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BUSINESS PLAN FOR THE NZ SHEEP DAIRY INDUSTRY

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Cover photo: Rural Wairarapa, one of NZ's sheep dairy hubs, © Simon Griffiths

EXECUTIVE SUMMARY

New Zealand pioneered the export of frozen sheep meat in 1882 and continues to be a world leader in many aspects of sheep breeding, meat and wool production and product development for both domestic and international markets. However we have never had a significant sheep milk industry and the question is *why* – or more importantly, *why not?*

Sheep milk has superior health properties, caters for the growing market premium around lactose intolerance, is arguably easier on the environment than other forms of dairy, and has a faster return on investment than cow milk.

Currently the world produces 10,122,522 Tonnes of fresh sheep milk, and parts of Europe and the Middle East have been milking for thousands of years. Some of the world's most famous food 'brands' are products made from sheep milk including *Rocquefort* (France), *Manchego* (Spain) , *Pecorino* (Italy) and *Feta* (Greece).

THIS **BUSINESS PLAN FOR THE NZ SHEEP DAIRY INDUSTRY** IS ONE PERSON'S OBSERVATIONS AND IDEAS AFTER TRAVELLING FOR 3 MONTHS WITH A NUFFIELD SCHOLARSHIP, MEETING AND WORKING WITH SHEEP MILK FARMERS, SMALL RUMINANT EXPERTS AND RETAILERS IN ISRAEL, FRANCE, UNITED KINGDOM, UNITED STATES OF AMERICA, ITALY AND NEW ZEALAND.

If NZ is to set up a strong sheep milk industry that has scale, high premiums and optimum volume we must think with the end in mind. Where do we want to position our products? And how are we going to get there? As a new industry we're going to face many hurdles. We need to be able to adapt quickly, and learn from others around the world.

This report is a culmination of observations and ideas gleaned from countries with vastly different geographical environments, market opportunities, political and environmental constraints to NZ.

The target market for this report is ***business people*** who want to invest in NZ agriculture, ***farmers*** looking at alternative land use, and ***food and wellness product producers*** looking at utilising the superior health benefits of NZ sheep milk to meet growing market demand locally and Internationally.

FOREWORD

As a child the author, **Lucy Griffiths** (nee Cruickshank) grew up on a sheep and beef farm in North Invercargill, New Zealand. Her parents were entrepreneurs and supplemented their income from the farm with full time careers in rural broadcasting and educational tourism, investing in the sharemarket and commercial and residential property, buying more adjoining land and also undeveloped land neighbouring the Awarua Wetlands, which her father developed on a tight budget in his spare time. The author loved living on Rosedale farm, but also being within the city boundary, which allowed opportunities to enjoy the best of both worlds.

The importance of spreading your assets so that you're not at the mercy of commodity pricing was learned early on. As a sixth generation family member to have lived on the property it is now one of her responsibilities to determine how the land will be managed profitably for future generations. The land was initially utilised for a sawmill, then diversified into a rope and twine mill, flax mills around the district, and a woollen mill. The Invercargill suburb of Rosedale is named after the family property.

After graduating from Otago with a double degree in Marketing and Physical Education the author spent seven years employed in marketing NZ seafood, wine, honey, meat and dairy products internationally and domestically before developing her own business, Innov8 Aotearoa, representing specialty NZ food producers, including sheep dairy products. Her business allowed her insight into the opportunity for farmers and food companies to produce and export premium products based on sheep milk.

As a nation NZ relies heavily on export revenues, and the government has set a growth agenda to double exports by 2025[1]. While NZ is one of the world's most productive producers, we need to look at ways to gain greater premiums through innovative new products underpinned with science and health benefits, smart packaging and branding and strong channel partners in high-end markets.

Based on these factors the author chose to study the sheep dairy industry in 6 markets – UK, USA, France, Italy, Switzerland and Israel. The focus of her study was to understand who is milking sheep, how they are doing it, where they are selling it, and if NZ could be the best at it, as we are often credited in the sheep and dairy sectors.

BASED ON THESE OBSERVATIONS THIS **BUSINESS PLAN FOR NZ SHEEP DAIRY** HAS BEEN COMPILED TO ADDRESS THE AREAS NZ NEEDS TO DEVELOP IN ORDER TO BECOME THE WORLD'S LEADER IN THIS SECTOR.

To date it appears no other Nuffield scholars have studied this industry.

Sheep Cheese in Carrefour Supermarket, Qatar.

[1] MBIE. (2012, August). Business Growth Agendas. B*uilding export markets.* P.11. Retrieved from http://www.mbie.govt.nz/pdf-library/what-we-do/business-growth-agenda/bga-reports/building-export-markets-bga-progress-report-august-2012.pdf

ACKNOWLEDGEMENTS

The author would like to sincerely acknowledge the opportunity that the *Nuffield Trustees* have given her for this life changing scholarship. Nuffield has opened up networks in all corners of the globe.

Thank you also to the following sponsors of Nuffield NZ including *The Agricultural and Marketing Research and Development Trust (AGMARDT), Dairy NZ, Beef and Lamb NZ, FMG Advice & Insurance, Mackenzie Charitable Foundation, The Foundation for Arable Research (FAR), Farmlands Cooperative and Meridian.* Thank you for your generosity and wisdom in choosing to support Nuffield and its vision.

The author would also like to thank *her family and her husband, Simon Griffiths,* for the ongoing moral support required to get through such an exciting yet taxing year of travel. Thanks also to all those who have hosted Lucy on her travels and all the NZ organisations who have provided their expertise, knowledge and in some cases funds to allow her to develop as a person and gain the insights she has. Those people and organisations include:

Bell Cai	NZTE	China
Campbell Cave	Ngai Tahu Seafood/Emerald Foods	China
Guillaiume Rudelle	Ronnaguet Sheep Dairy	France
Daniel Layton	Kibbutz Gazit	Israel
Haim & Mira Leibovich	Kibbutz Nordia	Israel
Ofier & Noga Langer	Israeli Dairy School	Israel
Omri Sharon	Havat Shikmim	Israel
Shlomi	Afimilk	Israel
Tamar & Pierre Kruger		Israel
Flavia & Flavio Spena		Italy
Nunzio Marcelli & Manuela Cozzi	La Porta dei Parchi	Italy
Brian Beuke	Neudorf	NZ
Craig Prichard	Massey University	NZ
David Baker	BakerAg	NZ
Janet & Miles King	Kingsmeade	NZ
John Brakenridge	NZ Merino/Landcorp	NZ
Justine Horgan	Blue River Dairy - Marketing Mgr	NZ
Liz & Dave Clayton	Sheep Milk Wairarapa	NZ
Derek & Chris Daniell	Wairere Rams	NZ
Matthew Pickering	Coach Approach	NZ
Richard Jones & the Poutama Board	Poutama Trust	NZ
Scottie Chapman	SCL	NZ
Board Members	Alliance Group	NZ
Reto Waefler	Sheep Farmer Lacaune	Switzerland
John Ryrie	Orchid Meadow Farm	UK
Simon Stott	Sheep Milk UK	UK
Missy & Joe Adiego	Haverton Hill	USA

INTRODUCTION

NZ has just five vertically integrated sheep dairy operations ranging in size from less than 100 stock units to one company which claims to have 25,000 stock units. According to Israel's Afimilk who are one of the world's largest milk equipment suppliers, NZ has the world's largest sheep dairy followed by a company in Spain which has 10,000 stock units. Most 'large' scale sheep dairies visited on the author's Nuffield journey were around the 1,000-1,500 stock unit size.

The world currently produces 10,122,522 T of fresh sheep milk[2] globally (1.6% of cow milk) as opposed to 625,753,801T of fresh cows milk and 17,846,118T of goats milk (2.8% of cow milk).
The top 5 producing nations in fresh sheep milk by the tonne:

1	CHINA MAINLAND	1,580,000
2	TURKEY	1,010,007
3	SYRIAN ARAB REPUBLIC	703,008
4	GREECE	699,500
5	ROMANIA	650,912

The largest consumer of sheep dairy products is the USA which consumes over half of the world's production of sheep cheese[3].

NEW ZEALAND CURRENTLY DOES NOT HAVE A **BUSINESS PLAN FOR THE NZ SHEEP DAIRY INDUSTRY** AND THIS REPORT ATTEMPTS TO SET A VISION FOR THE INDUSTRY, A PROJECTION FOR PRODUCTION, THE OPPORTUNITIES FOR THE INDUSTRY AND SOME CLEAR OBJECTIVES OVER THE NEXT 12 MONTHS AND BEYOND.

Milking time at NZ's largest Sheep Dairy, Blue River.

[2] Food and Agriculture Organization of the United States. (2014). Retrieved from http://www.sheep101.info/dairy.html
[3] The National Academies. (2008). *Changes in the sheep industry in the United States.* 4. Retrieved from http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/SheepFinal.pdf

CONTENTS

VISION – TO PRODUCE THE HIGHEST QUALITY SHEEP DAIRY PRODUCTS TO SERVICE THE WORLD'S MOST DISCERNING CLIENTS, RETURNING MAXIMUM PROFITS TO NZ PRODUCERS.

MISSION – TO BE THE WORLD'S MOST EFFICIENT AND PROFICIENT SHEEP MILK PRODUCERS AND MARKETERS.

OBJECTIVES – THE FOLLOWING OBJECTIVES FOR THE INDUSTRY ARE STRATEGIC PRIORITIES AND ARE BASED ON THE OBSERVATIONS AND OPINIONS OF THE AUTHOR FOLLOWING HER NUFFIELD TRAVELS.

1. BREEDING

To develop a strong NZ sheep dairy breed that suits NZ's environmental parameters, which combined with optimum feeding rations and the use of the latest technology, produces over time a ewe with a minimum of 2-3L of milk/day over a 200 day lactation.

The world's major sheep breeds that could be considered and trialled include East Friesian (NZ's most common breed), Lacaune (common in France), Awassi (common in the Middle East), Assaf (cross between an Awassi and a Friesian) developed in Israel. Please refer to appendix one outlining each breed and specific details about each.

Observation – Breeding programs are well advanced in some of the countries I visited like France and Israel. In France the Lacaune breed is used, and one of the features it is bred for is its quick let down of milk, within 2 minutes. In Israel, the Awassi has been crossed with the Friesian to provide maximum milk and meat returns, and to allow for production indoors in hot and challenging conditions. In NZ it appears the most sought after breed is East Friesian; however there may be a cross that allows for a hardier animal with higher milk volumes and niche meat markets. In order to scale up the industry quickly with superior genetics, sophisticated breeding techniques such as embryo transfers should be utilised.

2. INDUSTRY BODY

An industry body is needed to act as a collaborative voice for NZ sheep dairy, assisting with collectively marketing NZ sheep milk products off-shore, communicating best practice and assisting farmers wanting to get into the industry. The group would be a collective information portal for consumers, chefs, health specialists and food writers, have a policy and advocacy function, prepare funding bids and assist with new product development and research projects across all aspects of the SHEEP DAIRY channel.

Observation – In Israel, sheep milk is levied and an organisation has been formed to act on behalf of the farmers, research best animal husbandry, and pay for a marketing expert to work with major dairy group TNUVA[4].

[4] Flint, M. (2014, September 1). Export Manager, *Israeli Sheep Breeders Association*. (L. Griffiths, Interviewer)

Observation continued – In the Western world, the UK has an industry association called the British Sheep Dairy Association which is a portal of information. In November I attended and presented at their annual conference with around 70 other industry members. Likewise in the USA the Dairy Sheep Association of North America meets annually to network, exchange ideas and review research. Both organisations are funded on an annual membership fee basis plus sponsors.

The industry body in NZ may be like other useful NZ industry organisations such as NZ Winegrowers or Aquaculture NZ.

3. VALUE ADDED PRODUCTS

In order to gain the highest premiums, NZ needs to be focused on creating high value sheep milk niche products in the health, nutraceutical, pharmaceutical, infant care, elderly care, and gourmet food sectors.

Observation – An example of an industry in NZ that has done this well is the NZ manuka honey industry. In times gone past, Manuka Honey, with its strong flavour and dark viscous colour, was considered only suitable for stock food. Nowdays a 25+ active Manuka retails in Chinese supermarket Ole for the equivalent of $1000NZD/Kg. It is considered the healthiest honey in the world and this has been underpinned with science. In addition further premiums are being gained for adding value to this rare product. Whilst a large volume is sold as bulk honey and 'honey in a pot', a small but growing portion is going into high value-added wound care and beauty products that can increase returns exponentially.

4. RESEARCH INSTITUTES

At present the Government is supporting a 6 year research project with AgResearch alongside three of NZ's major sheep milk players. The research is around the following areas: sheep milk composition, sheep milk function, improving milk production through feeding and environmental footprint analysis.[5]

It is imperative that this research is continued so that NZ sheep milk is underpinned by credible science and its attributes can be marketed to separate it from competitors in other parts of the world.

Opinion – Whilst AgResearch are to be commended for leading this research, how can the information and results be released to the industry to assist all players? Whilst there much information on the net about the health properties of sheep milk, it appears to vary greatly from country to country, and between breeds.

In Israel, the industry employs the expertise of one of the Middle East's leading small ruminant experts to trial on farm research to maximise meat and milk yields for the whole industry. This expert has also spent a year in NZ. It may be prudent for NZ to enlist the skills of someone like this for a period of time, to work on linear feed formats and cycles to advance the industry.

[5] AgResearch (2013). *Boosting exports of the emerging New Zealand dairy sheep industry.*

5. PROFITABILITY

Gross margin and other financial modelling in the sheep dairy industry is easily found in markets like Britain and the USA, but NZ needs a robust model compiled to show farmers the financial benefits of investing in sheep milk. What is going to be very important is looking at feed options in relation to production outputs by analysing pasture based versus housed 'cut and carry' systems as they relate to costs and yields. A gross margin analysis has been attempted in the 'financials' section of this report.

Observation – In Israel an intensive housed model is used, much like the Dairy Goat Cooperative model in NZ. In other parts of the world such as the UK, USA, France, Switzerland and Italy, a combination of housed plus pasture system is used to maximise milk yields and protect animals from heat and cold. On Nuffield travels around NZ it appears that sheep having to walk large distances to the milk parlour twice a day have low performance milk yields of less than a litre/day but smaller farms where farmers keep animals close to the parlour and feed 300g/ewe of high protein rations produce volumes similar to those seen overseas (2L+/day).

6. OVERSEER BUDGET/ENVIRONMENTAL

Many articles have suggested dairy sheep could be less intensive on the land and better from an environmental perspective. NZ needs to run an overseer budget over current industry case studies to see how this stacks up, but in some areas of New Zealand where nitrate levels are at capacity, sheep dairy could produce a more viable return for the land and reduce environmental impact at the same time.

7. VOLUME POTENTIAL/EXPORT RETURNS

As mentioned, the current global volume of sheep milk produced is approximately 10 million T. If NZ could build its sheep dairy flock to 1 million ewes (approximately 5%) of the current ewe flock and increase feeding and genetics to average 600L/year then we could be in the top 10 global producers in 10 years. At the current price of $2/L farm gate this would value the industry at over NZ$1Bn. *See financial forecasts for further break down of costs and current and projected volumes and average lactations.*

Opinion – The industry needs to set realistic goals for production so that it can scale appropriately. As Tony Robbins says 'Setting goals is the first step in turning the invisible into the visible'.

8. TARGET MARKETS

As mentioned earlier, the USA is currently the world's largest sheep cheese consumer and yet it has just 3 sheep dairies larger than 1000 stock units. NZ has huge potential to supply the USA with premium sheep dairy products including butter, cheese, yoghurt and ice-cream.

Likewise Asia offers great potential for sheep dairy products, particularly in markets where NZ has free trade agreements such as China and Taiwan. The Asian market is interested in safe, healthy products from NZ and sheep dairy foods and health products are both in high demand. However the NZ Ministry of Primary Industries needs to be closely in the loop, and responsible for ensuring continuing and reliable access to overseas markets.

Observation & Opinion – In all the countries visited on Nuffield demand for sheep milk products was reported to be growing between 10-20%. NZ must be careful not to become too reliant on one country for its exports and conversely shouldn't have a 'shot gun approach' and sell to anyone who will buy. To build a premium brand for the industry 3 or 4 markets should be invested in. Before the industry invests heavily at a farming and breeding level, market contracts should be in place so that supply and demand is balanced and profits are maximised.

9. CROWD FUNDING/INVESTMENT

Corporate farmers such as MyFarm (myfarm.co.nz) and other agri-business syndicates could be useful in raising the capital required to scale up the industry quickly and convert farms into highly efficient sheep dairy operations. Set up costs for milking equipment can be high but industry experts Afimilk[7] in the Middle East mentioned that the return on investment for sheep dairy is 5 years on average ($3-4000 USD/sheep) versus 20 years for dairy cows ($20,000 USD/cow), based on the work they have done globally[6].

10. EQUIPMENT & TECHNOLOGY

Afimilk milking equipment's slogan is *'if you can't measure it, you can't manage it'*[7]. Of the farmers visited, all those getting the greatest yields and revenue from their flock were heavily invested in electronic milking equipment and electronic tagging. This equipment allows the farmer to identify the individual sheep number, the days since it last lambed, the number of lactations, when it was born, how many 'empty days' between pregnancy, how many artificial inseminations, days of lactation, birthed lambs, live lambs and litres/lactation. Culling decisions were based on this.

In Israel, linear modelling is used to determine the exact nutrition requirements of each animal, depending on whether the ewe is lactating or pregnant. Exact rations of different proteins, carbohydrates and minerals allow for maximum milk production and lactation length.

Opinion – NZ needs to be technology led on farm, search for the world's best equipment and adapt it to suit NZ.

11. INTERNATIONAL NETWORK OF BEST PRACTICE

NZ needs to be associated and networking with some of the world's progressive sheep dairy networks to exchange ideas. Some of the organisations that would be useful include the International Dairy Federation, Dairy Sheep & Goat Symposium (idfsheepandgoat.org), the British Sheep Dairy Association (BSDA, sheepdairying.com) and the Dairy Sheep Association of North America (DSANA, dsana.org).

NZ could also work closely with sheep dairy research institutes globally, such as the Spooner Agricultural Research Station, Dairy Sheep Research Farm University of Wisconsin.

12. WORLD CLASS QUALITY STANDARDS

If the NZ Sheep Dairy industry is to produce the highest quality milk in the world, a world class standard must be implemented.

According to an interview at Nordia Kibbutz, the largest sheep dairy in Israel, large sheep milk purchaser TNUVA measures the milk they supply for temperature, lactose, protein and fat. Somatic cell counts are also measured and 2 million/ml are considered unacceptable, 1 million/ml is the aim and TNUVA gives a financial bonus for levels less than 650 000/ml. Bacteria numbers are also measured, and 50 000/ml is the maximum allowed; under 20 000/ml gets a bonus. Producers are fined for water in the milk, and if any traces of blood or antibiotics are found, the milk is rejected[8].

[6] Azran, S. (2014, September 15). Sales Manager Small Ruminants, *Afimilk*. (L. Griffiths, Interviewer).
[7] Azran, S. (2014, September 15). Sales Manager Small Ruminants, *Afimilk*. (L. Griffiths, Interviewer).
[8] Doron. (2014, August 28). Farm Manager, *Nordia Kibbutz*. (L. Griffiths, Interviewer)

13. HUMAN RESOURCES - NEXT GENERATION - COURSE ON SHEEP DAIRY

An industry is only as strong as the talent, energy and enthusiasm of its people. If Sheep Dairy is going to be a key industry in the future, institutes such as Massey University, Lincoln University or Taratahi Agriculture Training Centre need to launch a dairy sheep qualification to teach the current and next generation about the sheep milk industry.

Opinion – If NZ becomes the world leader in sheep milk production, as it is in some other parts of agriculture, this course could be marketed as the leading qualification for all emerging markets including USA, UK, Australia and NZ.

SWOT

THIS SECTION OF THE REPORT OUTLINES THE STRENGTHS AND WEAKNESSES OF A NEW ZEALAND SHEEP DAIRY INDUSTRY AND THE EXTERNAL OPPORTUNITIES AND THREATS.

STRENGTHS

- NZ has no subsidies or quotas and is considered highly efficient.
- NZ dairy industry is a global leader and has formed a number of International companies.
- NZ is considered a world leader in sheep farming, breeding and research.
- The Dairy Goat Cooperative has proved that there is a market and financial viability for goat milk sold as a premium infant formula to Asia. This gives the NZ sheep dairy industry confidence for similar success.
- Current optimism amongst sheep farmers (meat)[9].
- NZ has strong International market partners in the food and wellness space, and is export focused.
- The Pure NZ brand has equity globally.
- Sheep dairy pioneers like Blue River, Waituhi Kuratau, Neudorf, Kingsmeade and Waiheke Island have shown there is a market for sheep dairy locally and globally.
- New entrant Landcorp, a state owned enterprise, adds credibility, scale and genetic expertise to the sector.
- NZ farmers are good adopters and developers of milking technology.
- Possible faster return on investment than dairy cows.
- Sheep milking will suit soil types like clay where cattle pugging makes farming of dairy cows impractical.
- Sheep milking will suit climates with drier summers, given the usually shorter lactation of 180-200 days, compared to cows at 280 to 300.
- Sheep milk has nearly double the milk solids of other milks, and an array of health properties that are superior to other milks *(see Appendix 2)*.
- NZ has had sheep dairy breeds (Awassi and East Friesian) adapting to our environment in NZ for the past 20 years, thanks to sheep breeding science pioneer and stock importer, Dr Jock Allison.

[9] Rabobank. (2014). *Surging optimism among sheep and beef farmers.* Scoop. Retrieved from http://www.scoop.co.nz/stories/BU1412/S00225/surging-optimism-among-sheep-and-beef-farmers.htm

WEAKNESSES

- No strong tradition of sheep milk consumption in NZ.
- Poor track record of sheep dairy in NZ/ small hobby farmers not taken seriously.
- Focus on production before establishing market partners.
- Small flocks of breeding stock.
- No sheep milk industry body, no one taking ownership of the segment.
- Capital set-up costs and additional feed costs are a disincentive for sheep farmers if there is no reliable market at the farm gate.
- Few skilled in the industry, no sheep dairy courses.
- No stringent quality standards.
- With the scale of the farm, logistics become a problem e.g 300 ewes vs 1,500 vs 10,000.
- Milking 7 days a week, twice a day.
- Little research to date about the industry.
- Lack of accessible industry information on how to set up in the industry and financial models.

OPPORTUNITIES

- Small farms with little land could use a part pasture, part housed model of farming which maintains NZ's pastoral point of difference while maximising milk yields via a cut and carry model. This method was observed in the USA, UK, Switzerland, Italy and France. In hot areas like Spain and Israel, sheep are fully housed.
- Marginal land for dairy farming can also be utilised in the dairy sheep industry[10].
- As the world continues to develop, the health and wellness markets are looking for products with functional food benefits, and sheep milk is a highly nutritious dairy product[11].
- Ethnic and religious market opportunities offer another opportunity for the NZ dairy sheep industry. High yielding milk breeds such as the Awassi and Assaf breeds are also highly sought after in the Muslim religion as halal slaughter. The 'fat tail' fatty meat is a delicacy in many parts of the Middle East.
- Retail prices of sheep milk products are at a premium price point in all the markets that were visited last year with Nuffield. For example Haverton Hill Creamery in the USA retails their fresh sheep milk for US$10.99/ quart in Wholefoods, ice-cream US$9.99/1pint (473ml), butter US$13.49/8oz (227g).
- NZ has the sheep dairy genetics available to produce the superior milk and meat breed called Assaf (East Friesian/Awassi cross).
- Sheep milk products are some of the most widely consumed and well known cheeses around the world[12].
- Formation of a cooperative model with a focus on premium quality products and ingredients such as Tatua in NZ.
- Fatty lamb is growing in demand as the 'fat is healthy' movement continues to gather momentum around the world e.g In Qatar the fat tail Awassi commands over 100% premium on Australian Merino. The NZ palate is changing towards a fattier meat ratio[13].
- UHT (ultra high temperature processing) style milk and flavoured milk which is shelf stable and gains a premium in parts of Asia. Note – in China 76% of the market is UHT and this product would not be compromised by heat when cool chains are not well developed.
- Rapidly westernising population in Asia, with an associated increase in dairy consumption[14].

[10] Potential seen in dairy sheep industry. (2014, June 17). *Radio NZ News*. Retrieved from http://www.radionz.co.nz/news/rural/247455/potential-seen-in-dairy-sheep-industry

[11] Nutrition. (2014). *Blue River Dairy*. Retrieved from: http://blueriverdairy.co.nz/nutrition/

[12] Sheep Milk Cheese. (n.d). In *Wikipedia*. Retrieved January 2, 2015, from http://en.m.wikipedia.org/wiki/Sheep_milk_cheese

[13] Benny, T. (2014, December 7). Flavour in the fat of tastiest lamb. *NZ Farmer*. Retrieved from http://www.stuff.co.nz/business/farming/sheep/63910651/Flavour-in-the-fat-of-tastiest-lamb

[14] Muratoglu, S. (2104, December 3). Chinese demand for dairy products spurs US exports. *Food Saftey News*. Retrieved from http://www.foodsafetynews.com/2014/12/chinese-demand-for-dairy-products-spurs-u-s-exports/#.VK3bMXn28eF

OPPORTUNITIES Continued

- NZ information portal for farmers and researchers.
- Financial viability and potential of the industry.
- Sheep dairy products cater to the lactose intolerant which is estimated to be affecting 75% of the world[15].
- Milk-fed lamb is a niche high-end food. Top NZ chef Al Brown uses Kingsmeade milk fed lamb in his Auckland restaurant Depot. He is also a regular user of sheep milk cheeses. As the industry grows, more will follow his lead.
- Environmental benefits/Overseer budget.
- Dairy sheep test farm and portal for info.
- AVH sheep and goat product traders in Netherlands bought by large group Emmi (Switzerland) due to growth in artisan cheeses and lactose intolerance[16].
- In every market visited on Nuffield, retailers and producers estimated global demand to be growing at around 10-20%/annum for sheep milk products.
- NZ sheep milk powder selling for up to 1288 CNY for 400g (NZ$695/Kg) in China.
- Unlike cow or goat milk, sheep milk has an advantage in that it can be frozen for up to a year with no loss in cheese making quality. (Fluid milk, however, is used for yogurt, another popular sheep milk product.) For many producers with a relatively small output and no nearby processor, freezing the milk is an ideal solution[17].
- Oravida currently flies fresh NZ cow's milk to China which sells for 138 CNY/2L (NZ$15/L). This could be a useful premium channel for fresh sheep's milk.
- Comvita currently sells a Manuka infused milk powder called *'Manuka Up'*. A similar health product with sheep's milk could be produced. Comvita and other Manuka honey companies may be useful partners to distribute sheep milk functional foods to markets in Asia.
- Luxury food company Lewis Rd Creamery in NZ is a good example of a company securing premiums for a luxury dairy range. A similar range could be launched in NZ with ice-cream, butter, fresh milk and flavoured milk.
- In Switzerland, France, the UK, USA, Italy and Israel, sheep dairy products are available in all high-end supermarkets. NZ supermarkets offer a very limited selection, and only specialty stores like Moore Wilson, Nosh and Farro offer a selection.
- The Dairy Goat Cooperative (DGC) claims to be the world's leading manufacturer of goat milk nutritional powder products. DGC developed the world's first commercialised infant formula from goat milk, and continues to develop and manufacture a range of consumer packaged nutritional powders based on goat milk. Could the Dairy Sheep Industry leverage off this success?

THREATS

- Synthetic milk[18] (lactose free) and A2 Milk[19].
- Inability to adapt to changing consumer trends.
- Failure to secure markets for products prior to establishing the industry.
- Difficulty in processing product due to distance of farms from current sheep milk 'hubs' in Southland, Nelson, the Wairarapa and Taupo.

[15] Lactose free foods market forecast 2014-2024 (2014, December 10). *PRNewswire.* Retrieved from http://www.prnewswire.com/news-releases/lactose-free-foods-market-forecast-2014-2024-300007607.html

[16] Nadeem, M. (2014, January 7). Sale Dutch firm AVH dairy trade. *NL Times.* Retrieved from http://www.nltimes.nl/2014/01/07/sale-dutch-firm-avh-dairy-trade/

[17] Dairy sheep big opportunities. (2004). *Sheep.* Retrieved from http://www.sheepmagazine.com/26-2/jd_belanger/

[18] Olson, S. (2014, October 28). Synthetic milk could be in your fridge by 2017, boosting quality of health, Environment. *Medical Daily.* Retrieved from http://www.cnbc.com/id/102241017, Coca-Cola lactose free milk - http://modernfarmer.com/2014/12/coca-cola-sell-sexy-lactose-free-milk-product-kind/

[19] Gorman, P. (2012, July 30). A2 milk soars overseas but not in NZ. *NZ Farmer.* Retrieved from http://www.stuff.co.nz/business/farming/7374629/A2-milk-soars-overseas-but-not-in-NZ

PRODUCTS

NZ has the opportunity to provide sheep milk products to multiple channels in the food, health, baby, geriatric, sports and beauty products. The range of products could include:

- Fresh milk bottled (raw, organic or pasteurised).
- UHT (single serve, 1 Litre, flavoured or plain).
- Frozen milk (allows for milk availability in the off-season).
- Milk Powder (skim or whole milk for use in health products).
- Whey protein (high in protein for sports nutrition or can be used to strengthen hair follicles).
- Cheese (higher fat content in sheep's milk enables it to make great quality cheese).
- Yoghurt (suitable for lactose intolerance market).
- Butter (whiter than standard cows butter).
- Ice-cream (because sheep milk has double the fat content, manufacture of ice-cream does not require extra fat added, so in comparison to other ice-cream it's lower in fat, and all natural from sheep milk).
- Ricotta.
- Infant formula (suitable for lactose intolerant babies and toddlers).
- Functional foods/nutraceuticals e.g. greenshell mussel oil/manuka lozenges/sheep milk vitamin tablets.
- Beauty products.
- Health supplement tablets (e.g vitamin C).

Other income from milk-fed lambs, meat, wool and leather is possible.

COMPETITIVE ADVANTAGE

New Zealand has a competitive advantage over other countries –

- Pasture based – animal welfare.
- Purity/Cleanliness 'Pure NZ' – brand perception.
- Tradition of innovation, farming and breeding.
- Free trade agreements with China and Taiwan.
- Not restricted by quotas or subsidies.
- Supportive government.
- Export assistance through New Zealand Trade and Enterprise, Callaghan Innovation and Primary Growth Partnerships (PGP).
- Potential for scale.
- Attitude – no tradition of sheep milking so not limited to what's been done in the past.

GLOBAL ANALYSIS

As part of the global analysis for this *Business Plan For the NZ Sheep Dairy Industry*, the author visited many farms and retailers on her Nuffield travels in India, Qatar, Netherlands, Turkey, France, USA, Israel, Italy, the UK, Switzerland and NZ.

Case studies on 25 sheep dairy farms visited in seven countries were assembled, and three contrasting farms from Italy, the UK and Israel have been included in Appendix 3 for your interest.

TARGET CUSTOMER

According to a sheep dairy expert Shlomi Azran met in Israel the three things driving demand for sheep milk globally ***–"it's trendy, it's healthy and it's traditional."***

The target markets are loosely identified by the author as follows:

PRODUCT	MARKET
Fresh milk bottled (raw, organic or pasteurised)	Auckland, Shanghai, Kuala Lumpur, Tokyo, Melbourne, Sydney
UHT (single serve, 1 Litre, flavoured or plain)	Through Taiwan, Vietnam, China, Malaysia
Frozen milk (allows for milk availability in the off-season)	As an ingredient for cheese production throughout NZ and Australia
Milk Powder (skim or whole milk for use in health products)	AVH traders based in Netherlands. As a health ingredient in manufacturing sector
Whey protein (high in protein for sports nutrition or can be used to strengthen hair follicles)	NZ, Australia
Cheese – higher fat content in sheep's milk enables it to make great quality cheese)	NZ - for the growing demand for artisan cheeses. Spot markets in Hong Kong, Shanghai and Beijing
Yoghurt (suitable for lactose intolerance market)	NZ, Australia
Butter – whiter than standard cows butter	USA and NZ
Ice-cream – because of sheep's milk higher fat content, manufacture of ice-cream it does not require extra fat added, so in comparison to other ice-cream it's lower fat	China, Taiwan, Singapore and NZ. Could be sold alongside NZ natural
Infant formula	Taiwan and China
Functional foods/nutraceuticals e.g greenshell mussel oil/ manuka lozenges/sheep milk vitamin tablets	Japan
Beauty products	Japan
Health supplement tablets (e.g vitamin C)	Japan and China

THE KEY **TARGET CONSUMERS** FOR SHEEP MILK PRODUCTS ARE:

- Lactose intolerant babies and adults – which as noted previously are over 70% of the world population.
- Health conscious consumers wanting functional food benefits.
- Educated.
- Affluent.

MARKETING AND SALES PLANNING

At present, all the NZ sheep dairy producers are marketing and selling their products individually. There may be benefits of 'working together' as a small nation to sell and market products off-shore. In the UK the author visited a group of 9 sheep milk producers who are marketing their products through 'Sheep Milk UK' to 19 dairy companies. The formation of the group has meant that the producers get a fixed annual price for their milk and no-one is undercutting the other. It has allowed the producers to focus on best quality rather than get distracted by having to sell it. It has maintained a high price point for the producer, and has set quality standards so that the buyer is getting a consistent supply of the finest milk. In one case, this has allowed a large dairy company, Grandma Singletons (singletons.uk.com) to export sheep cheese to the USA knowing they have the supply and the quality to meet stringent US standards.

On the author's travels around the world, Zespri, NZ's kiwifruit brand, was seen in high-end supermarkets from Italy to China, and many places in between. In each occasion it was immaculately presented and premium priced. Could the Zespri model work for NZ sheep milk, enabling combined marketing spend to build and position our products at the top end? Similarly, NZ Manuka honey was also seen in the same supermarkets globally, yet there was a proliferation of brands and quality standards which could be confusing for customers, and expensive for each NZ company to service.

In Italy the culture around food is that 'food is fashion'. Every year the country holds a festival for its most famous sheep cheese *'Pecorino'*. Provenance, or the source of the product, is important in Italy and the highest quality pecorino has a DOP certification; for example Pecorino Toscano DOP (Protected Designation of Origin Product), a Tuscan pecorino recognised by the European Union. In NZ, Kingsmeade names all its cheeses after local Wairarapa regions, for example Tinui Blue and Opaki Machego.

Roquefort in France, arguably the world's most well known, and one of the most expensive sheep cheeses, sources all its milk from 1700 farms in the Midi Pyrenees region, and all the milk for the famous brand must come from Lacaune sheep. Cheese is aged in caves in the Roquefort township. Provenance is key in selling this premium product, which retails in NZ supermarket Nosh for $139.99/kg.

In China, NZ fresh cow milk "Oravida" is advertised in magazines for 138RMB/2L (NZ$15/L) flown directly from the farmer to the consumer. There may be opportunities for the NZ sheep milk industry to 'cut out the middle men' and market directly to its consumers.

One group initiative that could assist the industry from a marketing and sales perspective is the formation of a *NZ Sheep Dairy Association (NZSDA)*. The association would need a logo, a website (showing NZ producers), social media interaction on local and global platforms, a public relations function; prepare an annual conference, exhibit at local and International farming and food shows, and be a face for the whole industry. The NZSDA would co-ordinate with food bloggers, health writers, social media strategies and food ambassadors, to educate and raise profile for the sector.

FROM A SALES PERSPECTIVE THE ASSOCIATION COULD EMPLOY A SALES AGENT IN KEY MARKETS TO REPRESENT THE INDUSTRY AND GROW IT, WORKING ALONGSIDE NZTE.

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.
6. *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 owners wages.

PROJECTED INDUSTRY GROWTH PER ANNUM

The author has also worked with various consultants to put together a basic target for the growth of the industry by stock units, average milk volumes and total value of the industry at a farm gate level. The industry will only be able to grow at the rates predicted with the assistance of embryo transfers and advanced genetics and alongside organisations like Landcorp Farming who have the stock numbers and finances to invest in the industry. Milk volumes will only increase with better genetics, stringent culling policies, quality feed in the form of total mixed rations. The industry will also require competent staff, the best electronic milking equipment and state of the art milk parlours and of course most importantly, the insatiable demand for NZ sheep milk around the world.

Notes

- $2/L is the current farm-gate price for NZ sheep milk (less than dairy goat)
- Kingsmeade 'high yield' ewes produce 600L of sheep milk/annum with minimal supplementary feed (300g/day).
- In a briefing paper to the NZ Government, Keith Neylon projects the industry could grow to 2 million sheep in 10 years[20]. Mr Neylon is owner of NZ (and the world's) largest sheep Dairy, Blue River Dairy based in Southland. For the purposes of this projection, this estimate has been reduced by half, to one billion ewes.

	NZ Total Flock (Ewes)	Milk/Ewe/Yr (L)	Total Milk/Yr (L)	Total Value Milk $ (farmgate)
	Growth 43%	Growth 11.5%		Sheep Milk Price $2.00/L
2015	25,000	200	5,000,000	$10,000,000
2016	35,750	223	7,972,250	$15,944,500
2017	51,123	249	12,711,354	$25,422,708
2018	73,105	277	20,267,618	$40,535,237
2019	104,540	309	32,315,704	$64,631,408
2020	149,493	345	51,525,775	$103,051,549
2021	213,775	384	82,155,271	$164,310,542
2022	305,698	429	130,992,472	$261,984,944
2023	437,148	478	208,860,947	$417,721,894
2024	625,121	533	333,018,337	$666,036,674
2025	**893,924**	**594**	**530,981,088**	**$1,061,962,175**

[20] Briefing on the sheep milking industry. (2013, February 21). *Report of the Primary Production Committee, NZ House of Representatives.* Retrieved from http://www.parliament.nz/resource/en-nz/50DBSCH_SCR5875_1/52fdf1746016cfee7fbc5427856f62ea346f3ff4

CONCLUSION

The NZ sheep dairy Industry offers the potential to be a billion dollar industry in 10 years time, if the right breeding programs, feed mixes and other technologies are implemented.

Demand for sheep milk products is growing worldwide, driven by three key factors – health, tradition and fashion.

NZ HAS PIONEERED A MAJOR SHEEP INDUSTRY AND IS A GLOBAL LEADER IN DAIRY. A SHEEP DAIRY INDUSTRY WOULD BE A NATURAL FIT FOR OUR CURRENT FARMING EXPERTISE AND A SIX MONTH LACTATION WOULD FIT THE PASTURE GROWTH CURVE BETTER FOR MANY REGIONS THAN A NINE MONTH COW LACTATION.

An industry is only as strong as the markets it serves, and NZ needs to be consumer led to ensure the sheep milk industry has strong supply contracts. Supply and demand need to be managed carefully.

Like any new industry there will be many trials, but as a country we must be creative, collaborative, flexible and adaptable.

As one astute NZ farmer commented to the author 'to get excited about any of this requires a steady and highly profitable farm gate return, to justify the risk of investing in an embryonic industry. Who is going to provide that "guaranteed" farm gate price?'.[21]

NZ's three top sheep dairy producers have all indicated they need more milk supply and all are paying $2 a litre or more. Farmers need contracts for supply or to establish their own markets prior to investing in this industry. NZ owes a lot to the humble sheep, and it may be the milk from the humble sheep that is the rising star for generations to come.

[21] Daniell, D. (2015, January 25). *Nuffield Scholar, Owner Wairere Rams.* (L. Griffiths, Interviewer)

ACTION PLAN - 12 MONTHS

This section outlines 13 actions required over the next 12 months to February 2016. The question is who is going to fund this, what's it going to cost and how many staff are required?

Initially the author expects the budget would be $120,000 which would cover a project manager, travel costs, website and marketing materials. Funding may come from organisations such as Poutama Trust, Ministry of Primary Industries or AGMARDT. Over time a milk levy or an association fee plus sponsors will be required.

1. BREEDING – Form a strategic alliance between a breeding partner and the NZ Sheep Dairy Association to identify and develop best genetics. *By August 2015.*

2. INDUSTRY BODY – Set up the NZ Sheep Dairy Association. Apply for appropriate start-up funding and charge an association fee, form a data-base for all of the industry from suppliers to the industry to sheep milk producers to product manufacturers. *By April 2015.*

3. VALUE ADDED PRODUCTS – Work alongside a nutrition school to develop new sheep dairy products as an assignment, and have an annual promotion in NZ restaurants and supermarkets at the start of the milking season. *By November 2015 for launch in 2016.*

4. RESEARCH INSTITUTES – AgResearch to give monthly updates to NZSDA. *By March 2015.*

5. PROFITABILITY/EXPORT RETURNS – Strategic alliance with a farm consultancy who can assist with setting realistic targets and profitability analysis for industry based on three farm sizes, increasing yields due to breeding/feeding/technology. *By July 2015.*

6. OVERSEER BUDGET/ENVIRONMENTAL – Specialist environmental consultant and or Beef and Lamb or Dairy NZ to assist with running this model for different parts of New Zealand. *By April 2015.*

7. VOLUME POTENTIAL – The industry needs to set realistic goals for production so that it can scale appropriately. Work with appropriate farm consultancy alongside NZSDA and its members. *By June 2015.*

8. TARGET MARKETS – Work with NZTE to explore partners and markets for products with the aim down the track of appointing a commission based sales representative in USA and Hong Kong. *By September 2015.*

9. CROWD FUNDING/INVESTMENT – Talk to MyFarm about opportunities and organise a farm investment. *By February 2016.*

10. EQUIPMENT & TECHNOLOGY – Present NZ Sheep Dairy Business Plan to key dairy sheep equipment suppliers and see if the industry can get a bulk deal. *By June 2015.*

11. INTERNATIONAL NETWORK OF BEST PRACTICE – NZ to send 5 industry members to the International Dairy Federation Dairy Sheep & Goat Symposium. *By March 2015.*

12. WORLD CLASS QUALITY STANDARDS – Produce a quality standard for NZ. By November 2015.

13. HUMAN RESOURCES – NEXT GENERATION – COURSE ON SHEEP DAIRY
    Taratahi, or another agriculture training centre to have sheep dairy course available. *By January 2016.*

APPENDICES

APPENDIX 1: MAJOR DAIRY SHEEP BREEDS

Information for this section has been sourced from Afimilk's powerpoint presentation to the author entitled 'Sheep around the World'. Supplementary information was sourced from the following website and from Nuffield observations and discussion - http://www.ansci.wisc.edu/extension-new%20copy/sheep/Publications_and_Proceedings/symposium_04/pdf%20of%20Dairy%20Sheep%20Proceedings/Berger%20Breeds%20of%20sheep%20editted%209-26-04%20Proc.pdf

ASSAF

Breed categories: dual-purpose (dairy and meat)

The Assaf breed of sheep is the result of crossbreeding the Awassi and East Friesian Milk sheep. In 1955, researchers of the Israeli Agricultural Research Organization (A.R.O) started this project aiming to improve the fecundity of the Awassi sheep. A combination of 3/8 East Friesian and 5/8 Awassi blood emerged as the best cross.

Most dairy sheep breeders in Israel have adopted the Assaf, which is considered not only a top quality dairy sheep and excellent mutton producer, but is also well-adapted to semi-extensive to extensive production systems. Under Israeli conditions, in which ewes have approximately 3 lambings in 2 years, the annual milk yield is around 650 litres. The demand for Assaf sheep is increasing every year. They have been exported from Israel to Spain, Portugal, Chile and Peru and could be a good breeding option for New Zealand due to their high milk and meat production.

The Assaf has a 'fat tail' which is the result of its Awassi genetics. This meat is highly prized in the Middle East. The meat has more fat than most of the lamb/mutton the author has eaten in NZ.

Roast Assaf lamb eaten whilst visiting Kibbutz Ramat Yahnan in Israel. Cooked by Shlomi Azran.

Assaf sheep resting in the heat at a Mushav in Tsipori, Israel with Tamar & Piere Kruger.

LACAUNE Breed categories: dairy

The Lacaune is the most numerous sheep breed in France. It is also milked in Switzerland and being used as a cross-breed in the UK to increase milk fats and protein levels. The Lacaune breed has been selected in France for increased milk production under a sophisticated selection program incorporating artificial insemination, milk recording, and progeny testing of sires, for longer than any other dairy sheep breed in the world. The author visited a farmer in France who mentioned that his sheep 'let down' their milk within 2 minutes. This rapid 'let down' has been developed by the industry genetics group to increase the speed of milking.

Lucy viewing Lacaune sheep at Ronnaguet Farm, Midi Pyrenees, France.

Annual genetic improvement for milk yield in the French Lacaune is estimated at 2.4% or 5.7 kg (12.5 lbs). The milk production of the Lacaune breed increased from 80 litres to 270 litres in about 30 years. This 270 litres in France is always measured over a milking period of just 165 days excluding the suckling phase (one month on the farm visited by the author).

Lacaune ewes produce milk with higher total solids than the East Friesians, but in slightly less volume. The sheep of the Lacaune breed produce the milk which is responsible for the famous Roquefort cheese which is seen in restaurants and retail stores the world over. The adult Lacaune has an average prolificacy of 170 to 180% with a rather long breeding season starting early (June-July) making it an ideal breed for late fall or early winter lambing.

AWASSI Breed categories: dairy, fat-tailed meat, carpet wool

The Awassi evolved as a nomadic sheep breed through centuries of natural and selective breeding to become the highest milk producing breed in the Middle East. The breed is of the Near Eastern fat-tailed type. The average Awassi ewe has single lactations over 300 litres (650 pounds) per 210-day lactation, and it is not uncommon for outstanding females to have 210 day lactations above 750 litres (1,625 lbs) with high butter fats.

The breed also has the advantage of natural hardiness and grazing ability. The males are horned and the females are usually polled. The fleece is mostly carpet type with a varying degree of hair.

The prolificacy is low (120-130%) and would significantly reduce lamb production.
Distribution: worldwide

Awassi sheep photographed by the author on a visit to Widam Food slaughterhouse, Qatar.

EAST FRIESIAN Breed categories: dairy, short-tailed

The origin of the Friesian sheep (Ostfriesisches Milchschaf) breeds is the region of Friesland extending along the North Sea coast westward from the Weser River in the northeast of Germany along the north coast of the Netherlands and south to the Schelde (Scheldt) River at the border of the Netherlands and Belgium.

The German East Friesian Milk Sheep is the best known and most important of the Friesian breeds and is the breed known in the scientific literature as the "East Friesian." The East Friesian is considered one of the best milking sheep in the world. Average production of 450-500L per lactation of 220-240 days and more have been recorded. It has, however, one of the lowest fat and protein contents (5.5-6.5% and 5% respectively), and the increase in fat content during the lactation is very small (1 to 2%). The lower fat and protein content is somewhat detrimental for the production of high quality sheep milk cheese entirely dependent on fat and protein for yield, flavor and texture. They are highly specialized animals and do poorly under extensive and large flock husbandry conditions. Friesian sheep cross well with local adapted breeds. Prolificacy of 230% has been reported, making this breed one of the most prolific breeds.

The author noted that all of New Zealand's industry utilises the East Friesian breed crossed with other breeds to build hardiness. In the UK, USA and Australia this breed was also the predominant one seen on the author's Nuffield travels. Demand for the East Friesian breed is very high in NZ at the time of writing this report, and prices are inflated (See financial forecasts) and will continue to be, as global demand for sheep milk products continues to grow.
Distribution: Worldwide

East-Friesian seen on a visit to Kingsmeade, Wairarapa, New Zealand

APPENDIX 2: HEALTH PROPERTIES OF SHEEP MILK[22]

Table 1
Average composition of basic nutrients in goat, sheep, cow and human milk

Composition	Goat	Sheep[a]	Cow	Human
Fat (%)	3.8	7.9	3.6	4.0
Solids-not-fat (%)	8.9	12.0	9.0	8.9
Lactose (%)	4.1	4.9	4.7	6.9
Protein (%)	3.4	6.2	3.2	1.2
Casein (%)	2.4	4.2	2.6	0.4
Albumin, globulin (%)	0.6	1.0	0.6	0.7
Non-protein N (%)	0.4	0.8	0.2	0.5
Ash (%)	0.8	0.9	0.7	0.3
Calories/100 ml	70	105	69	68

Data from Posati and Orr (1976), Jenness (1980), Larson and Smith (1974) and Haenlein and Caccese (1984).
[a] Anifantakis et al. (1980).

Table 11
Mineral and vitamin contents (amount in 100 g) of goat, sheep and cow milk as compared with human milk

Constituents	Goat	Sheep	Cow	Human
Mineral				
Ca (mg)	134	193	122	33
P (mg)	121	158	119	43
Mg (mg)	16	18	12	4
K (mg)	181	136	152	55
Na (mg)	41	44	58	15
Cl (mg)	150	160	100	60
S (mg)	28	29	32	14
Fe (mg)	0.07	0.08	0.08	0.20
Cu (mg)	0.05	0.04	0.06	0.06
Mn (mg)	0.032	0.007	0.02	0.07
Zn (mg)	0.56	0.57	0.53	0.38
I (mg)	0.022	0.020	0.021	0.007
Se (μg)	1.33	1.00	0.96	1.52
Al (mg)	n.a.	0.05–0.18	n.a.	0.06
Vitamin				
Vitamin A (IU)	185	146	126	190
Vitamin D (IU)	2.3	0.18 μg	2.0	1.4
Thiamine (mg)	0.068	0.08	0.045	0.017
Riboflavin (mg)	0.21	0.376	0.16	0.02
Niacin (mg)	0.27	0.416	0.08	0.17
Pantothenic acid (mg)	0.31	0.408	0.32	0.20
Vitamin B_6 (mg)	0.046	0.08	0.042	0.011
Folic acid (μg)	1.0	5.0	5.0	5.5
Biotin (μg)	1.5	0.93	2.0	0.4
Vitamin B_{12} (μg)	0.065	0.712	0.357	0.03
Vitamin C (mg)	1.29	4.16	0.94	5.00

Data from Posati and Orr (1976), Park and Chukwu (1988,1989), Jenness (1980), Haenlein and Caccese (1984), Debski et al. (1987), Coni et al. (1999), Gebhardt and Matthews (1991) and Park (2006a).

[22] Park, Y. W., Juárez, M., Ramos, M., & Haenlein, G. F. W. (2007). Physico-chemical characteristics of goat and sheep milk. *Small Ruminant Research*, 68(1), 88-113.

APPENDIX 3: CASE STUDIES

UK CASE STUDY - SHEEP MILK UK

Simon Stott set up Sheep Milk UK, a cluster of 9 sheep milk producers supplying 19 sheep dairies in his region. According to Stott, the demand for sheep milk is growing at over 10%/year. The cluster has worked exceptionally well, ensuring that customers and suppliers have set pricing, consistent year round supply, and exceptional quality measures.

On his own sheep dairy farm, Simon is always pushing for the highest volume and quality of milk, and he certainly doesn't skimp on feed or facilities for his prized animals. It was a pleasure meeting his hardworking parents, his children, and observing how he is developing his own brand of milk, ice-cream and cheeses to specifically appeal to the younger age group. He also has a classroom on site at the farm where he hosts around 40 groups a year, teaching them about sheep milk.

Stott was awarded sheep farmer of the year in the UK in 2011. Given his enthusiasm, energy and innovation, it was an obvious choice.

A few fast facts about Simon Stott and his sheep dairy operation:

- Started in 2000 because he was asked by a local dairy to supply sheep milk for a sheep cheese they were making for export.
- Has a flock of 700 sheep plus an additional 250 replacement stock, and was milking 550 in August 2014.
- Averages 650L/lactation/300 days lactation/years.
- Milk is tested for bacteria, milk fats, protein, antibiotics, bacta scan, water, blood.
- Breed is Friesland however low yield sheep (under 2L/day) are bred with Texel for meat. Hoggets are bred with Texel until their milking potential is gauged. Stott has just secured some Lacaune rams from France to increase milk fats percentage. Likes Friesland for their longer lactation, high lamb percentages, docile nature. Lacaune has a tighter jacket, better feet and higher butter and fat protein, which is good for cheese making.
- Believes that milking ability comes 50% from feed and 50% from breed.
- TMR (total mixed rations) are high energy and a refined blend of silage, whole crop grain (grown on farm), brewers grains (waste from beer), energy meal, corn, beet, treacle, molasses, yeast, calcium and mineral megalac. Need to feed heavily in the first 100 days and feed the same every day. Stott feeds approximately 3.5kg-4kg/day (40-55% dry matter). Once they drop off milk it is very hard to get yields back up.
- Most lamb in January and dry-off in November/December. Hoggets lamb in April at about 14months of age so they aren't 'scarred'. Try to keep the breeding cycle as natural as possible. Lambing yields scanned at 210% however 175% survival rate. Lambs spend first 24hrs with mother before being hand raised.
- Raise lambs on milk and haylage.
- All lamb in shed. Ewes stay in shed over night to keep udders clean and butter fat/protein levels high. Ewes are fed before evening milking and milked twice per day.
- Ewes are wiped before milking and sprayed after milking.
- Parlour isn't 'wet down' because it can cause lameness.
- High protein diet can affect feet of sheep. Uses a linktrospectrum antibiotic footbath to help with footrot and scald.
- Clears 20p/litre (NZD$0.40c). No money from wool.
- 50% income from milk and 50% from meat, breeding stock and colostrum.
- Looking at investing 200K in a new parlour.

ITALY CASE STUDY - LA PORTA DEI PARCHI (GATEWAY OF THE PARKS). ABRUZZO.

It was a privilege to spend a week working on this famous organic farm, La Porta Dei Parchi, in Anversa degli Abruzzi. The farm was founded in 1977 by Nunzio Marcelli and Manuela Cozzi, and is famous for its prized cheeses, which are sold in the best restaurants in Italy and the USA. Both Nunzio and Marcella are well known in the region, Nunzio is an advisor on organic farming to the Government and Marcella for teaching food marketing at the region's top agriculture university.

La Porta di Parchi operates on 1,100 hectares of farmland, runs a flock of 1300 Soppravizzano sheep and Spanish merino sheep with 15 Maremma sheep dogs, and employs 6 shepherds, 2 cheese-makers, and a vet. This is not the typical Italian farm which is usually small in scale and multi generational. The DOP system encourages small scale regional variety. A cheese awarded the DOP is most special. DOP stands for "Denominazione di Origine Protetta", which means Protected Designation of Origin. Similar to the AOC, the DOP guarantees that the milk of the cheese and production are from a certain location in Italy. Also, the methods of production must be traditional, and have fixed storage guidelines to ensure that the cheese ages correctly. It is mark of optimal quality and high standards.

From the early spring and into the late autumn, the sheep, the shepherds and their dogs, spend virtually their entire waking hours grazing in the mountain meadows of the Gran Sasso, feasting on the pristine mountain grass of wild mint, rosemary, oregano, fennel, and juniper. At their bio-agriturismo farm, La Porta dei Parchi, the accommodations include apartment-style rooms (30 beds) with kitchenette, a 50-seat restaurant as well as picturesque picnic and recreation areas.

One of the things that appealed about this operation was their clever marketing scheme 'Adopt a Pecora (sheep)', where you can pay an annual rate to adopt a sheep, and in return you receive their incredible Italian cheeses or meat, milk, wool and other products from the region. The concept is based on the Abruzzo tradition of local villagers paying the local shepherd to 'mind their sheep' in exchange for ready cash, making the most of the shepherds' grazing knowledge and their dogs' protection to ensure they got the most from their sheep. You in effect can choose to do the same, ensuring your cheese is really organic, delicious and helping sustain traditional lifestyles that don't harm the environment.

An example of what you get for 190 euros in addition to your Adoption certificate is:

- 3 kg pecorino cheese
- 1 kg of juniper-smoked ricotta
- 1 kg of salamelle di tratturo (sheep-salami)
- 1 pair of trekking socks

And you can choose whether you want it delivered at Christmas or mid-year. By becoming part of the *Adopt a Pecora* scheme you are entitled to a 10-20% discount on your accommodation & food if you stay there.

Lucy with an 'Adopt a Pecora (sheep)' certificate.

Some fast facts about La Porta Dei Parchi:

- In Italy the Government gives farm subsidies for organic farms, extensive farming (number of hectares) and number of animals.
- Aside from subsidies the farm gathers 35% of its income from tourism, 45% from cheese and 20% from meat.
- The sheep give small volumes of milk, around 400g/day and sheep are hand milked in the pasture or brought back to the parlour which milks 15 at a time, 2 x per day.
- Taxes in Italy are very high, around 50%.
- La Porta Dei Parchi sits on wild hill country which has up to 120 different plants per square metre, giving the sheep's milk and cheese a very distinctive taste.
- Nunzio and his Romanian shepherds were invited to travel to Kabul Afghanistan recently, to help restore pastoral traditions, particularly in the making of a durable, long-lasting cheese, that have been forgotten indirectly because of the country's decades of war.
- Products include – Organic raw unpasteurised milk, Organic cheese and (Fresh Ricotta, Pecorinoa Primo Sale (First salt), Ricotta Afumicata (Smoked ricotta with juniper berry), Cacio viorello, Gregoriano, Pecorino classic, Cacio cavallo.
- LA Porta Dei Parchi cheese retails in Italy for about €24/KG, ($NZ36/Kg) which is one of the most expensive cheeses in Italy.
- Ricotta afumicata, named best cheese in the USA, and sold in EATALY stores in New York. EATALY is a retail and restaurant store, showcasing Italian food fashion and tradition that is in 27 locations around the world. The EATALY New York store is now the 5th most visited tourist attraction in the city.
- Italians have been milking cheese for over 2000 years.
- Raw milk can be used in Italy for cheese making because bacteria is killed after 3 months maturation.

ISRAEL CASE STUDY - NORDIA KIBBUTZ

The author was kindly hosted in Israel by The Israel Dairy School (IDS) around the same time the Gaza war ceasefire was announced in September 2014. The IDS prepared working farm visits across Israel at four kibbutz and two mushav, and it was a highlight of the author's time on Nuffield.

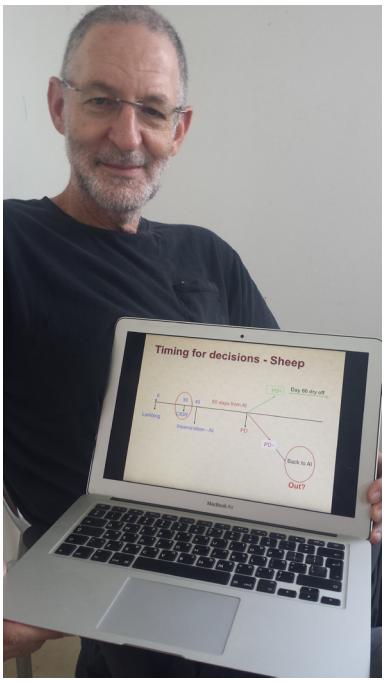
Because Israel is a 'new country', only re established as an independent state in 1948, its farming techniques are not bound by tradition. Consequently Israel was the most structured, efficient and technology driven country visited, in terms of sheep milk farming and production.

Assaf sheep feeding in sheds.

On all the farms visited every animal is electronically identified at birth, allowing farmers to make management decisions based on the productivity of each animal. Pasture is limited in Israel, so all animals are fully housed in high ceiling, well lit, airy sheds without sides. Unlike cows, sheep like being crowded and at Kibbutz Gazit an 80x22m shed houses 700 stock. Sheep however do not like competition for food, so an allowance of 30cm/ewe on troughs running along the middle of the sheds is allowed.

To the author, Haim explained the recommended system to maximise meat and milk production is as follows –

50 DAYS AFTER THE SHEEP GIVES BIRTH A CIDR (CONTROLLED INTERNAL DRUG RELEASE) IS USED TO SYNCHRONISE OESTROUS. 15 DAYS LATER THE SHEEP IS ARTIFICIALLY INSEMINATED. 55 DAYS LATER THE SHEEP IS SCANNED FOR PREGNANCY. IF IT IS PREGNANT THEN 31 DAYS LATER IT IS COMPLETELY DRIED OFF (DAY 86). THE WHOLE LACTATION CYCLE TAKES 151 DAYS AND LAMBING CYCLE 240 DAYS. This system means the ewe can achieve 3 lactations/lambings in 2 years. However, some farmers met in Israel preferred to CIDR after 60 days, to allow the animal better recovery time. 70% of sheep are pregnant after 1st AI cycle, 20% after the second cycle and 10% after the third cycle. However the third cycle ewes are usually slaughtered for meat.



Small ruminant expert Haim Leibovich PHD with his timing for decisions

Lactating ewes are fed 4.35Kg of very high protein TMR mix (total mix rations) daily as follows –

Ration (daily) for high yield lactating

TMR Lactating ewes	Kg	DM	fed DM
Corn whole grain	0.559	87%	0.486
Barley whole grain	0.326	87%	0.284
Sunflower mill	0.163	90%	0.147
Wheat whole grain	0.218	87%	0.189
Alfalfa hay	0.521	86%	0.448
Vetch hay	0.218	89%	0.194
Wheat silage	0.470	40%	0.188
Corn silage	0.951	32%	0.304
Soy bean mill	0.239	88%	0.211
Pellets 16% CP	0.653	87%	0.568
Salt	0.005	100%	0.005
Sodium Bi Carbonate	0.016	98%	0.016
Vitamins	0.011	95%	0.010
Total	4.35		3.05

A maintenance TMR mix is fed to non-lactating sheep because fat replacement stock are not desirable.

Roughage such as grass, alfalfa and wheat silage is grown in Israel, and concentrates such as corn, barley, wheat and soy bean mill are imported. Feed is delivered daily to farms around Israel, and is kept in large silos.

On Nordia Kibbutz, one of Israel's largest sheep dairy operations with 1300 lactating ewes, Doron the manager is from a banana production background. The Afimilk computer software used is the 'heart of the flock', allowing Doron to gauge twice a day at milking time the daily lactation of the ewe, number of days into its lactation, when the ewe was born, how many artificial inseminations it has had, how many lambs it hass produced, electric conductivity and total volume of milk per annum. On Nordia the milk parlour is a rapid exit 36x2 herring bone system which takes just 6 minutes per side to milk the ewes. An udder support hook assists placement of teats and automatic cup removal quickens the milking process. The Afimilk system predicts each animals daily lactation and alarms staff if the animal is under performing. Ewes are milked twice per day.

SOME FAST FACTS ABOUT NORDIA THAT ARE SIMILAR TO MANY OF ISRAEL'S MOST EFFICIENT SHEEP DAIRY KIBBUTZ AND MUSHAV:

Milking Assaf sheep using sophisticated Afimilk technology.

- As mentioned in Appendix 1, Assaf is the main breed used in Israel and average lactations at Nordia produces 670L/ewe/year.
- Freshly lactating ewes often produce 6L plus but the average is 4L/ewe.
- A ewe lactating for the first time produces 2-3L/day and this grows in the second and subsequent lactations to 3-4L.
- Lambs are immediately separated from mother and hand fed colostrums, before spending 30 days on milk powder from automatic feeders. Stress is reduced by not relocating the lambs, and by housing them in hygienic sheds with a saw dust bedding.
- Nordia lambs every month to ensure year round availability of milk.
- 5% of lambs die in the first 24hours and 10% more die before lambs are sold as meat at approximately 5-6 months old. At this stage the lambs are a whopping 59-69kg (growth average of 350g/day) after being fed on solid concentrates since weaning.
- No money made from wool.
- 55% of the farmers income is made from meat, 45% from milk which is why they lamb 1.5 times/year and have an accelerated lambing and lamb raising regime.
- Shearing of ewes takes place two months before lambing, to improve birth weights (an insight that Israel gleaned from NZ).
- 3 years is the average lactation length before ewes are killed for meat.
- A milk research fund is provided by the milk board levy in Israel to allow for research into milk quality and volume.
- Replace 45% of stock every year because there is such a good price for meat. 5% die and 40% are culled. Need 0.5 replacement lambs/ewe every year.
- Most farmers supply TNUVA under a quota system. TNUVA accepts milk over quota however farmers are penalised in price when this happens.
- In 2013 NORDIA cleared 500 shekels per animal (approximately NZ$169) after all expenses. 230 shekels was for milk and 270 shekels for meat.
- On Gazit, breeding ewe lambs 5 months old recently sold to Jordan for 1800 shekels (NZ$608) and ram lambs for 2500 shekels (NZ$845), showing that top dairy sheep breeding stock is in high demand all over the world.
- TNUVA markets the majority of sheep milk as Israeli Feta. This is sold predominantly in Israel, the USA and a little to the UK.

APPENDIX 4: UK SHEEP DAIRY GROSS MARGINS (British Sheep Dairy Association)

Notes – The costing below was put together for the John Nix Pocket Book and is 18 months old. The author's recent travels to Sheep Milk UK implied higher volumes and prices are now being achieved with the cluster being paid £1.10/L (NZ$2.20) and high yielding ewes were producing in excess of 600L/annum.

PERFORMANCE LEVELS	LOW	AVERAGE	HIGH
Milk Yield (litres) per Ewe per year	225	375	450
Sales:	£	£	£
Milk Value (1)	225	375	450
Value of Lambs (2)	112	112	112
Wool	2.4	2.4	2.4
Cull Ewes and Rams (3)	9	9	9
Output per Ewe	**348**	**498**	**573**
Variable Costs:			
Concentrates (4)		230.5	
Miscellaneous (inc. Vet & Med)		19	
Total Variable Costs (excluding forage)		**250**	
Gross Margin per Ewe before deducting Forage Variable Costs	98	248	323
Forage Variable Costs		20.5	
Gross Margin per Ewe	**79**	**227**	**302**
Stocking Rate (Ewes with Lambs per forage Hectare (acre))		11 (4.5)	
Gross Margin per Hectare	869	2497	3322

1. *Price:* 95p/L (NZ$1.90) at farm gate (range from 100p - 110p per litre).
2. *Lambing %:* 175%. Assume a 300 Friesland ewe flock. Retain 60 ewe lambs for flock replacements. Sell 390 finished lambs reared from 2 days old (inc. 15% mortality) at £60. If meat-type terminal sires used then cross-bred lamb values increase to £80.
3. *Cull ewes:* Assumed 18% culled at £50 per head (average, including mortality).
4. *Concentrates:* Milking ewes: 200 days at 1.5 kg/head/day, 100 days at 0.5 kg/head/day; cost £275 - £300/tonne. Ewe lamb replacements and artificially reared finished lambs at £75/head.
5. *Forage costs:* Quality silage: 1 tonne per milking ewe (or hay equivalent). Grazing: early grass in March/April; good grazing on leys or pasture; similar for dry stock and lambs.

Fixed Costs per Ewe: Labour (paid) £84; Power and Machinery £26; Property Costs £15; Other £15; Total, excluding Finance and Rent, £140.

Capital Costs of Equipment: Complete milking unit for 300 ewes (including yokes, bulk tank, dairy equipment, installation): £12,500 - £25,500. A small 50 ewe unit can be put together for £10,000.
Any building works would be additional to the above costs.
Acknowledgement: thanks to Anthony Hyde, FRICS, FBIAC, FRAgS.

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