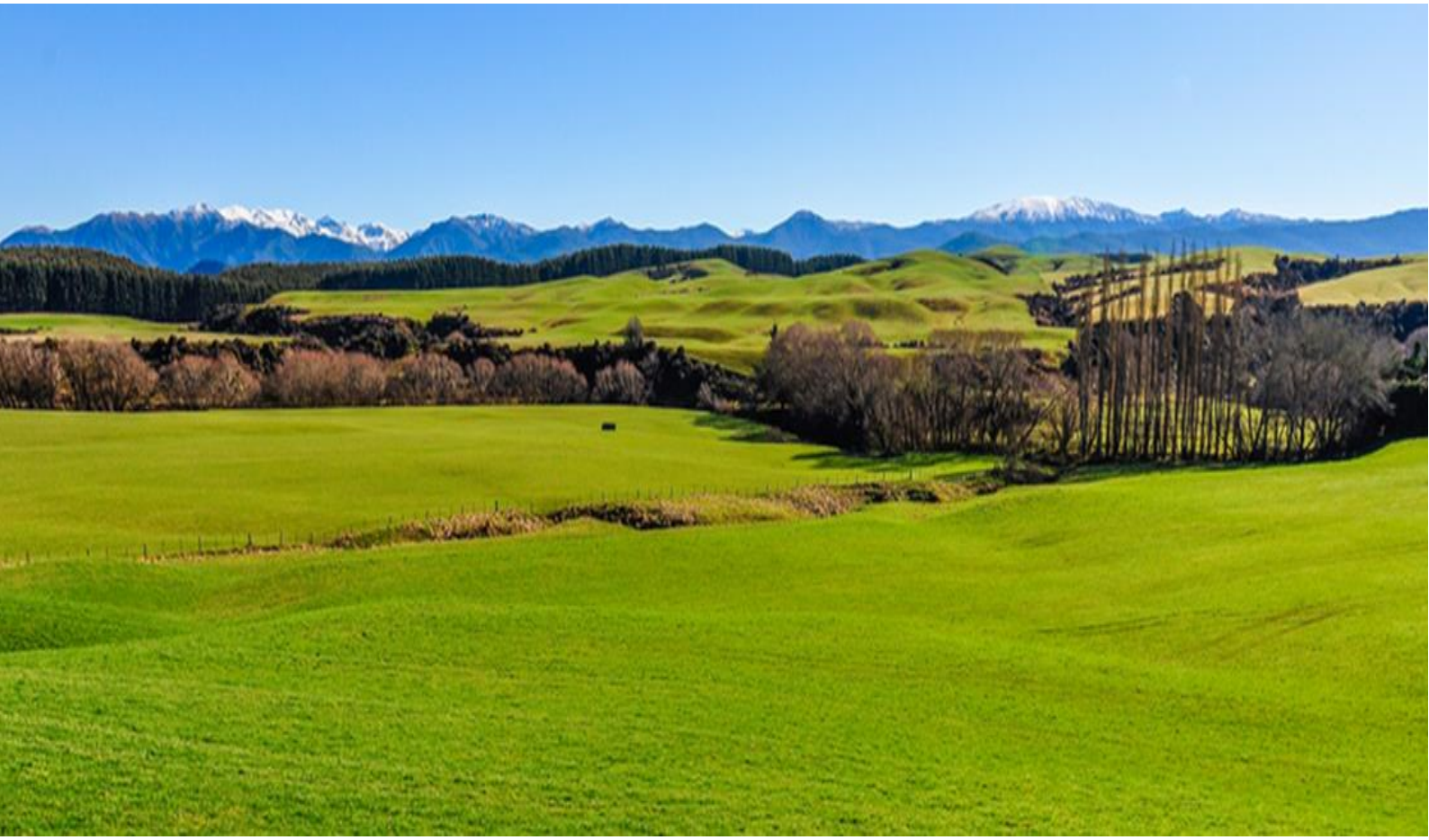
NZIER
NEW ZEALAND INSTITUTE OF ECONOMIC RESEARCH



The potential for sheep milking in Southland

Implications for farming, processing, education, and R&D

NZIER report to Southland Regional Development Strategy

December 2017

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice to clients in the public and private sectors, throughout New Zealand and Australia, and further afield.

NZIER is also known for its long-established Quarterly Survey of Business Opinion and Quarterly Predictions.

Our aim is to be the premier centre of applied economic research in New Zealand. We pride ourselves on our reputation for independence and delivering quality analysis in the right form, and at the right time, for our clients. We ensure quality through teamwork on individual projects, critical review at internal seminars, and by peer review at various stages through a project by a senior staff member otherwise not involved in the project.

Each year NZIER devotes resources to undertake and make freely available economic research and thinking aimed at promoting a better understanding of New Zealand's important economic challenges.

NZIER was established in 1958.

Authorship

This paper was prepared at NZIER by Chris Nixon.

It was quality approved by Mike Hensen and Colin Ansel.

The assistance of Daniel Pambudi is gratefully acknowledged.

L13 Willeston House, 22-28 Willeston | PO Box 3479, Wellington 6140
Tel +64 4 472 1880 | econ@nzier.org.nz

Key points

What is the size of the prize?

The sheep milk industry could be worth $124 million in 2040 dollars nearly 1.5% of Southland GDP in 2040. To achieve this potential, farms need to be much more productive and farmers and processors need to partner to sell niche products in high value markets.[1]

Three scenarios have been developed to illustrated potential: the central scenario, stretch target and a slow growth approach. Below we set out the GDP implications, value (in GDP contribution terms), non-monetary gains, and what is required to make it happen.

Contribution to GDP

Southland Contribution to GDP in 2040

	Central scenario	Stretch target	Slow growth
GDP (%)	1.5%	10.8%	0.81%
Value ($m)	$124 million	$923 million	$82 million
Non-monetary gains	Reduction in nutrient leaching (200 farms)	Significant reduction in nutrient leaching (2,000 farms)	Small reduction in nutrient leaching (for 100 farms)
Requires	Steady progress on nutrition, genetics and off farm investments	Intensive focus on nutrition and genetics. Rapid growth in processing and marketing	Growth along the chain is only partly able to overcome barriers to growth along the marketing chain

Source: NZIER

What will it take to achieve?

The sheep milk industry can have a bright future in Southland if deliberate steps are taken to improve the production platform, processing and marketing. Specific actions include:

- Marketing that will position sheep milk as a niche product in markets that will deliver premium prices (relative to bovine milk)
- Processing capabilities (in partnerships with farmers) that will convert sheep milk into niche branded products
- Farming configurations that are efficient at sheep milking, competitive with dairy and sheep (meat) farming (alternative land uses)

[1] With injections of more capital at the farm level, productivity could also be ramped up more quickly.

- Forging long term relationships with processors/marketers that give farmers the options to participate in the additional value creation.[2]

What will be the wider impacts on Southland?

The non-market gains/values from the development of sheep milking are also important. These include:

- Environmental benefits (roughly half the nitrate losses per hectare of bovine farming activity) and the on-going attempts to reduce effluent loss further
- An opportunity to attract scientific activity to assist with:
  - Developing on-farm sheep milking to New Zealand. The industry will need to develop further programmes around nutrition and genetics (among other things) to underpin industry development
  - Off farm activities. This will require identifying exactly why Asian consumers prefer sheep milk to other types of milk and tailoring processing so that products match these characteristics
- Increasing educational activity. Not the least of which is producing a practical guide to show potential sheep milk farmers best practice and transferring scientific information that benefits production and profitability.

Positive environmental impacts could be substantial over time

Sheepmilking will potentially have a significant impact on leaching. However, this will take time given the environmental systems affected i.e. it could take some years before lower nitrates, phosphorus, and potassium levels impact on water quality in the region.

Dairy sheep have a smaller environmental footprint. The manure is more easily assimilated into the pasture without significant leaching. Work by Smith et al (2017) suggests that leaching from sheepmilking operations is approximately half of the amount relative to a bovine operation. This is backed up by Lilburne et al., (2010) who come to a similar conclusion.

[2] Other advantages include improved on-farm environmental performance (relative to bovine cattle) and development of new products including nutraceuticals.

Summary of the paper

What needs to be achieved to reach 1.5% of Southland GDP by 2040?

The following table sets out the projected growth path for sheep milking within Southland to achieve the growth of 1.5% by 2040. It includes, at five yearly intervals, projected litres (total, per annum), estimated processing margin, and expected yearly capital consumption.

The gross output per annum value of farmgate sales (meat and milk) and sheep processing value is also included.

The second half of the table sets out contribution to GDP for selected years that correspond to the gross output set out in the first half of the table. Remembering that GDP is the wages, profit, and return on capital generated by sheep milking gross output operations.

The potential for sheep milking in Southland

Nominal $

	2025	2030	2035	2040[1]
Projected growth of the Southland sheep milk industry				
Sheep milk farmgate production (litres, per annum)	8,820,000	41,300,000	66,500,000	107,100,000
Processing value above farmgate value				210%
Capital expenditure ($M, per annum)				$5.0
Farmgate value ($M, per annum)	17.6	82.6	133.0	214.2
Sheep milk processing value ($M, per annum)	64.1	180.0	289.9	466.9
Meat processing value ($M, per annum)	1.3	3.8	6.1	9.8
Contributions to the Southland economy				
$ M, GDP Contribution, per annum				
Farmgate GDP contribution	8.8	40.8	64.5	101.6
Sheep milk processing	5.1	12.2	16.7	22.5
Sheep meat processing	0.2	0.5	0.6	0.9
Total GDP contribution	**14.1**	**53.5**	**81.8**	**125.0**
GDP as a percentage of total Southland GDP	**0.22%**	**0.76%**	**1.06%**	**1.46%**

(1) Potentially much greater with larger injections of capital.

Source: NZIER

When should it be done?

To achieve the 1.5% GDP contribution, the following activities need to be either achieved or got underway (see Figure below).

For farming the key drivers are volume per head per year and farm conversions. We have been conservative with genetic potential capping it at 300 litres per head by 2030. Currently this is being achieved in France so the potential is achievable. The number of farms converted is also achievable, if farmgate prices are maintained.

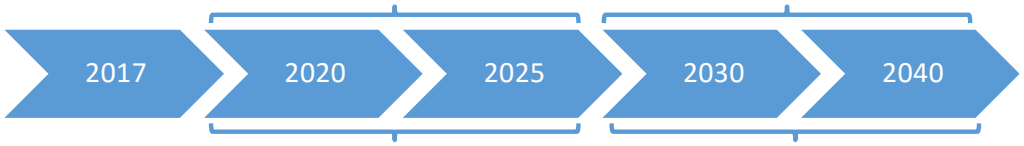
Processing facilities are highly dependent on the type of products sold into the market. The fresher the product the less expenditure required for processing investment. A half tonne dryer will be required by 2025 and other facilities will be dependent on product development.

Marketing will require the establishment of contacts within target markets. Once markets are established then other markets (depending on available supply) can be developed using the experience from the established markets.

The type of structure(s) put in place will need to be developed at the beginning of the period. Ideally, they will need to encourage farm conversions and support the development of Southland infrastructure.

Steps will have to be taken to establish the Southland-centric infrastructure required to support sheep milking operations. This includes – in the first instance – a "how to" handbook on sheep milking and the development of the scientific capabilities particularly examining genetics and nutrition.

Sequencing of activities



Farming				
Volumes (per head, per annum):	150	210	350	350
Farm conversions (no.):	4	18	42	72
Processing				
New processing:	Product dependent	Half tonne spray dryer	Further processing capability	
Marketing				
Development:	Est. connections	Diversification	Further market development	
Products:	Determine products?	Tailor to markets	Further product development	
Products:	On-going investigation into product features			
Structure				
Type:	Determine structure(s)			
Southland				
Education:	Handbook			
Genetics:	On-going development of genetic engine			
Nutrition:	On-going work into the nutritional needs			

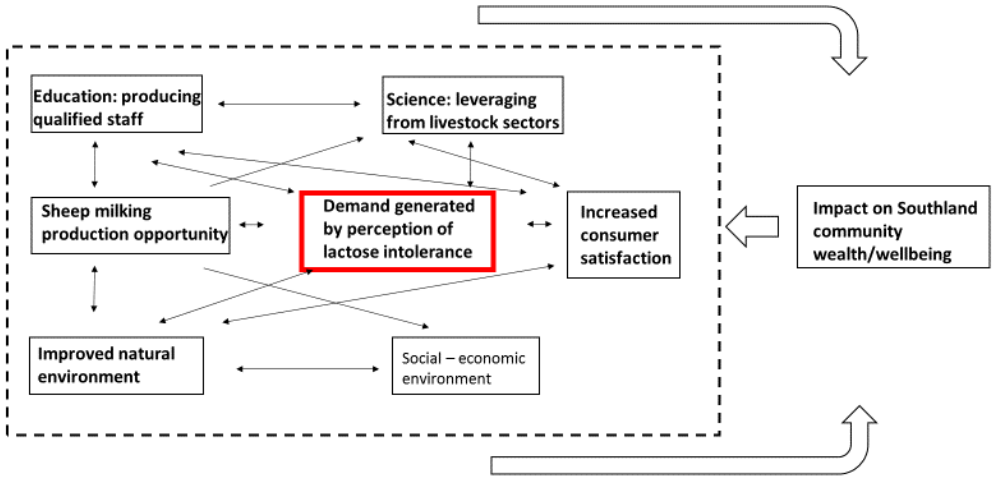
Source: NZIER

What are the connections with Southland?

The approach we have taken to Southland's development is to use a "gentle wind" model to illustrate how development can be generated. The basis of the model is incrementalism. There are a lot of tiny steps that need to be taken to develop the interconnections between the business and the social activities.

Below we set out the model. Central to the development is the opportunity: sheep milking and the business activities that need to be undertaken. To improve sheep milking chances of success requires the scientific, educational, and environmental inputs. By leveraging the existing infrastructure and developing new edges (possibly with the development of a virtual hub), the chances of developing a more vibrant and less replicable sheep milk industry in line with Southland's development priorities will be increased.

Framework for thinking about innovation



Source: Adapted from Swann (2016)

Contents

Appendices

Figures

Tables

1. Introduction

> *"… the sheep dairy industry is poised to expand and could build to become a billion dollar industry as indicated by Griffiths (2015). However, Geenty (1979) said pretty much the same thing."* Peterson and Prichard (2015)
>
> *"So first comes the money. Once you get the money, then you can get the talent, technology ... that's probably equally important to the crew."* Dennis Conner (2017)[3]

The Southland Regional Development Strategy (SoRDs) want to understand the likely potential impact on Southland of the development of the sheep milk industry.

The purpose of this report is to:

- Ask whether the development of a thriving sheep milk industry is possible in Southland given previous false starts (see first quote from Peterson and Prichard, 2015)[4]
- Set out the "size of the prize" if sheep milking was successful
- Set out what needs to be considered to make sheep milking successful (see second quote from Dennis Conner, 2017).

We have drawn on information from international and domestic sources, case studies of sheep milking in New Zealand, past assessments, the success of the goat milking cooperative in Waikato, information from industry, and perceptions from those who have experience in the sheep milk industry and related industries.

The main drivers of the opportunity are:

- An acceptance of sheep milk products in Asia as a premium product
- The middles class in Asia is expected to grow to 4.9 billion by 2030
- Southland sheep milking has already achieved commercial scale.

This paper focuses:

- Framing how Southland can think about the development
- The structural choices that farmers need to consider for the structure of their on- and off-farm activities
- Examining the size of the opportunity given a concerted effort to develop the industry in Southland
- What it will take to develop the industry. Given the:
  - Possible markets
  - Processing capability required
  - On-farm developments required to attract new players into sheep milking

[3] https://www.stuff.co.nz/sport/other-sports/94246942/dennis-conner-praises-team-new-zealand-and-disses-jimmy-spithill

[4] Previous failures have occurred because of an inability to establish markets or even when markets have been developed the inability to supply those markets on a consistent basis.

  - The infrastructure required to support the flow of milk (e.g. education and R&D)
- The impact on the environment
- The implications for well-being within the Southland community.

The analysis is intended to give decision-makers an initial indication of the likely costs, benefits, viability, and consideration as to what is necessary to advance the sheep milk industry.

This is an initial report and as such its depth reflects the scoping nature of the assessment. A further in-depth analysis will be required to:

- Detail what needs to happen and when
- The potential partners (on- and off-farm in New Zealand) and overseas
- Uncover any obstacles, strategies and tactics to overcome those issues.

2. The potential is real

2.1. Sheep milk's competitive advantage?

The competitive advantages of sheep milk over cow milk production are:

- The ability of sheep milk producers to use land not suitable for dairy farming
- The consumer perception (particularly in Asia) that sheep milk is easier to digest than cow milk

Sheep milk production is common around the world in areas where bovine farming was never a durable practical option.

A quick search of claimed benefits identifies two areas – but the evidence is inconclusive.[5] The issues focused on include:

- Allergic reaction to dairy products in some consumers. Milk from different animals (cow, goat and sheep) have different levels of protein. Consumers that have an allergic reaction[6] to cow milk may be better able to absorb goat and sheep milk
- Perceived intolerance to bovine milk. The most common form of intolerance is lactose intolerance caused by the lack of an enzyme (lactase), which breaks down lactose in milk. Bovine and ovine animals have the same amount of lactose. It is claimed that sheep milk is more acceptable to people who are lactose intolerant. This may or may not be true. The increase acceptability of sheep and goat milk may have something to do with the reduced bloating of the stomach.

What we observe in the market is:

- Qualitative claims extolling the virtues of sheep milk versus goat and cow milk
- A substantial premium for sheep milk because of its perceived qualities e.g. in infant formula
- Other differentiating factors that attempt to establish a competitive advantage. These are specific to New Zealand and include:
  - New Zealand's "clean image". On the Blue River Dairy Ltd. packaging, for example, the emphasis is on pictures of snow covered mountains and sheep on very green grass. While no in-depth research has been done on the Chinese market, mountains covered in snow are associated with a pure and clean image
  - Food safety and quality control. The strong institutional arrangements that govern New Zealand's food production system are a major point of difference which only a few food producers can match

[5] This does not mean that advantages will be found that distinguish sheep, goat and cow milk.

[6] This is an immunological reaction to something that the body perceives as harmful.

- Southland has pasture fed animals for most times of the year. This "free range" appeal is perceived to become more important
- Animal welfare codes of conduct are well entrenched in New Zealand farming systems
- Sustainability is becoming more important particularly in Southland. The environmental merits of ovine production are well understood (and there is an opportunity to increase awareness).

As further scientific and market research becomes available the emphasis on what to highlight in a marketing campaign is likely to change over time e.g. the trend towards inner health. The composition of cow, sheep and goat milk are set out in Appendix A.

2.2. Products

One of the advantages of milk is its versatility. There are many different types of products that could be offered to consumers all of which require varying degrees of processing.

According to Sinanoglou, (2015) sheep milk is extremely high in fat and conjugated linoleic acid (CLA) compared to other milk producing species. There are also large amounts of solids present in the milk. This makes sheep milk an excellent choice for making cheese and it produces higher yields of cheese compared to other milk producing species. One litre of sheep milk will produce a far higher amount of cheese than one litre of cow milk.

2.3. Current and potential production, processing, and marketing

2.3.1. Production

Southland has a major advantage over other parts of New Zealand. The only producer in Southland, Antara Ag Farms, has scale in production, better genetic potential, and contacts in the market unmatched by any other New Zealand producer. This puts Antara Ag and Southland at the forefront of sheep milk development in New Zealand.

Antara Ag operate 2 **farms** in Southland with approximately 9,000 ewes. They have a staff of 35. Despite having the best animals, current production per head (around 150 – 170 litres per head per year) is not sufficient or sustainable e.g. some European producers are obtaining over 300 litres per head per year.

To improve this situation will requires:

- Improvement in ewe rearing
- The development of top quality breeding ewes
- A reduction in milking parlour labour
- Constant development of effluent and water systems
- The development of sheep milking management systems
- An overall of genetics and breeding programmes.

Improvement in ewe rearing

Improves in ewe raising requires further work. The main reason for this is cost. The cost to rear far exceeds the value of the milk/meat that can be sold from animals. Further raising lambs on milk powder has resulted in high death rates and generally poor slow growing animals.

On some New Zealand farms, the replacements have been reared on their mothers' milk prior to or in some cases at the same time as milking. In these situations, the lambs are left to suckle on their mothers for between 30 and 40 days and then weaned so that the mothers can be milked for the remainder of their lactation. From there the lambs can be grown out as replacement milking ewes or fattened for meat.

On larger – more commercial farms – a hybrid system is being trialled of leaving lambs on and milking the ewes once a day for the first 30 days and after fully weaning, the ewes are milked twice a day for a further 150 days. So far there has been mixed success with this system i.e. the logistics of larger scale rearing had not been perfected (the same applies to shed rearing).

A key requirement is to develop a system that measures gains in a consistent manner. Structured research is needed into feeding systems and better measurement of inputs and outcomes to identify the best ways to increase quality replacements and fatten excess stock for meat production in the most efficient manner.

The development of top quality breeding ewes

The current stock owned by Antara Ag are capable of rearing top-quality replacements but they are not all up to the required milking standard. Using current rams (with lower genetic merit) will still improve the flock both for milk and meat. This is one way that the flock can be gradually improved.

Ewes produced that do not meet the required standard along with excess males can be used in the sheep meat industry.

A reduction in milking parlour labour

The labour required for milking sheep is significantly higher than bovine dairy production. This is because using a herringbone milking pit system takes 4 units of labour to milk around 700 – 800 ewes per hour.

New technology will change this equation and is necessary to reduce the labour units from 4 to 1 and increase the throughput. The development of new technology will be crucial to the development of the industry.

Of specific interest, would be to convert the herringbone pits to rotary systems.

Constant development of effluent and water systems

Effluent and water systems are likely to be a major focus of livestock farms as the regional council impose more stringent limits on discharge. Sheep milking opportunities will be more environmentally friendly relative to dairy farming however there is still much work to do to improve systems.

The development of sheep milking management systems

Sheep milking is in its infancy in New Zealand. Antara Ag has been farming sheep for milking purposes for over twelve years now and is still learning. Others have entered the industry and are starting from a lower base than Antara Ag (genetics and management know how).

The Antara Ag sheep milking operation is the biggest in New Zealand. To further the interests of the industry an operational blueprint for a fully commercial sheep milking farming operation – under New Zealand conditions – needs to be written and updated regularly as a basis for continuous improvement.

An overall of genetics and breeding programme

There is interest in bringing high performing genetics to New Zealand from places such as France. This is unlikely to be a smooth process given the different conditions and it would be prudent to expect performance issues as the stock adapt to Southland conditions (possibly over generations).

2.3.2. Processing, logistics and marketing

The current marketing of Southland sheep milk is going into the highest value market in the highest value product, that is, infant formula sold in 20 Chinese provinces.

Currently, an 800-gram tin of sheep milk infant formula retails in China for $NZ90 to $NZ100 depending on the exchange rate. This is a 100 to 200 percent premium over bovine infant milk formula (between NZ$ 30 and $NZ 40).

Blue River Dairy, based in Invercargill, is the major sheep milk processor/exporter of sheep milk products in New Zealand. When the Chinese infant formula market consolidated, the New Zealand owners of Blue River Dairy could not access the Chinese market for regulatory reasons.

Subsequently, Blue River Dairy was bought by a Chinese company and has restarted resupplying the Chinese market.

Demand for Blue River Dairy product is very strong with further developments being:

- A second shift being added to the processing plant in Southland
- Blue River Dairy contracting processing in the North Island (Waikato Innovation Park)
- The addition of goat and cow milk infant formula to the products being processed and sold by Blue River Dairy in China
- Blue River Dairy's Chinese parent company acquired a controlling share of Alimenta, an Italian processor of sheep milk. Powdered sheep milk from Alimenta is likely to be processed at the processing plant in Southland along with imported goat milk and bovine milk.

It is unlikely that current Southland production can meet Chinese infant formula demand for sheep milk in the near future.

The key issue is access to the Chinese infant formula market. Having a Chinese parent gives Blue River Dairy a market point of difference, as they have access to the tightly regulated Chinese market.

The potential importing of goat and sheep milk by Blue River Dairy suggests there is a substantial premium to processing in New Zealand. Although no work has been done on the specific reason for this it must be to do with trust in New Zealand processing systems and high-quality production.

This is examined in more detail in Section 5.

2.4. Yes; there is an opportunity for Southland

The sheep milk business in New Zealand is in its infancy (growth) phase. To the point where the focus is not on marketing and extolling the virtues of sheep milk but the logistics of supplying markets and dealing successfully with regulators. Demand outweighs supply.

New Zealand also has a strong brand and is well regarded in the market – even if the powder is imported to be processed. Further sheep milk is perceived to have advantages that bovine milk does not have, despite no scientific "proof".

On the production side, it will take a concentrated effort by stakeholders in the industry to lift production and processing to meet the demand. Currently Southland has the strongest genetics (Antara Ag Farms), the potential for infrastructure development (education, R&D), and the capital required to develop a viable industry within Southland.

This is reinforced by processors (other than Blue River Dairy) interviewed for this project:

- There is no doubt that a premium market exists for sheep milk product
- The most important issue is supplying enough product to meet the demand.

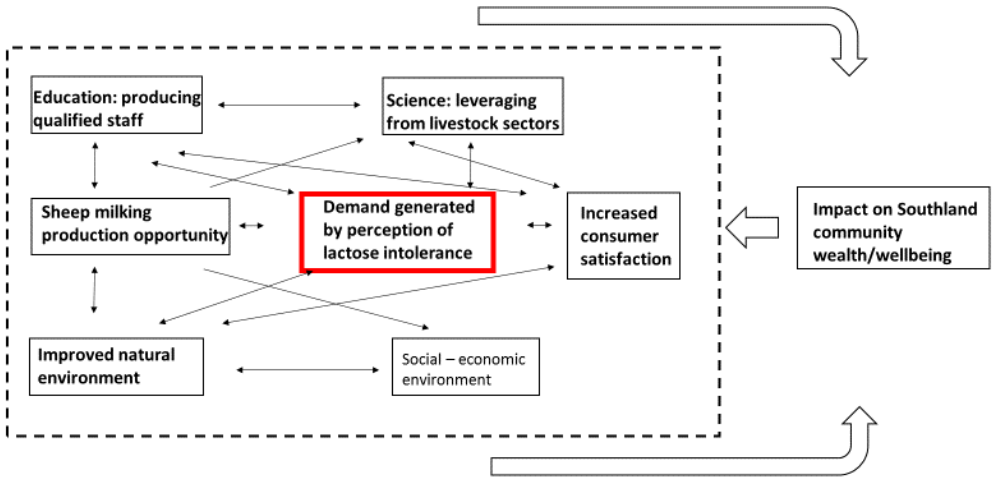
The supply side constraints are the limiting factor.

3. Framework

Figure 1 sets out the business and aggregate impacts and illustrates where developing new economic activity impacts on wider Southland priorities (Section 4). This involves detailing the potential impact of sheep milking under different scenarios. It sets the scene for potential growth and details the investments required to reach those growth levels. It provides a way of organising the project, capturing the diverse economic and social impacts.

The diagram shows that there is no one path to wealth creation. Innovation can come from anywhere. The model allows a better understanding of what creates and destroys wealth in a community i.e. what creates wealth reinforces and builds upon the soft and hard infrastructure. It can show the differing objectives of single entities and communities and how those differing objectives can impact on community goals.[7] However, to maximise the chances of success what is required are strong linkages between parts of the social infrastructure in Southland and the businesses that they are trying to foster. This will be key to the success of the sheep milking venture.

Figure 1 Framework for thinking about innovation



Source: Adapted from Swann (2016)

Figure 1 concentrates on the interaction between the various elements that foster development of the sheep milk industry. The importance of the strength of the linkages, in specific cases, depends on the detailed characteristics of opportunities

[7] We have chosen this system of relationships which, although abstract, seeks to capture the salient elements of the real world. Any real world problem will have a large number of variables with a large set of, often complex, relationships between them. We wish to draw out the main points of interest without the complications of all the issues. In this way, we hope to gain insight into the problem at hand and advance the solutions for it. The potential cost of this approach is that the process of abstraction has eliminated characteristics that are vital to the full understanding of the questions under discussion.

The design of this analysis has deliberately been kept simple. To do this we have abstracted from the full detail of the sheep milk marketing chain. This analysis should contain just sufficient complexity and reality to allow us to capture and illustrate the advantages and disadvantages of the strategies adopted.

being pursued e.g. the success or otherwise of test marketing new products might depend heavily on the education and R&D sectors being closely connected to a processing facility.

In the sheep milking case, the important linkages are between education, science and natural environment and their connections between the business (farming and processing), marketplace and consumers. A successful integration of these factors will impact on community wealth and wellbeing, regional income and have a positive impact on the environment.

The key demand signal is the perceived lactose intolerance of many Asian consumers. This means that ovine (sheep) milk has a marketing advantage over bovine (cow) milk but it competes with goat milk. Two issues are important:

- On the supply side, there is a lack of world-wide supply of premium quality goat and sheep milk (in contrast to bovine milk), therefore getting the right genetics and developing efficient and effective farming methods to meet market needs is a priority
- On the demand side, meeting regulatory requirements and establishing partnerships "in-markets" that allow for the establishment and maintenance of markets, particularly in Asia is necessary.

This approach allows us to develop a richer view for Southland. This is a model of sheep milking as seen by Southland society i.e. an aggregate perspective not an individual or entity perspective.

This has a number of immediate implications:

- Building strong and durable connections matters for sustained wealth creation not one or two business decisions
- There are gains from trade between society and individual entities. Businesses benefit from the infrastructure created by society (such as education and R&D facilities) and society benefits from entrepreneurs providing new opportunities
- The development of sustained economic development is complex. That complexity can be an advantage over time because others are unable to replicate the conditions and compete away the competitive position established.

The key reason for using this type of approach is it shows that different activities can contribute to wealth creation in a region and each activity has a role in creating wealth.

4. Setting the Scene

We have used the NZIER TERM-NZ Computable General Equilibrium (CGE) model to calculate the impact of a successful sheep milking venture in Southland under two scenarios (potential uptake and slow uptake). An overview of this model is in Appendix E.

We have put together a plausible growth track (potential uptake) given:

- What those in the market have said about the potential for sheep milk given current returns, likely growth of the middle class in Asia, and views about likely growth rates
- What would be required to process sheep milk products. Further processing facilities will be required and capital provision has been made (although the exact specification will depend on the products sold in the market)
- The biological constraints associated with increasing production (specifically improving the genetics and nutrition). This includes genetic gain 2.5% - 3.5% per annum and a gradual growth in sheep numbers until 2040.

We have also:

- Set up a "stretch" target where increased capital is applied at the beginning of period to generate increased sheep numbers (driving increased milk flow and returns from processing). This requires an intensive effort improving genetics and nutrition
- halved (slow uptake) the growth in production to illustrate the impacts of a slower growing sheep milk industry.

These three scenarios are reported below.

Table 1: Contribution to GDP

Southland Contribution to GDP in 2040

	Central scenario	Stretch target	Slow growth
GDP (%)	1.5%	10.8%	0.81%
Value ($m)	$124 million	$923 million	$82 million
Non-monetary gains	Reduction in nutrient leaching (200 farms)	Significant reduction in nutrient leaching (2,000 farms)	Small reduction in nutrient leaching (for 100 farms)
Requires	Steady progress on nutrition, genetics and off farm investments	Intensive focus on nutrition and genetics. Rapid growth in processing and marketing	Growth along the chain is only partly able to overcome barriers to growth along the marketing chain

Source: NZIER

We focus on the sheep milking operations specifically farming (dairy and meat operations) and processing.

4.1. Direct and indirect contributions

There is potential for sheep milking to diversify the Southland economy and be an important contributor. The direct contribution to the Southland economy could be close to $124.0 million in 2040 (or nearly 1.5% of Southland's GDP) in the central scenario.

Possibly even more valuable for the Southland region is the insight that if take-up/growth rates are slower than expected – say for example half that forecast – then the impact is still significant ($81.6 million or nearly 0.81% of GDP).

The stretch scenario illustrates the impact of a much more concentrated and intensive effort to lift genetic potential and improve nutrition. It also requires rapid market expansion supported by significant investments in processing infrastructure. This is a plausible scenario but comes at a higher risk, relative to other scenarios.

It is also worth noting that these impacts do include impacts on:

- Farm servicing companies (fertiliser, tractors, those involved in farm conversion etc.)
- Increased transport movements in Southland
- Supplying meat works with product.

The induced effects are attributable to the additional spending of sheep milk farmers if the sheep milk industry grows.

While we have not built land use change into the scenario we are also aware that the water quality issue could make sheep milking more attractive (given less runoff).

Further, indirect benefits are expected through better management and feeding systems that will flow through to all sheep farming operations.

Non-market gains/values that can potentially grow with the development of sheep milking are also important. These include:

- The environmental benefits (roughly half the nitrate losses per hectare of bovine farming activity) and the on-going attempts to reduce effluent loss further. Understanding the exact size of the benefits has yet to be worked out and it will depend on the number of sheep milking farms and what these farms are converted from e.g. the environmental gain might be minimal from a conversion from a sheepmeat farming operation and substantial from a dairy operation.
- Sheepmilking being a potential solution to required change in use for land. A recently published soil map for Southland based on different soil types strongly suggests restrictions on dairying in the future
- An increase in scientific activity that will assist:
  - On-farm sheep milking. This is new to New Zealand, so the industry will need to develop programmes around nutrition and genetics (among other things) to underpin industry development. This is looked at in more detail is Section 5

- Off-farm activity. Identifying exactly why Asian consumers prefer sheep milk to other milk will assist with marketing. This too is looked at in more detail in Section 5

- An increase in educational activity. Not the least of which is producing a practical guide to show potential sheep milk farmers best practice and also providing a way to transfer scientific information that assists productivity. This is looked at in section 7.

4.2. Contribution to Southland income

The potential of sheep milking is that it could be a significant industry in Southland, pumping millions of dollars of revenue into the local economy each year. The potential is set out in Table 2.

Implicit in the forecasts are capital investments in processing and increases in genetic potential and sheep numbers.

Table 2 The potential for sheep milking in Southland

Nominal $

	2025	2030	2035	2040[1]
Projected growth of the Southland sheep milk industry				
Sheep milk farmgate production (litres, per annum)	8,820,000	41,300,000	66,500,000	107,100,000
Processing value above farmgate value				210%
Capital expenditure ($M, per annum)				$5.0
Farmgate value ($M, per annum)	17.6	82.6	133.0	214.2
Sheep milk processing value ($M, per annum)	64.1	180.0	289.9	466.9
Meat processing value ($M, per annum)	1.3	3.8	6.1	9.8
Contributions to the Southland economy				
$ M, GDP Contribution, per annum				
Farmgate GDP contribution	8.8	40.8	64.5	101.6
Sheep milk processing	5.1	12.2	16.7	22.5
Sheep meat processing	0.2	0.5	0.6	0.9
Total GDP contribution	**14.1**	**53.5**	**81.8**	**125.0**
GDP as a percentage of total Southland GDP	**0.22%**	**0.76%**	**1.06%**	**1.46%**

(1) These figures could be higher if more capital in used at the farmgate.

Source: NZIER

Table 2 sets out the farmgate production and value, processing value and meat processing value. It then breaks down the contribution of each part of the sector. The gross output in the first part of the table contributes to Southland GDP in the second part of the table e.g. farmgate production value is converted into a GDP contribution. Farmgate GDP is the profit, wages and return on investment associated with the total farmgate value.

4.3. Export focus

The domestic market will be quite small. Therefore, the focus will be on developing export markets. What an export strategy needs to consider is examined in Section 5.

4.4. Investment

The amount of investment is currently uncertain given:

- The amount investment required to convert farms will be variable and differ markedly from farm to farm
- The type of product mix will determine the amount of capital investment in processing.

We have suggested a figure of $5 million per annum on average.

5. Marketing chain

Customers of New Zealand agricultural products are looking for suppliers who can consistently deliver quality products with transparent and safe production systems. Sheep milking products from Southland fits this bill.

Currently, supply channels cannot meet the demand in one product area in one market. This means further work is required to fully understand the market demand.

Below we look at world supply and imports, and possible markets, processing options, and what is required for increased production.

5.1. World supply and demand

What we know about traded sheep milk products is limited to cheese. The top ten producers of sheep milk are set out in Table 3. China produces the most, predominately in the western provinces of Xinjiang, Qinghai, Gansu and Tibet. Turkey and other Middle Eastern, and Mediterranean countries make up the bulk of the top ten producers.

Table 3 Top ten producing regions

Tonnes, 2014

Region	Tonnes
China	1,537,706
Turkey	1,113,937
Greece	772,072
Syrian Arab Republic	685,191
Romania	673,477
Spain	592,800
Somalia	503,523
Iran	445,000
Sudan	402,000
Italy	372,526

Source: FAO http://www.fao.org/faostat/en/#data/QL

World trade in sheep milk products is relatively scarce. What we do know is that the United States is the biggest market for sheep milk cheese with between 24,000 and 35,000 tonnes imported each year. Other major importers mostly are well below 10,000 tonnes.

5.2. Positioning of sheep milk products

On the supply side, there is limited trade in sheep milking products. Also, the ability of producers to "ramp up" production is limited. New Zealand has the ability to produce good quality sheep milk with a transparent supply chain (see Section 2.1 for supply side advantages).

On the demand side, sheep milk products attract a premium in the market for their perceived consumer benefits (almost double the price of bovine infant milk powder).

Our initial view is that positioning sheep milk products as a niche premium product is the most appropriate approach. Both supply and demand characteristics underpin this type of strategy.

Figure 2 sets out a stylised representation of where sheep milk products should be positioned. This is aspirational and will require over time:

- Development of market collaborations in different markets that maximise value
- Significant investment in brands
- Control of the marketing chain – niche products will require control along the marketing chain
- Development of market connections.

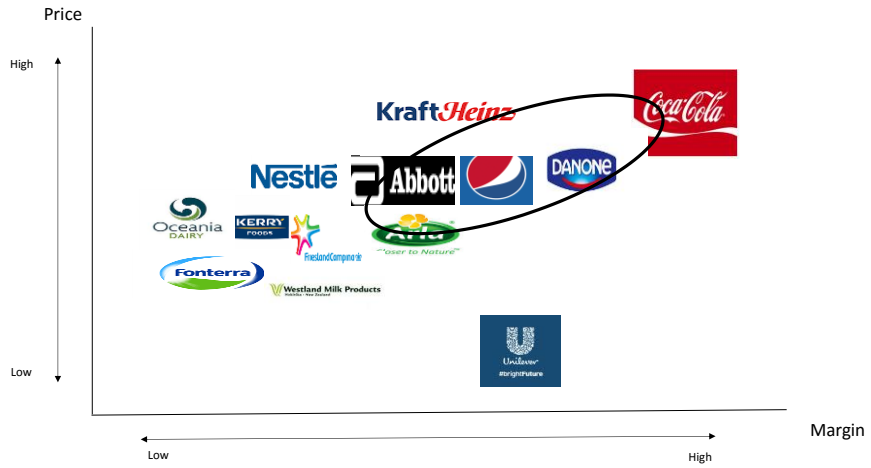
The long term aim is to mimic the behaviour and returns of much larger more well-known brands but be too small for those brands to react or consider them to be a threat. In this way sheep milk can fly under the radar and not attract significant competitive attention.

This will be a difficult task but it is the track being taken by the New Zealand Goat Milk Cooperative.[8] They have gradually expanded production in nutritional powders and now export to four Asian countries.

[8] See for example: http://www.dgc.co.nz/

Figure 2 Positioning of sheep milk products

Commodity versus premium products



Source: NZIER analysis

5.3. Achieving the market strategy – approach for a price setter

The marketing strategy needs to match the product characteristics and consumer tastes. In the case of sheep milking we know that:

- The Asian consumer is prepared to pay a premium for ovine over bovine milk (although the full extent of the markets will need to be further tested)
- There is a shortage of ovine milk and the number of consumers and their ability to pay for it are growing (see Figure 3), particularly in Asia
- Premium product market chains require more rather than less control by owners
- More control means much more co-ordination between producers, processing and marketers.

5.4. Markets

One of the major problems with milk exports is the relatively high tariffs on milk products. Many markets have very high tariffs and this makes it very difficult for New Zealand entities to compete effectively in those markets.

Starting from a small base means that the industry needs to develop an export strategy in a staged approach sorting out which markets it can access and at what price. This includes:

- Market identification (toe in the export water – test markets). Identifying potential new international markets based on a three- to five-year business plan and export strategy. Given the sophistication of the domestic market

this could include selected New Zealand as well as overseas markets This includes detailed desktop and in-market research including:

  - International site tours
  - Using market consultants/collaborations
  - Leveraging existing knowledge and networks

- Engagement and partnerships. Engaging with potential customers and identifying their consumers' specific product mix. This means developing strong working relationships across multiple levels and understanding what can be done to further open trade channels. In the short to medium term partnering will be important to reduce risk and increase likely market penetration
- Developing a product mix that meets the specific taste preferences of the consumers (controlling producing, processing, and possibly aspects of the marketing activities). This may not mean ownership of the whole chain by one group but it does mean coordination and a long-term commitment by participants. This is an iterative process that will require significant involvement from sales and new product development teams
- Diversifying markets. Depending on one market for one product is risky, therefore staging market entry into markets with more than one product over time is required
- Delivering a consistent high quality. Consistent product quality and delivery to customers requires:
  - Continually engage with the customer/consumers identifying new opportunities
  - Contribution of new learning from experience in different markets to further develop the marketing approach.
- Build Southland-centred elements (the infrastructure set out in the gentle wind model) that assist in maintaining a competitive edge in the market matters. This recognises that the market does not stand still therefore it is important to build in elements that are difficult to replicate (education, science and hub functions).

We are only at the beginning of this process therefore we are focused on the identification of possible markets.

This type of approach suits the development of the sheep milk industry because of the need to build up sheep numbers gradually – implicit in this is the inability to suddenly gear up and be an exporter to the world immediately.

A motivating factor for this type of approach (or a variant) is to move beyond the commodity trade. The aim is to develop a source of competitive and comparative advantage based on Southland's existing infrastructure, the approach to farming, and providing a unique product(s) that compete on other factors not solely based on price.

Sheep milk products offer an opportunity to shift the competitive appeal away from cost to product differentiation. A key to this approach is controlling the production and processing of sheep milk.

5.4.1. How might we think about which market?

Initially, there are a few prospective targets in the Asian market based on their acceptance of bovine milk (see Table 5). Bovine milk marketing identifies a segment that want milk but prefer sheep milk to cow milk.

Rather than set out a "gut feel", possibly a more systematic approach should be taken to understanding the markets with potential.

- Market analysis. Our aim here is to cut down on the residual risk/uncertainty generated by setting up in any particular market. This includes:
  - Setting out the candidates for market entry. We have made a start on this by examining some of the markets that could be explored based on bovine milk sales. Possibly this analysis could be further refined further to look as specific cities
  - Once the markets are identified the type of products that could be sold requires examination. This will depend on the processing configuration and types of products to be tested in the market
  - The development of partnerships within the market that can assist in the delivery of product
- Rank the markets and try to gauge the level of risk/uncertainty in each market. This requires classification of risk/uncertainty once a clearer picture of the markets, products and partners has been developed i.e.:
  - Group A: Is there a clear course of action? If so then these types of markets should be first "cabs off the rank"
  - Group B: Are their alternatives entry approaches? If there are a limited set of choices surrounding entry, then this group of markets should be grouped as secondary markets. Experience gained from entering the first group of markets may narrow options allowing for migration Group B into Group A markets
  - Group C: Are we completely uncertain about how to enter the market? Decisions will need to be made by working back (from experience in Group A markets) to define what you would have to believe to support market entry (in terms of sales, products and local contacts).

This approach is to reduce market entry risk/uncertainty. You can't reduce risk altogether but you can ensure that as much rigour and reality as possible is applied to the decisions about market entry.

5.4.2. Identification of markets

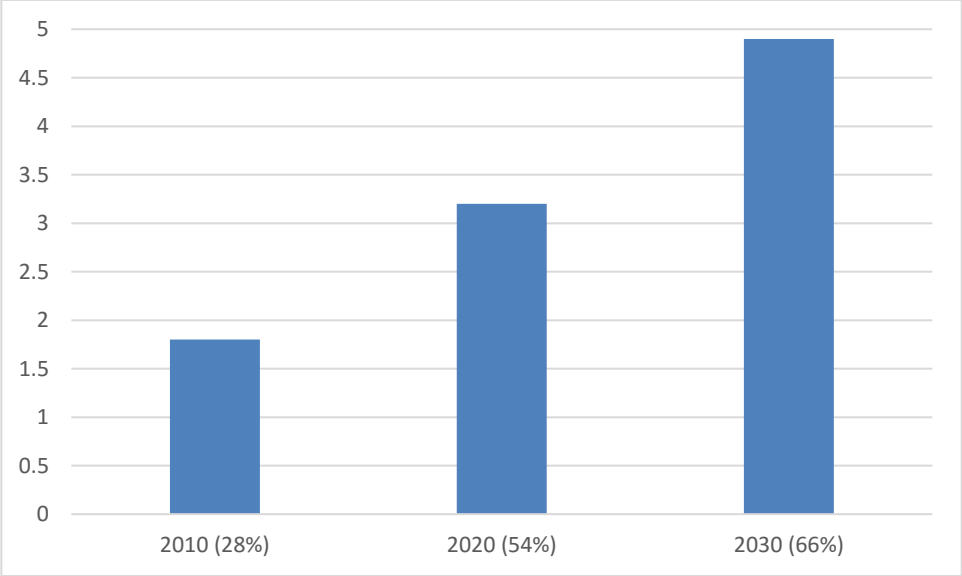
Preliminary work has been done on market entry.

However, the main reason for targeting Asian markets is that world demand is increasingly coming from emerging countries such as China. The OECD forecasts that by 2030 there will be an additional 3 billion middle class consumers in Asia. Consequently, Asian consumers are increasingly going to dictate terms of demand for consumer goods. Niche sheep milk products have an opportunity to capitalise on this growth.

Figure 3 shows that the vast majority of the growth in middle class will come from Asia (66%) in 2030.

Figure 3 The dramatic growth of the global middle class

Billions of additional consumers (% Asian middle class)



Source: OECD http://www.ukidf.org/documents/WorldDairySituation2013.pdf

The development of the criteria and market analysis comes from discussions with the major Southland players (Antara Ag and Blue River Dairy) and further investigation from NZIER.

Asia – the main target: potential demand

The current situation suggests the market for sheep milk products is likely to be much greater in the coming years as more milk-based products are consumed. At present Blue River Dairy's focus is on selling infant milk powder in China (one market, one product).

Taking China as an example, Table 4 suggests that the first target markets should be in the super regions where there is high wealth and more modern format supermarkets. Once these markets have been tested others in the more affluent coastal markets can be tested.

Table 4 Determining the target markets in China

	Per capita income (US $)	Cheese consumption	Comment
Total China	$6,000	0.002kg per capita	Most people do not have the income to purchase cheese
Affluent coastal provinces	$9,000	0.008kg per capita	10 coastal provinces have the affluence to provide a large consumer base but only a few have the infrastructure
Super regions (areas around Shanghai, Guangzhou, and Beijing)	$16,000	0.066kg per capita	A few super regions have strong growth prospects, the infrastructure, and large affluent populations

Source: The Economist Intelligence Unit (2016)

China is not the only market in Asia that should be considered for entry. In Table 5 we set out:

- The potential regions that could be targeted for sheep milk products. Further research could refine the specific target markets given income potential, type of product, point of sale, and local partners
- Access to markets at a macro-level. Free trade agreement (FTA) arrangements are important since they give some certainty about the level of entry that could be expected. Access is also highly dependent on behind the border rules and the ability of local partners to navigate domestic rules
- The likely demand in each region.

These thumbnail sketches of each market give only an indication of the potential for sheep milk products. Further work is required to understand the markets, potential partners and the determination of the types of products required.

Table 5 Summary of potential markets

Region/Country	Economic stability/growth	Access	Demand
Main targets			
China	Strong economic conditions for targeted consumers	Will need to be managed carefully despite free trade agreement. Local partner essential	Likely to be very strong growth with a premium over bovine milk
Japan	Stable economic conditions but little growth	High tariffs on dairy products	Niche or fad product only. High quality could produce high premiums
Indonesia	Growth rates average 4% per annum over the past 5 years	AANZFTA in place	Niche product – has roughly 75 million middle class consumers which will increase to 200 million by 2020
Taiwan	Stable economic conditions	Free trade agreement makes access easier	Potential for growth particularly as high quality niche products
Korea (Republic of)	Stable growth	Trade agreement in place but tariffs still high	Potential for growth particularly as high quality niche products
Malaysia	Strong economic growth	Trade agreement in place and most tariffs eliminated	Potential for growth particularly in the Muslim population
Singapore	Strong economic growth	Free trade agreement allows for open access	Small niche market
California	Stable economic growth	Tariffs on dairy products relatively high	Big importer of sheep milk cheese. Strong competition in the market
Middle East	Strong economic growth	Free trade agreement pending. Developing connections important	Niche product at premium prices
New Zealand domestic market (including Australia)	Moderate economic growth	Easy access	Niche products
Further targets			
Other Asian markets (e.g. Vietnam, Thailand, Philippines etc.)	Typically, high economic growth	Market access is variable and infrastructure poor	Only a niche product
European Union and the United Kingdom	Stable economic growth	Difficult entry requirements in a protected market	Strong competition with established brands

Source: NZIER

5.5. Processing

With rising milk production, the current processing facilities are not fit for purpose – they are too small and processing (input to retail product) cannot be done at the same site. The current production approach cannot be sustained.

Therefore, whatever platform or platforms emerge over the next 5 to 10 years they will be quite different from the current processing configuration.

Southland has one small processing plant with the capacity to process 3 million litres per year amount of product per year but:

- Some stages of the processing are undertaken in the North Island
- The plant in Southland is also processing goat milk (we are unsure of the source of the goat milk) and cow milk infant formula
- Ownership is now in Chinese hands (Blue River Nutrition HK, referred to as Blue River Dairy).
- Blue River Dairy have also bought a controlling share in processing facilities in Italy – some sheep milk powder will be shipped to New Zealand from Italy for further processing.

There are a number of processing options that could occur. These could be:

- A larger production facility owned by Blue River Dairy. This will include a substantial amount of imported powder
- Entry of existing milk processors into the Southland market
- The development of new facilities: an integrated sheep milking farming system and processor.

A rule of thumb is the fresher the product offering the less capital investment required. Less capital means less risk.

These approaches have strengths and weaknesses and all represent credible ways forward for the sheep milk industry in Southland.

Below we set out the trade-offs that need to be considered by those investing in new processing, other entities, and the community.

5.5.1. Market connections

The current export market for Southland sheep milk is through Blue River Dairy. The advantage that an enhanced Blue River Dairy processor has is the ability to convert sheep milk into high value infant formula in the Chinese market today. While this is a huge advantage currently; as sheep milk production increases and other products/countries are bought into the mix we expect this advantage to be eroded, since market entry and regulatory requirements for products other than infant formula are less onerous.

The ability of Blue River Dairy to maintain their market monopoly (at least out of Southland) is highly unlikely as the product range expands.

Blue River Dairy's dominance of Southland sheep milk exports could be challenged by another processor. An existing bovine milk processor may be able to navigate the infant formula market for sheep milk, particularly if it already has infant formula brands/markets established for bovine milk. As for other products, depending on the existing product range, it would have a much greater chance of delivering value than other options because of its experience in similar markets over the medium and long term.

A new integrated start-up would face an uphill battle to establish markets in the short term. There is little chance that it would be able to enter the high value Chinese infant formula milk market in the short term. Instead it would have to focus on other products within the domestic and Asian markets in the first instance – possibly with fresh product. Blue River Dairy would still be in the market for sheep milk so the farmers supplying the new processing facility would still receive sheep milk market prices i.e. a new avenue for their milk (the new processor) will increase farmgate milk price competition.

5.5.2. Consideration of processing options

The development of sheep milk farming and processing are interlinked. Further development of the processing sector is crucial to the region. This has implications for risk, the ownership structure of processing, and capacity.

Choosing the Blue River Dairy option is likely to be the lowest risk to the Southland community in the short run. It also is likely to offer the lowest return since most of the profits will remain with the Chinese owners.

This is not a "bad" thing since the region will benefit from salaries and wages already paid to processing staff. In fact, Blue River Dairy has added an extra shift and are also processing cows and goats milk. With the purchase of Alimenta,[9] Blue River Dairy do have options. One of those options would be to import product from Italy. This gives them a strong bargaining chip with suppliers in New Zealand and allows them to use elements of New Zealand branding in China which seem important to success. It will not encourage farmers to switch from other livestock products to sheep milk.

An existing processor is also likely to be a relatively low risk for Southland. It will bring capital, knowhow, and marketing plans that will allow farmers to develop a sheep milk industry. Whether it will allow for greater connections with Southland infrastructure remains to be seen and this will depend on the attitude of the processor owners. The long term success of such a venture will depend on the ability to sustain the Southland connection that benefits the producers, processors and the Southland region. Compatibility between the long term aims and objectives of producers and processors will be key to success.

A new integrated start-up will have the most risk and the highest reward. Not the least of which will be the development of markets other than the most lucrative infant formula market (such as probiotics). The challenge will be to link growing production to high value niche markets, attract money for the development of a processing facility, and attract enough farmers to produce the sheep milk.

It is also possible over the long term that all three options are in play or a combination of two of the options. This type of outcome could also be beneficial to Southland region.

[9] This presumes that Blue River Dairy maintains a processing site in Southland.

5.5.3. Improving infrastructure in Southland

Blue River Dairy is likely to develop their own infrastructure in a way that suits their world-wide operations. Their main advantage is in the Chinese infant formula market. As yet, they have not shown interest in further developing the infrastructure in Southland. This includes development of education or R&D facilities.

This does not mean that it is not going to occur but currently no moves have been made or suggested. In fact, the opposite has been proposed with goat milk being imported (or sourced outside Southland) and planned imports of sheep milk powder from Alimenta. This suggests that branding product as New Zealand made/manufactured is an integral part of their strategy – not production in Southland.

Involvement by an existing processor will be highly dependent on the attitude of the processor and the relationship between the processor and farmers who supply the sheep milk. If a long term relationships are established, then there is the possibility that other Southland regional connections can be made and developed at low risk.

A Southland start-up would have the most potential to develop facilities that suit Southland. A processing hub in the region where processing, education and R&D can co-locate. This would give Southland interests more control and allow the processing capability to evolve in ways to develop a variety of products for a variety of markets. This however will have a higher risk than other options.

One deviation from the start-up approach could be a virtual hub. A hub could act as a co-ordinating entity for processing, educational and scientific support for farming activities. In this way, it could bring together the value chain in an integrated way that combines elements of all or some of the options.

5.5.4. Summary

Table 6 sets out some of the issues that farmers/investors/stakeholders need to consider when thinking about the future of sheep milking in Southland. For example:

- The augmented Blue River Dairy option is the lowest risk but will it encourage further development of the industry within Southland e.g. farming, processing, and supporting services?
- The existing processor option may give Southland the best of both worlds – low risk and a vibrant sheep milk industry. However, it will depend on the attitude of the processor over time to locating in Southland and fostering other services
- Developing an integrated start-up within Southland will give Southland interests a controlling interest. It is also the highest risk since they need to develop the markets, fund the processing facilities, and develop the farming culture to supply the product.

Table 6 does not give a right or wrong answer. Different stakeholders will have different views and will attach different weightings to each issue. In the table we have illustrated the options that Southland needs to consider and highlighted the strengths and weaknesses of the different options.

Also, the approaches can be combined e.g. the co-ordinating hub could be a combination of an existing processor and a new start-up.

Table 6 Summary of approaches and issues that need to be considered

	Current situation with an expanded Blue River Dairy	Use of existing processor	New integrated start-up
Market connections (short term)	+++	++	+
Market connections (long term)	++	+++	++
Lowest risk to Southland	+++	++	+
Capturing value for Southland	+	++	+++
Development of Southland infrastructure	+	++	+++

Source: NZIER

5.6. Farming

Key considerations for sheep milking operations are:

- Farms must be profitable
- Conversions need to be relatively risk free.

5.6.1. Farms must be profitable

To attract new suppliers and investors to the industry it must be financially attractive. We have a very strong steer from past performance in New Zealand agriculture (the deer industry and kiwifruit industry) that moving from an existing industry into something new is primarily driven by superior returns.

The basis of superior returns revolves around:

- Stable and attractive milk prices that deliver higher returns than meat
- Good per head production
- Predictable cost structures.

The milk price must encourage switching

Farmers and processors benefit from a stable and predictable milk price and this is a prime motivation to join the industry. Fluctuating or dropping milk prices will not attract new participants. Suppliers require a price that makes them profitable from their first season with the ability to improve profitability as they improve their management techniques and genetic improvements flow through.

One way of achieving this is through longer term contracts (2-3 years) to give participants certainty.

Per head milk production: the genetic engine is vital

The average per head production has under-performed and does not cover the cost of production ($2.00 per litre). This is quickly improving with better feed, better selection criteria, and better management.

Improved ewe productive capacity along with highly skilled managers with technical support (education and R&D) is necessary for farmers to consistently improve sheep milk production yields.

This includes the need for a continually updated management manual to ensure best practice and continual improvement across all aspects of the business.

Cost structure: sheep are not just smaller versions of cows

Under the current farming regimes Antara Ag has been able to establish a relatively stable and known cost structure for operating the sheep milking platforms and run-off (see Figure 4).

Two areas of cost control are important:

- Feed – specifically the grazing platform
- Labour.

When comparing sheep milking to the bovine industry, labour can be a significantly higher cost (per kg of milk and production/revenue) and grazing off is also higher because of the shorter lactation (6 months compared to 9 months).

In establishing the initial ideal flock size for an owner operator, the labour component is a major consideration. A starting point for a “mum and dad” operation that requires minimal labour involves:

- A rotary milking shed that processes 1,000 sheep an hour (to do this currently requires 4 to 5 staff). However, a system has been developed for goats in Europe which reduces staff to 1 at the required sheep numbers per hour
- Development of automatic milking technology with potential to significantly reduce labour input but also improve yield, disease detection, and prevention.

Under the various scenarios, we envisage a similar pattern emerging where a new integrated start-up offers the best chance of these issues being addressed.

Comparing this to other farming ventures is problematic. It is unlikely that further bovine milking operations will start up in Southland given the restrictions that will be imposed because of water quality issues (this is already impacting on land prices).

Sheepmeat and deer farming will be cheaper to convert since land prices are lower. In these operations, potentially returns might be lower also and this would need to be factored into the buying decision.

Figure 4 Illustrative operating costs

Dollars, per annum

Operating costs							
	Quantity		Units	Cost per unit		Total cost estimate	
	Low	High		Low	High	Low	High
Labour	1	1		35,000	45,000	35,000	45,000
Animal health	4,000	5,000	Ewes	17.0	20.0	68,000	100,000
Shearing	3,000	5,000	Ewes	3.0	3.5	9,000	17,500
Weed & Pest control	350	350	Hectares	15	17	5,250	5,950
Fertiliser, crops, and supplements	200	250	Hectares	350	400	70,000	100,000
Maintenance (Dairy shed)				14,000	17,000	14,000	17,000
Electricity	200,000	300,000	kWh	0.10	0.12	20,000	36,000
Vehicle Expenses				15,000	18,000	15,000	18,000
Freight				3,000	5,000	3,000	5,000
R & M				10,000	15,000	10,000	15,000
Admin Costs				10,000	15,000	10,000	15,000
Standing Charges				25,000	35,000	25,000	35,000
Depreciation				30,000	45,000	30,000	45,000
Debt Servicing				200,000	250,000	200,000	250,000
Shed feed	3,000	5,000		8	12	24,000	60,000
Lamb rearing	380	450		45	55	17,100	24,750
Total operating expenses						**479,250**	**659,450**

Source: NZIER and Antara Ag

5.6.2. The conversion risk needs to be manageable

To make it attractive to new entrants, simplicity is a key consideration. For new entrants, it will be a new venture with opportunities and challenges. In the initial stages, it will be necessary to guide new entrants through a conversion to reduce the risk. It is also an opportunity to pack around the new entrant, education and R&D services that assist the process.

Cost of converting existing dairy or dry stock properties

The costs of converting an existing dairy farm for sheep milking will be limited to converting the milking shed, installing an effluent system, upgrading some fencing and changing over water troughs (see Figure 5). Also, the varieties of grass for an existing bovine dairy will be changed as part of a renewal programme. Other issues such as distance from milking parlour will also need to be considered.

Conversion of dry stock properties will be similar to a traditional dairy conversion. These costs will vary from property to property. The main cost will be building a milking parlour. The type of milking parlour will have a significant impact on cost since the more automated the parlour the higher the fixed costs. The trade-off is between higher fixed costs and less running costs, particularly less labour.

The other major cost will be the effluent management system. It is more than likely that standards for effluent management will become tighter as time goes on. Application of fertiliser, animal welfare, and use of water will be areas where work is required. Therefore, linking R&D and education with on-farm management will be an important area of focus for the new industry.

Figure 5 Illustrative cost of conversion

Dollars

Establishment costs							
	Quantity		Units	Cost per unit		Total cost estimate	
	Low	High		Low	High	Low	High
Milking shed + effluent system	1	1		900,000	1,300,000	900,000	1,300,000
Fencing	10,000	23,000	metres	4.5	6.5	45,000	149,500
Races	2,000	8,000	metres	20	25	40,000	200,000
Water supply	1	1		50,000	200,000	50,000	200,000
Pasture renewal	75	150	hectares	900	1,200	67,500	180,000
Farm equipment	1	1		200,000	250,000	200,000	250,000
Livestock	1,500	1,500	Ewes	400	600	600,000	900,000
Livestock sales	400	450	Ewes	70	80	28,000	36,000
Company shares	50,000	50,000	shares	10	12	500,000	600,000
Admin costs	1	1		40,000	60,000	40,000	60,000
Total cost estimate						**2,442,500**	**3,839,500**
Note that these costs will be highly dependent on the type of farm converted and costs will vary widely							

Source: NZIER and Antara Ag

Cost and availability of suitable livestock

A crucial component of the new venture will be stock to ensure that suitable milk production per animal can be produced and there is room for further productivity gains. Currently the number of viable sheep in New Zealand is relatively small.

One alternative is to import the genetics to improve yield. While this seems straight forward there are a lot hurdles to overcome. These include:

- The genetic material operates under different conditions e.g. the Lacunae are winter lambing animals
- Different operating systems e.g. the French Lacunae are mainly housed indoors and grain fed
- It will take time to bring the genetics into the country and there is no guarantee that they will thrive in New Zealand conditions.

If this can be done, a further challenge will be cost effective rearing of quality replacement ewes. For example, to capitalise on improving genetics and keeping the ewe flock production continually improving requires a replacement range of 25-30% per annum.

To grow numbers off the current base requires a very high proportion of ewe lambs to be retained – however the more retained can compromise quality. To understand the balance that is required between retaining and culling requires more research.

Summary of structural choices and their impact on farms

The risks of developing the livestock to the point where they are viable (i.e. a breakeven level of 175 litres per ewe) are much greater than setting up a processing facility that potentially can access sheep milk powder from other parts of the world.

Therefore, it is very unlikely that Blue River Dairy and an existing processor will be interested in developing a farming business in Southland.

In fact, the opposite could be true. Blue River Dairy are already putting pressures on Antara Ag to drop prices for milk. This is even though they cannot get enough product. Further the ability to bring in powder from Italy will strengthen Blue River Dairy's hand.

Encouraging a further processor into Southland may be one way of developing a more stable milk price. However, this will depend heavily on the attitude of the processor and whether they will be willing to nurture the industry given its infancy. They are unlikely to materially assist the development of sheep milk farming in Southland although they may be more supportive of the hub concept.[10]

A new start-up or virtual hub would also support farmer conversion. Two main hurdles exist:

- Access to markets and ensuring that there is enough capital to sustain market development, negotiating contract processing, and paying farmers a stable price that allows them to be profitable
- Building the genetic base. It is likely to be that the entity that fully understands what is needed, can take the necessary risks and raise the capital to develop and establish an economically viable flock.

Table 7 Summary of approaches and issues that need to be considered at the farmgate

	Current situation with an expanded Blue River Dairy	Use of existing processor	New integrated start-up
Farm profitability			
Establish profitability for farmers	+	++	++
Good per head milk production	+	++	+++
Farm cost structures	+	++	+++
Conversion needs to be worth the risk			
Cost of conversion	+	++	+++
Cost of available livestock	+	+++	+++

Source: NZIER

[10] In this instance a hub refers to an approach created, designed, managed and maintained and financially supported by a form of regional or local government working in partnership with public sector, private sector and voluntary sector organisations to provide agree shared facilities at a low-cost for a specific period of time.

6. Structural choices

To achieve the goals set out in Section 4 will require an increase in the number of farms and small scale processing facilities. The immediate question is what type of industry structures will induce farmers and investors to "buy into the proposition". Below we set out the options that farmers should contemplate.

The debate over the "optimal" business structure for farming and farm output processing has been going on for some time. For those new to the debate the inconclusive nature of answers suggests things are much more complex than some protagonists would like people to believe.

In this section, we set out:

- The classical straw doll approach as to the perceived strengths and weaknesses of cooperatives and investor owned firms (IOFs)
- The issues that IOF and cooperatives need to address
- Conclusions on structure.

Table 8 sets out the classical view of IOF versus cooperatives. To compare the various perceived strengths and weaknesses we have used:

- A profit maximising IOF
- A cooperative in the style of Fonterra which will take all milk
- A new generation club/cooperative that has strict rules on production.

Unfortunately, not all the plus (+) signs are equal since the details of each industry are different: you cannot just add up the + signs and declare a winner.

The aim is give the reader a flavour of the hotly contested debate on industry structure – not to give the reader a definitive answer – so that they understand the strengths and weaknesses of the various structures.

6.1. Proportionality

Proportionality requires that the economic results to be distributed in such a way as to avoid one member gaining at the expense of another. In a traditional cooperative for example, an increase supply of milk from one participant can cause market disruption since it can reduce the price of milk for all participants. The individual may benefit but the returns to other cooperative members may be reduced.

In an IOF firm and a club/cooperative both have rules in place that limit or sanction increased milk supply from suppliers. An understanding of how much milk will be supplied, prior to production starting, introduces a degree of fairness and improved efficiency over and above a traditional cooperative.

6.2. Efficiency

The IOF is the dominant form of business structure operated society. The main theoretical arguments pointing out the perceived deficiencies of cooperatives and IOFs in this area are set out in Appendix A.

A new generation cooperative has more rules governing its operations and is perceived to be able put in place approaches that increase management transparency and accountability i.e. reduced uncertainty around processing levels and ensuring that assets match market needs. Traditional cooperatives are perceived to not be able to control supply so there is a potential to over produce – reducing returns to farmers.

The strength of the cooperative approach is that it will take the milk every day, this may from a farmers' perspective override the (serious) issues around monitoring cooperative performance.

In a market where the cooperative/IOFs have no special regulatory powers or exceptions, farmers are free to choose the type of structure that suits their business. Therefore, this is not a matter for regulatory oversight or direction.

6.3. Democracy

Cooperatives are democratic organisations, IOFs are not.

Cooperatives and their affairs are typically administered by persons elected or appointed according to certain regulations by the members and accountable to them. A democratically controlled arrangement allows members to influence the organisation to which they have chosen to belong. The cooperative approach implies treating people as "origins of action" rather than perceived as "objects" to be manipulated or serviced – a criticism often levelled at IOFs.

Members "control" the cooperative. Furthermore, each member's right to control should relate to the individual and not to the extent of the member's use of or financial investment in the cooperative.

The principle of democratic control does not, however, specify the type of voting that should be used. Nevertheless, one member, one vote is by far the most common arrangement. Alternatives might include voting based on patronage or voting based on equity.

6.4. Limited interest returns on capital

In a cooperative, the rationale for limiting returns on capital is that the patrons shall not benefit as investors. If such a situation were permitted, those in control might well seek to drastically change the character of the cooperative's operation. Emphasis then is likely to be on protection of returns on investment rather than on service to members. This effort could then destroy the basic purpose of the cooperative. Members are presumably operating their individual firms such that they maximise their own returns on investment, but such an objective need not coincide with the cooperative adopting the same objective (Zwanenberg, 1997).

6.5. Voluntary

In an open market all structural options are voluntary. It is interesting to note that in big open markets, such as the United States, cooperatives have found a space in agricultural markets and have persisted over time. This suggests that cooperative

behaviour does describe behaviour in certain circumstances and certain markets. However, IOFs are the dominant structure in most markets and most circumstances.

6.6. Transparency of management

IOFs are relatively transparent with a market for exchanging equity shares. Share prices are one indicator that can incentivise management. Therefore, the transparency afforded by the share market increase accountability on management.

For cooperatives to improve transparency requires adequate benchmarks. This is more difficult than farmers/other interested parties might expect since the ability to transparently compare different operations is limited e.g. you may have similar cooperatives in different parts of the country doing similar things but performance may be different because of "uncontrollable" such as weather conditions or favourable market conditions.

Sorting out the impact of management on the business is much harder under cooperative conditions.

6.7. Raising capital

IOFs are the dominant model in everyday business life. They have greater transparency of performance and can be very efficient. They also have easy access to capital markets.

Cooperatives need to work harder to achieve the degree of transparency and raise capital. It does not mean it cannot be done given that the boundary between debt and equity is no longer precise in complex financial markets, cooperatives have numerous opportunities to access capital while retaining their key characteristics.

6.8. Long term engagement

A major weakness perceived by farmers of IOF is the concerns about opportunistic behaviour. Farmers who require milk to be picked up on a regular basis because of its highly perishable nature can be at a major disadvantage particularly if there is only one processor. This is looked at in Appendix A.

For farmers, the firmest type of contract is ownership. Therefore, a cooperative approach over the long term is appealing since it guarantees that their milk will be picked up on a regular basis year-on-year. This type of issue is called the "holdup problem".

6.9. Conclusions on structure

Table 8 sets out some of the issues that farmers need to consider when developing the structure that best suits them. In Appendix B we have also examined some of the economic theory associated with the firm and practice that need to be further considered.

Table 8 Stylised view of the differences between cooperatives and investor owned firms

	IOFs	Traditional cooperative	New generation club/cooperative
Proportionality	+++	+	+++
Efficiency	+++	+	++
Limited interest (return) on capital	+	+++	+++
Democratic control	+	++	+++
Voluntary	+++	+++	+++
Transparency of management	+++	+	++
Raising capital	+++	++	++
Long term engagement	+	+++	+++

Source: NZIER

IOFs and cooperatives/club models are a rational organisational response to the particular conditions and risks that characterise transactions between farmers and milk processors.

Cooperatives can be vertically integrated, which allows farmers to maximise joint on-farm and off-farm profit. A by-product of this form of vertical integration may be that cooperatives do not aim to maximise off-farm profit. However, it would be wrong to interpret this as a sign of inefficiency, just as one would not expect every unit within an IOF to aim for a maximum independent profit.

IOFs and cooperatives are subject to constant challenge. The most efficient and effective structure is one that best describes the economic organisation given the nature of product produced, ability to monitor management, and the ability to tap into funding sources.

7. Implications for the industry and Southland Inc

What are the critical issues for Southland? Specifically, what are the pieces of the marketing chain that will add value for the region in terms of the "spillover" effects and when will investors be needed to drive the process for the benefit of the entities involved and Southland?

We are focused on the role and extent of the marketing and its importance in capturing value. The key drivers are:

- A core focus on innovation and new product development (milk is a versatile product with a wide range of applications)
- Access to skills (farming, technical, marketing, operations, and logistics).
- Ability to build strong brands (the unique advantages of New Zealand production give Southland production of sheep milk an edge)
- Ability to gain market share (i.e. be number one or two in the market)
- Investment in market research (e.g. preliminary evidence exists that sheep milk products has a potential market in Asia – this will need to be verified)
- Access to distribution channels (e.g. each region will be different therefore investment is required to understand how value can be captured in each marketing chain)
- Access to a wide range of technology (e.g. process, preservation, packaging)
- Capital investment (e.g. capital is required in all scenarios for the industry to grow)
- Scale (e.g. volume of milk and scale in processing will be required to maintain returns to the farmer, entities involved and region).

More generally we know that there is strong demand for New Zealand manufactured value added branded products. The market has identified this as a major opportunity, as evidenced by the local and foreign investment in the food processing sector e.g. the acquisition of Blue River Dairy by Chinese interests.

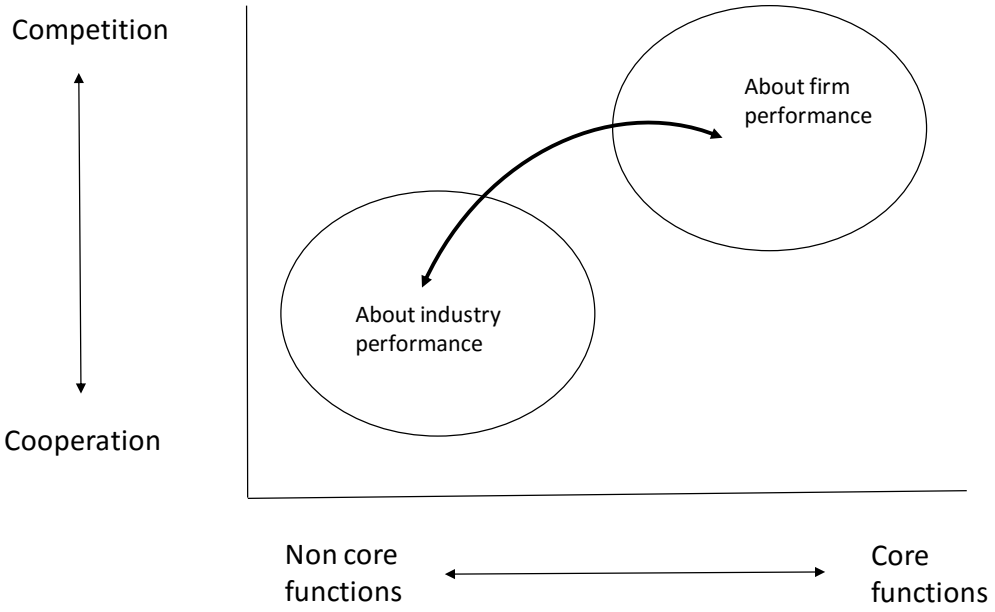
7.1. Who does what?

From the list above there are number of what could be described as public and private actions.

A fundamental question is to set out the boundaries of industry good. What should farmers/processors/exporters do individually and what should be undertaken by the collective industry under the leadership of Southland.

Figure 6 shows at a high level where entities can efficiently compete and where they can cooperate.

Figure 6 Approach to where to cooperate and where to compete



Source: NZIER

In a market, competition is preferred to cooperation in most instances, however there are some areas where co-operation can improve total industry performance: "a raising all boats effect". The rule of thumb is where there is market failure[11] or collective industry benefits then cooperation is likely to be beneficial. Therefore, coordination with entities such as SoRDS, education providers and R&D organisations can be beneficial.

In the sheep milking context, it is unlikely that strategies that farmers, processors, and exporters are employing to develop markets and attract farmers into the industry would result in industry good outcomes (there may be exceptions such as a biosecurity incursion or something where collective action is required urgently). These are core functions to the businesses involved and it's their area of focus.

The case for co-operation depends on whether an intervention can provide durable long term benefits for industry and Southland i.e. where Southland can assist in creating competitive edges that competitors outside New Zealand cannot replicate which will benefit Southland as well as the farmers and processors. The scant literature on the subject suggests that prime candidates for cooperation are:

- Improving the R&D base within the industry
- Improving the human resource base of the industry
- Improving standards by sharing knowledge.

Successful co-operation relies on transparent and efficient mechanisms for industry, education and R&D participants to share information on activities that contribute to setting up a competitive edge. The basis for co-operation would be recognition by the majority of industry participants, and supporting infrastructure that the potential gains

[11] A situation where the market left on its own fails to allocate resources efficiently.

from a co-operative approach to expanded sheep milking production, processing and exports makes sense.

7.2. An industry plan is required to capture value

7.2.1. Don't try this at home… unless you are committed

The competition is tough and getting tougher. New Zealand companies are new to the game of processed food exports. Competitors are typically bigger and have a long history and bigger global reach in food manufacturing.

Should New Zealand agricultural companies/entities attempt to move up the value chain given the obstacles in place? What we know is that:

- The closer that you are to the consumer the more likely you are to improve return on investment
- Second mover advantage at scale is likely to be successful (Chandler, 1990).

Commitment over time is important. Underpinning that commitment with action is important since there is little point embarking on this process if:

- It is not properly resourced
- The venture does not have some edge – either a comparative or competitive advantage
- The unique knowledge on how the value chain works for the product(s) being developed is absent.

7.2.2. Building competitiveness and durability for Southland

Southland's agriculturally-related infrastructure is well established. What might be required is some re-purposing of existing infrastructure to meet the challenges that sheep milking will bring.

There is confidence that Southland's food farming/manufacturing/marketing can succeed in supporting sheep milking given its internal capability and the strength of the agricultural infrastructure (this is the development of soft and hard infrastructure set out in the framework and the strength of the connections).

As an export industry in early development, there is a need for these capabilities to undergo significant further development.

A mature, coordinated and functional approach will reduce costs and risks of innovation and growth. Profitable growth therefore "lifts all boats" contributing to further industry development.

Below we set out some of the elements required to develop a capability that is difficult to replicate by others.

7.2.3. Education and R&D

There is no blue print for sheep milking in New Zealand. Antara Ag has been in the business for 12 years and is now the biggest entity in New Zealand. There are no other entities in Southland but there are a few scattered (hobby) herds in the South Island.

All learning has come from the mistakes made and being at the "bleeding edge". The operation undertaken by Antara Ag is of commercial scale and they are still learning as they go. However, education and R&D contributions continue to be required and include:

- At the farmgate level:
  - An operational blueprint for operating a fully commercial sheep milk farming operation in New Zealand conditions
  - Connecting our academic knowledge to underpin a fully operational farm
  - The development of a manual that could be updated on annual basis over at least the first five years to grow the depth of experience and knowledge
  - A more systematic approach to genetic improvement and measurement of that improvement
- At the processing level:
  - Further understanding of the optimal size and configuration of a sheep milking processing facility
  - Further understanding the development of a robust distribution, handling, and storage systems that allow for the adoption of proven new technology with an emphasis on how the doubling of volumes can be handled
  - An understanding of the likelihood that "inside" and "outside" investments will be forthcoming
- At the marketing level:
  - Proactive approach to market access negotiations ensuring that access occurs within reasonable timeframes
  - An industry wide understanding of changing markets and likely long term competitor strategies
  - An information system that services industry participants. Making information on new innovations available to those who can best use them.

Ideally, the development of a coordinating hub located next to an educational/R&D facility would further assist kick starting the industry. The types of issues suggested above can be incrementally worked on depending upon an agreed prioritisation process. This may or may not include a processing facility since this could be contracted out or undertaken by an existing processor.

There are obvious benefits of being able to tap into existing knowledge, infrastructure and experience, sharing overheads and reducing or even removing the need for large capital investments. The cross fertilisation of ideas is also important since successful solutions to the more difficult issues can involve multi-disciplinary approaches.

Further, such an approach may allow for a more durable and incremental approach where farming, processing, and marketing systems are coordinated with product supply and processing in a cost efficient way.

Getting this piece of the jigsaw right can have a major impact on the industry and contributing industries. In regions where there is a significant presence of food manufacturing it is recognised as a major engine of growth.

Over time it can be a significant driver of demand for a wide range of sectors. This includes machinery and equipment, manufacturing, packaging, ICT and professional services. The growth of the processed foods industry is recognised as a key driver of growth in a regional economy. The economy-wide modelling done for this project demonstrates that this possibly could have a significant impact on the Southland regional economy.

The aim here is to build an industry and wrap around capability that incrementally moves towards a step change. To achieve a step change involves developing systems and capabilities that a competitor knows you are doing but cannot replicate.

For this to be achieved requires:

- A strong cohesive industry where there is agreement – in most cases – on where to compete and where to cooperate
- Ways of attracting farmers and assisting their entry with wrap around services that improve up-take rates of farming systems and is backed up by information system that enables rapid tech-transfer
- Improvement in skills through a close connection, through a coordinating hub with courses, practical approaches and assistance to solve specific issues
- A research and development system which generates further new products
- New production techniques that not only allow for increased volumes but also allow for transfer of best practice
- Pressure to innovate along the marketing chain.

7.2.4. The possible impact on the environment will be small but will grow over time

The most sensitive parts of the Southland catchments (the estuaries, lagoons and coastal lakes) are showing signs of stress.

The estuaries for two of the region's main rivers (the Jacobs River and New River's estuaries at the bottom of the Aparima and Oreti Rivers) have areas that were rapidly deteriorating due to excess sediment and nutrients.

There has been a 12-fold increase in dairying in Southland over the last 20 years. The multiple and complex factors that determine the environmental state (particularly water) however, means that it is not certain to the extent to which dairying is the major cause of water pollution problems. The impacts can vary widely depending on soil type, topography, climate and management. There is the legacy effect of past land use with a 30-40 year average time lag between water entering the groundwater aquifers and its reappearance as surface water.

We are aware that improved environmental outcomes for (mainly) water quality must go beyond substituting sheep milking for dairy and include work on an industry strategy.

The ecological health at the majority of the river and stream monitoring sites is good or very good, and sediment and faecal bacteria levels have held relatively steady. However, the region has high levels of nutrients present in these waterways (some of the highest in the country) and for nitrogen there are increasing trends, in both surface and groundwater.

The growth of sheep milking flocks in Southland will have less of an impact than bovine dairy herds. If we use nitrate leaching as the comparison factor for the impact of sheep and dairy cattle farming systems on the environment, dairy farming equates to approximately 63 kg/ha of nitrate leaching greater than that of an intensive sheep system (Lilburne et al., 2010). A sheep milking operation is likely to be half that at 30 - 35 kg/ha.

This is backed up by new research from Agresearch (Smith 2017). It also suggests that leaching from sheepmilking will be approximately 50% (nitrates, phosphorus, and potassium levels) less than a bovine operation.

More work in Southland conditions will be required to further test these conclusions.

7.2.5. Socio-economic factors

Two mechanisms are important when illustrating how sheepmilking impacts on Southland's socio-economic wellbeing:

- The direct economic opportunities that sheep milk industry can provide
- The indirect benefits that can arise through a co-ordinating hub (e.g. through the promotion of education, science, and environmental categories).

Both are interrelated and show that the potential development of sheep milking in the region is more than just economic activity. It also shows what communities such as Southland can do to support in a constructive way the development of the sheep milk industry so that it maximises its potential for the industry and more importantly for the community.

This will be incremental and involve:

- Diversification of the economy which allows for products that have different drivers. This assists with economic resilience
- Technology transfer from Antara Ag, science and education, to farmers, processors and marketers
- Building export capability through the development of a marketing chain that can deliver a variety of products
- Reinforcing the competitive advantage to Southland by providing services that are not replicable in other competing regions/countries
- Increasing co-ordination between the regional infrastructure (soft and hard) and industry to develop further opportunities
- More jobs on-farm, in processing and marketing in the region
- Increasing knowledge-related jobs in Southland

- Attracting further foreign investment in the sheep milk industry
- Facilitating movement up the value chain with the development processing capabilities and capitalising on marketing opportunities
- Improving environmental outcomes.

Table 9 Understanding the linkages between sectors

		Effect of						
		Education	Science	Business	Marketplace	Socio-economic	Natural environment	Consumption
Effect on:	Education		Adopts training methodologies developed	Acts as a target for educational need	Pinpoints market wants	Improves the quality of graduates	Further understanding of the issues	Further targets nutritional qualities
	Science	Reinforces scientific principles		Enhances capability	Focuses R&D effort	Emphasis on the whole value chain	Demands discovery of better practice	Drives further demand for information
	Business	Reinforces the basis for best practice	Discovery of better approaches/techniques		Provides the niche opportunities	Sets out the rules for business practice	Increases the need for transparency of environmental practice	Drives the need for more unique products
	Marketplace	Enhances sheep milk's premium quality appeal	Demonstrates product qualities	Generates new products		Sets a licence to farm	More conscious of environmental concerns	Trends monitored closely
	Socio-economic	Reinforces industry durability	Reinforces industry durability	Sustains activity creating durable growth	Contributes to social resilience through diversification		Demands more information	Strong linkages between demand and durable industries
	Natural environment	Improves environmental outcomes	Discovery of improved environmental outcomes	Offers alternative land use	Demands more transparent production methods	Demands a certain quality		Further transparency required
	Consumption	Better informed customer	More clearly defined nutritional value	Larger variety of product choice	Sets out the size of the "prize"	Determines product choice	Increases the need for transparency	

Source: Adapted from Swann (2016)

7.3. Timing of decisions

7.3.1. It is about incremental innovation over time

Incremental innovation drives industries forward. Encouraging and facilitating individuals within the industry to focus on incremental improvements that can create growth momentum is crucial.

There is no crystal ball: we do not know – for sure – what the sources of innovation will be that sustains the industry and makes it thrive. Therefore, to maximise the chances of a successful growth strategy a focus and pressure must be kept on all parts of the marketing chain rather than a specific area.

Crucial to the process is to ensure that detailed information is available as quickly as possible to those who need it. This is particularly so for the growers because of the long implementation lead times. In all parts of the marketing chain participants will have to make decisions about whether they compete or co-operate. This is discussed in the next section.

Further, there needs to be market alignment: there is no point having the right product if it cannot be delivered to the market, if market access is limited or non-existent, or worse still we are beaten to the punch by a better product from a competitor.

The approach is to examine all opportunities for innovation along the marketing chain. This requires looking at the detail of the leads and lags associated with the innovation processes, particularly for innovation behind the farm gate.

Hall and Scobie (2006) show that it can take up to twenty years before an innovation can fully be capitalised on, therefore the timeline for possible industry success stretches out until 2040.

7.3.2. Delivering the plan

We have developed a timeline that details (in a preliminary way) the expected outcomes from the preferred strategic direction and detail how functions will be delivered. This will involve:

- Understanding the expectations of industry (Antara Ag, Blue River Dairy, and potential entrants) and Southland
- Understanding what new opportunities can provide: new products and new markets
- Understanding the potential for farmer conversions
- Setting out an approach to extend development including education and R&D capabilities and incentives to co-operate.

The approach to achieving the 2040 sheep milk strategy needs to be export driven as the domestic markets do not offer sufficient growth potential (in most but not all cases).

Also given the time frame – 22 years – the increase of $80 million in sales at the farmgate targeted by the strategy, the delivery of the strategy has to rely primarily on known methods to increase production that have already been developed and are ready for market testing.

This reasoning suggests that to achieve the strategy the focus will ned to be on:

- The development of new products in established markets and new markets for established products. There may also be opportunities to apply the lessons learnt from increasing the sales in China to selling new products to new markets. These initiatives would assist in diversifying industry markets
- Increasing in milk yield through improved sheep management with possible new genetics e.g. use of French lacunae genetics may be of assistance in this process, although the introduction new genetics requires careful management and measurement of gains.

Regardless of the growth option chosen, generic problems of increasing export demand (in existing or new markets) need to be addressed.

In respect of the readiness of these intensive growing systems we understand that:

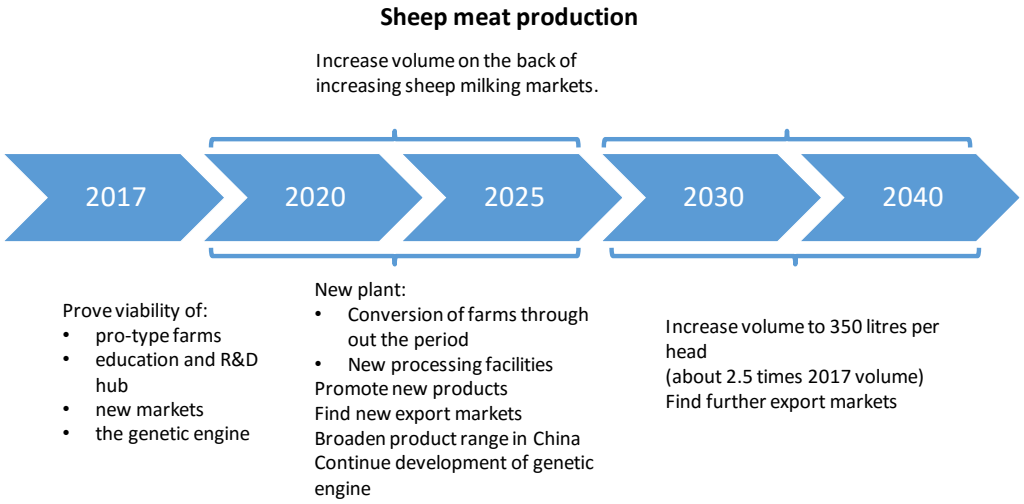
- The move from 150 litres per animal to 300 litres per animal will require investment in the development of the genetic engine and systems that assist in its measurement
- The approach will have to go through a proof of concept stage since the ability to raise per animal performance dramatically is not yet proven in New Zealand conditions. Time will be required to develop and prove techniques that will assist in increasing performance. This could take more than 5 years
- Sheep milk demand is expected to markedly increase on the basis that Asian consumers find it more palatable relative to bovine milk.

The range of options for the delivery of the production increase required to increase sales by $80 million can be illustrated by considering what would be required to achieve the strategy. Our high-level scenarios for these options are:

- Sheep milk: assuming prices similar in 2040 and production increases to 41 million litres would require:
  - 60 converted farms
  - New processing facilities
- Sheep meat: assuming prices similar in 2040 and a production increases.

Figure 7 sets out the approach to planning the timing of investments.

Figure 7 Timing of decisions



Source: NZIER

8. References

Chandler A (1990) *Scale and Scope: The Dynamics of Industrial Capitalism*. The Belknap Press of Harvard University Press.

Cook M (1995) The future of US Agricultural Cooperatives: A Neo-institutional Approach. *American Journal of Agricultural Economics* 77: 1153-1159.

Geenty K (1979) Sheep Dairying. *New Zealand Agricultural Science*. 13: pp118-122.

Griffiths L (2015) Business Plan for the NZ Sheep Dairy Industry. http://nzaginvest.co.nz/wp-content/uploads/2015/10/2014_BUSINESS-PLAN-FOR-THE-NZ-SHEEP-DAIRY-INDUSTRY_Lucy_Griffiths.pdf

Hall J and Scobie G (2006) The Role of R&D in Productivity Growth: The Case of Agriculture in New Zealand: 1927-2001. New Zealand Treasury Working Paper 06/01. http://www.treasury.govt.nz/publications/research-policy/wp/2006/06-01/twp06-01.pdf

Harte L (1987), Creeping Privatisation of Irish Cooperatives: A Transaction Cost Explanation in J. Nilsson and G van Dijk (eds), *Strategies and Structures in the Agro-food Industries*, Van Corcum and Co, The Netherlands.

Henehan B and Anderson B (1994), *Decision Making in Membership Organisations*, Research Bulletin 94-5. Cornell University, Ithaca.

Lilburne L, Lynne I, Webb T (2016), Issues in Land Use Capability Class to set nitrogen leaching limits in moisture-deficient areas – a South Island Case Study. *New Zealand Journal of Agricultural Research*. Vol 59 Issue 1.

Martin S (1993), *Advanced Industrial Economics*, Blackwell, Cambridge.

Peterson S and Prichard C (2015), The sheep dairy industry in New Zealand: a review. *Proceedings of the New Zealand Society of Animal Production*. 2015. Vol 75 pp119-126.

Royer J (1999), Cooperative Organisational Strategies: A Neo-Institutional Digest in *Journal of Cooperatives* 14: 44-67

Sinanoglou, V (2015). "Assessment of lactation stage and breed effect on sheep milk fatty acid profile and lipid quality indices". *Journal of Dairy Science and Technology*. 95: 509–531.

Smith L, Longhurst R, Monaghan R, and Bartlett N., (2017), Characterising the volumes and chemical characteristics of dairy sheep effluent in New Zealand. *New Zealand Journal of Agricultural Research November 2017*.

Swann G (2014) *Common Innovation*. Elgar.

Williamson (1981) The Modern Corporation: Origins, Evolution, Attributes. *Journal of Economic Literature*. 19: 1537-1568

Zwanenberg A (1997) *European Dairy Cooperatives: Developing New Strategies*. PhD thesis, University College Cork.

Appendix A Nutrition

The attributes of sheep milk are due to the higher concentration of solids. The attributes include:

- Nearly twice the fats and proteins of cow and goat milk
- More soluble fats
- More whey protein
- Does not react negatively to freezing
- Naturally homogenised
- Ability to make specific cheeses and reconstitutes well to make processed cheese
- Sheep yoghurt exhibits a stronger structure and has less serum separation.

Table 10 Comparison of nutrition

Milk composition analysis per 100 grams

Constituents	Unit	Cow	Goat	Sheep
Water	g	87.8	88.9	83.0
Protein	g	3.2	3.1	5.4
Fat	g	3.9	3.5	7.0
Carbohydrate	G	4.8	4.4	5.1
Energy	kcal	66	60	95
	kJ	275	253	396
Sugars (Lactose)	G	4.8	4.4	4.9
Saturated	G	2.4	2.3	3.8
Mono-unsaturated	G	1.1	0.8	1.5
Polyunsaturated	G	0.1	0.1	0.3
Cholesterol	mg	14	10	11
Calcium	IU	120	100	170

Source: Sinanoglou (2015)

Appendix B The structural issues confronting farmers

As discussed, the IOF model is the dominant approach to business structure in society. Depending on the type of structure considered (IOF, traditional cooperative, or new generation model) the following structural design issues need to be sorted.

A classic market failure encountered by farmers concerns the ***holdup*** problem, and the opportunistic behaviour associated with asset fixity. The holdup problem is acute in milking as the farmer's output is highly perishable; if alternative outlets are not available to the farmer, the farmer is susceptible to holdup by the processor.

Contracts are not always acceptable as a means of dealing with holdup; production is variable on a daily and an annual basis, therefore the tendency for contracts to be incomplete is high. Incomplete contracts leave all the risk with individual farmers, and in a highly asset specific business such as farming, high rates of risk aversion are both the norm and prudent. Hence, cooperatives are a viable and durable solution to the holdup problem.

Horizon problems are when an investor's claim on the net cash flow generated by an asset is expected to terminate before the end of the asset's useful life. This phenomenon becomes a problem because it leads to under-investment. The problem occurs in cooperatives because of the structure of the rights to residual claims. The solution to this problem rests with mechanisms that allow delivery rights to be capitalised.

Portfolio problems occur because members are required to invest in the cooperative in proportion to their use of the cooperative, and because equity shares in the cooperative generally cannot be freely sold or purchased. Hence, members are unable to diversify their individual investment portfolios according to their wealth and risk preferences. There is no obvious solution to this problem within the cooperative context, but on the other hand, it is really only a *problem* according to the theoretical literature. If individuals really are concerned about their wealth and risk preferences being skewed by membership in a cooperative, they can always leave.

Control problems, i.e. principal-agent problems, exist in any firm but can be exacerbated in cooperatives because of the absence of a market for exchanging equity shares, and the lack of equity-based instruments available to incentivise management. The ability to adequately benchmark performance is critical to resolving control problems.

Influence *cost* problems arise because the cooperative often seeks to engage in a wider range of activities with a more diverse set of objectives than other organisations. This can lead to costly efforts by members to seek and/or gain influence. The resolution to this problem is in the design of adequate governance structures.

B.1 Will cooperatives be redundant?

Cooperatives are a rational, logical, and economically sound response to certain market conditions. But are there any factors that could lead to a cooperative no longer being the most logical means of arranging the business?

Some models point to their irrelevance. However, in the case of sheep milk, the basic factor of perishability seems unlikely to go away in the near future. Technological advances, the likes of which are not on the horizon yet, may eventually negate some of the reasons for cooperatives in spite of perishability.

For example, there are some extremely large dairy farms in the United States with on-farm ultrafiltration plants. This technology enables the farmer to economically transport milk very large distances which in turn provides the opportunity to access many outlets for the milk. While we are not suggesting that such a development is likely in New Zealand, the point is that technology may one day provide some farmers with options that don't require the use of cooperatives.

Appendix C Theoretical and practical issues

C.1 Theoretical issues

C.1.1 Transaction cost literature

Transactions costs are the costs of organising and transacting exchanges. The concept of transaction costs has a long history but the basic arguments were set out by Coase in 1937. Coase wondered why firms even existed if economic activity is guided and regulated by the market price system. Moreover, if it is efficient to coordinate some economic activity through the direction of an entrepreneur rather than a price system, then why not place all economic activities under the direction of a *single* entrepreneur? Coase's explanation was cast in terms of the inefficiencies of transacting in a world of imperfect information. Essentially, when the transactions costs of market exchange are high, it may be less costly to coordinate production within a firm instead of within a market (Royer, 1999).

Despite the early work of Coase, the sustained study of firm organisation did not take off until the contributions of Williamson (see Martin (1993) and the references therein). Williamson elaborated a transaction cost theory of the firm based on the twin assumptions of bounded rationality and opportunism in the presence of uncertainty.

Bounded rationality refers to human behaviour that is "intendedly rational, but only limitedly so". It recognises that the human capacity to process complex information is severely limited. In other words, humans do not have unlimited reasoning power. Consequently, the internal organisation of firms is, in part, a response to costs that would not exist if owners or managers of a firm had unlimited reasoning power.

Opportunism is defined by Williamson as "self-interest plus guile". It is essentially the assumption that economic agents non-cooperatively pursue their own self-interest. In such a world, economic agents will not assume that contracts made across markets will automatically be honoured, if it is costly to enforce a contract or to seek damages for violation of a contract. Rather, they will expect individuals or firms with whom they have negotiated a contract to break it if the expected benefit from adhering to the contract, net of expected penalties, exceeds the expected benefit from adhering to the contract. Some transactions will be brought within the firm because it is easier to monitor performance of the transaction if it is carried out by employees rather than via a contract between independent opportunistic agents (Martin, 1993).

As Williamson (1981) states:

> *But for the simultaneous existence of both bounded rationality and opportunism, all economic contracting problems are trivial... Thus, but for bounded rationality, all economic exchange could be effectively organised by contract...*
>
> *Ubiquitous, albeit incomplete, contracting would nevertheless be feasible if economic agents were completely trustworthy.*

Williamson's comment sums up in a nutshell the rationale for cooperative action in a business world dominated by efficient IOFs.

Contracts play an important role in transaction cost analysis. The existence of a contract enables the parties involved in an exchange to fulfil their obligations sequentially by protecting them from opportunistic behaviour, thereby lowering the costs of the transaction. However, not all contracts are equally effective. The ability of a contract to facilitate exchange depends on the "completeness" of the contract and the relevant legal environment. A *complete contract* eliminates opportunistic behaviour because it specifies each party's rights and responsibilities under every conceivable contingency. But designing such a contract is frequently impossible (Royer, 1999).

Incomplete contracts, on the other hand, do not fully specify the rights, responsibilities, and actions of each party. They involve some degree of open-endedness or ambiguity. Three factors contribute to incomplete contracting: bounded rationality, difficulties in specifying and/or measuring performance, and asymmetric information.

Attributes of transactions

Williamson (1985) identifies three attributes of transactions that are critically important in determining the optimal organisational arrangement:

1. Asset specificity – the degree to which transactions are supported by durable, transaction-specific investments
2. The uncertainty to which transactions are subject
3. The frequency with which transactions occur.

Each of these characteristics leads to an internal mechanism for coordinating exchanges to be favoured over the reliance on market exchanges. In the case of sheep milk farmers, the logical internal mechanism could be a cooperative.

Asset specificity

According to Williamson, the importance of asset specificity to transaction economics is difficult to exaggerate. It refers to an investment whose value for alternative uses is significantly lower than in its intended use. Asset specificity in the sheep milk industry can be found at both the farm and the processing level. While less severe, it can also be argued to exist even further down the supply chain within the marketing and distribution activities.

Clearly the land used for sheep milking is a fixed asset, but this does not necessarily make it a specific asset, i.e. the land could be used for something other than sheep milking. However, substantial additional investments beyond the cost of land are

required to create a sheep milk farm. Such improvements are unambiguously specific to dairy farming, and once these investments have been undertaken, the owner of that piece of land becomes financially "locked in" to sheep milking for a considerable period of time.

Some of the sheep milking-specific investments required to improve the land include:

- Smaller paddocks than other pastoral agricultural pursuits to support a rotational grazing system, and configured such that they all have easy access to a central walkway
- Water reticulated to all paddocks
- Specific grass varieties and feed crops to provide the appropriate pasture for milk production (as opposed to pasture suited to sheep or beef production)
- A milking shed complete with the appropriate machinery for extracting and storing milk, and dealing with effluent disposal
- A variety of other machinery and building types specific to sheep milking
- The human capital investment required is not insignificant either.

At the processing level, practically everything is highly sheep milking specific. Moreover, it has an economic life of at least ten years.

Uncertainty

Uncertainty provides one of the vehicles by which bounded rationality and opportunism manifest themselves; it is simply not possible to prepare for and anticipate *precisely* all of the possible alternatives and their consequences in a sheep milking farming operation.

Weather is clearly the major source of uncertainty with sheep milk farming in New Zealand. It determines the feed supply and therefore the quantity of milk that will be produced. It also plays a role in determining milk quality and composition (which affects the milk's value), and disease and stress in sheep.

At the processing level, uncertainty about the precise milk supply level, and its timing, creates uncertainty about the required level of processing capacity. The problem is compounded when product mix decisions are added to the calculations.

Frequency

A high frequency of transactions influences the need for specialised governance structures. In other words, a simple contracting mechanism is less likely to be effective when the transaction occurs frequently.

The fact that cows must be milked twice per day coupled with milk's extremely perishable nature means that the transaction between farmers and processors must occur frequently. In fact, it takes place daily.

C.1.2 Business performance analysis

In any business enterprise it is necessary to monitor and communicate its performance. An analysis of the financial performance is typically indicated by means

of ratios, i.e. debt ratio, debt-equity ratio, return on investment, return on equity, and many others.

Business performance analysis relies heavily on two key concepts: profit and equity. In the case of a cooperative, extreme care must be exercised when using these concepts. The milk processing entity cannot be analysed entirely independently of the member farm firms. In essence, the cooperative can be viewed as a network including milk producing member farm firms and the milk processing firm in which the interests of the farm firms take precedence (Zwanenberg, 1997).

IFOs do not have these types of problems.

C.1.3 Profit

Profit can be considered to have three intrinsic attributes: (i) the aim of the profit, (ii) the destination of the profit, and (iii) the determination of profits. It is clearly the *aim* of any firm to realise a difference between income and costs (although in the case of a cooperative firm, costs would exclude the payment for milk). Where cooperatives and IOFs diverge, however, is in the *destination* and *determination* of profits (Zwanenberg, 1997).

For an IOF, profit is simply turnover minus costs, including the cost of purchasing raw materials. There are then two possibilities as to the destination of this profit: either it is added to reserves or it is paid out as dividends.

The destination of the earnings in a cooperative is entirely different. The difference between income and costs (excluding the raw milk costs) is available for two purposes: milk price payment and addition to reserves.

The choice of how much to retain is influenced by:

- The need for capital
- The size of existing reserves relative to the need for capital
- The existence and level of other risk-bearing capital
- The fiscal regime, i.e. the tax environment and the relative attractiveness of adding to reserves versus other forms of financing.

Having determined how much money is to be devoted to the price of milk, the cooperative must then decide on how this price is to be paid throughout the year, i.e. how much to pay in advance, will the per unit price vary with peak versus off-peak, etc.

The key point is that for a cooperative, the choice of how much to pay for milk is determined by the success of the cooperative as well as by the choice of how much to add to reserves. To label the amount added to reserves as profit in the way that an IOF reports profit is misleading. To consider both the amount devoted to the milk price plus the amount added to reserves as profit is equally misleading. While both IOFs and cooperatives attempt to realise cost-efficiency, maximum turnover, and the like, cooperatives have their goal determined by the goals of the member firms whereas IOFs derive their goals from those of the shareholders (i.e. investors) (Zwanenberg, 1997).

C.1.4 Equity

Solvency can be analysed as the ratio between equity and debts. In an IOF the distinction between the two is clear: reserves and share capital are equity. The distinction is not always so clear in a cooperative. For example, financing arrangements can be formulated whereby a member's capital (or a portion thereof) in the cooperative is not strictly defined as permanent capital. Normally capital is considered equity if it gives voting power, is permanent, is risk-bearing, and is the basis of determining credit worthiness.

To the extent that equity is defined differently across businesses, it makes performance measures relying on equity and debt ratios difficult to compare.

C.1.5 Agency theory

Agency theory concerns the problems of agency relationships, which occur whenever one individual, called the agent, acts on behalf of another, called the principal. Generally, the principal owns an asset and employs an agent to increase its value. Because the objectives of the agent are not usually identical to those of the principal, the agent may not always best represent the interests of the principal. In other words, the separation of ownership from control could lead managers to pursue their own objectives at the expense of owners (Royer, 1999).

Problems in the principal-agent relationship arising from the diversity of objectives can be eliminated if the principal and the agent are able to agree on a *complete* contract. But as we have already discussed, the characteristics of transactions in the sheep milk industry may give rise to incomplete contracts.

The principal-agent problem is usually applied to the corporate form of firm organisation, where a management team is employed by the board representing many owners. However, in the absence of a market for exchanging equity shares and the lack of equity-based management incentive mechanisms (e.g. stock options) suggests that such problems are potentially more serious in cooperative organisations. As a result, cooperative theorists have used the insights gained from the agency theory literature to refine cooperative governance and performance monitoring models.

C.1.6 Life cycle models

Several authors have developed "life cycle models" as a means of explaining why some firms choose a cooperative organisation whereas others do not. The models tend to predict that certain conditions will give rise to the formation of a cooperative, the cooperative will then grow and evolve, and eventually it declines and becomes redundant. However, the life cycle models assume that the market conditions that gave rise to the cooperative in the first place somehow change, and when they no longer exist, the need for the cooperative no longer exists either.

In the case of dairy/sheep milk cooperatives, however, the life cycle models tend not to complete the cycle. The essential feature of the market never changes, i.e. farmers are always left with a perishable product in a market environment where they are one of many sellers facing few buyers. In other words, as the models predict, cooperatives will persist indefinitely because of chronic market failure.

The notion of a complete life cycle has greater validity in situations where the driving force for the cooperative's formation was "an association of the weak". To the extent

that cooperatives are less efficient than corporations, one can expect a transition from the cooperative organisational form to a corporate form. This is sometimes confused with size, i.e. it has been suggested that cooperatives have some inherent size limit and when it is reached, the transition to a corporate form of organisation is inevitable. Such a view is extremely difficult to reconcile with the observed reality, especially in the dairy sector. Dairy/sheep milking, more than practically any other agricultural sector, is dominated by cooperatives engaged in milk processing and marketing.

Three examples of cooperative life cycle models can be found in Henehan and Anderson (1994), Cook (1995), and Harte (1997). As already noted, they are all quite similar. By way of example, the four phases of the Anderson model are:

1. ***Problem oriented phase:*** The cooperative is formed to deal with some perceived problem, as opposed to maximise profit. Usually the problem is associated with the loss of markets or unacceptable prices. Once the "survival" mode has passed, the cooperative turns its attention to improving returns.
2. ***Internally oriented phase:*** Here the focus is on improving returns by reducing costs, increasing operating efficiencies, and providing additional services to members. Attaining economies of scale and countervailing market power are important considerations at this point. According to Anderson, marketing receives little attention.
3. ***Externally oriented phase:*** Now the focus turns to marketing, particularly value-added marketing. It is usually accompanied by the realisation that the best way to serve the interests of members is to look after those of the customers. Although the risks of value-added marketing are greater, the returns are also greater. This phase is typically associated with a surge in research and development and the building of brands. As Anderson points out, successful cooperatives may never move on from this phase.
4. ***The sell-out phase:*** In this final phase, the cooperative may elect to sell the entire business and exit the market. Clearly, this strategy does not suit farmers seeking a secure outlet for their milk. Alternatively, they may decide to divest just a portion of the business, usually the value-added portion. Such a move may be driven by a reluctance of farmers to contribute the necessary capital to keep the business growing.

C.2 Practical application

This discussion takes place in the context of Zwanenberg's (1997) four challenges.

C.2.1 The milk intake strategy

Zwanenberg (1997) begins his discussion of the milk intake strategy by asking these questions. Should the cooperative carry the obligation to process all members' milk? Should supply from non-members be accepted? Should different prices be paid for different quantities or qualities? Should the milk price paid out be dependent on the cooperative firm's results? And we would add: should the price be different at different locations and time periods?

C.2.2 Obligation to process all milk

If the cooperative firm were to behave as a "normal" firm, say, an IOF, then the milk intake choice would be straight forward. Managers would select a range of activities to undertake that maximised the owners' return on investment, and from this would emerge a required quantity of raw milk. The firm would buy that much and no more. Such an approach by a cooperative would be tantamount to the following priority order in objectives:

1. Maximise the long term milk price
2. Delivery security for members.

As Zwanenberg (1997) states, an appeal to the insights of the transaction costs theory suggests that for the cooperative, this order is upside down. The members' delivery right is the cooperative's "conditio sine qua non". The primary reason a farmer joins the cooperative is the unconditional right it provides to deliver their produce. While the milk price is important to the farmer, it is not the first priority. The promise of a guaranteed market or outlet, even when terms are less favourable than some transitory alternative, means the farmer will undertake the transaction.

While the cooperative should have a constant obligation to process all the members' milk, it is not precluded from imposing conditions, or paying different prices for different quantities, different delivery patterns, or different qualities. In other words, the principle of proportionality applies to the milk intake strategy.

C.2.3 Non-member supplies

While requiring patrons to be members before they use the services of the cooperative helps to develop membership responsibility, makes for a better understanding of objectives and operations, and builds stronger financial support, there appears to be no unanimity on the question of whether cooperatives should trade exclusively with members. For example, if there is an excess capacity in processing, then surely it makes sense to accept non-member milk provided the marginal return exceeds the cost paid for the milk. Where problems arise is when non-members are paid a price that exceeds that paid to members, even if it makes economic sense at the time to do so.

Zwanenberg (1997) suggests that while the intake of non-member milk may at times have short term advantages, it should be subject to two caveats: the price offered to non-members should be lower than that paid to members, and a limit should be imposed on the proportion of non-member milk accepted.

C.2.4 Different prices for different quantities, locations, or times

The practice of using incentives such as premiums to attract milk outside of peak times or penalties to discourage poor quality milk is widely accepted.

Conferring benefits such as a higher price on "big" or "close" farmers up to the point of the cost-saving they deliver to the cooperative is entirely in keeping with the cooperative principles we outlined earlier. Operating the cooperative in a manner that assures members benefit in proportion to their use of the cooperative is a central feature that distinguishes cooperatives apart from other businesses.

C.2.5 Milk price and cooperative results

A frequent criticism of cooperatives is that the price members receive for their milk is indistinguishable from the performance value, or surplus, earned by the cooperative.

It is argued that this leads to excess production and would not occur if only processing was arranged under some "more efficient" organisational form. But such a criticism is really just a theoretical artefact. There is nothing inherent in cooperatives that prevents the milk price and the performance value from being separated.

In any event, there is no evidence in New Zealand that over production has ever been an issue. In fact, the opposite might be argued: sales managers frequently complain that they have insufficient product to meet the demands they face. Furthermore, the world is replete with examples where price is found to exceed marginal cost.

C.3 Financing

The key question with the financing of sheep milk cooperatives is whether risk-bearing capital should be supplied entirely by the members or whether non-members may be asked to contribute to the build-up of risk-bearing capital as well. The opportunity to attract capital from sources other than that of the members gives the cooperative room to strengthen its position. However, the danger is that non-members might be able to interfere with the strategy of the cooperative to the detriment of the optimal strategy chosen by members for their firms.

C.4 Conditions of membership

The rights and obligations of the members need to be viewed from the essential characteristics of the cooperative. Entry fees can be used to protect the interests of the incumbent members.

Resignation fees also fit in with the principles of cooperatives. The members leaving the cooperative leave their fellow members with a capacity problem. Although, this should not be confused with the right of a member to leave and take their fair value out of the cooperative either.

Appendix D Can sheep milk follow bovine milk?

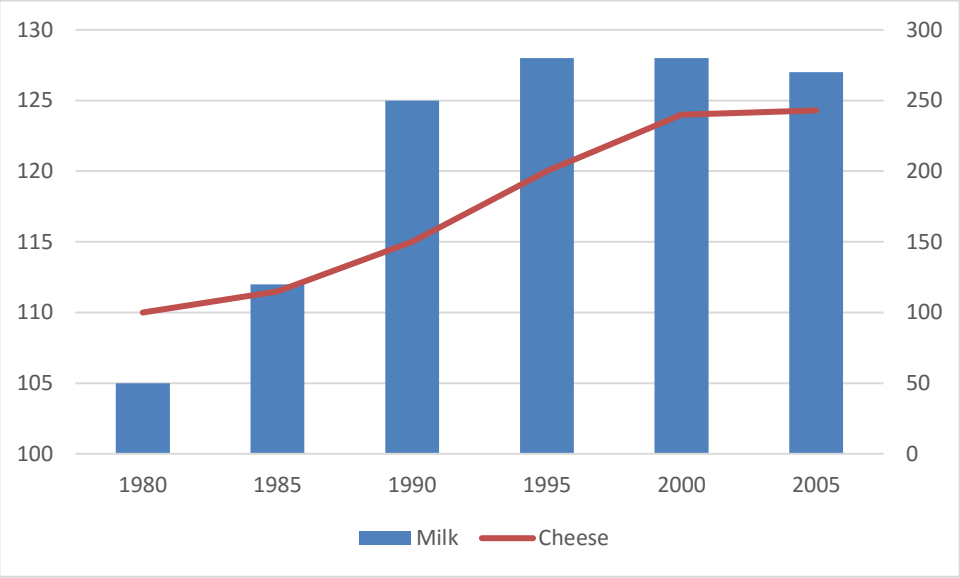
As an example, the following diagrams compare countries with a similar heritage of dairy consumption (such as Japan) to illustrate the likely increase in consumption of bovine milk and cheese production. As already discussed the development of sheep milking products are likely to be more highly favoured by Asian consumers given their perceived advantages (real or imagined).

This establishes that the likely demand for sheep milk products, with infant formula being the flagship product, is likely to grow given the twin assumptions that similar growth occurred with bovine milk/cheese demand and that Asian consumers have similar characteristics to a "like" market such as Japan.

Figure 8 below shows the lagged consumption of cheese to fresh milk of between 5-10 years.

Figure 8 Japanese milk and lagged cheese consumption

Moving average indexed to 1980 consumption 1980-2005

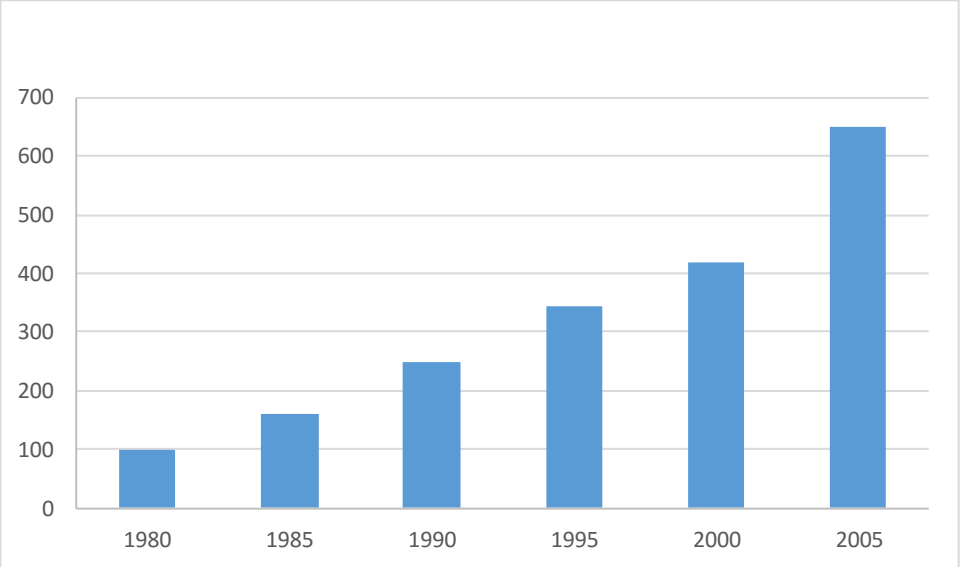


Source: NZIER

As an example, the historical bovine milk production for China is shown in Figure 9. If China follows the same pattern as Japan, cheese consumption – including sheep milk cheese consumption (and other products) – is likely to grow in the next few years.

Figure 9 Milk consumption in China

Moving average indexed to 1980 consumption, 1980-2002



Source: NZIER

Further the demand is likely to greatest on the Eastern seaboard provinces of China as the following table suggests.

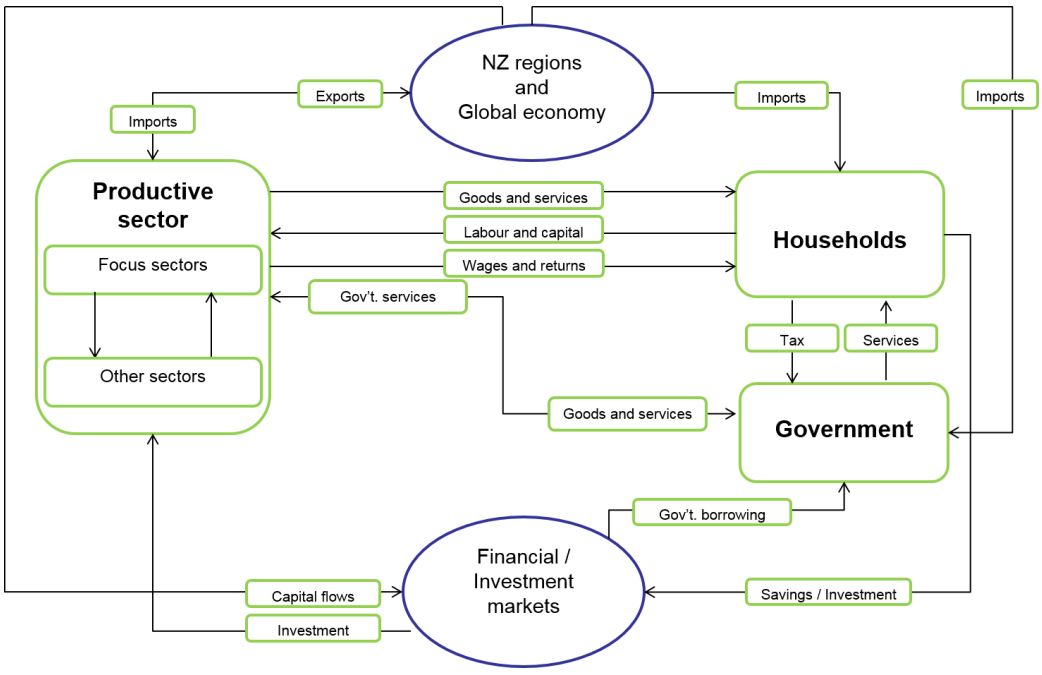
Appendix E Overview of TERM-NZ CGE model

Our regional CGE model, TERM-NZ

NZIER's regional CGE model, TERM-NZ, is a bottom-up model of the New Zealand economy, which begins with components of the economy and sums them up to obtain an aggregate description of the economy. It is based on Statistics New Zealand's 2013 input-output tables, which have been updated to reflect the economy in 2017.

A visual representation of TERM-NZ is shown in Figure 10. It highlights how the model is able to capture the complex and multidirectional relationships between the various parts of each regional economy and how they interact with the rest of New Zealand and rest of the world.

Figure 10 CGE models show the whole economy



Source: NZIER

As far as we know, TERM-NZ is the only bottom-up regional CGE model of the New Zealand economy currently in use. It therefore offers a unique capability to show how regional policy would impact on the region and New Zealand as a whole.

More technical details on the model are available on request.

The model includes 106 industries and 201 commodities in its standard form.