. Reduce negative discharges to the environment (in the form of wastes and emissions).
8. In addition, there is a real opportunity to put 'numbers' on the products we use to help with decision making and behaviour. The development of more work in Life Cycle Assessment modeling of Agriculture use and the production of materials is a big opportunity. This model, *"which is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling"* could be a game changer for farmers where we assign real numbers to our impacts, can measure these and reduce these.

The overarching theme to improve in each of the recommendations is to be able to Calculate & Educate.



A further idea, could be to start to develop our own NZ based agrocycle type diagrams that also include how to identify and to aim to close the loop.

This diagram was designed by me to depict a closed loop system for farming where (clockwise; electricity, inputs (arrow into a box), outputs (truck), animals, land, transport/fuel, processing plant are all in a loop. Where one part of the cycle might 'cause' an output, perhaps another part of the cycle can use that output or manage it.

There is merit in our farmers thinking about their place in the 'big picture' of the product, from origin to end use/destination.

Figure 25 - NZ Circular AgroCycle Diagram

So what for me? I have been working with Professor Kiara Winans from Davis University in California who has done work on LCA in the dairy sector - albeit the American style of farming. We are working together to see what we can develop in this sector.

I will be starting an extramural Post Grad Certificate in Circular Economy from Bradford Uni (UK) in July to increase my knowledge in this area.

I have purchased the web domains - www.circularag.com, www.circularagriculture.co.nz, www.Porohita.co.nz (Māori word for circle) and associated sites to develop a business based on developing a circular economy for agriculture consulting. This is still being developed.



Figure 26 - New Business Logo

My project title - 'What a Waste' ends with me knowing that if farms don't get credit for all their numbers - that would be a waste.

My plan is to ensure that doesn't happen.

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Appendix One

Farmsource Workshop Notes: April 17th

Question 1: Name the types of Waste on a Dairy Farm

Effluent, containers/packaging, timber, metals, fencing, tyres, household, sludge, oil, chemicals, feed bags, silage wrap, rubberware, bobby/slinky calves, urea bags, animal health needles and medicine packaging, spray cans/tail paint, bits of broken machinery, pallets, chemical drums, expired chemicals, filter sleeves, milking gloves, alkathene and netting.

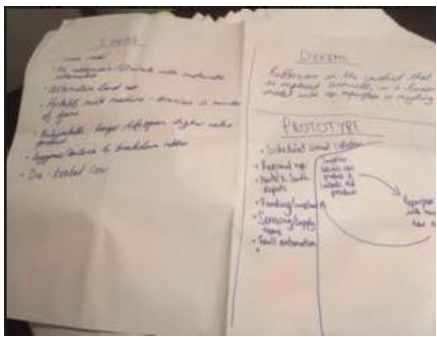
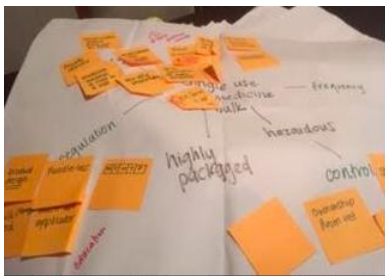
Question 2: What are the current options for waste management

Plasback	Agrecovery	Re use
Skip bin	Burn	Bury

Question 3: What is a Circular Economy

Discussion - one person was able to say that it was where the loops were closed and no waste was created. Other people had not heard the term before.


Question 4: What options can you think of (using Design Thinking Process) to improve waste?

	<p>Rubberware: scheduled annual collection. Regional reps. North/South depots. Investment in R and D in how to recycle/reuse. Repurpose rubberware into new product. When supplier delivers new product they have to take away the old one. Lease model. Biodegradable formula. Enzyme/bacteria found to break down rubberware. Perhaps even a one teated cow (genetically modified) reducing by 3/4.</p>
	<p>Single Use Medicine: needleless administration of drug developed. Vets to take used product back. Cows required to have robotic diagnostics (so targeted treatments - no more guesswork). Subscription model - fixed amount for animal health. No more prescriptions where farmers can have drugs on hand - all drugs dispensed at time required. Multi use applicators.</p>

	<p>Dairy Shed disposables: shed chemical - vendor responsible for packaging. Recyclable or compostable milking gloves. Recyclable aerosol cans. Rubberware - different product developed for the same purpose. Farm recycling stations compulsory. Waste oil market found. lease/logistic model for bulk requirements like rubber ware or shed chemicals.</p>
	<p>Bale wrap: edible wrap to market and cost effective. Store wrap in a bin that then gives automated alert requiring collection. Manufactured into clean burning fuel - can farms have their own 'enviro friendly' incinerator generating energy? How to keep in use longer eg. used as windbreak for riparian planting.</p>
	<p>Milking gloves: check what healthcare sector do? Compostable. Biodegradable. Reused as e.g. garden ties or rubber bands. Council to supply dairy waste bin for weekly collection.</p>

Question 5: What are the opportunities in our sector?

<p>Educating the people producing products to make it easy(easier) for farmers to reuse, reduce, waste etc. (a number of comments along these lines).</p> <p>Working with manufacturers, suppliers and retailers more to see what best practice is and what technology is out there to be tapped into.</p> <p>Reward good practice.</p>	<p>Create demand for better solutions.</p> <p>Legislate change.</p> <p>World leading chance to change.</p> <p>Replace plastics with better options (paper, card, wood).</p> <p>Supplier responsible for collecting their own company's waste.</p>	<p>Find a demand for our waste - other sectors that could utilise our packaging etc.</p> <p>Educate the younger generations.</p> <p>No single use anything.</p> <p>Product stewardship - increase in requirements.</p>
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<p>Make it part of farm plans that look like they'll be required in the future for all farms.</p> <p>Community collection service - raise funds for groups.</p>	<p>Bulk storage on farm instead of smaller storage containers.</p> <p>Bulk delivery - shed dispenser for chemical instead of all sheds having to have 200 litre drums</p> <p>Milk companies put waste as a requirement in handbook.</p>	
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Question 6: How do you feel (red hat thinking) about Farm Waste, Circular Economy or in General?

Farm Waste	Circular Economy	In General
<p>Don't appreciate it</p> <p>Feel disappointed in it</p> <p>Consume, Consume model</p> <p>Need to be more diligent</p> <p>Disappointed part of the problem</p> <p>Its ugly</p> <p>Time consuming to deal with</p>	<p>Should happen</p> <p>Not a level playing field</p> <p>Opportunity to Improve Behaviour and philosophical change is required</p> <p>Make it easy</p> <p>Start at consumption</p>	<p>When should companies be held accountable for their waste?</p> <p>"Life Cycle" is being thought of but little action.</p> <p>Growing awareness of current rubbish system not being sustainable.</p>

Question 7: What were the Positive, Minus and Interesting parts of today's session?

Positive	Minus	Interesting
<p>Listening to others think outside the square</p> <p>Sustainability is becoming the norm.</p> <p>Circular thinking</p> <p>Agrecovery has many manufacturers using the service</p> <p>So many people open to finding solutions.</p> <p>Opportunity is available to be leaders in this space.</p> <p>Didn't know Agrecovery or Plasback existed until today.</p> <p>Future developments and industry growth possibilities.</p> <p>Can make some significant impact.</p> <p>People willing to work together to develop solutions.</p>	<p>Lack of awareness of current schemes available.</p> <p>Plastic and packaging is creating issues on farm.</p> <p>Change needs to happen soon.</p> <p>Lack of awareness of the challenge ahead. Need more people to commit to working in this space.</p> <p>Actually seeing how big the problem is.</p> <p>There are vendors currently not part of a stewardship scheme.</p> <p>How much farm waste there actually is.</p> <p>SBN haven't included ag in their plans or talks to date.</p> <p>Realising haven't been trying very hard to deal with waste.</p>	<p>Other people's ideas</p> <p>Interesting innovative ideas</p> <p>How collectively we can have an impact.</p> <p>How many info points/people there are in the dairy sector.</p> <p>Views on how to best communicate with farmers.</p> <p>The possibilities of the circular economy.</p> <p>Some regions/companies are already rewarding good behaviour.</p> <p>All sectors have common interest in reducing waste.</p> <p>Ecolab can reuse their drums 8 times.</p> <p>How big the issue of farm waste is.</p>

Appendix Two

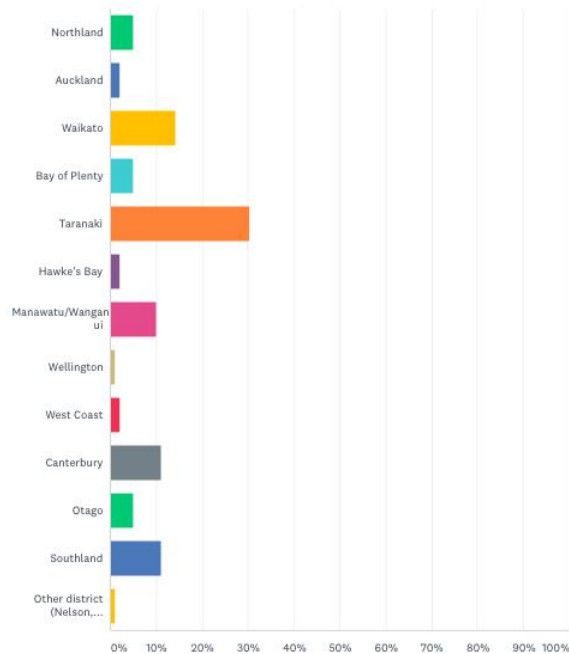
Survey Monkey Survey - Collated Data

Survey was open from 24 April to May 4th 10 days: 100 responses

Q1: Location

What Regional Council area do you live in?

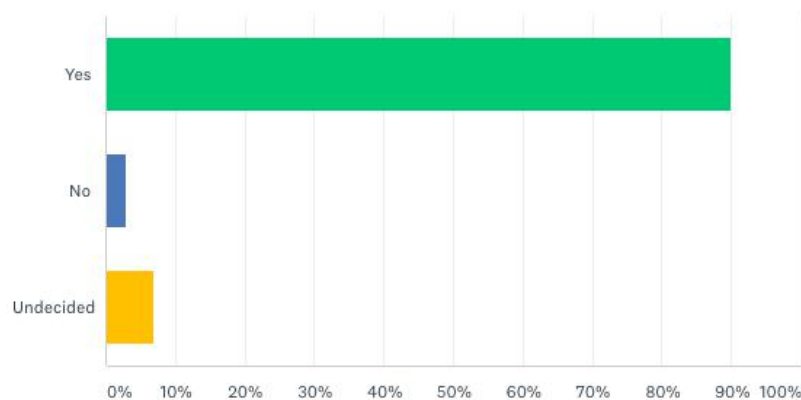
Answered: 99 Skipped: 1



ANSWER CHOICES	RESPONSES
Northland	5.05% 5
Auckland	2.02% 2
Waikato	14.14% 14
Bay of Plenty	5.05% 5
Taranaki	30.30% 30
Hawke's Bay	2.02% 2
Manawatu/Wanganui	10.10% 10
Wellington	1.01% 1
West Coast	2.02% 2
Canterbury	11.11% 11
Otago	5.05% 5
Southland	11.11% 11
Other district (Nelson, Marlborough, Gisborne, Tasman)	Responses 1.01% 1
TOTAL	99

Q2: Opinion Question - Do you think the NZ Dairy Industry needs to improve the amount of 'rubbish' produced on farm, how we deal with it and options for recycling/reusing/composting etc?

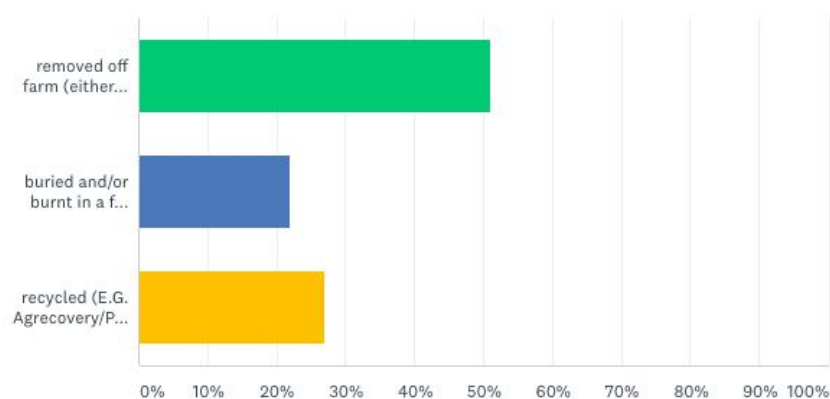
Answered: 100 Skipped: 0



ANSWER CHOICES	RESPONSES	
▼ Yes	90.00%	90
▼ No	3.00%	3
▼ Undecided	7.00%	7
TOTAL		100

Q3:Your on farm rubbish (non-biological/non-organic) is MAINLY (select ONE - what you would MAINLY do with rubbish)... Note: rubbish from farm can be thought of as everything from silage wrap to rubberware to spray paint, latex gloves to meal bags - all the things we would consider rubbish.

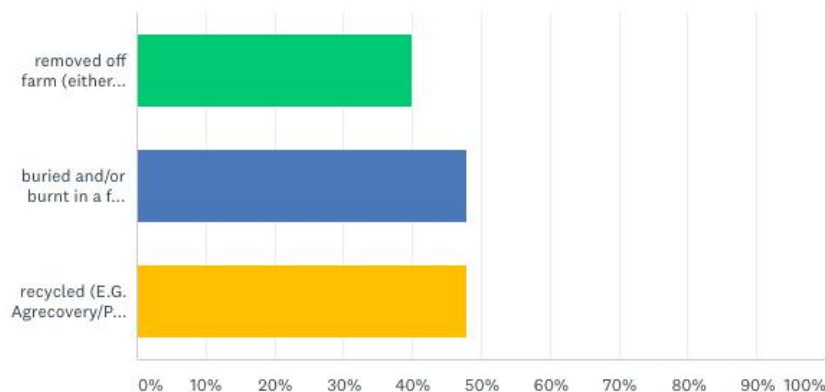
Answered: 100 Skipped: 0



ANSWER CHOICES	RESPONSES	
▼ removed off farm (either by you or in a skippy bin) to landfill.	51.00%	51
▼ buried and/or burnt in a farm hole.	22.00%	22
▼ recycled (E.G. Agrecovery/Plasbak schemes for silage/plastics), composted, re-used.	27.00%	27
TOTAL		100

Q4: Your on farm rubbish (non-biological/non-organic) is also SOMETIMES... (select as many as you use)

Answered: 100 Skipped: 0



ANSWER CHOICES	RESPONSES
removed off farm (either by you or in a skippy bin) to landfill.	40.00% 40
buried and/or burnt in a farm hole.	48.00% 48
recycled (E.G. Agrecovery/Plasbak schemes for silage/plastics), composted or re-used.	48.00% 48
Total Respondents: 100	

Q5: What would help you improve how you deal with rubbish on farm? Rank these 1-7 - where 1 is the option that would help you best and 7 being the option that would help you least...

	1	2	3	4	5	6	7	TOTAL	SCORE
The council rubbish services offered (at the gate pick up, easier recycling options etc).	38.04% 35	15.22% 14	11.96% 11	8.70% 8	6.52% 6	6.52% 6	13.04% 12	92	4.98
More information about how to improve how you can deal with farm rubbish in YOUR region.	3.26% 3	16.30% 15	10.87% 10	19.57% 18	21.74% 20	17.39% 16	10.87% 10	92	3.64
At point of purchase - clear information on the products that can be e.g. recycled, composted etc	1.12% 1	10.11% 9	29.21% 26	14.61% 13	22.47% 20	11.24% 10	11.24% 10	89	3.74
At point of manufacture - make item /packaging that don't end up as 'waste' at end of life	27.17% 25	18.48% 17	10.87% 10	22.83% 21	8.70% 8	4.35% 4	7.61% 7	92	4.89
At end of life of the product - clear information from manufacturer (on label perhaps?) as to how to 'dispose' of it in the best way available.	7.61% 7	6.52% 6	14.13% 13	15.22% 14	33.70% 31	14.13% 13	8.70% 8	92	3.62
An on phone information 'App' - take a pic of a product/packaging and it will tell you how to dispose of 'it'.	2.17% 2	7.61% 7	9.78% 9	11.96% 11	5.43% 5	30.43% 28	32.61% 30	92	2.67
More investment/technology into the sector to be more innovative with types of products required e.g. silage	24.74% 24	25.77% 25	14.43% 14	7.22% 7	3.09% 3	13.40% 13	11.34% 11	97	4.76