KELLOGG Rural Leadership PROGRAMME

Sheep Milking in New Zealand –An Analytical Review

Contents:

Introduction

The subject of my *Kellogg Industry Applied Project* is a discussion on the advantages and disadvantages for farmers investing in the production of sheep milk.

I have determined there is value in the compilation of a discussion document which identifies the key variables influencing successful commercial sheep milking business. These are current and potential dairy sheep industry dynamics and parameters, market and product opportunities, production cost structure based upon differing capital cost inputs, and the projected returns on investment.

My research is delivered as a discussion document due to the nature of my findings. Through substantial critical thought and analytical processes, I have found there to be many component permutations. This research could be extended into a fully-fledged business plan aimed at attracting investment into a new dairy sheep venture.

The key elements of this report include:

- Analysis of current industry strength, the identification of possible regional producer groups, and the availability of existing processing opportunities.
- A comprehensive SWOT analysis.
- An investigation of the potential supply chain model options both nationally & internationally.
- An analysis of different sheep milk farming systems placed under different load pressures in order to assess return on investment viability
- An assessment of the opportunity to become a market (price) maker (either as an independent producer or collectively with others).
- Key metrics will include capital expenditure requirements and potential ROIs, with sensitivity analysis to identify the risk and growth pain points.

This topic is of importance to me because it will provide the catalyst to develop an entry-level sheep milking business, capitalising on the intellectual property I have created through the project process. Sheep milking can provide a viable career or business pathway for me and my family. I would like to make a significant contribution to the industry and intend to take a leadership role within it.

Equally, this topic is important to the primary sector because it will provide business growth opportunities for traditional dry stock farmers to diversify, provide pathways for young people to build their careers, support the conservation of rural communities, improved returns for conventional sheep farmers (and others) through an additional income stream, and contributing to the preservation of a traditional pastoral industry.

Method

This report will incorporate data collection, literature review, interpretation, a scoping business plan and my final recommendation.

I initially created a mind map to aid in the critical analysis of this research. This mapping exercise provided a framework for setting out the report in a methodical and constructive manner. A copy of the original map is annexed (schedule 6) to this report.

With Patrick Aldwell's suggestion I involved the 'Business Mentor NZ' organisation to assist me with my project. I initially contacted Ray Schofield, CEO of BMNZ who forwarded my request to the Manawatu coordinator. I have since been assigned a specialist business mentor from the Manawatu, Peter French. Peter is an ex-farmer and successful businessman and he has provided me with feedback in regards to formulating my business plan moving forward. I have had ongoing access to the significant online resources that a membership of BMNZ provides.

Over the last six months I have developed links with a number of individuals and authorities whom are either researching or are currently investing in the NZ sheep milk industry; their insight has been invaluable.

Qualitative research has included input from the MPI, B+LNZ, milk companies, university academics, renowned sheep milk experts and commercial entities, interviews with principal leaders from the industry, current domestic research programs, existing and historical data sources as well as international data & research.

I have significantly referred to the sheep milking business model produced by Lucy Griffiths (nee Cruikshank) for her Nuffield Scholarship submission, and have used some of the empirical research she undertook in 2014 to aid me.

The Initial Investigation

My initial investigations have shown that whilst the actual milking platforms are relatively easy to develop and operate, the potential limiting factors for creating a viable and sustainable dairy sheep business are based around genetics procurement, product processing capability and market supply and demand opportunities.

However, there doesn't appear to be a robust, commercial, full feasibility-model currently available in NZ that has been produced to evidence the financial implications of investing in sheep milk production. I suggest that this would be the logical next step for me following on from this report.

The big questions:

Initial research suggests there are innumerable permutations for selecting the most appropriate farming system to suit an individual farmer's requirements.

There is little concrete information for new entrants, however what we do know is:

- The industry has had a couple of false starts since the importation of East Friesian genetics by Allison and Hamilton in 1992, with activity and endeavor waxing and waning in the last 20 years. No significant sustainable industry growth has occurred.
- The commercial production pioneers have all taken slightly different routes for business growth. The domestic market is comparatively small with local producers supplying artisan products regionally. There is only one current exporter of scale, Blue River Dairies, Southland, who are exporting milk powder and infant formula.
- Growth of those businesses is mainly driven by production first, consumer demand growth second, and then the scaling of production and expansion.
- Globally sheep milking is practiced at many levels of production and intensity. From the small domestic flocks in Syria and Greece, through to the large 1,000 ewe Israeli housed flocks. Blue River Dairy Ltd from Southland is the world's largest with around 25,000 animals.
- Wide yield variance between highest and lowest performing sheep in the country, (ranging between 100L and 400L per ewe) with limited focus on genetic gain in the last 20 years.
- No stringent quality standards. Other than the MPI code of good industry practice guidelines and the risk management protocols set by current processors.
- No central governing body to oversee industry development, promotion and help secure new markets.

The Main Issues

I have identified and categorised into six categories the main issues when considering sheep milking as a viable business:

(1) Products, supply chain and marketing:

The single biggest question anyone considering sheep milking should ask is '*who is going to buy my milk?*'

New producers must take responsibility for securing a market for their product to minimise the very real risk that having worked hard to produce milk, no one wants it or will pay enough to warrant the effort.

The existing supply chain opportunities are limited both regionally and also vertically.

If an entrant wishes to focus on milk production alone, then it is essential to obtain a supply arrangement with a local processor. Existing sheep product manufacturers are paying around $2/L for fresh sheep milk.

- **Do it all yourself:**

If the entrant wishes to develop their own 'paddock to plate' vertically integrated story, the primary question should be 'are you capable of producing a product, developing a brand and building a customer base?'

It may be prudent to work with a local processor to toll process the milk into the final product allowing you to focus on influencing supply and demand. If however, the entrant was to do it themselves, then the cost of manufacturing a product and taking it to market is significantly more as it consumes resources and time.

Commissioning your own manufacturing facility, complying with relevant food safety legislation, including rigorous risk management and quality assurance processes, is very expensive. For example a small scale cheese manufacturer in the Manawatu took two years to design and build the facility, absorbing at least $200,000 in capital expenditure. The cost would have been far greater if the owners didn't have the specialist science knowledge and experience to do the majority of the technical design work themselves.

- **Work with a manufacturer:**

In recent discussions, several regional sheep milk product manufacturers have stated they currently have both the capacity and the consumer demand to purchase more fresh milk.

Cheese, yoghurt, ice cream, fresh milk, whole sheep milk powder and infant formula are being produced nationally for both domestic and international markets.

As a milk supplier another consideration is whether to focus on milk production volume or on milk solids composition? Cheese makers want higher percentages of fats and proteins to make better product. The percentages of milk solids can vary naturally through the season, but this can be influenced by the feeding regime[1]

- **Producer Groups**

With interest piquing throughout the country, it is prudent to collaborate with other local producers to form a producer group. Producer Groups are able to share costs and pass the savings onto the consumer. The economies of scale, buying power, strengthened negotiation position and risk dilution is attractive, as is the sharing of information and building up expertise within the group benefiting all of the members.

A successful producer group could ultimately morph into a recognised cooperative structure generating even greater economic benefits through sustained marketing and promotion activity as well as providing more risk certainty around farm gate returns ($/L or $/kg MS).

The Dairy Goat Co-operative (N.Z.) Ltd (DGC) states on its website that 'it believes in the enduring value of the co-operative business model, which is based on maximising sustainable returns, wealth and future security for its farmer shareholders'. The cautious approach to sustainable expansion that the co-op has demonstrated over the past decade is certainly seen to be successful for the shareholders. The organisation is in growth mode bringing on 2 -3 milk supply shareholders per year as stimulated demand grows through their promotion channels.

- **Equity Partnerships:**

Another opportunity is to collaborate with equity partners either on farm or off farm. Working with others who possess complimentary skills, seek investment partners (silent or otherwise) or bring in individuals who want hands on input (sweat equity) are all possibilities available to the sheep milker. The cow dairy industry has developed some robust and successful equity models that could be emulated by the sheep milk industry.

[1] Opinion gained from (presentation by Dr. Sam Peterson, FoodHQ Ewe Milk Products and Sheep Dairying Conference, Massey Food HQ, Feb 2015)

- **Work with a Marketing Specialist:**

There are specialist marketing organisations in New Zealand who have proven experience in developing supply channels into niche markets worldwide. They have the capacity to introduce new products into the mix.

It is critical that they demonstrate expertise in exporting high value dairy products or perishable goods. They should impress that they really know their target markets by proving the demand opportunity and assure that they manage the entire supply chain end to end. Export is complex and fraught with potential pitfalls, so reputation and track record are paramount.

The key observation made here is:

'Are you inclined to be a sheep milk farmer, a manufacturing processor, a marketer and a wholesaler/retailer or should you concentrate on what you do best?'

The answer should revolve around identifying your core strengths and determining how should you play to them?

Whichever supply chain route is chosen, it is more expedient to work with others to ensure greater success and longevity of the operation.

(2) Livestock and stock management:

Various speakers at the FoodHQ Ewe Milk Products and Sheep Dairying Conference have suggested that the biggest hindrance in establishing a viable sheep milk industry is the lack of a strong milk-sheep genetics base within New Zealand.

Some milk breed genetics (Awassi & East Friesian breeds) were imported into the country back in 1991/2. With a relatively small national flock of around 25 – 30,000 specific milk breed sheep, there is a strong desire to allow for the importation of new genetics. The pre-eminent genetics in this field is the French domestic Lacaune breed which, through rigorous selection and milk recording, has shown an enormous gain in milk yield per animal (6.3% per year gain per ewe milk yield within the breed over a 30-year period based on the government agency program.) *Source: Sheep dairying in France, Francis Barillet,1995*.

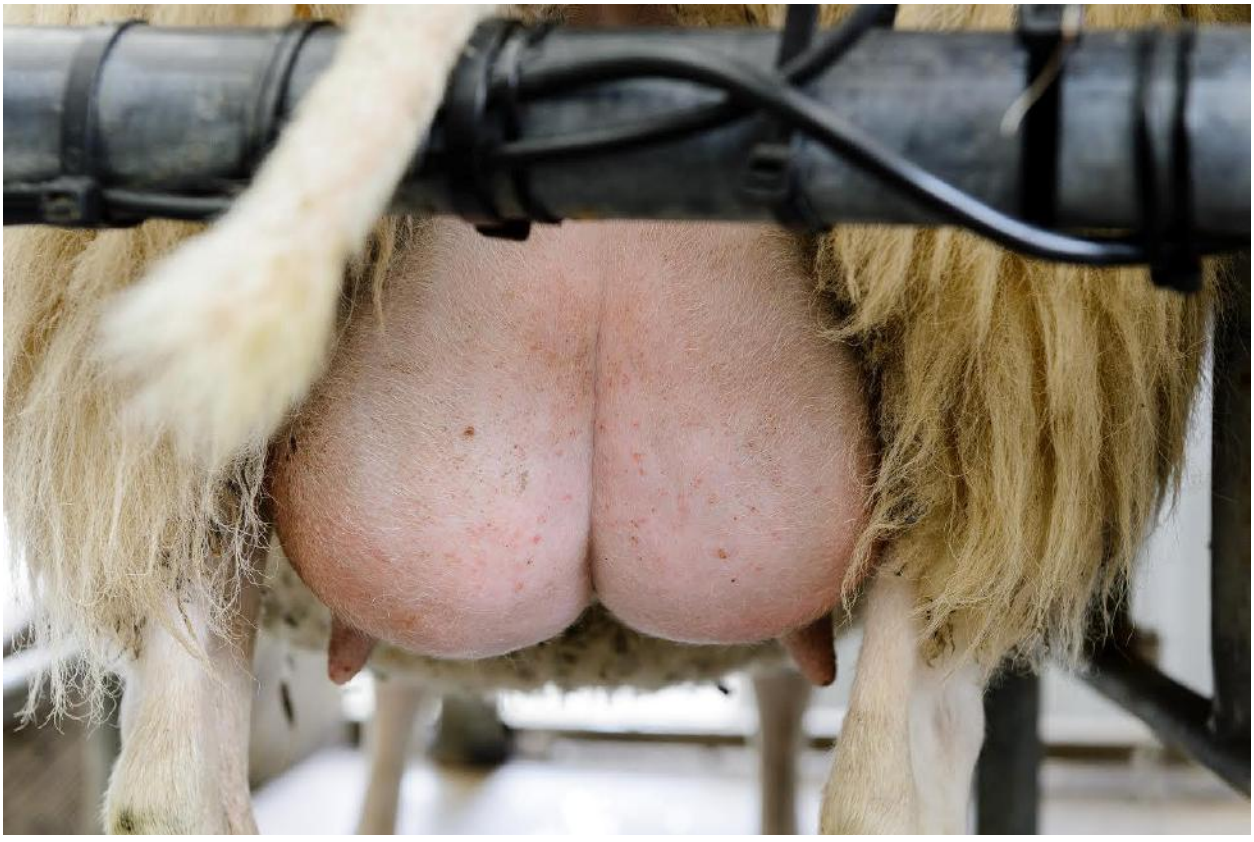
Pure bred East Friesian (EF) have been previously crossed with Poll Dorset and other breeds such as Coopworth to improve hybrid vigour, conformation and the suitability and hardiness to climate.

It is acknowledged that within the various commercial flocks, daily yields range from 700ml to 2L per animal. Milk recording is also a relatively new phenomenon in those businesses; therefore culling selection criteria have historically been based on udder conformation, feet problems and other undesirable traits. Surprisingly, milk yield has been a secondary consideration.

Prof. Nicolas Lopez-Villalobos, Genetics expert, Massey University stated at the FoodHQ Ewe Milk Products and Sheep Dairying Conference that milk production in sheep is influenced by genetics (80%), feed (10%) and environment (10%).

With Landcorp's recent entry into the sheep milk industry, plus the dedicated activity of some independent genetics companies in this arena, there will be inevitable momentum towards more rapid genetic gain for milk yield.

John Ryrie, the new manager of Landcorp's sheep milk farm and past chair of the British Dairy Sheep association, suggests that new entrants should purchase the best milk breed rams available to them, cross them over other early lamb producing breeds and start the genetics plan with subsequent generations.



Artificial Insemination (A.I.), Embryo Transfer (ET) and artificial breeding plans, such as the Cornell Star system[2]., have also influenced speeding up genetic gain. This technology, whilst expensive, is proven within New Zealand and offers strong solutions for farmers to build viable flocks quickly.

[2] the Cornell Star model (reference section)

(3) Size of flock and its husbandry

The decision on determining the size of the initial flock should really be based on a number of factors: -

- Identifying how much demand there is for the milk and whether you can obtain a binding supply price guarantee,
- How much debt risk you are prepared to take on,
- The amount of capital you are willing to invest,
- The confidence you have in managing the intensive husbandry inevitably required,
- And the impact the new enterprise will have on your existing business activity.

There are trains of thought which suggest that building a 300 mixed age ewe flock plus replacements and sires is the optimum initial scale for setting up the business.

However, before determining the actual numbers it is important to assess some of the key influencers that will affect that decision making.

- **Milking times:**

The number of milking times per day and the lactation length is a question that depends on whether lambs are removed off ewes at 48 – 72 hours (having had access to sufficient colostrum) to immediately start to milk the animal, or accept lower yields by sharing the milk between lamb and vat once per day -either from day three or after a six week weaning interval. There is evidence to show that maximum yield is attained by twice-daily machine milking.

The decision to milk the ewe to full lactation potential thus gaining maximum yield over an extended lactation length, has been researched and the optimum is based on 180 -200 day lactation, milked twice a day through peak milk supply, reducing to once per day in later lactation before drying off.

- **Lambing Interval:**

Concentrated lambing interval is another consideration. Tightening the lambing period for the whole flock creates its own demands. Ewes and lambs have significant $ value and a high mortality rate is revenue opportunity lost. Lambs should no longer be treated as the bi-product of obtaining milk. Milk breeds have greater fecundity than conventional breeds resulting in higher proportions of multiple births, so expect more lambs on the ground. The rearing costs of lambs to weaning (mainly comprised of feed and labour) also needs to be factored into the equation at around $85 per lamb[3].

[3] Lucy Griffith, 2014 Nuffield Scholar.

The labour requirement for hand rearing or overseeing an automated feed system places significant demands on farm labour (akin to calf rearing). Dedicated facilities must be provided to ensure successful rearing. The husbandry regime is more complex than calf rearing because younger lambs do not adapt to automated milk machines as easily as calves, therefore there is a need for constant monitoring.

Globally there is a proven market in the food industry for milk fed lamb killed at six weeks, and the food industry pay a premium for this product. The market is not yet established here, so consequently market research to search out and stimulate demand is paramount. This may be a lucrative way to deal with the surplus male offspring born from the replacement programme, rather than euthanize and slink them.

Surplus replacement ewe and ram hoggets offer another income stream by selling them back into the industry. Tight supply of capital breeding stock has seen ewe hoggets selling for up to $350 each in 2015, assuming the genetics warrant it. This is another reason why flock records and milk recording are valuable to the operation as proof authentication.

Crossing a terminal sire over the remainder of the non-replacement flock will provide good growth rates and optimum carcass weight for the remaining lambs.

- **Seasonal versus non seasonal lambing:**

In the case of year round milk supply, seasonal versus non-seasonal lambing is another big decision. Sheep milk has been successfully frozen in batches for use out of season.[4] Powder made in-season can be reconstituted for use in cheese and other products, so seasonal milking can work from a supply point. Seasonal milking mirrors the growth pattern of a grass based system, so may provide the most cost effective $/kg/DM.

Disadvantages to all year round production is the requirement and cost of supplementary feed outside of the peak feed growth season and the intensive management and skill required to run it. This may be offset by the ability to lamb three times in two years, keeping the ewe in milk for a longer period within that time frame[5].

Downie-Melrose and Trafford[6] showed in their modeling that non-seasonal sheep dairy is more profitable, but believed that the additional husbandry skills and technologies required will deter early adopters from utilising this system.

Other questions include whether ewes should be wintered off farm and brought back to lamb, which enables the milk block to be stocked more intensively at the point that spring growth occurs. With grazing lease costs averaging between $1.50 - $2.50 per head per week, the cost of say twelve

[4] Waituhi-Kuratau Trust.
[5] the Cornell Star model (reference section)

[6] *Downie-Melrose, K and Trafford, G. A Bio economic Feasibility Study of Sheep Dairy Systems in Canterbury. Lincoln 2014.*

weeks grazing off-farm prior to lambing, consuming someone else's grass may be an attractive option.

Similarly sending young stock off farm to be raised through to hogget or even two tooth age may prove attractive for several reasons:

- It allows you to dedicate the milking platform to the milking flock (allowing greater stocking rates and total milk volume),
- It isolates the younger animals who carry the greatest worm burden away from the main flock. This is important because currently there isn't an anthelmintic with on-label use for dairy sheep in milk.

To lamb and milk them as hoggets or two tooth's is a husbandry question. Miles King from Kingsmeade suggests that it is easier to train sheep to milk as 'children' (hogget's) rather than 'petulant teenagers' (two tooth's). It really comes down to the trade-off between economics and husbandry.

Finally, it is pointed out that the care of rams cannot be overlooked. Pure bred rams have greater welfare requirements than conventional breeds as they are not as hardy. They need to be included in the flock husbandry plan so that they are kept in optimum condition.

(4) Feed and Nutrition

All sources consulted have stated that supplementary feeding of milking ewes is essential in order to maximise yield and fulfill genetic potential.

A grass diet may never deliver sufficient nutrition to match the animal's energy requirement, particularly when the animal is at peak lactation. Contrary to conventional sheep farming systems, the milk ewe needs to start lactation in optimum condition and maintain it for as long as possible to maximise lactation length and yield.

Milk breed ewes have higher nutritional requirement than conventional lamb rearing ewes because they are generally heavier. Ewes often weigh in excess of 70kg and have high maintenance requirements. Typically milking ewes need to consume feed up to 4% of bodyweight daily to maximise production[7].

[7] Downie-Melrose, K 'A Bio economic Feasibility Study of Sheep Dairy systems in Canterbury, BAgSc, Lincoln, 2014.

Sward length, quality & composition (including particle size and fibre content) greatly influence metabolisable energy availability (MJME/day) and if the ewes are expected to stay off paddock for more than one hour per milking (walking to and from the shed / standing in the yard) then the energy deficits cannot be rectified through limited time grazing alone. The physiological limitations of sheep mean they may not actually be able to physically eat enough to match that energy demand.

Global doctrine has shown that ewes respond well to additional feed, mainly in the form of grain fed in the shed to entice animals to willingly comply at milking time.

Nutrition plans are essential to balance the inputs to ensure optimum diet. Total mixed rations with high protein levels (pellets or kibbled grains) may be fed at rates between 0.5 – 1.5 kg per day. Milk recording to allow optimum rations to be fed during different phases of the lactation is handy, but requires greater capital outlay to install yield meter equipment.

Supplementary feed in the form of silage or other feed crops may be necessary additions to the nutrition plan. This will be especially true if out of season milking is pursued, because plant growth will not match nutritional demand.

(5) Plant, buildings and equipment:

At this point it is timely to discuss the type of milking parlour required. The size of the initial flock, potential scale of future development and available capital all influence the selection of the equipment at the outset.

There is an opportunity to use either shed based fixed plant or mobile/ transportable equipment as there are now various commercially proven options for both in use and available from around the world.

- **Fixed or mobile plant?**

Katrina Lee (DeLaval sheep and goat specialist for Aus. /NZ) provided the preferable equipment options from the perspective of setting up either a 300 ewe or a 1,000 ewe shed based system.

	Fixed stall	Parallel stall	Pulsation only	Full flock management	Installation
300 ewes	✓		$ 68,750.00	$ 78,750.00	$ 28,500.00
1000 ewes		✓	$ 275,000.00	$ 315,000.00	$ 85,000.00
excl GST					

The pulsation only equipment includes:
Stalling Clusters Automation (pulsators) Supply & delivery lines Cleaning unit Plate cooler Teat sprayer Vacuum pump

The full flock management costs additionally include:
Portal ID Milk meters (MM25SG) MPC580 milking point control plus pulsators

The figures don't include the bulk tank/vat as these tend to be sourced in NZ.

If you factor the cost of the shed infrastructure and in shed feed systems. The Lincoln technical manual indicates that good quality covered housing for sheep and goats may cost up to $300/sq.m. Milking shed, covered housing and lamb housing for 1,000 ewes may cost over $650,000.

- **Mobile Units:**

DeLaval are only just starting to look at equipping mobile units globally with pulsation equipment. The cost is around NZD 45,000, excluding installation, for a 24 cup unit.

Cleaning and cooling systems may take more work to install so additional cost may be incurred.

Full flock management equipment may not be robust enough to stand the vibration and additional space is required to locate it. However there is an assumption that such a system would incur a total cost of about NZD 120,000 excluding installation.

In theory a 24 cup system could process 150 animals per hour assuming entry time of 5 seconds per animal, an exit of 2 seconds per animal via a gang exit and 6 second cluster attachment time.

Ian MacDonald from Excel Livestock has been trialling a trailer he commissioned Rakaia Engineering Ltd to build. He believes that a 24 cup trailer would cost $130,000 - $150,000 to build including pulsation equipment installation. However the chill unit and vat would need to sit in an additional refrigerated truck unit, which also acts as the tow vehicle. This could cost an additional $45,000 -$50,000.

Greek system using DeLaval stalling and pulsation equipment.

(6) Scale and intensity of the operation:

Katrina Lee, in her presentation at the 2015 AgInnovation conference, challenged the attendees to think about the intensity of a sheep milk farming operation.

Intensively managed flocks are housed and milked indoors with feed provided to them (zero grazed in a 'cut and carry' system), lamb in mobs all year round.AI technology is used to produce continuous milk supply and early weaned lambs are raised in purpose built facilities.

Complex husbandry planning and associated greater labour inputs do appear successful when they were trialed in Israel and Italy.[8] It suits larger flocks where the associated economies of scale may outweigh the high capital investment and high operating costs that are incurred. A producer may mitigate risk by maximising milk volume and revenue.

[8] (Griffiths, L, Nuffield scholar ,)

Interestingly, Blue River Dairies Ltd have developed and run their farming system along this intensive line. In mid-2014 they chose to lamb and milk seasonally, citing the high cost of ensuring milk production all year round.

By way of comparison, contrast that intensive operation to one based on a more traditional extensive sheep farm system; Ewes live and graze outdoors, rely largely on a grass based diet and lamb outdoors with minimum intervention. Lambs suckle through to six week weaning before commencing milking and ewes may only be fed minimal supplementary feed in parlour to entice them to cooperate.

In the following table two contrasting extensive and intensive production systems are compared theoretically. It is apparent that the two business systems would be driven in very different ways to produce milk output:

Comparison of extensive and intensive farming systems:

	Extensive Farm System	**Intensive farm system**
Number of sheep	300 (plus replacements)	1,000 (plus replacements)
Resources consumed	Lowest resource input	Highest resources input
Development costs	Lowest development cost	Highest development cost
Integration into existing business	Add onto existing farm business	Add onto existing dairy business?
Minimum area required (based on 12.5 Su/ha*)	43ha.	84ha
Capital stock availability	Ewes from farm crossed with imported genetics – home breeding plan	Capital flock imported
Dairy platform dedicated to milk flock and/ or replacements	All animals kept on farm, so platform shared for all livestock	Ewes wintered off farm Hoggets raised off farm
Lamb rearing regime	Lambs weaned at six weeks – then milking commences	Lambs removed at 48 hrs. and ewes milked
Milking regime	Once a day milking from six weeks	Twice per day milking from day one, reducing to once a day in mid/ late lactation
Replacement breeding policy	Limited replacements required are bred	Significant replacement plan sourcing best available genetics
Ram type used	Terminal Sire used for market lamb production	Milk bred rams used over the flock to speed up genetic gain
Lamb Plan	Replacements retained. Surplus Lambs finished for meat	Replacements selected and retained Surplus lambs either euthanized for slinks, or reared for 6 week milk fed lamb market

		Or, surplus ewe and ram hoggets sold back into the industry for breeding
Housing system	Paddock kept flock	Milk flock housed
	Lambing outdoors with minimum intervention	Intensive lambing indoors
	Natural seasonal reproduction	Cornell star system breeding programme* for all year round milk supply
Total mixed ration policy	Limited quantity of supplementary feed fed in parlour as enticement	TMR and silage supplements fed as nutrition plan for milk production
	TMR delivered manually (scoop)	Automated feed delivery system in shed
Grazing system	Paddock rotation	Cut & carry (grass delivered to housed flock)
Milk recording	Manual flock recording, no individual milk recording	Integrated flock & milk recording installed
Milking system	24 cup mobile unit	Larger 48 unit herring bone / rotary
Milking equipment	Mobile (paddock) based	Fixed shed and equipment
Throughput	150 hour	300 hour
Lactation length	150 days (commencing six weeks after lambing)	200 days (commencing 48 hours after lambing)
Labour input (FTE)	0.5 (part time milker) plus additional seasonal when required	(2.5) plus additional lambing help.
Capex on land, stock & plant	$835,000*	$1,800,000**
Potential annual revenue (Milk only)	$90,000 (300 ewes x 150 day x 1.0 L/ day average x $2/L)	$800,000 (1000 ewes x 200 days x 2L/day average x $2/L)

**Trailer & equipment, land & stock, ** milking shed & equipment, housing shed, land & stock*

With so many questions raised it would seem that the solutions/ route for business development depends on the individual's appetite for business growth and the intensity craved. Initial test flock building to scale depends on market demand for product– future investment requirement – additional resources – capital, labour, access to more animals, breeding programme etc.

Dollars and sense….

So the questions remain about just how much revenue you could earn from these alternative farm systems and is there an optimum farm system for maximising return in investment?

The theoretical modeling work undertaken by Downie-Melrose and Trafford in 2014[9] indicates that less intensive farms generate less milk revenue as a percentage of total revenue earned from the flock. This is because the focus of the business is as much about raising lambs for market as producing milk. In sharing the milk between lamb and vat, the length of lactation and total yield per ewe are impacted to a greater degree when compared to a more intensively managed system.

Is there an optimum farm system that generates the best return on capital?

The computer modeling undertaken by Guy Trafford for Synlait Milk Ltd in 2013 and reported in the Downie-Melrose, K (2014) thesis certainly showed that an intensive farming system relying on wintering ewes and young stock off farm could provide greater financial return than other permutations of intensity (those based on seasonal milk production with lambs reared on or off ewes) and indeed far exceeded an unimproved extensive lamb focused sheep enterprise.

The paper '*A Bio economic Feasibility Study of Sheep Dairy Systems in Canterbury*' created by Trafford and Downie-Melrose put significant effort into modeling scenarios using linear programming, Farmax farm plan and overseer models.

Based around a common resource (irrigated, flat and fertile Canterbury plain land), four scenarios were created and compared to a fifth conventional sheep breeding and finishing system.

The systems tested were:

1. Conventional non-milking sheep breeding and finishing
2. Seasonal sheep dairy system with lambs weaned at three days old and reared until six weeks old
3. Seasonal sheep dairy system with lambs remaining with ewes until six weeks
4. Seasonal sheep dairy system with ewes milked in conjunction with rearing lambs
5. Wintering and rearing young stock off farm.

[9] *Downie-Melrose, K and Trafford, G. Sheep dairy systems have the potential to significantly improve the profitability and the efficiency of New Zealand sheep systems. A Bio economic Feasibility Study of Sheep Dairy Systems in Canterbury, 2014.*

The report concluded that*:*

- All of the sheep dairy systems are significantly more profitable than the conventional sheep systems and lamb rearing systems which require less milk inputs from ewes more profitable than those where the ewe has the major role in lamb rearing.
- The returns per system ranged from $5,052 cash profit per ha for a wintering off farm system, to $2,847 for a foster from three days of age system, to $2,078 and $1,101 for the two 'share milking' systems with the ewes.
- All of these systems are more profitable than the conventional systems which returns $567 per ha. However, all these results are highly dependable upon product prices.

The authors went on to say that at that point (2013/14) cow dairy milk solids were at a record $8.40/ kg MS, so the returns from sheep milk couldn't match those of cow dairying.

My belief is that if the same modeling systems were completed again in 2014/15, with a cow dairy payout that has almost halved to $4.40/kg/MS, the findings of that report would present a very different picture.

SWOT Analysis

Strengths

- Tri-product revenue – wool, milk and meat. Offers third income stream.
- Can make significant contribution to existing farm business….Kate D-M figs
- Sheep milking with 200day lactation suits drier climates and can match regional seasonal feed growth availability to a greater degree than cow dairy lactations.
- With some 30,000 milk breed animals in NZ, there is an existing (if limited) genetic pool to access.
- Sheep milking business will suit both cow dairy farmers and traditional sheep farmers.
- Lower capital costs than cow dairy with possible faster return on investment.
- Existing industry supplies national and international markets.
- Landcorp has entered the market which gives immediate industry growth.
- Potential to start small – land area, local market, cheaper milking system, extensive input, limited resources and personnel.
- Accepted food source - health & nutritional benefits of sheep milk offer opportunity.
- Suits the existing entrepreneurial spirit within cow dairy & traditional sheep farming.
- Existing pioneers have broken the ground for a burgeoning industry.
- Current farm gate returns of around $2/L ($17/

Weaknesses

- Processing and marketing opportunities are thinly spread across the nation.
- Limited opportunity to sell milk to local/ regional processors is disincentive to invest.
- Limited sources of specialist industry technical knowledge on-shore.
- Limited access to specialist industry technical knowledge on-shore.
- Limited existing, proven business & financial modeling information available.
- Lack of industry body. Fragmentation of supply is isolating for producers. Cottage/artisan industry has had to develop without any support.
- The increased work load may prove unattractive.
- Nutritional requirement of milk flock is not same as existing sheep production (for meat). Needs mindset change & reprogramming feed production plans.
- Milk ewes cannot be expected to thrive and milk to potential on marginal sheep country.
- Access to limited genetics pool makes breeding gains harder to attain.
- RMP, legislation, nutrient loss plans are unobtainable off the shelf. Experienced consultants and auditors few and far between.

Opportunities

- Domestic and international consumer demand expansion. Growth markets on/ off shore.
- Blue River has significant capacity to take all sheep milk NZ could produce.
- Start small, intensive prototyping on farm and then scale up
- Small land area required for sheep milk platform
- Smaller capex costs
- Health benefits
- Lactose intolerance – suitable product
- Willingness for Govt, Callaghan, Agmardt, Landcorp, Tertiary institutions, CRI's etc. to invest in research and education.
- Formation of the NZ dairy sheep association in 2015 – get the national discussion going.
- Cow dairy environmental impact is constrained. Sheep dairying has smaller footprint.
- Returns - Much higher than dry stock (3 x)
- Risk/Diversification - Range of products, milk, meat and wool.
- Expertise – New Zealand high level of expertise and infrastructure in sheep farming, breeding Management –for sheep farmers the animal and farm management is very familiar.

Threats

- Price instability - returns too low for investment certainty.
- Limited processing capability – loss of Neudorf, change of ownership for Blue River, Kingsmeade.
- Fragmented marketing opportunity.
- Lack of governing body to oversee standards
- Lack of governing body to promote industry
- Lifestyle choice - Some farmers may not want the extra workload.
- Start-up investment - Older farmers may already have paid off their mortgages
- Capital - Large initial capital outlay to buy milking sheep, shed, feed systems etc.
- Risk - Still no guaranteed market, very little current infrastructure.
- Labour – need to employ more permanent staff (or share milk)

Discussion and Conclusion:

My research has shown the following points:

- It is apparent that there is healthy and growing market demand for sheep products nationally and internationally, but to take advantage of it a new entrant would need to secure a supply contract with a processor or marketing company with proven results in selling artisan products.
- Key components of the supply chain are essential – reliable, committed processors will give confidence to producers.
- An industry body that advocates, promotes, supports, creates quality standards (even if voluntary) and records national genetics would be advantageous.
- It is a question of scale and intensity. Modeling shows that intensive farm platform that focuses on milk yield and volume by weaning lambs early, wintering ewes off farm and maximising lactation length makes the greatest return.
- However commissioning a mobile plant will cost far less and allows you to start farming with less risk at a smaller scale. Learn to walk before you run.
- Sheep are not just mini cows – the husbandry of the milk bred ewe is significant. Look after her properly and she will look after you.
- A nutrition plan is essential to maximise milk output. Supplementary protein in the form of total mixed ration does pay dividends.
- The current gene pool is limited. Start with the best you can obtain, but plan to improve genetic potential as quickly as possible. The difference between 700mls per day and 2L of milk per day will make or break you whether you have 100 ewes or 1,000.
- The industry will attract existing sheep farmers and cow dairy farmers as well as provide sustainable career pathways for future generations.
- Assess your own competences. Focus on your strengths and partner up with others to strengthen your weaknesses. Collaboration with like-minded business people or others who have complementary skills is advised.
- Build a team of experts around you. This is particularly important when navigating the legislation, risk management maze and positively influencing the production systems.
- Assume that you will make mistakes on the way. The industry pioneers have all learnt the hard way. Upskill by researching national and international production methods and assess how they would fit into your farming system and what benefits or drawbacks they would create.

Personally, I am confident that the industry has enormous potential. It will provide me with a growth opportunity that will stimulate, challenge and fulfil my own business and personal goals. I intend to take my sheep milk aspirations to business plan stage.

Damian R Buckley | June 2015

Schedule 1

Market analysis:

Between 2009 and 2012 the total volume of sheep milk produced globally is estimated to have increased from increased from 8.461m tonnes to 10.122m tonnes.

Depending on reporting sources, sheep milk has only an estimated 1.4 percent share of the global dairy market but the trade potential from many reports shows year on year demand growth.

Lucy Griffith in her recent Nuffield Scholarship tour claims that in all the countries she visited, national demand for sheep milk products was reported to be growing between 10 – 20%.

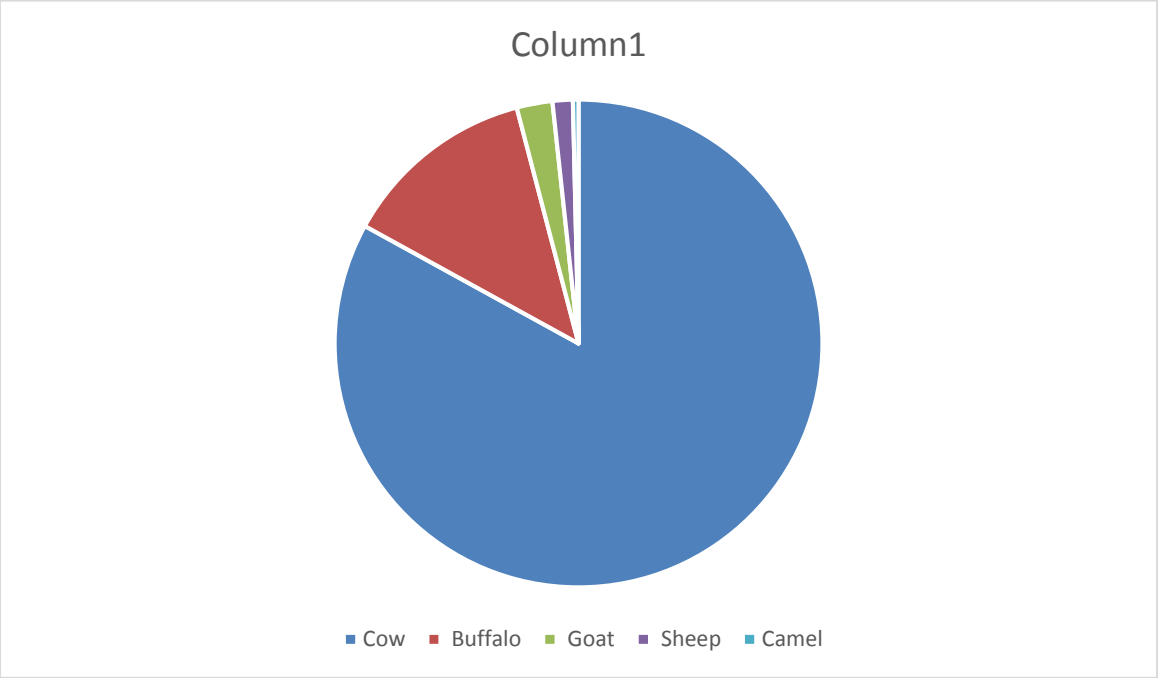
Demand for animal milk products as a transportable protein is forecast to grow to over 100 billion litres by 2020. Sheep milk will benefit from the overall market expansion (even if it only maintains its share of the market)

Interesting facts:

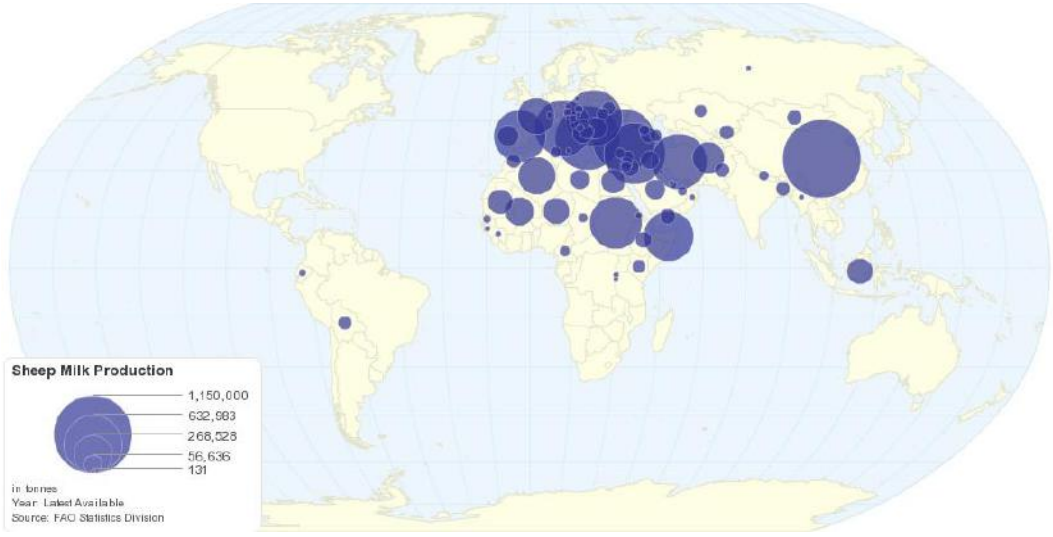
- China produces 1.5 million tonnes of sheep milk annually
- New Zealand has the largest sheep dairy operation in the world (Blue River Dairies Ltd) with 25,000 stock units. The next largest is in Spain.
- The largest consumer of sheep dairy products is the USA, which consumes over half of the world's production of sheep cheese.
- The world's commercial dairy sheep industry is concentrated in Europe and countries on / near the Mediterranean Sea.
- The industry is in its infancy in the United States. Despite being the world's biggest importer of sheep cheese, there are only three farms with more than 1,000 ewes

Cow	625,754,261	83.0
Buffalo	97,417,135	12.9
Goat	17,846,118	2.4
Sheep	**10,122,522**	**1.3**
Camel	2,785,382	0.4

(**Source**: *FAO of United Nations, 2012, retrieved http://www.sheep101.info/dairy.html*)

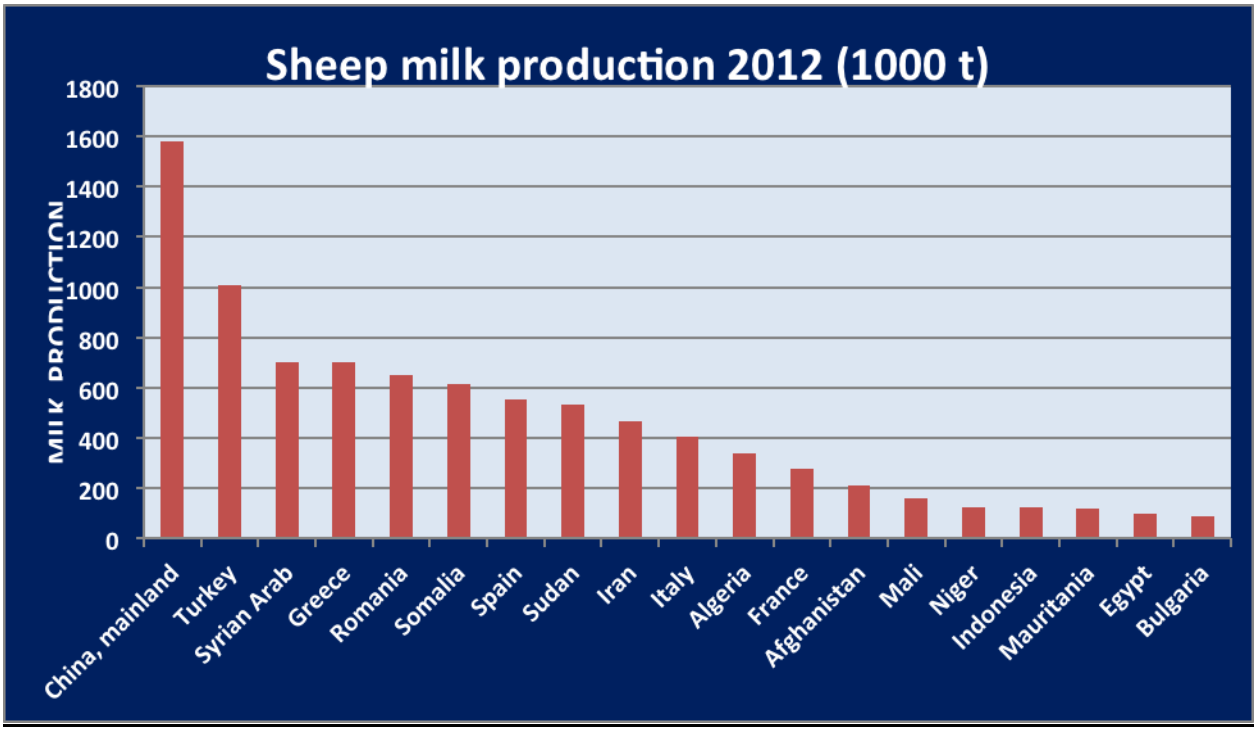


(**Source**: *FAO of United Nations, 2012, retrieved http://www.sheep101.info/dairy.html*)



Source: FAO Statistics Division

Schedule 2



Source: *Katrina Lee, DeLaval sheep & Goat specialist– Just add milk presentation, AgInnovation May 2015*

Schedule 3

Table 4 : Production of milk from different animals - average 2006-2009

	Sheep milk		Goat milk		Cow milk		Camel milk		Buffalo milk		Milk, total	
	Volume 1000 t	Share %	Volume 1000 t	Share %	Volume 1000 t	Share %	Volume 1000 t	Share %	Volume 1000 t	Share %	Volume 1000 t	Share %
Developed	**327**	**0.9**	**2516**	**0.8**	**320886**	**98.1**	**0**	**0.0**	**228**	**0.1**	**327000**	**100**
Formerly centrally planned economies	101	1.1	858	0.8	99367	98.4	0	0.0	13	0.0	101000	100
Industrialized	243	0.9	1782	0.7	238381	98.1	0	0.0	221	0.1	243000	100
Developing	**309**	**1.8**	**10623**	**3.4**	**221174**	**71.6**	**1292**	**0.4**	**69983**	**22.6**	**309000**	**100**
East and Southeast Asia	45	2.8	587	1.3	39479	88.7	19	0.0	3124	7.0	44500	100
China	39	2.8	265	0.7	34950	88.9	15	0.0	2925	7.4	39300	100
Rest of East and Southeast Asia	5	2.9	322	6.2	4529	87.0	4	0.1	199	3.8	5207	100
Latin America and the Caribbean	62	0.0	449	0.7	61811	99.2	0	0.0	0	0.0	62300	100
Brazil	20	0.0	136	0.7	19976	99.4	0	0.0	0	0.0	20100	100
Rest of Latin America and the Caribbean	42	0.1	312	0.7	41836	99.1	0	0.0	0	0.0	42200	100
South Asia	126	0.1	5751	4.6	55972	44.4	0	0.0	64520	51.2	126000	100
India	89	0.0	2927	3.3	43466	48.7	0	0.0	42799	48.0	89200	100
Rest of South Asia	37	0.2	2824	7.6	12506	33.7	0	0.0	21721	58.5	37100	100
Near East and North Africa	35	8.4	1231	3.6	27924	80.9	142	0.4	2333	6.8	34500	100
Sub-Saharan Africa	23	4.8	2391	10.3	18691	80.2	1127	4.8	0	0.0	23300	100
World	**8641**	**1.4**	**13144**	**2.1**	**542069**	**85.4**	**1292**	**0.2**	**70211**	**11.1**	**635000**	**100**

Source: FAOSTAT (2011)

'...Globally cow milk represents 83 percent of global total milk production and at least 80 percent of total production in all regions except South Asia, where its share is less than half (44 percent). In addition to cow milk, only buffalo milk makes a substantial contribution at the global level accounting for 11 percent of global production and 23 percent of developing country production. The contribution of milk from goats (3.4 percent), sheep (1.4 percent) and camels (0.2 percent) is limited at the global level and only slightly higher among the developing countries as a group.

Sheep milk is important Near East and North Africa, with 8.4 percent of production, somewhat less in sub-Saharan Africa (4.8 percent) and East and Southeast Asia (2.8 percent), but marginal in other regions.

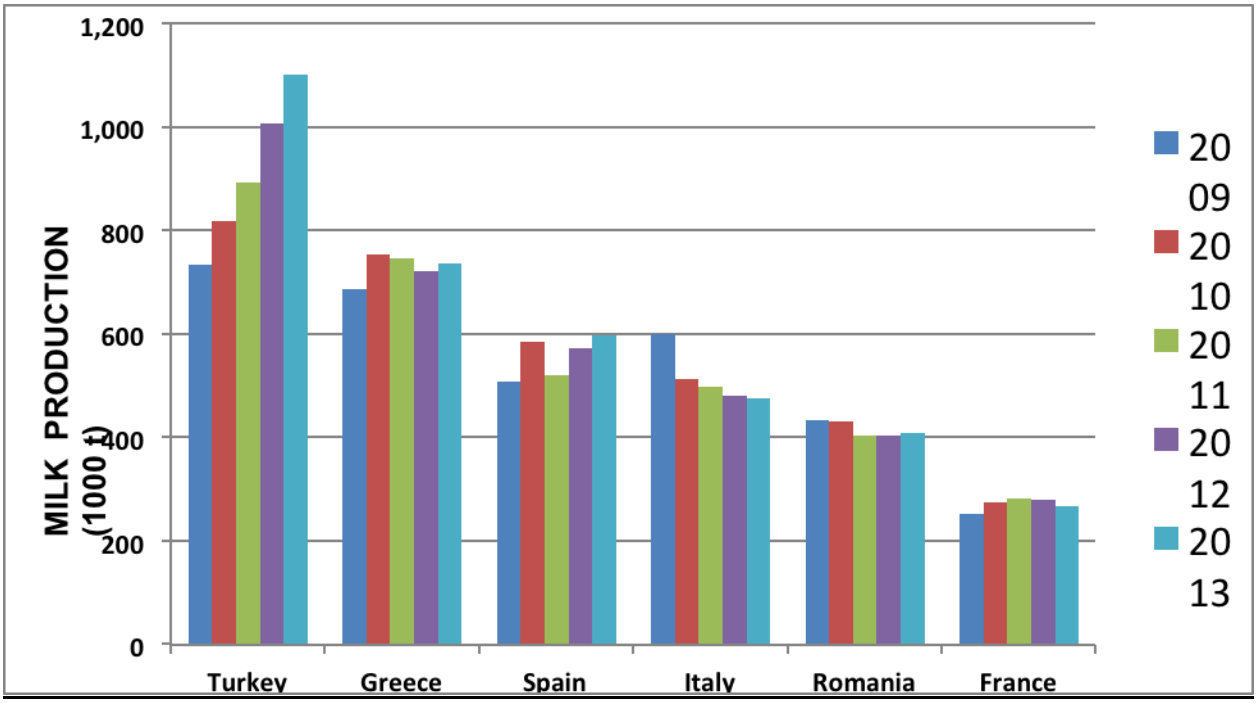
Sheep milk accounted for 3.9 percent of milk production in South-East Asia, more than 4 percent in China and 7.5 percent in North Africa and the Middle East. As well, the United States imported about half of the world's sheep cheese last year.'

Email extract from Paul Sinclair, director, Maven Consulting, Wellington, Aug 2014

Questions: Where are the end consumers and what will they buy?

- Cheese aficionados (European and North American)
- Allergy sensitive consumers (globally)
- People used to eating sheep milk products (Middle East, Mediterranean, South Eastern Europe, South East Asia)
- Processed products (pizza cheese) – North America

Source: *Katrina Lee, DeLaval sheep & Goat specialist– Just add milk presentation, AgInnovation May 2015*



Source: *Katrina Lee, DeLaval sheep & Goat specialist– Just add milk presentation, AgInnovation May 2015*

Schedule 4

Lucy's figures from her report – sensitivity based on production volume per ewe.

FINANCIAL FORECASTS/BUDGET

As mentioned previously one of the benefits of sheep milking is the quick return on investment (five years versus twenty for dairy cows). In order to test if this is the case in NZ the author has put together the following Gross Margin analysis, based on a UK template and with the help of local sheep dairy firm Kingsmeade.
The capital costs, variable costs and gross margin calculations for a flock of 300 East Friesian ewes in the NZ market currently are estimated below. Based on the assumptions outlined below, the author believes a mid to high lactating flock could produce a return on investment within 3-6 years (excluding land costs). A low lactating flock would lose money. To compare to the UK see Appendix 4.

PERFORMANCE LEVELS LOW AVERAGE HIGH

Milk Yield (litres) per Ewe per year 200 400 600

Sales: $ $ $

Milk Value (1) 400 800 1200

Lambs (2) 129 129 129

Wool (3) 13.2 13.2 13.2

Cull Ewes and Rams (4) 13.5 13.5 13.5

Output per Ewe 555.7 955.7 1355.7

Variable Costs:

Concentrates (5) 216 306 396

Miscellaneous (inc. Vet, Med & Shearing) 45 45 45

Total Variable Costs (excluding forage) 261 351 441

Gross Margin per Ewe 294.7 604.7 914.7

Deducting Forage Variable Costs (6) 20 20 20

Gross Margin per Ewe 274.7 584.7 894.7

Stocking Rate (Ewes with Lambs per forage Ha) 12.5 12.5 12.5

Gross Margin per Hectare (excl GST) $ 3,434 $ 7,309 $ 11,184

Notes:
1. Price: $2 per litre at farm gate.

2. Lambing %: 175%. Assume a 300 ewe flock (525 lambs). Retain 60 ewe lambs for flock replacements. Sell 386 cow milk-fed lambs at $100. (inc. 15% mortality). If ewe lambs for selling to other sheep milk producers, lamb value increases to $250. Milk-Fed lambs 6-8 weeks sold direct to restaurants.
3. Wool: Current season this is worth $3.30/kg and each ewe has approximately 4Kg.
4. Cull ewes: Assumed 18% culled at $75 per head (average, including mortality) 6 years old+.
5. Concentrates: Milking ewes: 200 days at 0.5-1.5 kg/head/day; cost $900/tonne. Ewe lamb replacements and artificially reared finished lambs at $85/head x 446.
Forage costs: Additional silage or hay for feeding. ***Fixed Costs per Ewe:*** Labour (paid) $170; Power & Machinery $52; Property Costs $30; Other $30; Total excl Finance & Rent - $282

CAPITAL COSTS

Hoggets (300 x $350) $ 105,000

Rams (3 x $1000) $ 3,000

Sheds x 2 for housing stock, milking parlour (24), tanks, 3 automatic feeders and electronic measuring equipment $ 500,000

Capital costs total $ 608,000

Land (good land) 12.5 sheep/hectare @ $20,000/hectare = 24 hectares $ 480,000

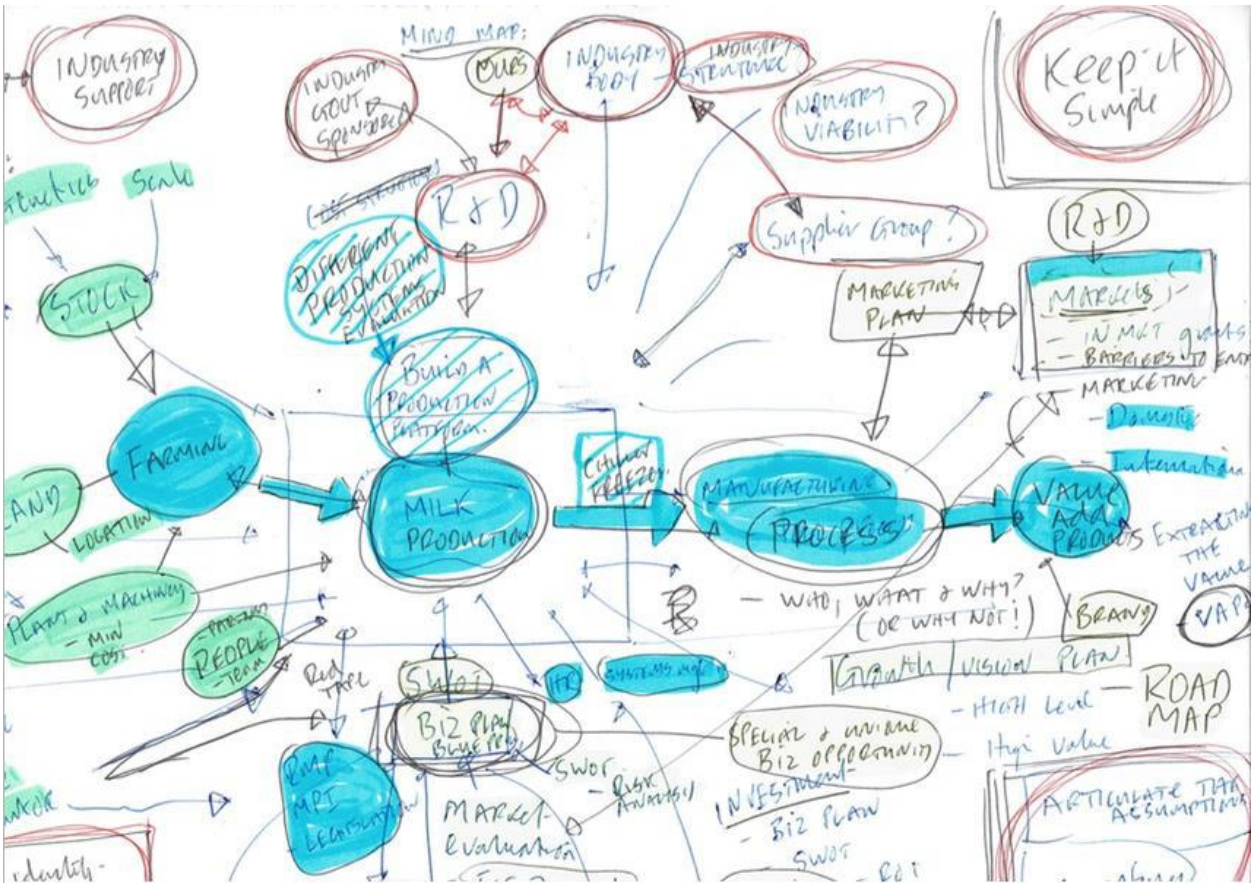
Alternatively – may be able to lease at $750/hectare/year $ 18,000

Assumptions

- 200 day lactation.
- Friesian-cross with standard NZ meat breed (Low lactation).
- Pure Friesian (Average lactation).
- Friesian/Awassi cross (Assaf) (High lactation).
- All ewes close to parlour (24 hectares). Ewes housed in evening.
- Maintaining flock (20%) versus growing flock.
- Lambs removed from mother at 24hours and raised on cow milk powder - $85/10Kg.
- Lambs sold as milk-fed lamb direct to restaurants for $100/lamb. 6-8wk.
- Low lactating ewes fed high protein TMR mix averaging 500g/day.
- Medium lactating ewes fed high protein TMR mix averaging 1000g/day.
- High lactating ewes fed high protein TMR mix averaging 1000g/day.
- Demand outstrips supply for breeding stock so ewe lamb prices high at $250 each.
- Hogget lambs high cost to purchase at $350 each due to current demand.
- Larger farms may have to feed more to compensate for ewes walking further to parlour.
- Currently East Friesian lambs – $250.
- Hogget (have had 1 lamb) – $350.
- Ram – $1000.
- Ewes – $500.

Low lactation scenario – farmer would make a loss.
Medium lactation scenario – 6 years return on investment or "pay back" on extra capital injected. This does not allow for annual profit, excludes land costs and does not include owner's wages.
High lactation scenario – 3.25 years return on investment or "pay back" on extra capital injected. This does not allow for annual profit, excludes land costs and does not include owner's wages.

Schedule 5



Mindmap – D Buckley 2015

Schedule 6

Discussion: Whether dairy conversion back to sheep, sheep farm to dairy, or progressive pathway option for sharemilker or shepherd.

Less Capital required for land, stock & plant, Operating expenditure not dissimilar to cow dairy?

Guy Trafford has given some thought to the subject.

(Extracts from: Trafford, G. Sheep dairying proposal prepared for Synlait Milk Ltd, Lincoln, 2013.)

- To gain farmer support clear positive signals would need to be sent out with a prescription indicating costs, returns and technical and genetic requirements. Given the mixed history of sheep dairying in New Zealand it would be important not to over hype the potential but offer it as a complementary industry to the existing sheep industry. Based upon conversations had, early adopters are likely to be small holders. While these may be a useful component to a fledgling industry it will require adoption by several medium sized producers to gain the acceptance and critical mass for the industry to move forward. The risks to participants would depend upon the financial investments required. For producers if they adopt a 'low cost' system then if at a future time the milk market was deemed uneconomic then they could switch back to the existing meat market. (GT)
- Two things need to occur to result in a viable sheep dairy industry. One is the establishment of a processor prepared to purchase milk at an economically viable price and the second is enough sheep dairy producers to supply the processor with enough milk to provide a reliable supply onto the market.
- When viewing the results two perspectives can be taken. The first is; can a sheep dairy system compete with existing sheep breeding and finishing systems?
- Based upon the economic and productive values used in this study; sheep dairying is considerably more profitable with a greater than 4% increase in return on assets (ROA) and approximately $490,372 greater profitability. This increase can be achieved with a $1,000,000 in capital structures and an additional 1.5 labour units. Due to the seasonal nature of this system milking is envisaged to finish by the end of February. This shortened season, in comparison to cow systems, plus the fact that the sheep are off grazing for 14 weeks of the year mean that 'lifestyle', which is considered to be an important part of sheep and beef systems, is enabled to be maintained. This should make this industry more attractive to both permanent and part time staff. Sheep systems also have a considerably lighter environmental 'footprint' when the issue around nitrate leaching is examined. An intensive sheep system on a medium light soil has an estimated nitrogen leaching rate of 16kgs per ha, more than the dryland system (8kgs per ha), but considerably less than cow dairying which for a 3.5cows per ha system 3 herd has an estimate 27kgs N per ha (ECAN. 2012). This factor may gain

greater importance when regulations regarding nitrate leaching are brought in, especially on very light soils where the cow system has an estimated leaching level of 44kgs N per ha.

- The second perspective regarding sheep dairying is; can it compete with cow dairy systems? This can separated into two views also; would an existing sheep farmer be more attracted to convert to cow dairying and would an existing cow dairy farmer be attracted to convert to a sheep dairy system 3?
- Cow dairying has the benefit of having a well-developed supply value chain and industry support. This considerably reduces both market risk and production risk.
- However, with the potential environmental constraints being applied to intensive cow dairying more uncertainty is occurring. In addition, a lack of skilled labour is impacting upon productivity (Trafford. 2012) and adding to managerial stress. Most sheep farmers believe they operate 'animal friendly' systems i.e. lambs are reared and animals are allowed to express 'natural behaviors''. For cow dairies to operate in the same manner current indications are that profitability would be compromised. However, given the number of conversions from sheep systems to dairy systems that have been occurring sheep farmers appear to be able to adjust to the dairy paradigm.
- For dairy farmers to switch to a sheep system appears unlikely in the current economic climate. The additional capital expenses in the dairy system that enable sheep dairy to compete on a ROA basis have already been sunk and, apart from livestock, unlikely to be able to liquidated, therefore providing a financial disincentive to change. $7 per kg, change now of course.
- While anecdotal indications are that sheep farmers would be willing to adopt sheep dairy systems there are some key components of the value chain that needs to occur?
- The major component is a reliable processor who has the capacity to invest in the product collection, processing and market development. In addition the genetics required to meet the production targets need to be multiplied up. The basis of a national flock already exist however the numbers do not.

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With thanks to NZX Agri for allowing me to use images from Countrywide Magazine.

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'Coalition of the willing'- Craig Prichard, Massey Business School – newspaper article- http://www.ruralnewsgroup.co.nz/rural-news/rural-management/high-society-for-sheep-milking

Cornell Star system, D.E. Hogue, Cornell University 1991
http://www.sheep.cornell.edu/management/breeding/star/description.html

Conferences attended:

The inaugural FoodHQ Ewe Milk Products and Sheep Dairying Conference, held at Massey Food HQ campus in Feb 2015.

Also I recently attended the AgInnovation Conference (May 2015) and listened to the sheep milk presentation 'Just add milk' from Katrina Lee, DeLaval sheep and goat specialist Aus./NZ.

Memberships:

I am a member of the sheep dairying steering group – whose initial focus is to set up a national body to provide support to the burgeoning industry.

Articles:

June 2015 Country Wide Sheep Special: Damian Buckley

With thanks:

Lucy Griffiths, Craig Prichard, Guy Trafford, Katrina Lee, Rod Finch, Ade & Gill Walcroft from Cartwheel Creamery, Chelsea Millar, Eleanor Belham, Miles and Janet King from Kingsmeade Cheese, Ian MacDonald, Erin Hutchinson, Glen Herud & Terry Brosnahan

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