Creating alternative primary agri-food industries: The feasibility of establishing a large-scale sheep milk industry in Ireland through collaboration and cooperation

A report for:

NUFFIELD IRELAND

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Disclaimer

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1. Executive Summary

In this report, the author explores the opportunity to establish a large-scale sheep milk industry in Ireland and provide the basis of a roadmap to initiate and enable the sector's growth.

The motivation for this is that despite the Irish sheep industry exporting close to €500m worth of lamb, the sector is struggling with both viability and attracting new entrants. Alongside this, lamb consumption in its two main export markets is declining. In both the UK and France, per capita lamb consumption has dropped by over 50% over a 15-year period up to 2019. There is significant input cost inflation, the wool market has collapsed, and there has been increased competition from Australian and New Zealand producers who are supplying lamb appreciably under Irish prices. The current strategy to overcome this is the introduction of headage payment, which is currently €20/ewe.

In Europe, the main sheep milk-producing countries are France, Spain, Greece and Italy (FGIS), and they produce circa 2 billion litres of sheep milk, which is predominately made into cheese. These countries are generally accepted to be "in the eye of the climate change storm". They are also facing significant challenges of generational renewal and reliance on bought-in feed for their intensive indoor systems. For example, Castille de Leon province in Spain, the main sheep milk province, has been one of the most depopulated areas in Europe over the past 30 years. Sheep milk production has consolidated into intensive systems where the production costs are circa 62% feed and 18% labour. They are experiencing declines in milk production as farmers leave the sector. This has resulted in large milk price increases. Unlike the Irish sheep meat sector, the dairy sheep sector has a supply problem, not a market problem.

Based on supply deficits, demand growth and comparing Ireland to other milk-producing countries, such as France, where 30% of the sheep are milked, the author has set out the following targets for the industry:

The immediate opportunity

There are 2 billion litres of sheep milk produced from the four main producers in Europe (France, Greece, Italy and Spain). Ireland can easily target 2% of this market. This requires circa 120,000 dairy sheep (3% of the flock on the island of Ireland) supporting 350 family farms making a living in rural Ireland. This is 41m litres converting to c. 7000mt of cheese, resulting in an wholesale cheese value of close to €90m.

The author also illustrates through a long-term stretch scenario where 10% of the sheep are milked, and using EY's economic multipliers that were used in the Irish dairy impact report, that the sheep milk industry could have a €800m impact in rural Ireland.

Based on overseas visits, desk research and discussions with industry stakeholders, the author presents how Ireland can take on this opportunity by providing the basis of a roadmap involving each supply chain step. The author focuses on creating a farming model and ecosystem that works with family farm structure on smaller land holdings without derogation.

New Zealand have proven the economic and environmental opportunities that a grass-based sheep milk production can offer. It is clear that the competitive advantages that Irish cow dairy farmers enjoy over their European counterparts are also relevant to sheep dairy (a small, outdoor, grass-eating ruminant producing milk solids). It has 30-50% less nitrates leaching, lower GHG emissions on a per hectare basis and an efficient conversion of dry matter to milk solids (comparable to cows). There is no significant loss in lamb quality when utilising dual purpose breeds.

From the author's perspective, what makes sheep milking attractive for a farmer:

- Family farms can have 390 sheep on 75acre (30 hectares).
- Without nitrates derogation (increasing sustainability credentials).
- Profitable at the lowest milk price in Europe (resilient).
- 1hr20min milking time, twice a day for 200 days.

- Ewe rears lamb for the first 30 days then the lamb is weaned (only milk with natural rearing)
- Works on a grass-based model.

Unlike other new industries proposed for Irish farmers, sheep milking doesn't require a year-on-year subsidies or policy change, such as organics, forestry and biomethane (feed-in-tariff) industry. These sectors are also not clearly full-time farming options for new entrants. Currently, the sheep sector receives a headage payment of €20/ewe. Sheep milking can underpin the sheep meat sector by creating a more balanced supply of lamb for the meat processors and in turn, a more consistent supply/offering to EU buyers.

Most sheep milk is processed into cheese, which is supplied in markets such as the USA, Germany, and the UK. These products and markets suit Ireland's infrastructure, distribution, and seasonal production system.

It is widely recognised that the Irish dairy cow industry has peaked. The reduction in nitrate limits and the impact of banding have reduced the income potential of dairy cows. With the large capex requirement, it is increasingly difficult to justify the investment, particularly at the scale of most Irish farms. Sheep milk offers this full-time opportunity to family farms across Ireland.

The author concludes with several recommendations for public and private stakeholders to advance the industry. These include establishing a sheep milk working group, which will be tasked with formulating a strategic plan for the industry, building a demonstration farm to lead a genetic program, testing farming systems, and serving as a showcase to Irish farmers. The author also recommends creating differentiated, branded products and facilitating access to processing capacity, which allows the industry to supply export markets from the outset feasibly.

Summary of rationale

- 3.6m sheep on the island of Ireland are largely unprofitable and declining in numbers.
- Potential to support the resilience of the sheep sector, which has seen increased government subsidies.
- Full-time income opportunity for small family farms (70 acres and under).
- New Zealand findings:
    - Sheep are producing 350-400L/ewe from an 80% pasture-based diet. Pasture-based diet will have a significant cost advantage over indoor systems across Europe.
    - NZ returns of €160/ewe, after labour is paid, is attractive
- Strong environmental credentials (New Zealand research).
- 50% lower nitrates leaching than cows.
- Lower GHG on a per-hectare basis.
- NZ targets exports of $750m-$1b in exports by 2035.
- Sheep milk is an efficient product to produce (good feed efficiency), comparable with dairy cows.
- The current milk deficits and prices of sheep milk across Europe look set to continue. Dairy production of all kinds is challenged in Southern Europe.
- Products and markets are a good fit for the Irish dairy ecosystem.
- The timing of industry could be very good to link up with the Irish dairy co-op industry. Stranded dairy processing is being shut down and could be repurposed.

The author welcomes all engagement regarding this report.

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4. Abbreviations

AotM	Agriculture of the Middle
ANZ	Australia and New Zealand
CAP	Common Agricultural Policy
DAFM	Department of Agriculture, Food and Marine
DIT	Dublin Institute of Technology
DMI	Dry Matter Intake
EBI	Economic Breeding Index
FGIS	France, Greece, Italy, Spain (Main European sheep milk-producing countries)
GHG	Greenhouse gas
ICBF	Irish Cattle Breeding Federation
ICSA	Irish Cattle and Sheep Farmers Association
IDA	Industrial Development Agency
IFA	Irish Farmers Association
JV	Joint venture
MTL	Moorepark Technology Limited
NDC	National Dairy Council
NZ	New Zealand
NZD	New Zealand Dollar
SCC	Somatic cell count
SWS	Sheep Welfare Scheme
TBC	Total Bacterial Count
UCD	University College Dublin

5. Foreword

Although I didn't grow up on a traditional farm, I was immersed in agricultural life through family, friends and neighbours. My father, John, is a retired Teagasc advisor and Rockwell Agricultural College lecturer. He also maintained a small flock of ewes when I was young.

After finishing a Science degree at UCD, I worked in the pharmaceutical industry for a year. I knew immediately that this wasn't the path for me, so I decided that the industry I wanted to be involved in was the agri-food sector. To educate myself, I completed a two-year Erasmus European Master in Food Innovation and Product Design (www.Fipdes.eu). This gave me a broad overview of this area, gaining perspectives from Ireland, France and Sweden. There were also 23 people in my class from 15 different countries with a strong alumni community. I was the only Irish person in my year. This experience was, in many ways, one of the reasons I wanted to pursue a Nuffield Scholarship, gaining another opportunity to open doors and develop relationships with people of similar passions worldwide.

As my MSc programme concluded, Michael, my brother, was looking into opportunities to get into full-time farming. There were growing discussions in New Zealand about developing a sheep milk industry, notably presented by another Nuffield scholar, Lucy Griffiths. With Michael's education in agriculture and mine in food, we felt there was an opportunity to explore sheep milking in Ireland. We took over a small existing farm and started supplying artisan cheesemakers in Ireland. After initially developing some artisanal products, we focused on a strategy to turn this into a proposition that could get other farmers involved.

In Ireland, there has been a significant focus on research, agri-tech and investment into how Irish farmers can be more efficient and productive in the same traditional farming systems. However, there is insufficient focus on what else Irish farmers can produce. This contrasts with somewhere like New Zealand, who have built a number of new primary industries over the past 20-30 years.

My motivation for taking on this scholarship was to utilise the access and support that Nuffield would give me to explore sheep milk as a viable, scalable land use for Irish farmers while getting to travel and grow my network. I hope this report illustrates the opportunity for sheep milk in Ireland, highlighting one potential alternative agricultural land use.

6. Acknowledgements

Being selected as a Nuffield Scholar has been a huge honour. It is a special organisation with an important role and history in our sector. It has been great to meet the people involved in and linked to Nuffield in Ireland and internationally. It has been a special experience.

I'd first like to thank my parents, John and Margaret, for their constant support and for giving me the confidence to pursue a left-of-field business. I'd also like to thank my brother, Michael, for his support while I was away; he would be equally suited to pursue a Nuffield scholarship.

I want to thank several people who have helped me throughout the past two years. These include Karen Brosnan, Catherine Lascurettes, John Tyrell, Joe Leonard and my mentors, Seamus Quigley and Ciara O'Halloran, who supported me with my report.

I also want to acknowledge three other Irish scholars with whom I completed this journey: Alex Eivers, Ray Ó'Foghlú and Brian McCarthy. It has been great to become friends and work through this with you.

Regarding my research, I'd like to thank everyone I met who gave me their time and insights from across Ireland and abroad.

The Nuffield experience involves so many people that it is impossible to acknowledge everyone. It is a great organisation that can open many doors and is an enduring benefit to all scholars. I want to thank the various Nuffield boards, trustees, sponsors, and scholars who continue building Nuffield and its worldwide influence. A special thank you to my sponsor, the Golden Jubilee Trust.

Figure 1: Day 2 of my GFP in Japan

with Ray Ó'Foglú (Ire), Rob Bell (Aus), Mikey Densham (Aus), Lynsey Stratford (NZ), Hans Loder (Aus), Vanessa Chiamulera (Brazil), John Foley (NZ) and Kathryn Fleay (Aus).

7. Aim & Objectives

Aim

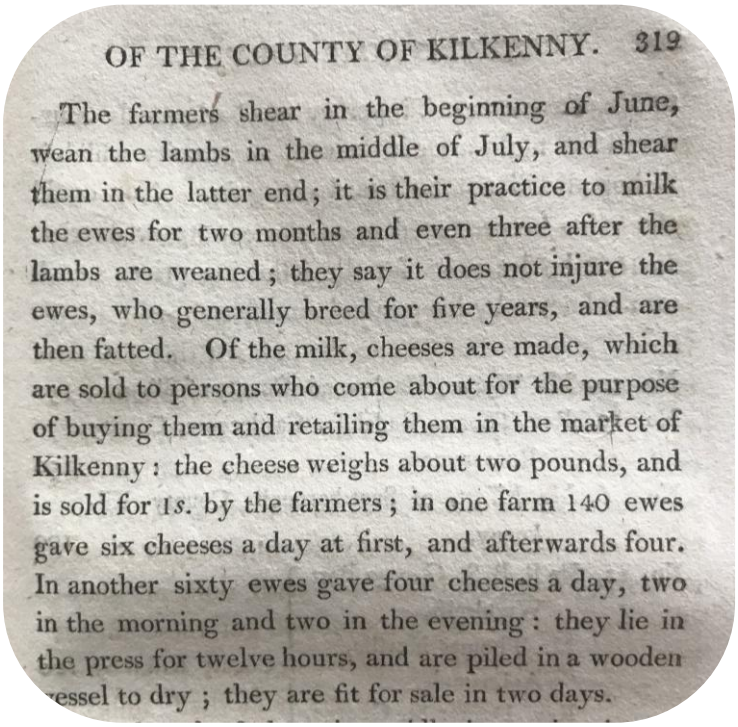
To explore the opportunity that sheep milk represents to Irish farmers and provide the basis of a roadmap for the industry, from the author's research and findings

Objectives

- Understand and present the situation of the Irish sheep meat and global sheep milk sectors.
- Present and highlight the rationale for establishing an Irish sheep milk industry
- Explore how to initiate and enable the industry.
- Make recommendations on how to advance the industry

A little history lesson:

1. The extract below is from a book titled Of the County of Kilkenny in the year 1800. Irish farmers previously knew the value of sheep milk. Something that is not considered at all today! I credit Suzanna Crampton for sharing this on her Twitter page: Zwartbles Ireland.



OF THE COUNTY OF KILKENNY. 319

The farmers shear in the beginning of June, wean the lambs in the middle of July, and shear them in the latter end; it is their practice to milk the ewes for two months and even three after the lambs are weaned; they say it does not injure the ewes, who generally breed for five years, and are then fatted. Of the milk, cheeses are made, which are sold to persons who come about for the purpose of buying them and retailing them in the market of Kilkenny: the cheese weighs about two pounds, and is sold for 1*s.* by the farmers; in one farm 140 ewes gave six cheeses a day at first, and afterwards four. In another sixty ewes gave four cheeses a day, two in the morning and two in the evening: they lie in the press for twelve hours, and are piled in a wooden vessel to dry; they are fit for sale in two days.

Figure 2: Sheep milking in Co. Kilkenny in 1800

2. The Irish festival of Imbolc / St. Brigid's day is a traditional Irish festival on the 1st of February. The word "Imbolc" is derived from "Ewe's milk" owing to the return of milk to the early Irish diet with the February lambing, providing great sustenance to the Irish people.

It would be well if, in studying the past, we could always bear in mind the problems of the present, and go to that past to seek large views of what is of lasting importance to the human race.

- Arnold Toynbee - "Lectures on The Industrial Revolution", 1884

8. Introduction

Ireland has matured into a world renowned, export-orientated food producer. In 2021, Ireland's food and drink exports exceeded €14 billion for the first time. Irish food is sold in 180 markets worldwide. The Irish Government intends to grow the value of agri-food exports to €21 billion by 2030 (DAFM, 2021).

These achievements and ambitious targets are underpinned by a livestock sector rooted in a sustainable grass-based production system. As the global need for top-tier food rises with population growth and urbanisation, the Irish agri-food sector is strongly positioned to fulfil this growing demand.

However, farmers' economic viability is essential in order for them to continue production and to help them to deliver environmental and social sustainability objectives. Besides dairy production, the viability of other land uses in Ireland is generally low and often heavily dependent on EU subsides. The inherent challenges these systems face are their cost structure, scale and producing global commodities. It is difficult to have a positive long-term outlook for many of these options.

Gerry Boyle, former Teagasc Director, noted that there is "no easy alternative for Irish farmers", but the alternative will most likely focus on the "natural advantages of growing grass in Ireland". The lack of viable alternatives is a real challenge for farmers. However, the Irish cow dairy industry continues to be the powerhouse behind Irish agriculture and is globally competitive despite operating at a modest scale on farms. It is noted that Prof. Boyle suggested that sheep will continue to play a role in Ireland (Boyle, 2019).

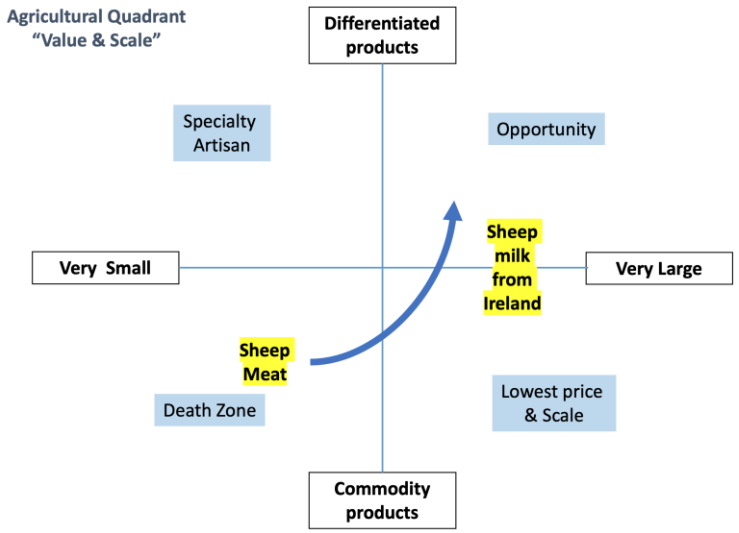
Ireland has a sheep sector focused on meat production. Wool is effectively a waste product due to the price farmers receive. There is one other product that sheep produce that Ireland ignores - sheep milk. Most people in Ireland do not know you can even milk a sheep!

Sheep dairy is an important sector globally. In the scale of global dairy production, sheep milk production (10.5 billion litres) represents 1.3% of all milk produced. It is 40% bigger than global organic cow milk production and 30% bigger than the Irish cow dairy industry. Goat, sheep and mixed milk cheeses represent 9% of the EU's total cheese production of 850,000mt (International Dairy Federation, 2020) (Bord Bia, 2022).

The global sheep dairy sector is a Mediterranean story, with 46% of global sheep milk coming from this region. With the challenges these regions face with drought and high input costs, Ireland is positioned to offer a differentiated product focusing on the production of sheep milk from grass and leveraging off the success of the cow dairy industry. The current Irish sheep dairy sector is tiny, with 5/6 farmers. However, there are 3.6 million meat sheep on the island of Ireland. These are farmers with significant livestock and grassland production expertise operating a predominately unviable farming system with limited opportunity to improve their current business model.

Agriculture of the Middle concept

There is a concept called Agriculture of the Middle (AotM) which addresses challenges faced by medium-scale family farms, caught between large commodity producers and niche boutique operations. In Ireland, where agricultural competitiveness is a concern, the author believes that this concept should be a point of discussion and it will be referred to when exploring the potential of sheep milk. The author believes that sheep milk offers a strong alignment with AotM principles by offering a manageable scale for family farms while tapping into global niche markets with high-quality products. By focusing on sheep milk production, Irish farmers can navigate economic challenges and pursue sustainability.



(Author's own adaption) *Figure 3: Agricultural quadrant*

Three Horizons Growth Model

This model was highlighted to the author through conversations with John Foley, New Zealand Nuffield Scholar. A link to John's report is at the end of this document.

To quote John's report: "The Three Horizons Growth Model, developed by Bill Sharpe, has become a key tool for creating forward-thinking in organisations. This model allows organisations and sectors to consider growth-orientated futures without taking their eye off the current state. Its ease of use and its ability to present complex problems in a simple manner means it has become widely used in business strategy."

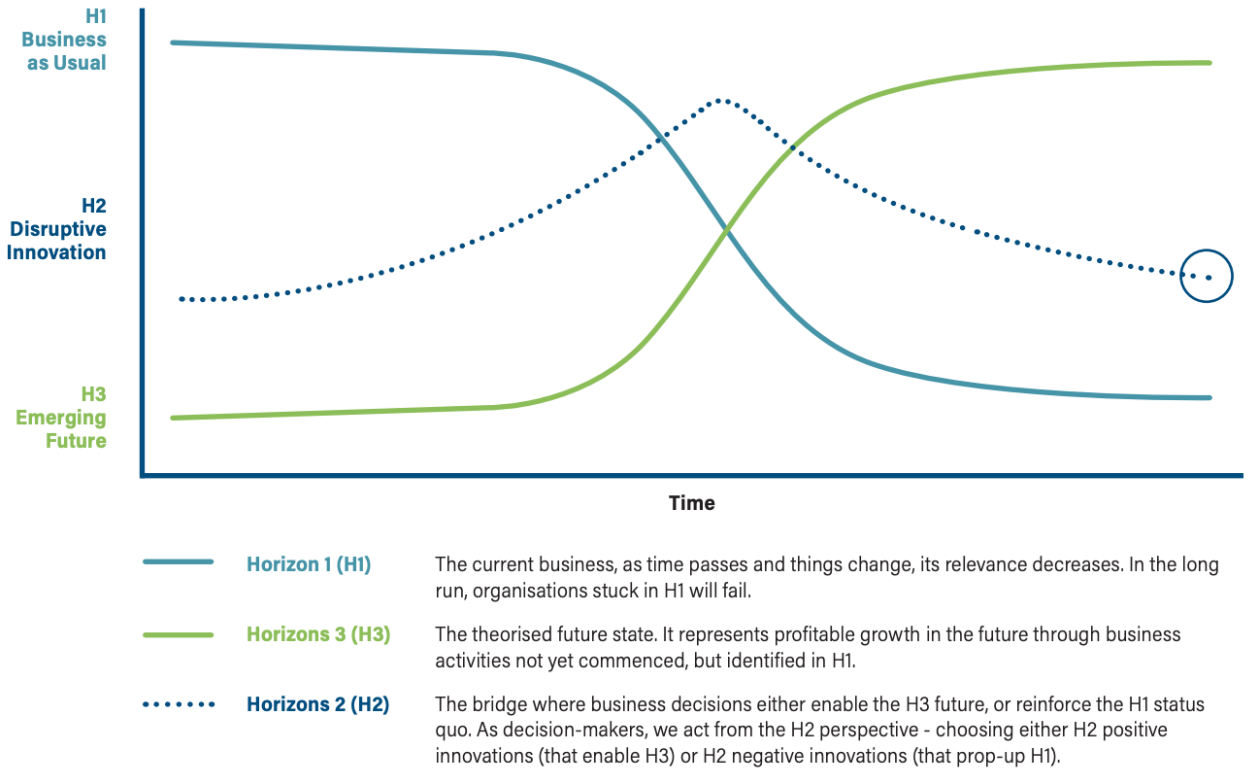


Figure 4 The Three Horizon model taken from John Foley's report

Using the explanations in the figure above, The sheep sector is in horizon 1. The reality is that the Irish sheep and beef industries are in a state of decline. There was 4.8m sheep in the Republic of Ireland in 1992, and now there is 2.7m in 2022.

Efforts by the industry such as Sustainable Beef & Lamb Assurance Scheme, the use of genetics and the formation of the wool council are all positive Horizon 2 contributions. These efforts will improve the sector through optimisation, efficiency and incremental increases in output, but are they enough to make the sector attractive to new entrants or sustain family farms? Teagasc must be respected because the results from the demonstration farm in Athenry do provide a degree of hope; however, for whatever reason, these outputs are not reflected in the national average.

The sheep industry is the largest entrant into the government's organic scheme. This is despite 70% of the organic lamb currently being sold as conventional lamb. Alongside this, the government has introduced a sheep subsidy of €20/ewe, which is supporting the sector. While these funds are essential through extraordinary events such as Covid-19 pandemic and the cost inflation caused by the war in Ukraine, the author would argue that both the organic and direct subsidies could be seen as negative horizon 2 developments as they are propping up the sheep sector's horizon 1 practices.

Could some of these funds be directed towards a "Horizon 3" ambition for the sector?

To quote the respected former Secretary General of the Department of Finance, TK Whitaker, voted Irish man of the 20th century:

"If we do not expand production on a competitive basis, we shall fail to provide the basis necessary for the economic independence and material progress of the community."

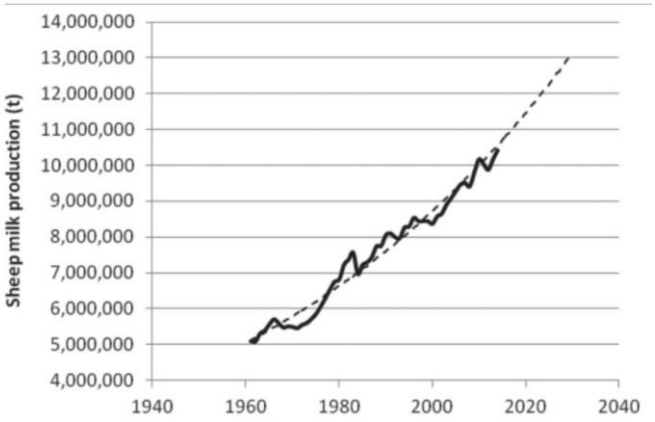
New Zealand has realised this. They realized they had to find a way to create a viable, profitable future for their sheep sector. In 2016, they developed a public-private investment programme aptly called Sheep—Horizon 3. The focus of this programme is sheep milk. The goal is to develop a billion-dollar sheep milk industry, and they are making great progress. This model is in the appendix.

This report will explore the viability of creating a large-scale sheep milk industry in Ireland, and as the author believes this is the first Irish Nuffield report focusing on the sheep sector, the author will also provide a broad introduction to the wider sheep sector and its challenges.

The author hopes that by presenting this report, the industry will consider sheep milk as a possible option towards increasing the viability of the sheep milk sector and as a way of providing full time income opportunities to young Irish farmers.

9. Intro to Global Sheep Milk Production

There are currently 10.5 billion litres of sheep milk produced globally, accounting for 1.3% of global milk production. There has been a steady growth of sheep milk across the last century. Typically, it plays a significant role in remote areas with less favourable land conditions, thus adding to the resilience of rural farm incomes. While sheep meat production slowly decreases, sheep milk has shown to be robust over the past 25 years. For example, lamb consumption has dropped by 55% in the UK from 2008 to 2019. While the UK is the largest export market for Cypriot Halloumi, a traditionally sheep milk cheese, which has doubled product sales between 2013 and 2017 to €163m (Stewart, 2021) (Vines, 2018).



(Pulina et al., 2018)

Figure 5: Sheep milk volume growth

Figure 6: Global Sheep milk Production	
829 Billion litres (BL)	Total Global Milk Production In 2019

Milk by Species				
Cow	Buffalo	Goat	Sheep	Camel
81%	15.1%	2.2%	1.3%	0.4%
671 BL	125 BL	18.2 BL	10.5 BL	3.3 BL

Organic Cow	0.9%	7.5 BL
Irish Dairy	1.0%	8.7 BL

(KPMG, 2018) (Bord Bia, 2022)

Where is it produced?

Sheep milk centres around the Mediterranean, North Africa, the Middle East, Asia, and China. However, the industrialised sheep milk sectors are based around the Mediterranean basin. It is estimated that 46% of the world's sheep milk comes from this region.

Figure 7: Sheep milk around the Mediterranean basin

European sheep milk production across the four main producers (FGIS): Spain (514m), France (296m), Greece (700m) and Italy (540m) = 2050 million litres. Interestingly, there is more sheep milk produced in Greece than cow milk.

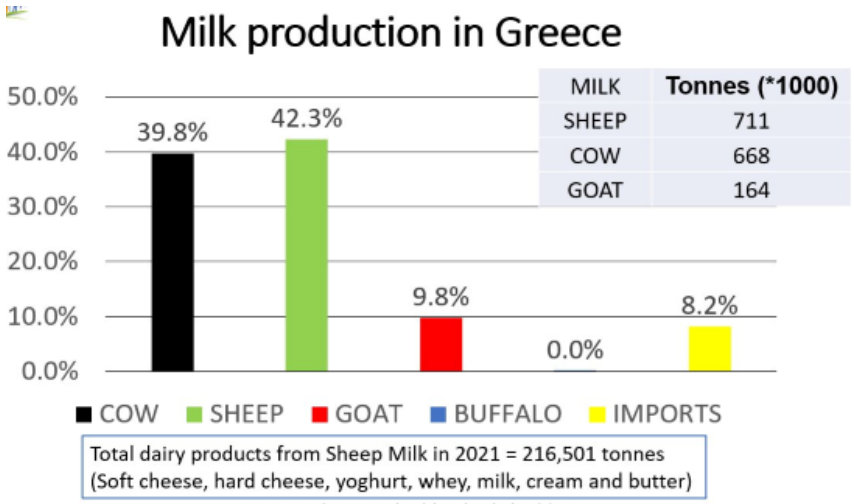


Figure 8: Milk production in Greece

Diversity & adaptability of production methods

A key strength of the European sheep dairy sector is the adaptability of sheep, leading to a wide diversity of production systems. These range from extensive models, such as Greece's traditional transhumance systems, to highly intensive, fully indoor operations with farms managing over 3,000 ewes, as well as many systems that fall between these two extremes.

Sheep can forage and survive in many environments, and thus, the management of sheep is generally linked to the natural resources available; this means huge diversity in the sheep dairy sector in terms of the genetics, inputs, level of mechanisation, and thus the outputs and resulting productivity metrics.

Many farms have two important incomes: milk and meat. The offspring from dairy sheep are not considered a waste product, which would be the case for other dairy systems. In Israel, many farms have three lambings in two years, leading to a large output of meat and milk. The strong domestic price for lamb mainly drives this. (Lebovich, 2016)

With the production system, milk production can vary from 100 litres per ewe per year in extensive systems to 1000L+ per ewe in intensive systems. Interestingly, there is still a large number of sheep being hand-milked across Europe; this is seen mainly in transhumance systems in Greece.

The management of the lambs can also vary from entirely artificial rearing (Spain/Italy), to leaving the lambs on ewes for two days (NZ) or, in the case of France, who allow the ewe rear the lamb for up to 30 days.

Why is sheep milk consumed?

Ease of digestion

Studies suggest that sheep milk is an excellent alternative for individuals who struggle to digest cow's milk, as it is less likely to cause sensitivities or digestive discomfort.

Sheep milk is naturally an A2-type milk, free from A1 beta-casein protein found in most cow milk, which has been associated with digestive discomforts such as painful cramps and bloating. Proteins in sheep milk differ from those in cow's milk in structure and composition. Sheep milk is also higher in short to medium-chain fatty acids, which makes it easier to digest.

Nutrition

Fresh sheep milk has higher levels of vitamins - A, B_1, B_2, B_6, B_{12}, C, and E and minerals – Calcium, Magnesium, Phosphorous, and Zinc than cow and goat milk.

Sheep milk naturally contains up to 60% more protein and calcium when compared to goat and cow milk. Sheep milk has naturally eight times more lactoferrin than cow's milk and four times more than goat's milk. Lactoferrin is a dairy bioactive that has immune-boosting properties.

Taste and tradition

Sheep milk's taste profile is like cow's milk but creamier. It differs from goat milk as it doesn't have a strong aroma and no salty/gamey flavour. Non-cow milks sell on their unique taste and texture profiles (Mintel: Beyond cow). Non-cow's milk benefits from a positive health perception in some markets. Australian and US consumers see non-cow milk (goat and sheep) as more natural. (Mintel, 2021).

Sheep milk is a traditional product with substantial cultural significance across the world. This is evident when analysing the Protected Designation of Origin (PDO) label of the European Union, which safeguards traditional agri-food products.

Advantage of sheep milk for cheese

The overwhelming majority of sheep milk is consumed in cheese form. Sheep milk lends itself to cheese production because of its high solids (with high levels of fat and protein, and high calcium content), which results in sheep milk yielding more cheese per litre than goat's or cow's milk.

Comparing the milk composition of cow, goat, and sheep

Component	Cow	Goat	Sheep
Total solids (g/L)	120	140	**190**
Protein (g/L)	35	40	**60**
Fat (g/L)	40	50	**70**
Lactose (g/L)	50	40	50
Energy (kJ/L)	2,800	2,800	**4,200**
Calcium (mg/100 mL)	120	130	**200**
Phosphorus (mg/100 g)	120	120	**140**

Figure 9: Cow, Goat and Sheep milk composition
(Barnett et al., 2016)

10. Current outlook of the EU dairy sheep sector

The sheep milk sector in Europe is in an interesting state. Its flagship products (Feta, Halloumi, Manchego, Pecorino, and Roquefort) perform strongly with brand recognition globally. These regions focus on producing specialised, culturally significant products and this has helped protect the industry (milk of all types) from other dairy producers from around the world. However, there are several significant challenges that the industry faces as highlighted below.

Current perspective of the dairy sector in Greece & Spain:

Below is a submission to the EU Commission requesting urgent support for the sheep and goat sectors to avoid "imminent collapse".

10.10.2022
Question for written answer E-003325/2022
to the Commission
Rule 138
Ioannis Lagos (NI)

Subject: Imminent collapse of dairy sector in Greece

The dairy sector in Greece, with a workforce of over 350 000, is now on the verge of total collapse, with the cost of feed and energy having doubled since 2019, now accounting for 85% of production costs, while the cost of producing goat and sheep milk, net of labour, is now up to around EUR 1.64. This is forcing many farmers to slaughter or sell their flocks or simply leave them short of feed. As a result, Greek sheep and goat milk production was down by 1.5% in the first half of 2022, with a further 5% decrease expected by 2023, Greek exports of PDO products such as feta are in danger of declining and the rural exodus is expected to accelerate. At the same time, large dairy companies are taking advantage of the dire situation in which producers find themselves to keep purchase prices at cost level, notwithstanding the inversely proportional increase in supermarket prices.

In view of this:

1. Does the Commission plan to take drastic measures to keep afloat an industry hard hit by the crisis, given the inevitably danger of other primary sector activities being dragged down with it?

2. Will it step in to put an end to concerted practices by large dairy companies that are being given a free rein when it comes to profiteering at the expense of producers and consumers?

(Lagos, 2022)

According to one article in Spain, the author wrote: "The Spanish dairy sector denounces that it is losing competitiveness compared to the rest of Europe". "Spain has the most expensive milk at source paid to the farmer in the European Union (except Malta and Cyprus)." "In the case of sheep milk, the price paid at origin in Spain is the highest in the historical series, which is stimulating new and modern productions in other countries of the European Union" and not in Spain. (Europa Press, 2023)

Climate change

The biggest challenge facing the sheep milk sector in the EU is its location in the Mediterranean basin, typically arid, rugged regions. The Mediterranean region is widely acknowledged as one of the most exposed in the world to the effects of climate change, water scarcity, biodiversity loss and land degradation. (Antonelli, 2022). The region is warming 20% faster than the global average and is said to be in the "eye of the climate change storm" (Ibáñez Sales, 2022).

An example of this challenge is the flood from Storm Daniel in September 2023 in Greece, which is estimated to have drowned 100,000 dairy sheep and goats (Agriniosite, 2023). The sheep dairy sectors across Spain, Italy and Greece are economically, socially, and culturally important. Their governments support them during challenging times such as drought, but the author isn't sure this will be effective long term.

Traditional methods - poor uptake of modern methods

There is still a considerable prevalence of dairy sheep farmers utilising traditional farming methods. This can result in one or several of the following practices – hand milking, transhumance (nomadic), mountain regions, small-scale cheesemaking, and using rustic breeds. They use rustic breeds because they can operate in challenging environments where better dairy breeds can't survive. The challenge with traditional methods is that they are typically less economically attractive and thus struggle with generational renewal.

Reliance on one product

In October 2019, many EU dairy products faced a 25% additional tariff upon arrival in the US, impacting Italian Pecorino cheese exports, which rely on the US market for approximately 60% of their export sales. This tariff hike led to increased prices and reduced demand in the US. The COVID-19 pandemic further disrupted the global specialty cheese market in 2020, particularly affecting the food service sector, a crucial market for specialty cheese, which faced closures during the pandemic.

Generational renewal

Social isolation and the low social rank of sheep farmers, who tend to be dispersed in rural areas, have led to challenges such as labour shortages and generational renewal. This is exemplified best in Spain, where the term "La España vaciada" ("emptied Spain") "encompasses agriculture-reliant regions in the vast interior of the country such as Castile and León and Castile-La Mancha" – the main sheep milk producing zones. The province of Zamora, in Castile and León, has seen its population drop by over 30 per cent since 1975 (Hedgecoe, 2022). In Sardinia, the sheep milk industry has started to recruit shepherds from Kyrgyzstan to provide labour to the industry (Borrelli, 2023).

Other challenges

Copy-cat products such as Feta style (white) cheeses & failure to protect names in export markets are also a concern.

Sheep milk deficits

- The supply is struggling to maintain and meet the market demand for sheep milk products.
- In Spain, there has been a drop of 9.8% in the number of sheep dairy farmers in Spain from 2021 to 2022. In the accumulated of the first five months of 2023, Spain shows a reduction of 6.1%, falling from 234.8 million litres to 220.5. (Agronews, 2023)
- In France, 294.4 million litres of sheep's milk were delivered to industry in 2022, a decrease of 2.5% compared to 2021. (DRAAF, 2023)
- In Greece: More than 10,000 sheep and goat farms, with more than 500,000 heads of livestock in this category, have been absent from this sector in the last three years.

Sheep Milk Price

- The average sheep milk price in Spain for the past 5 years is €1.33/L (2020-2024) (CLAL, 2024). This is similar around Europe.

Greek Insight

During his Nuffield scholarship, the author visited Greece. Epirus Dairy (Greece) has developed its own intensive farms to serve as demonstration farms for its suppliers and to bolster its own supply to their factory. They are concerned that their suppliers are not adapting modern methods to their farming, and thus, their supply is at risk. It currently has plans to build 3 more farms. In Greece, they predict that changes that will occur in the sheep and goat sector will mirror the changes that the cow dairy industry has had over the past 20 years, which has seen a decline. Greece is exceptionally deficient in cows' milk, amounting to only 40% self-sufficiency (Siafakas, 2019).

Figure 10: Sheep feeding belt and lamb rearing system in Greece

The above two pictures show the intensive set-up of the Epirus dairy's own farms. They have the best technology and data collection as they try to push the industry and their farm suppliers forward.

Figure 11: Feeding mixing silos and outside a sheep dairy processing plant

On the Epirus farm, they control the diet by making up their own feeds on-site. The picture on the right is me outside one of Epirus's main Feta factories. Below is a 64-bail rotary milking parlour from the equipment supplier Milkplan from Greece. It is capable of milking 600-800 sheep per hour.

Figure 12: Sheep rotary parlour in Greece, supplier - Milkplan

New Zealand Outlook

Due to sheep milk's nutritional and digestive qualities, it is increasingly sought after as an alternative to cow milk products, particularly in Asia. The New Zealand sheep milk industry is targeting this. The emergence of New Zealand is a fascinating proxy for this industry for Ireland. See the perspective of Stuart Gordon, CEO of the Waikato Innovation Park, where the two sheep milk dryers are located; this was taken from Stuart's LinkedIn.

Figure 13: NZ perspective from an industry CEO, Stuart Gordon

The opportunity that New Zealand is targeting relates to the fact that the Goat milk infant formula sector has grown from a $0.9 billion market to an estimated $13.6 billion market in 10 years; the belief is that sheep milk can mirror this growth over the next few years because goat milk has broken down the consumer barriers that milk can come from animals other than a cow (Nuchev, 2019). The OECD forecasts that by 2030, there will be an additional 3 billion middle-class consumers in Asia, and an estimated 70% of Asians are intolerant of cow's milk. This provides the sheep milk industry with an opportunity to fill the gap and market to consumers who are intolerant of cow's milk. (NZIER, 2018)

In her report titled: Business Plan for NZ Sheep Dairy, Lucy Griffiths, Nuffield Scholar, said sheep milk has the potential to be "a billion-dollar industry for NZ". NZ are on their way to this target, and much of their learnings will be shared throughout this report.

Conclusion

Sheep milk has a strong position in the premium cheese market. It has responded favourably to cost inflation, with products such as Pecorino and Feta continuing to be sought after. Sheep milk is not a typical commodity. It is not traded like whole milk powder. Only Pecorino Romano has an auction system. Milk production per ewe continues to grow, and with consolidation, it remains one of the key tools to keep the industry economically sustainable.

However, the fundamentals of producing sheep milk (or any other milk) around the Mediterranean basin have been challenged in recent years due to the effects of drought and the high cost of inputs. The intensive producers are reliant on bought-in feed for their housed flocks.

It must face the challenges of renewing its producers in the context of the rural population and the accentuation of extreme climatic events, which call into question the sustainability of dairy systems, both intensive and extensive. There is a new embedded cost of producing milk (cow and sheep), and the generational change will mean that there will be more intensive and larger-scale production from fewer farms.

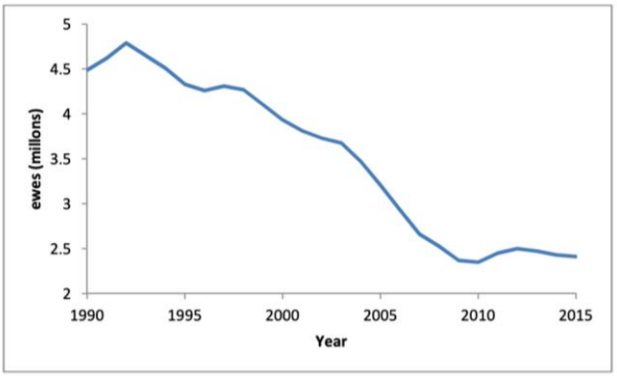
A good proxy for sheep milk is the movement of the wine industry into the UK. Nearly £480 million has been invested in English vineyards over the past five years as southern Europe becomes less suitable for certain types of grapes. (FarmingUK, 2023)

Despite the challenges, the sheep dairy market is a significant, lucrative opportunity for those who can produce milk efficiently.

11. The Irish sheep industry

Numbers:

- Sheep production engages the second-largest number of farmers among all farm sectors in the country.
- There are 36,163 active sheep farms, accounting for 2.7m breeding ewes in 2021. The size of the national ewe flock declined dramatically since its peak (4.8 million) in 1992.
- Ireland is the fourth largest sheep meat exporter worldwide and the second largest exporter of sheep meat in the EU. A total of 2,922,046 sheep were processed in 2022.



(Keady & Hanrahan, 2016) *Figure 14: Number of ewes in the national flock between 1990 and 2015*

Economic value:

- The sheep industry is an important economic component of our local economy and generates wider economic activity and employment in rural communities nationwide.
- The sheep sector is strongly export-oriented, and in 2022, exports to over 35 countries were valued at €476m, an increase of 17%, with over 75,000t of sheep meat exported representing a 10% increase. CAP payments are hugely important to the Irish rural economy each year. (IFA, 2023)

Environmental and societal value:

- Irish sheep meat production aligns seamlessly with our national drive for a sustainable Agri-Food sector, boasting strong environmental credentials.
- Sheep farming thrives on challenging terrains, fuelling socioeconomic activity in these regions. This, in turn, significantly contributes to the biodiversity and broader environmental goals across the country where sheep farming is practised.
- Sheep meat plays a central role in many religious celebrations, ensuring its continued importance in key markets. Notable examples include Eid al-Adha (Islam), Passover (Judaism), and Easter (Christianity).

Export markets:

- Domestic lamb consumption accounts for approximately 24% of total sheep meat production, the balance being exported primarily to Europe. France and the UK are our principal markets for sheep meat and account for 30.5% and 26% of sheep meat exports, respectively.
- Over 70% of Irish organic lamb is sold into conventional markets (McCullough, 2016). Despite generous organic subsidies, many farmers continue to enter the scheme—even though the lack of dedicated processing and market channels means most organic lamb loses its premium. This represents a clear supply chain and market failure: the system incentivises organic production without ensuring the infrastructure or demand to support it.

Challenges

- Gross margins on sheep farms decreased by 14%, while net margins decreased 81% to €7/ewe in 2022, which included the SWS payment. €7/ewe return in the sector is unsustainable.

Cost and margins on € per ewe basis			
	2021	2022	Difference
Gross Output	200	215	15
Concentrate Feed	32	38	6
Pasture & Forage	21	45	24
Other Direct Costs	22	23	1
Total Direct Costs	76	107	31
Gross Margin	125	108	-17
Fixed Costs	86	101	15
Total Costs	162	208	46
Net Margin	39	7	-32

(IFA, 2023) *Figure 15: IFA calculations on Sheep margins from an IFA circulation document*

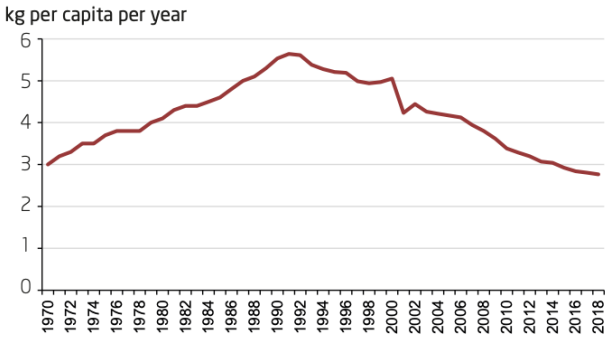
- Sheep farming is a vulnerable low-income sector that heavily depends on direct payments for their income. Direct Payments contribute over 100% to overall family farm incomes.
- Low incomes are prohibiting new entrants to the sector. In 2020, only 7% of sheep farmers were under the age of 35. "The average age of a sheep farmer is 56 years of age. We are not encouraging young people to get into an important agricultural sector" (Ryan, 2022)
- Limited adoption of technology and advanced practices has kept lambs reared per ewe rates stagnant across the industry.

	1993 to 1995	2013 to 2015
Stocking rate (ewes/ha)	8.5	7.5
Lambs reared per ewe joined	1.3	1.3

(Keady & Hanrahan, 2016) *Figure 16: Changes in flock productivity in the past 20 years*

Market outlook for Irish Sheep meat:

- Lamb is an expensive meat compared to beef, pork or chicken. Consumption weakens when inflationary or recessionary pressures are put on consumers.
- Another significant industry challenge is consumption in the key export markets. In the UK, lamb consumption has dropped by 55% between 2008 and 2019 (Stewart, 2021). In France, consumption has fallen from 5.5 kg per capita per year in the 1990s to 2.8 kg per capita per year in 2018, which equates to close to a 50% drop (FranceAgriMer, 2020). This contrasts dramatically with certain sheep cheeses – Feta, see below.



(FranceAgriMer, 2020)

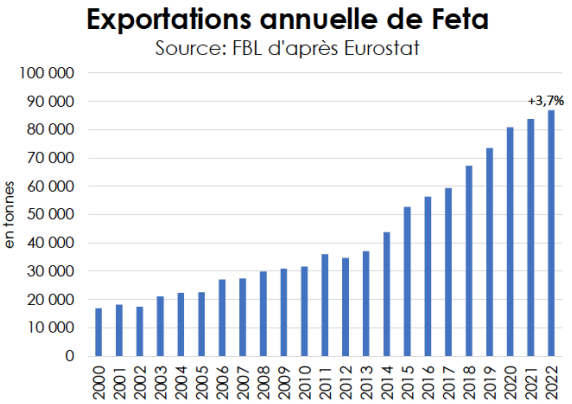


Figure 17: Annual lamb consumption per capita in France and growth of feta exports

- In the last few years, Australian and New Zealand (ANZ) producers have gained considerable access to the UK market post-Brexit and increased their quota to the EU market. This will mean increased competition for Irish farmers. The ability of ANZ farmers to produce lamb for considerably less than Irish farmers remains a significant challenge. See the prices below in the various markets. ANZ prices are between 40% to 50% cheaper than Ireland in 2023.

(Bord Bia & McMenamin, 2023) *Figure 18: International Lamb Prices 2022-23*

Industry and Government response:

- In 2016, the government introduced the Sheep Welfare Scheme, which provided a payment of €10/ewe if the farmer committed to specific actions to benefit their flock and, as a result, the industry. This scheme has since been called the Sheep Improvement Scheme, and the payment has been increased to €12/ewe and further increased to €20/ewe in the Government budget for 2024.
- In response to the wool crisis, the government initiated a €100,000 feasibility study for the market opportunities for Irish-grown wool. The author has comments on this in the appendix.

Conclusion

The Irish sheep industry is a professional and competent sector with established farmers and support structures. Through the likes of Teagasc and Sheep Ireland, the industry has been pushed forward with research and innovation. It is one of the leading exporters of sheep meat in the world.

However, the industry faces significant challenges. Wool prices have collapsed, and no real easy wins can be drawn from the wool feasibility study. Additionally, sheep meat consumption is down 50% or more in Ireland's two main export markets.

The prices being received by farmers are not viable. Family farm incomes are over 100% dependent on subsidies. Due to the scale that ANZ farmers operate at, lamb prices are still 40% lower than those in Ireland, with no subsidies. This is a scale and price that Ireland can't compete with. ANZ have also increased their access to the UK and EU markets. Irish lamb has recently gained access to the US and Chinese markets. However, the industry will be competing with ANZ in this markets as well.

The frustrating aspect of the current crisis is that the progressive farmers, who follow the latest research, implement technology and push output from their farms, will have been hit the most by recent cost inflation. No matter how hard they work or improve their farm, their ability to grow their income is limited; even before the recent crisis, between 2017 and 2019, only 3% of sheep farmers made over €50,000 per year.

The success of the dairy industry will have drawn many young people away from the sheep industry, which is already suffering from an ageing farmer base. To illustrate the problem, the Sheep chair of ICSA, Sean McNamara, made a stark claim: "It's all over. Farmers are not going to produce lamb anymore, that's it" (Agriland, 2024). It's hard to be positive about the industry in its current form.

The industry is crucial to rural areas of Ireland. From a government viewpoint, the industry also draws large CAP funding into Ireland and contributes close to €400m in export revenue.

The industry needs a vision for a viable future, as there is a feeling the industry is at a precarious stage. It needs a plan to tackle these challenges and/or adapt its approach.

12. The Rationale for an Irish Sheep Milk Industry

Why not?

The first question that arises is simple: why not? Why isn't Ireland exploring sheep milk production at scale? Given the sector's strong presence across Europe, there's no clear reason it couldn't also thrive in Ireland.

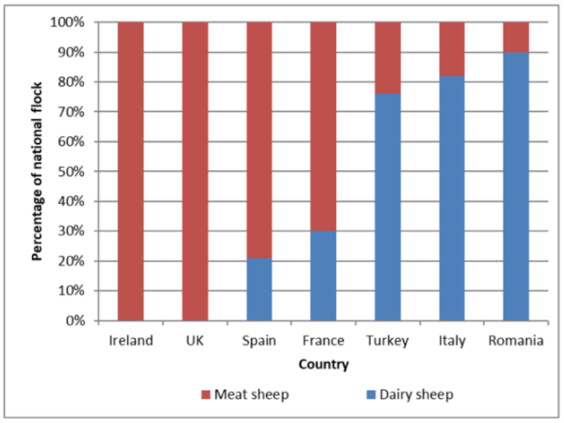


Figure 19: The ratio of dairy and meat-focused sheep for selected EU countries

Despite having a well-established sheep farming industry, Ireland (along with the UK) lags behind other European nations in developing a sheep milk sector. This gap is evident through initiatives such as the EU's SheepNet and the Life Green Sheep project, where Ireland remains notably absent. While countries like France, Italy, Romania, and Spain contribute significantly to both sheep meat and milk production, Ireland stands out as the only major player without meaningful engagement in sheep milk production (Eurostat, 2018).

New Zealand has recognised the opportunity to establish a sheep milk sector to complement its sheep and dairy sectors. Lucy Griffiths, a Nuffield scholar, completed a report and stated that sheep milk has a $1 billion potential for NZ farmers. A recent $20m project, Scale-up, co-funded by NZ government estimates a potential revenue of $750m- $1b by 2035. Ireland and New Zealand have always been linked through their grass based systems and export orientation so this is highly relevant to Ireland.

Wales have recognised the opportunity and recently, the Welsh government have committed £1.6m to sheep dairy research. (Sheep Dairy Wales, 2023). Reports estimate that the industry has a £100m - £400m potential.

Economic potential (on-farm)

Rather than develop a model, the author is presenting an independent New Zealand model to assess.

First model: 600 ewes on 40 hectares | Milk price of $13.80/kgMS | 320L yield in year 5

Existing infrastructure	Yes				
Farm size (hectares)	40				
Number of dairy sheep	600				
Expected shed design	20 bale swing or 30 bale rotary				
Expected capital cost	$200k - $400k				
FTE staff	1 - 1.5				
Year	1	2	3	4	5
Total milk solid production (kgs)	28080	29160	30240	32400	34560
Total gross profit	$387,504	$402,408	$417,312	$447,120	$476,928
Cash surplus after expenses	$87,504	$102,408	$117,312	$147,120	$176,928
Cash surplus per hectare	**$2,188**	**$2,560**	**$2,933**	**$3,678**	**$4,423**

(Venture Taranaki, 2022)

Figure 20: NZ Sheep Dairy model financials

This model most applies to an Irish context: 100 acres and under, one-person operation, low capex. The above model indicates a return of $4,423 per hectare (€2500 per hectare) after labour is paid. The milk price is in line with the European price as of October 2022, circa €1.35/L. On a per ewe basis, it is €164 profit per ewe after labour is paid.

In an Irish context, the above model would have 195kgN/ha, under the 250 or 220 derogation range.

It must be noted that the model above is based on 320L/ewe/year. NZ operators are already hitting yields of 350-400L. Ewes across Europe produce 1000L per year, so there is potential scope for higher yields.

In the appendix, there is another NZ model which has greater detail, showcasing a similar return.

The author is convinced of the economic merit and viability for farmers on smaller land blocks in Ireland.

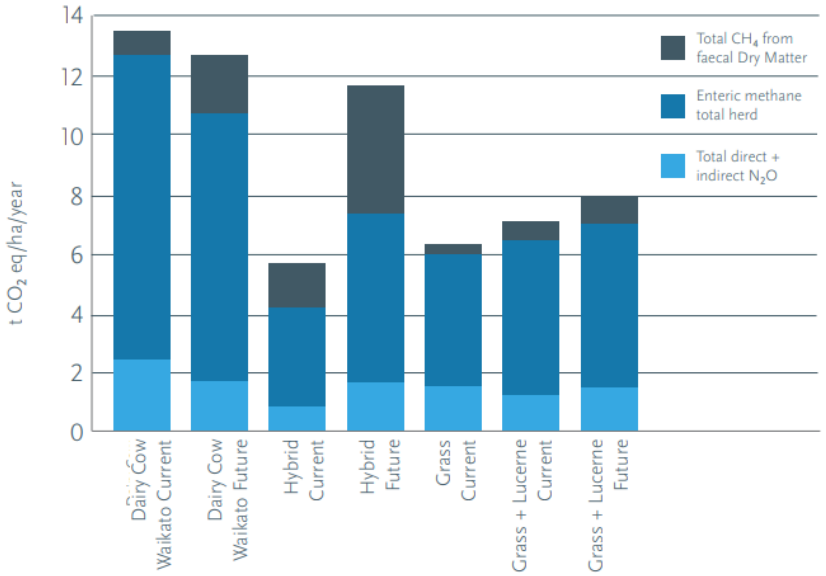
Limited farmer options

For small landholders in Ireland, transitioning into cow dairy farming faces challenges like derogation, high entry costs, and yield banding, making it increasingly difficult to justify. However, sheep dairy presents a more feasible alternative due to its lower capital investment requirements. Despite this, Irish farmers have limited alternatives beyond grass-fed livestock for generating a full-time income. Some recent options include supplying the biomethane industry, transitioning to organic farming for subsidies, or diversifying into forestry or solar energy, which can be compatible with sheep farming.

Environmental potential

All indications are that sheep milk production is an environmentally sustainable, low-impact way of producing high-quality nutrition, particularly from a grass-based system. There is strong anecdotal evidence such as: Gentle on the land, no slurry production, shorter milking season, carbon sequestration through wool production and even nicknamed the "golden hoof" through its ability to rejuvenate the land.

After anecdotes, New Zealand research indicates that sheep milk production is more sustainable than cow milk production based on per hectare. Alongside this, one of the main criticisms of Irish agriculture is its impact on water quality. NZ research indicates 30-50% less nitrates leaching than bovine. The chart below shows 2 dairy cow systems (in the NZ, first two on the left) against five various sheep production models - Showcasing that on a per hectare basis, sheep milk has a lower GHG emissions than cows.



(Day & Samuelsson, 2021) *Figure 21: NZ Environmental impact of sheep dairy compared to cow dairy*

The milk potential from grass #Grasstomilk

Irish agriculture's fundamental advantage is its ability to grow grass. It is the consumer's preference but its primary impact is its ability to provide a low, resilient cost of production.

The ability of Ireland to produce milk from grass is evident by Bord Bia's Grass-fed standard. The minimum acceptable grass-fed figure for an individual herd to qualify as grass-fed is 90% on a fresh weight basis. It is estimated that 99% of Irish dairy farms meet this grass-fed threshold.

On a dry matter basis, Irish dairy cows are averaging 82% of their intake from grass (60% from grazed grass + 20% from silage). The remainder comes from concentrates. The benefit of this is meant that, over the period of 2012–2017, the net margin of Irish cow dairy farmers was highest across EU countries. This is despite the milk price in Ireland being the lowest among the EU countries covered in the Teagasc study (Shalloo & O'Connor, 2020).

From a Irish sheep meat perspective, sheep also have a strong ability to utilise grass. In intensive mid-season prime lamb production systems, grazed grass accounts for 86% of total dry matter intake.

Comparing Spain to Ireland

Spain is generally accepted as the commodity producer of sheep milk in Europe. Typical Assaf breed's diet below across the year, with an average of 55% concentrate across all stages. The accepted average dry matter intake (DMI) of high-producing dairy ewe is 3kg (Ledda, 2023).

Stage	Concentrate, kg/d	Forage, kg/d	Concentrate, %
Mating	1.49 ± 0.07	1.18 ± 0.06	55.2 ± 1.7
Late pregnancy	0.94 ± 0.03	0.95 ± 0.05	50.8 ± 1.7
Early lactation	1.97 ± 0.06	1.31 ± 0.06	60.5 ± 1.5
Midlactation	1.74 ± 0.05	1.43 ± 0.06	55.6 ± 1.5
Late lactation	1.09 ± 0.05	1.25 ± 0.07	47.1 ± 1.6
Drying-off	0.45 ± 0.03	1.02 ± 0.06	32.2 ± 1.9

(Milán, 2011)

Figure 22: Assaf sheep diets in Spain

On the author's travels in Spain, to Torrenaya farm, which has 3000 ewes, of which there are 2000 milked at any one time. The farmer, Luis Bravo, explained that the ewes had a DMI of 3.2kg. His flock average was at 700L/year. The farm has 12 lambing periods per year.

Irish costs: From Teagasc figures, grazed grass costs circa €75 per tonne DM, pit silage circa €160 per tonne DM, and concentrate approximately €250 per tonne. (Teagasc, 2018)

Advantages of the Irish/NZ system

The advantages of the Irish system are probably best illustrated in the below table based on Irish and NZ research, presented in the Positive Farmer's report on grass-based production. The table first illustrates the relative cost advantage of grazed grass vs concentrates. Secondly, the table shows the strong importance of various metrics in a farmer's business i.e., the low cost of production or production per hectare are much stronger influences on profitability compared to yield per cow/sheep, which is the only factor which Spanish farmers can work on. For context, in New Zealand now on Maui Milk's Wakino farm is achieving 400L/ewe/year from an 80% pasture diet (grass, lucerne, chicory).

Table 1: Relative costs per kilo of dry matter

	€
Grass	1
Grass silage	2.5 to 3.0
Concentrates	4 to 6

Table 2: Drivers of Dairy Farm Profitability

Factor	Correlation with Profit	Relative importance for profitability
Cost of production	0.70	14 x
Production/ha	0.36	7 x
Production/cow	0.19	4 x
Extra feed per cow	0.05	1

Summary of 20 years NZ Dairy Economic Survey data

(Positive Farmers, 2015)

Figure 23 Relative costs of feed, drivers of farm profitability

Sheep Milk - Efficiency

Analysing the differences between milking sheep and cows, a significant factor to think about is to evaluate the efficiency of sheep in transforming grass into milk. Sheep possess the ability to convert dry matter into milk at a rate comparable to cows. The research below is from Spring Sheep NZ, where in 2018, still very early in their genetic development, from a pasture-based ewe was recording a feed efficiency of circa 12% kgDM to kgMS. This compares favourably to Irish dairy cow's feed conversion (Spring Sheep, 2018).

Product & market fit

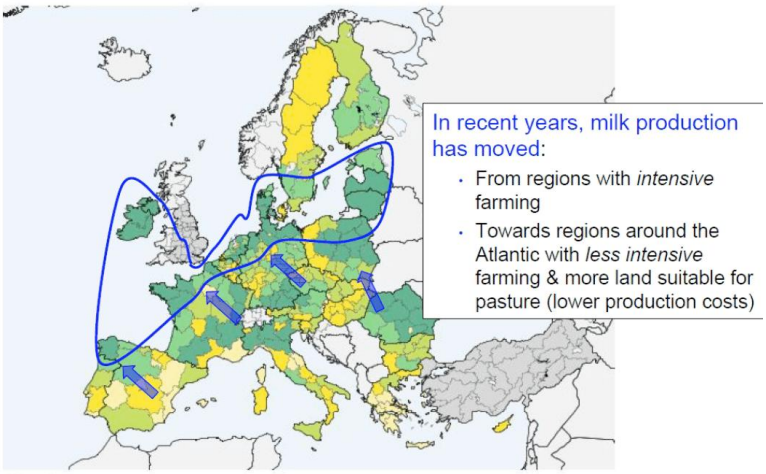
Cheese is the main product made from sheep milk. Ireland is a world-leading exporter of cheese. Ireland is the 2nd largest cheese producer per capita in Europe, largely thanks to its co-operative industry, including Ornua. The main markets for sheep cheese are the US, UK and Germany, and there is wider global appeal. These are markets in which Ireland has strong brand recognition and distribution. For example, circa 50% of the exported Pecorino Romano goes to the US market. Sheep milk cheese can be a good fit for Ireland in terms of production and export.

Challenges facing EU sheep milk sector - supply deficits.

The rationale for Ireland exploring sheep milk is only strengthened by the challenges faced by the sector across Europe. These challenges were explored earlier in this report.

As analysed by the European Parliamentary Research Service (EPRS) in 2012, these challenges have seen EU milk production move towards the Atlantic regions. See the following map of the trends and note all arrows away from the major sheep milk countries, towards Ireland! (EPRS, 2012)

Map 1 – Movements in milk production at regional level in the EU



(EPRS, 2012)

Figure 24: Movements of milk production at a regional level in the EU

Partnership with the Irish dairy cow sector

The Irish dairy sector is still predominately farmer owned and controlled and under the ICOS banner, there are 17 dairy co-ops, 10 of which are processing businesses. Dairy exports are dominated by Ornua, a co-operative owned by the majority of those dairy co-ops. The impact and scale of the Irish dairy make it a very significant indigenous industry. In 2022, EY reported that the total output of €17.6billion. See summary below. One of the best rationale for building a sheep milk sector in Ireland is the ability to partner and leverage off all the expertise, networks and assets that the industry has.

Figure 25 Summary of EY's report on Irish dairy

Since the removal of quotas, Irish dairy has grown by over 50% and has delivered a profitable farm enterprise for its farmers. However, this period of expansion is over. The estimate milk volume growth between 2023 and 2030 is 0.6% annually to 9.2bn litres. This is mainly due to environmental regulation and impact of generational renewal. However, this slowdown was not anticipated by the co-ops, where it was predicted that the annual production would approach 11bn litres by 2030. As a result of this, there has been considerable overspend on capex across the country. Recently, Arrabawn announced the closure of a milk bottling plant and Lakeland announced the closure of 3 plants, including a spray drying facility in Lough Egish. This is all before the decision on Ireland's nitrates derogation is made.

Alongside this, the seasonal nature of Irish dairy milk supply results in average capacity utilisation of approximately 62%, with other EU countries achieving over 92%.

The total milk intake in 2023 was 8.5bn litres, down 4% on the previous year. In 2024, the new Tirlán/Royal A-ware JV cheese factory will come on stream, which will require 500m litres, nearly 6% of the milk pool.

Both Lakeland, Tirlan and Dairygold have announced that they have established investment funds to diversify their operations, as they seek value add opportunities, seen by Dairygold's acquisition of Vita Actives, that could end up close to €100m.

Why would the sheep sector partner with the dairy co-ops?

The rationale for the sheep milk sector is clear. By leveraging the strengths and networks of dairy cow co-ops, the sheep sector can potentially access markets, benefit from economies of scale and access processing assets without carrying the capex spend.

Why would the dairy co-ops start processing sheep milk?

- High value utilisation from stranded/underutilised assets.
- New milk pool from existing catchment areas, therefore, strengthen their communities.
- Strong ESG credentials of the industry.
- Complimentary products and markets to existing operations.
- Economic return.
- Create a more robust rural economy.
- Some of the co-ops may value sheep milk as a method of diversification which may help them remain independent.

By working together, the Irish sheep milk sector and the dairy industry can create a win-win situation.

Summary of Rationale for building the sector

NZ has proven, after a short genetic development period, that they are producing 350-400L/ewe from an 80% pasture-based diet.

Pasture-based diet will have a significant cost advantage over indoor systems across Europe.

Economically and environmentally, it is a good fit for Ireland.

NZ returns of €160/ewe, after labour is paid, is attractive.

Sheep milk is an efficient product to produce (good feed efficiency), comparable with dairy cows.

The current deficits and prices of sheep milk across Europe look set to continue. Dairy production of all kinds is challenged in Southern Europe.

Products and markets are a good fit for the Irish dairy ecosystem.

Irish farmers have limited opportunities to diversify beyond traditional sectors.

The timing of industry could be very good to link up with the Irish dairy co-op industry.

13. Vision for the industry

Bottom-up rationale - French sheep industry structure.

- In France, the national sheep flock can be divided into suckler (meat) sheep: 3.8 million heads owned by 36,000 farms, and dairy sheep, 1.6 million heads owned by 4,600 farms.
- Dairy sheep represent 30% of the French national flock.
- On average, there are 348 sheep per sheep dairy farm, compared to 105 per suckler farm.
- France has a similar economy and living standards to Ireland.

Top-down rationale

European sheep milk production across the four leading producers (FGIS): Spain (514m), France (296m), Greece (700m) and Italy (540m) = 2050 million litres.

Assumption: 5% reduction of FGIS milk pool over the next ten years = 102.5m litres

1% per annum growth in demand for FGIS's cheese products over the next ten years = 2242m litres

Potential deficit of 295m litres (2242-(2050-102.5)

The potential scale of an Irish dairy sheep industry

- Taking an all-island approach: 2.7m in the Republic and 0.95m in the North, so 3.65m breeding ewes.
- Assumptions:
    - If the French sheep dairy industry is at 30% of the national flock, then Ireland can achieve a minimum of 10% of breeding ewes.
    - An average flock of 368 sheep per farm on 70 acres (under derogation).
    - Purely focus on existing sheep cheese markets.

The immediate opportunity

Ireland can easily target 2% of this market. This requires circa 120,000 dairy sheep (3% of the flock on the island of Ireland) supporting 350 family farms. 41m litres converting to c.7000mt of cheese, resulting in an wholesale cheese value of close to €90m.

Long-term stretch target

10% of the sheep in Ireland transition to dairy production: 350,000 ewes producing 320L each, totalling 112m litres converting to 19,000mt of cheese. This would be 1000 family farms across Ireland making a full-time income. This is less than 40% of the projected sheep milk deficit from the four main EU producers.

Cheese value: €240m

Lamb would be available all year around as dairy sheep lamb earlier, lifting the average price.

Lamb value: 350K ewes x 1.2 x 19kg carcass x €8/kg = €64m farmgate + circa 35% processing margin = €85m

Total value: €325m (direct outputs)

EY economic multipliers from their dairy industry report (direct output €7b, total output 17.6b): 2.5x

Total impact: €800m

This would have a large stabilising impact on the sheep meat sector.

What is the ideal scenario?

In setting out the critical factors to success, from a farmer's perspective, for a sheep dairy industry, Gerard Buckley (Nuffield scholar) previously reported on the key factors that shape a dairy farmer's level of success and that are within their control.

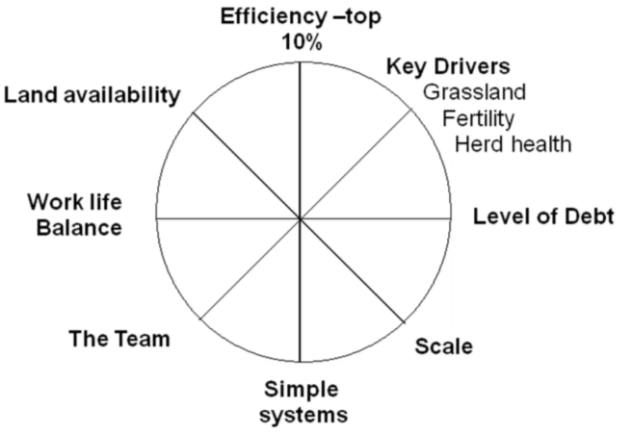


Figure 26 Key factors to success for an Irish dairy farmer (Buckley)

The industry will be: (Considering what made Irish bovine dairy a success)

- Grass-fed: To achieve cost competitiveness, resilience, and environmental sustainability
- Achieving the lowest production costs in Europe.
- Profitable to sustain a living on a on smaller land block (circa 75 acres).
- Labour efficient: a 1-person job and milking needs to be under 1.5 hours in the parlour.
- Manageable cost of entry
- Under one cohesive, vertically integrated structure to protect the value created and avoid excess competition.
- Partner with the Irish dairy co-ops to process and bring these products to market efficiently and develop multiple products for multiple markets - resilience
- A productive use of land. See author's comparison of systems in Ireland on output per ha basis.

Productivity per hectare Output focused								
				Meat Sheep		**Dairy Sheep**		**Dairy Cow**
			Number of animals / hectare	13		14		2.1
			Litre per animal			320		5700
			Litres per hectare			4480		11970
Milk solids	**Sheep**	**Cow**					Kg/hectare	
Fat	0.065	0.041				291	Fat	491
Protein	0.053	0.034				237	Protein	407
Lactose	0.05	0.05				224	lactose	599
			Fat and protein per hectare			529		898
milk price per L	€1.20	€0.45						
			Milk value per hectare			€5,376		€5,387
			Lambs per ewe	1.5		1.5		
			Slaughter carcass weight	21	kg	18	kg	dairy
			Lambs per hectare	20		21		calves
			Kg of lamb per hectare	410		378		considered
								no value
		Value per of lamb per hectar	€7.5/kg	€3,071		€2,835		
			Total output	**€3,071**		**€8,211**		**€5,387**

Figure 27 Comparing the estimated productivity per ha of sheep meat, dairy sheep and dairy cows.
Author's workings.

14. Insights for the Irish sheep milk industry

In this chapter, the author will provide insights, examples, research, and findings to initiate a discussion on creating a sheep milk industry in Ireland.

This chapter will focus on 5 areas:

A. Genetics insights
B. Farm Production System & Infrastructure insights
C. Products, Markets and Processing insights
D. Industry structure insights
E. Supports, Research & Funding insights

A Mission-Led Approach

Highlighted to the author by the work of two Nuffield Scholars, John Foley and Ray O'Foghlu

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To quote Ray's report:

"The Mission Approach", Economist Mariana Mazucattu proposes a mechanism to ensure that large and strategically important change not only occurs but does so in ways that are positively transformative rather than inhibiting. It is called the "Mission Approach".

"Complex problems require more attention to ways in which social issues interact with political and existing technological issues, the need for smart regulation, and critical feedback processes. Mazucattu sets out her five principles of a Mission approach:

1. They should be bold and address societal value
2. They should have concrete targets—so you know when you get there
3. They should involve research and innovation with technological readiness over a limited time
4. They should foster cross-sectoral, cross-actor, and cross-disciplinary collaborations
5. They should allow multiple competing and bottom-up solutions.

New Zealand Sheep Milk "Mission"

NZ has clearly taken the "mission approach" to the sheep milk industry and established a strategic framework for its expansion. See the framework in the appendix. It created a public-private partnership project called Sheep – Horizon Three. A six year programme which started in 2016.

- It aimed to build a high-value and sustainable New Zealand sheep dairy industry by building a fit-for-purpose New Zealand sheep milk farming system, which is:

Suited to imported genetics | Commercially viable | Environmentally sustainable | Replicable by NZ farmers

- The programme targeted the creation of $200 million annual gross revenue for New Zealand's sheep dairy industry by 2030 and an aspirational target of $700 million in the same timeframe.
- Total project funding was $31.3m, with the Government contributing up to $12.56m.
- The project has since been followed up by another project called "Scale Up", because of the success of the initial project. The government contributed $7.9m to the $19.9m new sheep milk programme. (Beehive, 2022)

Ireland's view: There have been occasions when the Irish industry has come together, such as the John Malone Sheep report, but it wasn't seeking transformational goals (Malone, 2007). Ireland is starting to take a "food systems approach" to its food strategy, and therefore, this "mission approach" could be adopted.

Author's discussion:

The author believes this to be as relevant to Ireland as to NZ, where the clear strategic focus mobilises private and public skillsets and provides the basis for risk capital to fund potentially nationally important projects.

An Irish-specific framework could be adapted, taking lessons from NZ's approach.

As seen in the recent dairy expansion, the Irish farmer base will respond when national policy meets a clear opportunity.

Irish sheep milk has the potential to be a case for sustainable development in action, fitting in with numerous UN Sustainability Development Goals (SDGs). This should help unlock government support.

- Goal 2: Zero Hunger - sustainable food production systems to meet the global demand for food.
- Goal 3: Producing healthy, nutritious dairy products
- Goal 8: Decent work and Economic growth – creating employment opportunities in rural areas.
- Goal 9: Industry, Innovation, and Infrastructure – Scaling indigenous industries
- Goal 11: Safeguarding Irish communities, cultural and natural heritage
- Goal 12: Responsible Production and Consumption - Generating milk through grass-based systems involves harmonious collaboration with nature.
- Goal 15: Life on Land - Grass-fed dairy production fosters soil health.
- Goal 17: Partnerships for the Goals - Mutually beneficial partnerships across the value chain.

Figure 28: Relevant UN sustainability goals for the Irish sheep milk industry

A. Genetic insights

Key considerations for a dairy sheep in Ireland:

- Grass-based system – provides the multitude of benefits highlighted in previous sections.
- Suited to Irish climate – wet, outdoors, walking - requires a level of robustness
- Milk yield of 350L+ with high solids
- Milk quality (TBC & SCC)
- Good live-weight gain and meat quality of lambs - preserve the meat aspect of the sheep production.
- Good temperament/milk-ability, good udder conformation for milking, good fertility

Challenges:

- This sheep does not currently exist in Ireland. Small initial population to drive genetic gain
- Biosecurity – This must be respected when interacting with genetics from other countries.
- Balancing growth vs improvement: For example, a flock realistically needs to have a replacement rate of 35% in the early years to maximise genetic gain. However, this will slow the growth in the population size with such a high replacement rate. The result is that most females are required to contribute more lambs and milk, so a huge focus needs to go on selecting the rams.

Breeds

There are several good dairy breeds across Europe, such as the Lacaune, East Friesian and Assaf.

The characteristics of these breeds are similar as they are all from intensive/semi-intensive production systems. Some of the shared features are:

- Indoor/ hybrid model
- High-performing, potentially delicate animals, so they need good management
- High yielding > 350L+
- Medium to long lactations 170-300 days
- A diet consisting of concentrate and forages, TMR

There are other dairy breeds across Europe with lower yields and potential advantages to Ireland, (robustness, for example), but they aren't from dedicated breeding programs, which poses a challenge.

Spanish lessons www.assafe.es

- One of the leading dairy sheep breeding associations in the world.
- The breeding cert (appendix 1) shows the ancestry of the ram with the mothers hitting 900 – 1100L in their 2nd and 3rd lactations.
- Many farmers are at the stage where if the ewe lamb doesn't hit 400L in its first 150 days, they don't retain it.
- Many farmers in the association take daily milk recordings of each ewe, and then once a month, the yields are independently taken and verified by third-party technicians. The farmers commit to artificially inseminating at least 25% of the flock to the best available genetics, and if identified, they sell their best genetics to the breeding centre. The genetic centre, Ovigen, has 200 of the best rams to disperse across the network.
- Disease control – pasteurise colostrum before given to lambs, Farms have a high replacement rate.

Figure 29 Author outside the sheep breeding centre in Spain

French lessons

- A population of 800,000 dairy sheep on the Lacaune breed in the Roquefort region. 560,000 ewes are bred AI with semen from progeny-tested sires.
- Averaged gain of circa 5.5L/year over the past 30 years. This delivers year-on-year for the farmer's output and bottom line.
- Genetic traits selected have changed over time to focus not only on milk volume gain but also health, milk-ability, solids, etc.
- Suggestions:
- Farmers must respect the programme and the "greater good".
- Farmers with high-performing livestock must sell rams to society for distribution.
- Rams & AI must be coordinated. Data collection is essential (Labatut, 2017)

New Zealand lessons – huge learnings for Ireland

- There was no existing breed that offered a complete solution for the NZ industry
- Genetic diversity and hybrid vigour are essential.
- Both dairy companies established their own breeds from their internal breeding programmes.
- Maui Milk was led by the people who played a role in the KiwiCross cow and had a similar mindset for the development of the sheep sector: "Breed Agnostic", take all best available genetics, implement hybrid vigour, data collect, select based on a breeding index, repeat.
- In a relatively short time, NZ is now hitting sustainable yields of 350L+.

NZ Genetic Case Study – "Tap Tap"

- Twin ewe lambs (one is called Tap-tap) are born from:
    a. Lacaune ram from imported embryos from France
    b. First generation cross of mature NZ East Friesian ram and Coopworth (meat breed):
    c. Result: 50% Lacaune, 25% EF, 25% Coopworth
- In the first lactation, Tap-tap produces 376 litres in 171 days
    a. The estimated mature equivalent of 526L in 171 days.
    b. Twin sister did 295L in 153 days. **See the slides in the appendix.**

Conclusion: genetic gain can be rapid, cross-breeding works, and local genetics play a role.

Sheep Ireland

Sheep Ireland was established to implement a genetic improvement breeding programme for the Irish sheep meat industry and increase the national flock productivity and profitability. The skillset is in Ireland to advance sheep milking genetic development rapidly.

Sheep Ireland is also involved in the INZAC project, a multi-year project working with the best of Irish and NZ sheep genetics, which could be relevant and potentially extended to sheep milk.

B. Farm Production System & Infrastructure insights

Intro

At the farm level, it will be essential to incorporate transferable principles of cow dairy in Ireland by converting grass to milk to profit in a seasonal system. This is a differentiator and competitive advantage.

As Bill O'Keeffe concluded in his Nuffield report, titled "Efficient and Sustainable Expansion of Irish Dairy Farming": "We have the most sustainable dairy industry in the world, and as we expand that industry, we need to maintain that advantage over our competitors. As we push stocking rates on our milking platforms, we need to ensure that we don't incorporate inefficiencies or pose too much of a risk to the environment. When we sell a product to a customer, they take ownership of that product and its production cycle, whether it's a litre of milk or a tonne of milk powder. They demand a sustainable product across all social, economic and environmental measurements."

The lessons from an Irish dairy cow system are:

In an Irish dairy cow environment, David Kerr, Nuffield Scholar, suggested the following:

- In a "no frills" herringbone milking parlour, 60-80 minutes was a sustainable time, but he caveated it when he experienced on a large farm seeing 80 cows milked in 11 minutes as a reason for a rotary.
- Simple grass-based systems are easier to implement and duplicate. They can reduce labour costs. Complicated systems add stress and increase costs.
- Scale on its own will not improve the lot of Irish dairy farmers; efficiency is essential to derive any benefits from increased herd size.
- Family farm operations, in general, will achieve better outcomes than operations which rely on hired labour because of greater attention to detail.
- In summary, good grassland management coupled with fertile cows, good infrastructure and cost control are the keys to successful pastoral dairy farming. Adopting the KIS principle – Keep it Simple! (Kerr, 2006)

So, for Irish farmer adoption to occur, the following considerations will be made:

- Profitability
- Cost of entry
- Stability of outlet/price
- Predictable cost structures
- Labour efficiency

Key areas in the sheep dairy system are: Feeding | Breeding | Rearing | Milking | Housing

Spanish insights

- The main system in Spain is entirely indoor, and typical farms are milking all year round.
- FFG Ovino farm could have circa 1400 sheep, but 850 are in the parlour at any one time. The sheep are on intensive diets of concentrates with mainly Alfalfa, Maize Silage, and Soya. They have four feeding diets for the sheep, which often arrive already prepared for the farmer. These are for the dry period, before lambing, high production, and low production periods.

French insights

- As part of the PDO label for the Roquefort Cheese, the milk for the cheese can't be used until 30 days after lambing. The ewe rears the lamb. This results in a reduction in yield, but it is offset by the ease of management, no milk replacer, fewer losses and a better image to consumers.
- French system is more forage-based than Spain.

NZ insights

- New Zealand started it out with large capital projects on the demonstration farms. However, it is noted that they are moving towards more approachable farm conversion projects.
- They maintain the option to keep ewes partially indoors but the aim to maximise the pastoral-based system. Farmers in NZ use various methods to deal with the lamb.

Existing infrastructure

The assumption setting out is that the early adopters will have a good level of existing infrastructure and housing from their dry-stock enterprises. With that, the main investment will be a milking parlour.

Milking parlour

The type of milking parlour will have a significant impact on cost since the more automated the parlour, the higher the fixed costs. The trade-off is between higher fixed costs and less running costs (labour).

Since the start of 2023, DAFM has approved grants for sheep milk parlours. This helps negate another key concern of the farmer, the risk of investment in converting their dry stock farm to a dairy farm. However, rotary parlours are not part of the grant system yet!

A young farmer or woman's grant aid is paid at the rate of 60% up to a maximum of €90,000 per holding, while the standard grant is set at 40%. A maximum of €160,000 between two or more parties in a farm partnership. (DAFM, 2023)

Without providing any commercial information, the author received the following quotes from reputable southern European manufacturers:

- 24 x 2 Herringbone swing over parlour for €80,000 ex works. This is a basic installation without cluster removers and a milk tank. The estimated total cost of this project is estimated €130,000. If both the young farmer and the standard grant are applied via farm partnership, the parlour could be installed for €65,000. This style of herringbone would facilitate milking 300+ sheep per hour with one labour unit.
- 60-unit rotary for €120,000 ex-works. This was without cluster removers, assembly, building, milk tank, planning permission, three-phase electricity, or concrete work. However, all sheep rotaries are bolted to the ground, so they are a much lighter installation than the cow equivalent. The author estimates circa €200,000 +/- 10%. This can milk 600-800 sheep/hr.

It must be noted that the standard build of the expanding NZ industry is a 42-a-side herringbone shed. One supplier has 1400 ewes through this setup in 2 hours per milking at peak, with two labour units. They recommend this for anywhere between 700 – 1400 Ewes.

The case for grant-aided rotary parlour

The government should reconsider the lack of grant support for sheep rotary parlours if the farmer has a sufficient environmental plan.

45-unit rotary can be operated by one person and milk 400-500 sheep in an hour.

Milking sheep, similar to cows, is different as there are more clusters to put on, so they can benefit from rotary at a small scale.

The merits of this is significant. The two main sources of cost in the typical lowest-price sheep milk zone in Europe (Castilla y Leon, Spain) are feed (at 61.6% of total cost) and labour (at 18.2%) (Milán, 2011). Ireland can't compete with the cost of outside labour in Southern Europe, so Ireland must use technology where impactful. Farmers must be supported to compete here.

Where this project struggles is in the event that the farmer requires additional labour or milking becomes or is perceived to be an arduous task, which it shouldn't.

Sheep milk rotaries are fundamentally different to cow milk rotaries:

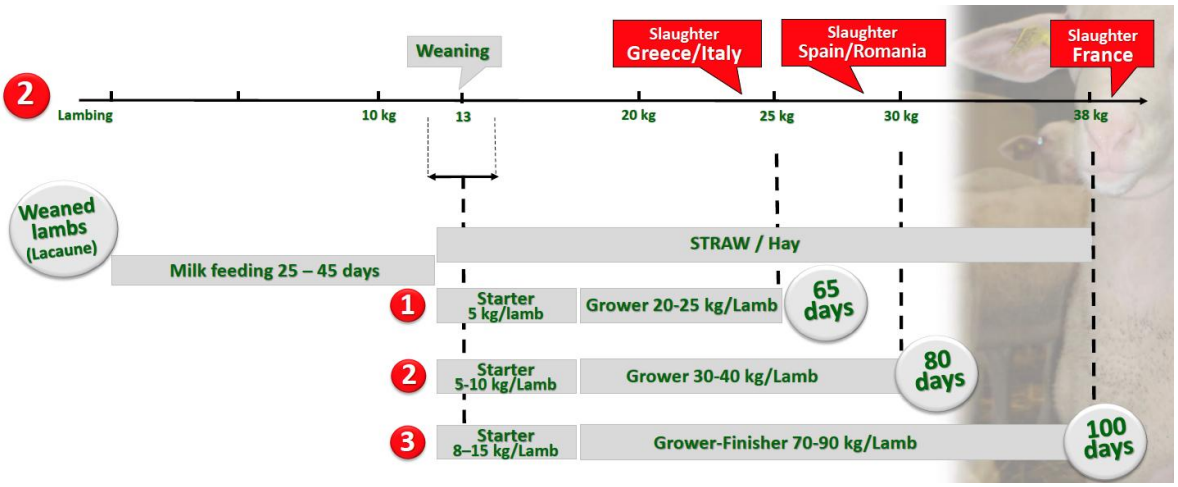
Not major developments with a small footprint (bolted to the ground).

Sheep need to be milked out in a timely fashion (welfare risk)

Small-scale rotaries are available (30 bale rotary in NZ financial model for 600 ewes).

Lamb rearing insights

40% of the lamb in Europe comes from dairy sheep. It is not a by-product of the system. The lamb can be naturally reared by the ewe or the lamb can be taken away immediately or after 2/3 days and placed on milk replacer. The French system is probably most interesting to Ireland. The lamb is reared for 30 days by its mother and then the lamb goes to specialised fattening units. After 100 days, the lamb is hitting a 38kg bodyweight and ready for slaughter. The lamb contributes 20-30% of the income. This system (with breeding) is interesting from an Irish perspective. See figure below.



(Aoun, 2021)

Figure 30 lamb system across Europe

C. Products, Markets and Processing insights

Having explored the current sheep milk market and its products briefly throughout the document, the author will cover the two main product opportunities here from a practical point of view.

The seasonal pattern of milk production in Ireland, which follows the grass curve, has both advantageous effects at the farm level and detrimental consequences for processors. For processors, this situation leads to poor capacity utilisation (previously discussed) and a narrower range of products, predominantly centred around the creation of lower-margin, storable dairy commodities.

Cheese

From the developed sheep milk industries (FGIS), the end products for sheep milk are predominately cheese. As previously mentioned, the characteristics of sheep milk (high solids and calcium) make the milk very good for cheese manufacturing. For Pecorino Romano, the yield of milk (kg) to cheese (kg) is between 6:1 and 5.7:1. This compares with cow's milk hard cheese, which is typically 10:1 (Pulina, 2021)

With strong domestic consumption where sheep milk is produced, the three big export markets for these cheeses are mainly the US, Germany, and the UK. This is also where there is a strong reputation for Irish dairy.

Ireland has the expertise and manufacturing capabilities to produce cheeses, particularly hard cheeses and increasingly continental-style cheeses.

A significant amount of sheep milk is used in mixed milk cheeses, particularly in Spain, Greece, and Cyprus. This could lead to product development partnerships with the dairy cow industry.

In large-scale cheese production, milk makes up 88% of the production cost, so it is a low-cost way of converting milk into a saleable product (Chr Hansen). Importantly it can still be relatively cost-effective even at a modest scale.

The sheep dairy industry could seek suitable partners in joint venture (JV) arrangements. These joint ventures would bring together the milk supply with added technologies and marketing ability from proven companies to provide growth to both current and innovative new products. This has been a tool used by the Irish dairy cow industry:

- JV between Royal A-Ware and Tirlan to build a large continental cheese factory in Ireland, Kilkenny Cheese Ltd (https://www.kilkennycheese.ie/), opening in 2024
- JV between Dairygold and Tine to produce Jarlsberg

The additional attraction of cheese is that it can be both an everyday and a premium product, depending on how you approach the category. This is seen particularly in the likes of Feta, Roquefort, and Manchego, which command significant premiums over copycat imitations of the products.

Powder

There is an increasing demand for sheep milk powder and other nutritional products, such as infant formula, in Asia. This is currently being led by New Zealand and Asian interests. This is due to its unique digestion and nutritional qualities. For example, of the 786 infant formula recipes on the Chinese market, 213 (27%) are goat and sheep milk. This category is often referred to as the "Yang" milk category. (ChemLinked, 2023)

The challenge with milk powder is the impact of scale on cost is significant due to the high energy demand. There is a requirement for a medium-scale spray drying plant in Ireland because no spray dryer can currently produce sheep milk powder feasibly. MTL has a 100kg/hr dryer, which is an R&D scale. North Cork Creameries have a 2.5mt/hr, but it is dedicated to North Cork's supply and products. There is no in-between.

In 2012, New Zealand's first and only independent product development spray dryer. It was commissioned for $11m, primarily funded by the government-sponsored New Zealand Food Innovation Network. In the first five years of operation, this 500kg/hr dryer's clients exported more than $186m of product and invested

$143m because of having access to this facility to scale their businesses (Windsor Energy, 2021). As a result of the 500kg/hr, the decision was made to commission a second dryer that has 2.4 times the capacity of the older dryer at 1.2 tonnes of powder/hour. This cost $50m. (Rural News Group, 2020)

Other products

Ice cream | UHT | Yoghurt | Skincare

The author's current perspective is that none of these products have the volume potential of powder and cheese to deliver for the industry but can certainly play a high-value, niche role and potentially serve the domestic or UK markets well.

Author's Discussion

As the cow dairy industry consolidates, there could be scope to have one of the spray dryers to become a flexible operation to process sheep, organic cows and other kinds of milk and speciality products such as bovine colostrum and plant-based products. There is no reason it can't have the same impact as the Food Waikato dryer.

The stability and proximity of markets and conversion costs make cheese an attractive product. The author believes that the industry needs to develop a commodity-style product to build scale and provide a steady outlet. In tandem with this, the project needs a branded product that can deliver higher margins over time and develop a PDO cheese, focusing on the uniqueness of Irish grass-based sheep milk.

The Author visited SIAL and ANUGA Food expos in France and Germany during the scholarship. There is a significant interest in a new sheep milk pool from Ireland.

What was acknowledged was that Ireland can also become a profitable supply of sheep milk raw materials. Northern European dairy manufacturers depend on sheep milk supplies from Southern Europe. Ireland can feasibly transport bulk tankers of thermized milk in Northern Europe.

While it may take time to develop a quality hard cheese that the industry champions, undoubtedly, Ireland can produce and market a cheese that delivers consistently strong returns for the industry.

From a theoretical perspective, Michael Porter said there are two ways to compete in a global economy:

1. Being the lowest cost supplier of an undifferentiated commodity (price).
2. Providing the market with a unique or superior value in product quality, special features or after-sales service (differentiation).

The author believes Irish sheep milk is positioned to do both with its aforementioned production advantages over the rest of the EU sheep milk production areas.

D. Industry structure insights

Irish dairy

Irish dairy has been successful due to its much-discussed natural advantages. However, it had many challenges and inefficiencies as it expanded. In the early 1900s, there was a sole focus on exporting butter. Farmers were given back skim milk for personal consumption or feeding livestock, leading to massive wastage. The government needed to set up the Dairy Disposal Company (DDC) to help rationalise and consolidate the sector. Too many creameries in the country were operating inefficiently, so the DDC was left running many creameries across the country and effectively subsidising the industry. "During more than 50 years of existence, the DDC evolved into far more an organisation devoted exclusively to the disposal of the commodity" (Kerry Way, 2001). The DDC was finished by 1978. This level of inefficiency that the dairy cow industry was afforded as it developed wouldn't work today. However, it shows at certain times that pushing through challenges and inefficiencies is worth it.

The straightforward answer regarding structuring the sheep milk industry is to say: let's mirror the dairy cow co-operative structure in Ireland, which has delivered hugely for the farmers. However, the author asks why the industry hasn't happened thus far. How is the industry structured abroad, and what other possible structures could also be deployed?

Agriculture of the Middle (AotM) concept: what is important to a sheep dairy farmer?

- Better economies of scale
- Promote the development of diversification activities
- Easier access for new entrants
- More efficient use of fixed costs (labour, machinery, land, administrative and service costs)
- Better use of farmers' skills and specialisms (Macken-Walsh, 2010)

"What is the future for farmers whose resources (human, physical, capital) do not permit a rebirth as a large business, yet whose aspirations are still to earn a living in farming?" **Individual farms often do not have the sufficient scale to partner with large entities, so they must be coordinated and work together.**

Factors to be considered:

- The need and source of capital - funding requirement
- The importance of having one entity to deliver and preserve value and avoiding competition.
- All milk is collected, processed, and paid for efficiently on a seasonal supply curve.
- Resilience of the family farm, grass-based model

Similarities to cow dairy

Structuring the industry correctly is an important step to ensure value is created and maintained at each part of the value chain. The Kerrygold / Ornua approach has delivered a strong value to the dairy sector, and there are many lessons from this, such as it was provided export exclusivity in the early years to avoid Irish butter competing with itself in the British market. The main task is to deliver one strong proposition into the market that represents the whole value chain that will drive sustainable value into the industry.

Irish sheep milk will face many international competitors, so there is no need to have multiple Irish sheep brands in export markets. A new Irish sheep milk supply chain in world markets will be successful because it can be superior in quality, transparency, traceability, suitability, accessibility, and sustainability to our competitors across the world. This is highlighted in Peter Thiel's book, Zero to One. Peter highlights that competition erodes value and profit. Industries and businesses should strive to establish monopolies with clear differentiated products. (Thiel, 2014)

Significant overlap exists between the cow and the proposed sheep dairy industries, which will likely result in partnerships across the supply chain with Irish dairy co-ops. These could include: Milk collection, R&D, Milk testing and quality, Processing and manufacturing, Marketing and Sales

Other speciality milks

Across Ireland, there are a number of speciality milk producers and companies operational such as Goat, Buffalo, Jersey, A2, Organic cow, Sheep and Plant-based.

They experience similar challenges centred around the need for economies of scale to process and export effectively. There could be scope for the development of a Speciality Milk Ireland Conference to discuss the challenges faced.

Collaboration plays a huge role in many sectors, but especially in the niche dairy industry, as it allows the actors to benefit from the economies of scale that most of the conventional dairy companies benefit from. This is seen with the Little Milk Company who, by forming strategic alliances with farmhouse cheesemakers and co-ops around Ireland, were able to access a high level of processing and expertise for a low level of investment compared to a situation where they had to build their own facility.

Japanese findings https://aoifarm-gr.com/

On the author's Nuffield travels to Japan, visited Kushima Aoifarm, a sweet potato company. Their company position is: "The position of farmers has always been weak. There is no rest; quality depends on the weather, and prices depend on the market. The average age of domestic farmers is now over 65. Someone has to do it. We have no choice but to do it. With a strong will, we go beyond the times, and we grow. Farmer. Be dignified. Strong agriculture to enrich people." Their response to building a supply chain:

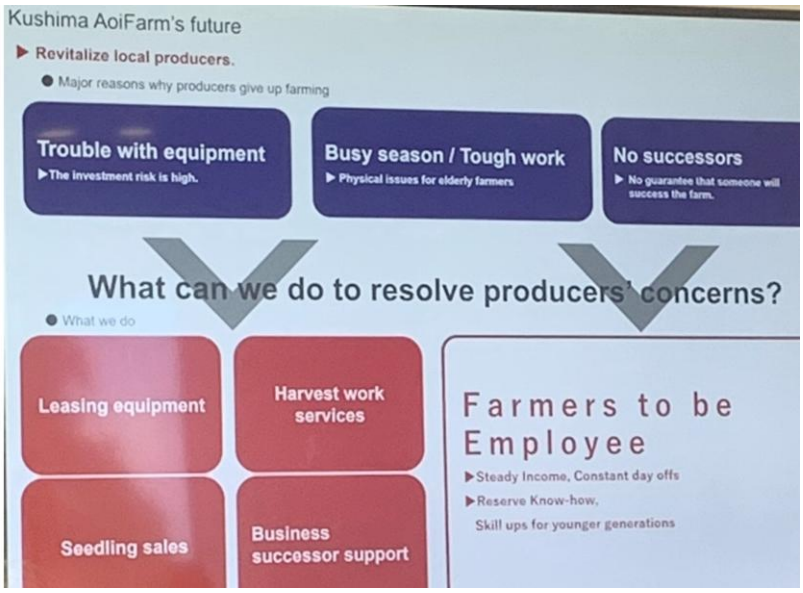


Figure 31: AOI partnership philosophy with their Japanese farmers

USA findings

Superior Farms, a large sheep meat processor in the US, is an ESOP company (Employee Stock Ownership Plan), where the entire company is owned by the employees.

Lodi Winegrape Commission, which represents the common interests of over 800 Lodi winegrowers with programs in marketing, research, and sustainable production.

New Zealand Findings

- **Fonterra** is a large-scale co-op that processes 80% of NZ cow milk. They have used JV model repeatedly across the world. They created a traded shareholder fund to stabilise the capital base by allowing external investors to participate.
- **Synlait** is a publicly listed company. Farmers receive a milk price and are free to invest in shares.
- **Zespri** is an international "corporatised cooperative." It has a regulated monopoly on exports of New Zealand-grown kiwifruit.
- **Spring Sheep** is 50:50 JV between SLC investment company and Landcorp, a state-owned enterprise. It offers multi-year sheep milk contracts to farmers.

European findings

The sheep milk farmers are typically aligned with producer groups/co-ops, which bulk sell their lambs and milk. There is rarely equity participation in processing or products. The regions are dominated by major dairy companies such as Lactalis in Spain and France.

Irish findings

Irish dairy is dominated by the cooperative movement, which has delivered for Irish dairy farmers. Although three of the largest co-ops, Kerry, Tirlan and Dairygold, have accessed the private capital through share market listings over the years. All three are now back in farmer ownership.

The organic sector, with circa 60 suppliers, has been unable to structure itself into a dedicated co-op structure. They supply major co-ops for liquid milk markets, supply private dairy companies and formed groups such as the Little Milk Company, which is a privately held company between circa ten farmers.

Origins of Kerry group - 1973

The first project, in the origin of Kerry group, was North Kerry Milk Products Ltd (NKMP). It started with three shareholders: the State-owned Dairy Disposal Company (42.5%), a federation of eight small farmer co-operatives (42.5%) and US company, Erie Casein (15%). They committed to a JV to finance a dairy processing facility in Listowel to manufacture milk protein (casein) for export to the US. Erie Casein provided a guaranteed market for the edible casein output, a relatively new dairy product for Ireland at that time.

Initial funding for the JV:	£81,000	Share capital, North Kerry Co-operatives Creameries, Ltd.
	£81,000	Share capital, Dairy Disposal Company, Ltd.
	£28,000	Share capital, Erie Casein Company, AG
	£145,000	IDA grant
	£95,000	ACC Loan (Agricultural Credit Corporation, Ltd.)
	£145,000	Taisce Stait (a seven-year, non-interest-bearing government loan)[36]
	£575,000	Total

Figure 32: Initial funding for the first Kerry project

In the first year, NKMP processed 16m gallons of skim milk to produce 2,000mt of casein with a staff of 40 people and recorded profits of £127,000 on a turnover of £1.3m (Kennelly, 2001).

It must be acknowledged that the state provided 65% of the required funding through an IDA grant, non-interest bearing loan, and equity funding through the Dairy Disposal Company.

Lesson: Potential of market partners & JVs, structures can evolve over time, importance of state support

Author's discussion

Ensuring fair and equitable trading conditions for all parties along the value chain is paramount, regardless of the organizational structure. This encompasses aspects such as setting fair milk prices, quality standards, production volumes, and collection timings. Moreover, strategic implementation of product, market, and supply chain strategies involving all stakeholders is essential to secure and maintain fair pricing.

E. Supports, Research & Funding insights

Within the Irish research and support ecosystem, there exists the skills and expertise to scale the industry, such as:

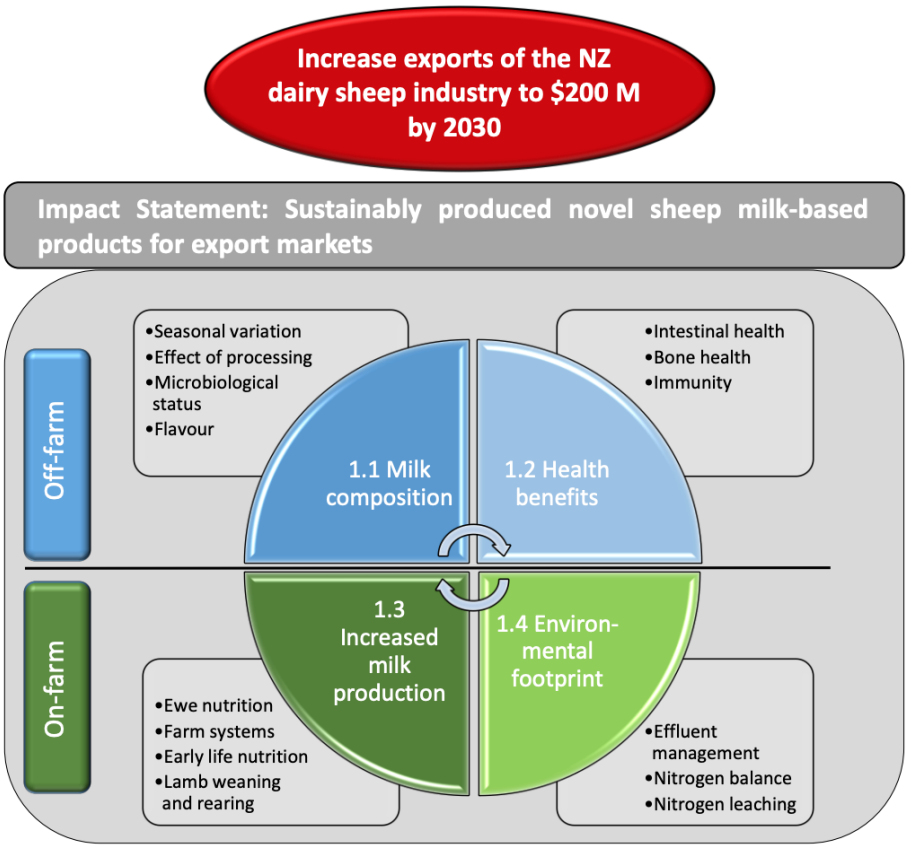
Teagasc (& MTL) | DAFM | Food for Health Ireland | Sheep Ireland | Bord Bia |Enterprise Ireland

Ireland Strategic Investment Fund | Including the agri-food institutes in third-level colleges.

Alongside this, within the dairy and sheep industries, everything is there to make this a success.

NZ Research – lessons

- The following site showcases some of the work of Teagasc's equivalent in NZ, AgResearch, has completed on sheep milk: www.agresearch.co.nz/sheep-milk
- New Zealand has been successful in developing multiple new scalable primary agricultural land uses for farmers, while Ireland has not, such as:
- Venison and, recently, deer milk
- Alternative milk - Goat, Organic, A2, Sheep
- Horticulture / Viticulture - Kiwi, Wine
- Potentially, it is the larger importance of primary production to their economy or lack of limitations from EU funding, but maybe it's their "mission approach" style that has played a significant role, where all areas of the value chain are researched and developed holistically for an overall goal. See the example below.



(Samuelsson, 2018)

Figure 33: Holistic (on- and off-farm) NZ sheep milk research

Discussion on co-ordination, structuring, policy, and funding

Supporting an emerging primary industry is not straightforward. It requires coordination, trust and funding right through the supply chain, including supply and demand, to match up on their growth plans. "Ireland Inc" is currently engaged in a number of emerging industries, such as:

- Organic sector – dairy, horticulture, meat etc
- Biomethane and other renewables – solar and wind
- Forestry and other eco-schemes.

Through EU and national funds, Ireland can allocate funding to initiate and enable an industry. In some cases, it provides subsidies. The government provides subsidies to participants in an industry deemed advantageous to the public. There are many examples of the government stepping in or being required to make something happen.

Organics – annual payments: The organic scheme payments are significant. Offering annual payments of between €250 to €350/ha for livestock sectors and an additional €1400 for administration expenses (Irish Organic Association, 2023). There is expected to be €257m invested into the organic sector between 2023 and 2027, as Ireland targets 10% land in organics. This is a significant annual public expense despite a questionable market demand, highlighted several EU members. (Moran, 2023)

Forums: The government has established working groups (forums) to focus on overcoming challenges facing the sectors and co-ordinating the sector's growth. I.e. Organic Forum and the Wool Council.

Biomethane strategy: As the CEO of the Irish Bioenergy Association, Sean Finan, states, "mobilisation of an Irish biomethane industry lies firmly in the hands of the Government and key policymakers" and that "a support mechanism is required by the industry to bridge the gap between the cost of production of biomethane and price of fossil gas". (Finan, 2023)

Milkflex scheme: Through ISIF and with commercial partners, a debt scheme, Milkflex, was established. This scheme linked the farmers' debt obligations to their milk cheques, allowing for a flexible repayment schedule. This supported the expansion of the dairy industry.

Author's discussion

When analysing the supports being made available for other industries, which are arguably less fundamentally strong as they require long-term, year-after-year support, the sheep milk industry should be bullish in its request for funding to initiate and enable the industry.

There is also the concept of the Lindy effect, which is the idea that the older something is, the longer it's likely to be around in the future (Taleb, 2012). Sheep milk has been around longer than many other potential industries for Irish farmers.

15. Roadmap and concluding discussion

Roadmap

Cottage industries face many challenges and inefficiencies. These include basics such as milk delivery, handling peak milk (cheese vat size), cost of manufacturing, accessing genetics and even poor access to finance. A cottage industry will struggle to become a prominent industry without a coherent strategy incorporating the entire value chain. The current size of the sheep milk industry in Ireland does not reflect its potential. In the same way, the current Biogas and Off-shore wind sectors are not reflective of their potential.

Based on the authors findings, the best way to develop this sector is a coherent plan to produce a 1000mt of cheese over a 5–7-year period, the equivalent of 20,000 sheep. This is the starting level where there is basic efficiency in processing, logistics, farmer supports and marketing. This is potential a plan that can attract investment. The sector must attract an experienced dairy processor to tap into the sector's expertise.

Schematic of the proposed farm system

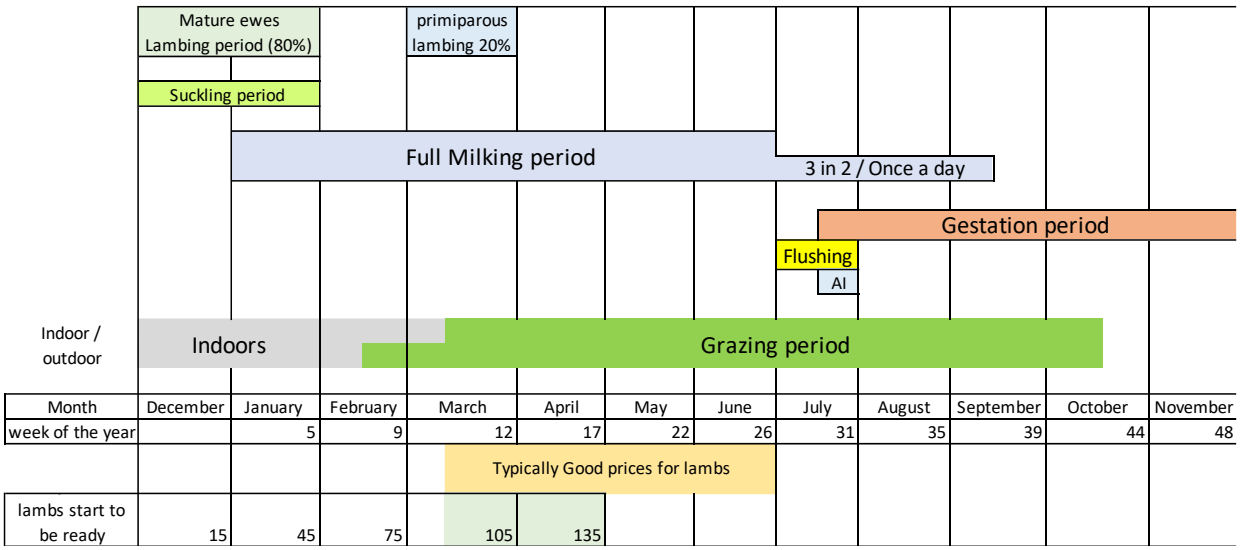


Figure 34 Author's schematic diagram of the farm system

Family farms can have 390 sheep on 75acre (30 hectares) with 1hr20min milking time. At this stocking rate, they are under nitrates derogation limit (increasing sustainability credentials). Ireland can be the most cost effective producer of sheep milk in Europe. In the early years, the farmers with sufficient housing and infrastructure can easily enter sheep milk as the only capex is the milking parlour.

The lambing should occur in December/January/February. The industry should focus on a natural rearing system. With a flock of 350 ewes, this can mean that the farmer splits his flock into bunches of 50 ewes and milks them once per day, during the first month while the ewe is rearing the lamb, to maintain milk yield. The ewe stays in for the first month and the aim should be that the ewe practically hits its peak yields in the shed, and when weather allows start to leave them out. As sheep are lighter than cows, there is nearly always an opportunity to leave the sheep out for the a few hours during the early season. The lamb should leave the farm after 30 days (like the French system) and go to specialist fattening units. Lambs are available at time when there is historically always a stronger price.

The author has worked on a financial model for the farmer. However, the view is that this report is a fundamental analysis of the opportunity and is mainly based on providing insights from existing sheep-dairy industries in other countries. The author would welcome engagement from the reader to discuss the financials. As New Zealand suggests, the returns from sheep dairy can consistently compete with cow dairy. It can mirror the Irish cow dairy industry and be "the envy of the rest of Europe".

Genetic and milk volume growth

- There must be a base level of imported genetics to produce milk and supply genetics. This would result in 1 large farm of 1000-2000 ewes which can be isolated.
- Through AI, sexed semen and embryo transfer, the genetics can be distributed to other flocks. Using these technologies, it is possible to double numbers every year, with some level of replacement.
- The breeding program must balance milk potential and robust for Irish conditions. This could lead to the development of new potential sheep breeds for Ireland. See below.
- Initially, the breeding should seek government support as it is considered a public good and, in the future, the work could be funded by levies, paid breeding services, and grants.

"Belssaf" (Belclare x Assaf) / "Grassaf" (grass based Assaf) / "Belac" (Belclare x Lacaune)

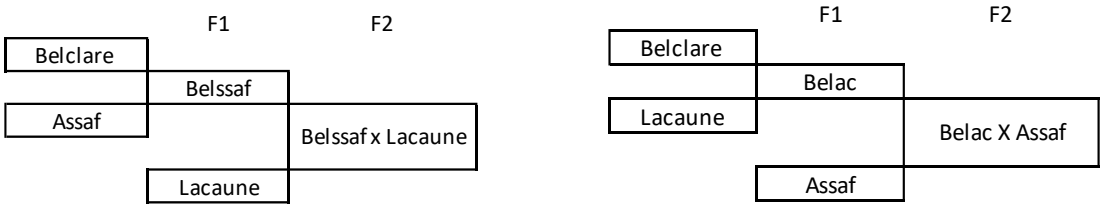


Figure 35: New dairy sheep crossbreed concepts for Ireland created by the author.

Processing and markets

The project should focus on producing two products initially, industrial sheep cheese and then branded retail products. The manufacturing of the products should ideally work in with a dairy co-op seeking to diversify and enter high value categories. The industry can partner with Irish or international distributors, who are seeking out sheep milk products and can provide distribution channels.

Market and Supply

Despite the scale and competence of the sheep sector in Ireland, it is at a critical stage. It is struggling for viability, attracting new entrants, and consumption of lamb has dropped considerably in the two main markets, France and the UK. The meat sector has the market problem.

On the other hand, the EU sheep milk has a supply shortage of demand. The problems it faces are the opposite of the Irish sector. It is a supply problem. These countries will structure to grow or even maintain their milk production. In Spain, as one source states, "Despite the historically high prices, there is no stimulation of production from new or existing producers." It states that "the Spanish dairy sector denounces that it is losing competitiveness compared to the rest of Europe" (Europa Press, 2023).

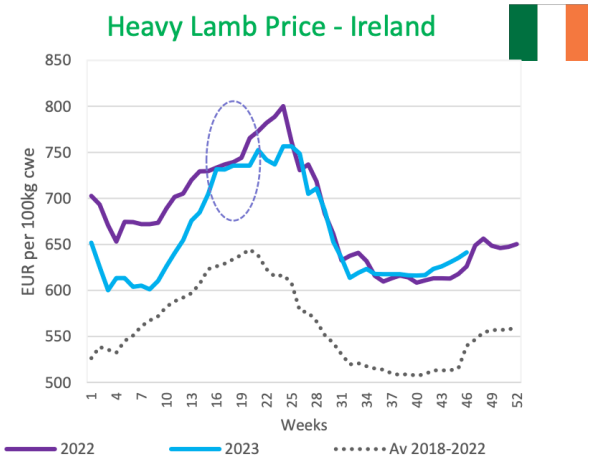
The immediate opportunity

There are 2 billion litres of sheep milk produced from the four main producers in Europe (France, Greece, Italy and Spain). Ireland can easily target 2% of this market. This requires circa 120,000 dairy sheep (3% of the flock on the island of Ireland) supporting 350 family farms making a living in rural Ireland. This is 41m litres converting to c.7000mt of cheese, resulting in an wholesale cheese value of close to €90m.

Impact on sheep meat sector

If Ireland achieved a large scale sheep sector, it would underpin the sustainability of the entire sector. Based on 120,000 dairy ewes, it would move 180,000 spring lambs earlier in the year and thus levelling the supply for the promotion of Irish lamb, hopefully resulting in the typical lowland sheep farmer here currently getting a better price later in the year. There could also be benefits in aligning ourselves to French market. The level supply would allow the factories to have better utilisation and better production scheduling. This were concerns in the Malone report.

Levelling the supply of lamb is only feasible by having a sheep milk sector!



(Kinsella, 2023)

Figure 36 Prices of lambs throughout the year

Formula for success

Taking another clip from the book "The Kerry Way", the Kerry Group has a formula that states:

Strategy × Capability × Capital = Sustained Profitable Growth

In this report, the author has discussed a number of approaches to products, structures, genetics and farming systems that could form the basis of a robust strategy for the sheep milk sector. Given the capability across the Irish food sector, there is plenty of relevant expertise across dairy, sheep, processing and export marketing to drive the growth of the industry.

Given the strength of Ireland's economy with substantial budgetary surpluses and the Government's willingness to support projects that it deems of significant national and EU importance, there should be public funding available to support this national initiative.

Ireland has pitched itself as the leader of the *Sustainable Food System* approach and development. Establishing a sheep milk industry in Ireland and helping the EU maintain its sheep milk production would be a great exemplary project for the sector.

There is a great opportunity for 1000+ family farms in Ireland to make a good living, supplying a product to premium markets. The investment required to initiate this industry is nominal, particularly when taking the view of what can be achieved. If the industry can take a "Mission approach" or a "Food System development approach" and holistically takes this on, from the author's perspective, it can only succeed.

Ireland has the capability, the capital and the author hopes to have presented the ground work for a strategy. It is down to the willingness of Ireland Inc to make it happen. In the next section, the author will make some recommendations to begin advancing the industry. In appendix, see the SWOT analysis.

Thank you.

16. Recommendations

Following on from the Roadmap, the author's provides a a short list of recommendations to initiate and enable the industry.

1. Establish a Sheep Milk Mission

The relevant stakeholders (Teagasc, Bord Bia, EI, farmers, processors) for this proposed industry must come together, form a working group and develop a holistic, multi-year sheep milk mission to scale the industry. This co-ordination ranges from genetics, managing the milk pool, securing processing and market development. The group must form a growth plan that attracts investment and financing. The author recommends 20,000 sheep in 6-7 years for 1000mt of cheese and attracting one of the dairy co-ops to the sector through supports and incentives.

2. Farm system development

The work here would involve a test farm with best-imported genetics and technology to showcase the model to Irish farmers and, in general, advance the industry's knowledge and expertise. A proposal here could be to set up a sheep milk demonstration farm in partnership with Teagasc Athenry. Teagasc and the industry should create a technical manual for farmers and have a number of training days and courses for interested farmers.

3. Genetic programme

As outlined in the Roadmap, the sector must develop a targeted breeding programme, supported by Sheep Ireland (ICBF), to produce dairy sheep suited to Irish conditions and reduce the risks associated with importing unsuitable or potentially diseased animals.

4. Financial support

Sheep milk rotary parlours should be approved for the TAMS grant. The Milkflex programme (or call it "Sheepflex") could be designed and made available to farmers to support financing of their farm capex programmes.

The project should seek the involvement of public funders such as the Irish Strategic Investment Fund to provide long-term capital. The Kerry project, with over 64% of the projects funding provided by the state, shows the importance and impact this can make.

5. Market development

Bord Bia and other relevant industry stakeholders should conduct market research to determine the sheep milk industry's best value/volume propositions. This would include developing a differentiated product offering and brand for the market. The industry should identify partners that can deliver scale and premium markets. This could result in JV opportunities, as seen across the dairy industry.

6. Processing capacity

Achieving growth in the sheep milk industry will necessitate the development of processing capabilities that enable the production of various products tailored to market needs, ensuring steady and substantial returns. The author recommends bringing an experienced dairy co-op on board with relevant experience. The industry will either be able to access spare capacity with the dairy co-ops or potentially require its own specialty processing, where potential partnerships with the organic sector might be available.

7. Sheep meat compatibility

The long-term resilience of this sector is having a diverse income from lamb and milk. Lambs must attempt to meet the current Irish lamb specifications. A focus needs to be placed on how these lambs are finished either on-farm or more likely a development of specialist fattening units to cater for these early lambs.

17. Appendices

Appendix 1: SWOT Analysis

Strengths

- Low-cost grass-based production system, valued by the consumer
- Low cost of entry
- Ireland is renowned for sheep and milk production.
- Irish food R&D expertise
- High animal welfare standards
- High environmental standards through programs such as Origin Green
- Shorter lactation (200 days) will suit land that isn't suited to bovine dairy
- Global Irish reputation for food.
- Strong government ecosystem of Enterprise Ireland, Bord Bia and Teagasc.
- Subsidies through direct payments and the Sheep Improvement scheme.
- No major support is required, such as what is necessary for Organics and Biomethane
- Dairy infrastructure and network with increasingly spare capacity.
- Sheep milk has healthy and unique qualities.
- Established market opportunity globally with robust demand.

Weakness

- There is no tradition of sheep milk production or consumption in Ireland.
- Lack of dairy sheep genetics
- Lack of knowledge across the supply chain on sheep milk
- There is no dedicated processing at present
- No Irish-based research to date.

Opportunities

- Farm diversification using existing land, infrastructure, and sheep.
- Potential to be the lowest cost producer of sheep milk in Europe, mirroring our bovine industry.
- 3.6m sheep on the island that are practically unprofitable, farmers want change.
- Spin-off benefits
    - Compatibility with solar
    - Partnering with Tillage farmers for lamb finishing – regenerative agriculture
    - Sheep dairy farmers will lamb earlier than normal sheep producers, flattening the supply curve.
- Access to world-leading dairy sheep genetic programmes.
- Utilise existing/spare processing capacity from the bovine industry
- Partner with other speciality kinds of milk on processing – Organic cow, A2, goat, etc.
- Create a PDO of a grass-based Irish sheep cheese to compete with PDOs of France, Italy, and Spain.
- Meeting large EU sheep milk deficits
- Diverse income streams – milk & lamb
- Shorter milking season.
- Product development opportunities
- The world is seeking out healthy, safe, nutritious, natural food
- Sheep dairy products cater to the dairy intolerant, particularly in Asia.
- Become organic, as organic payments can bolster income.

Threats

- Competing land uses such as forestry or dairy cows.
- Biosecurity on importing genetics
- Feasibility of processing at small scale
- NZ's growing interest in sheep milk
- Changing consumer preference - Plant-based or synthetic milk

Appendix: Wool feasibility report

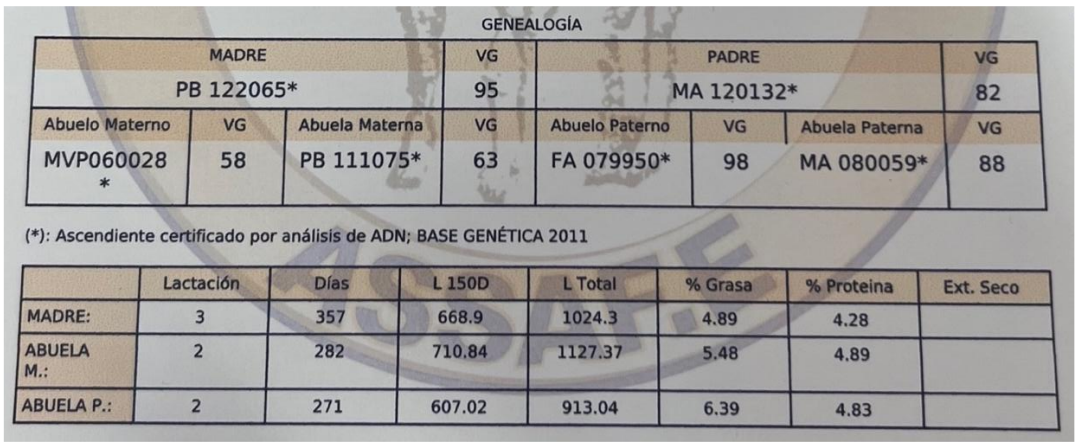
The author recommends reading the Wool Feasibility study commissioned by DAFM and published in July 2022.

- Over the past decades, sheep wool has completely eroded in value. This is mainly due to competition with synthetic fibres and the incompatibility of standard Irish-grown wool with textiles.
- Shearing is a crucial management practice on sheep farms for the health and welfare of the flock that has now become a significant production cost.
- On a per-ewe basis, Irish wool currently delivers €0.10 – 0.50/ewe but costs €2-3/ewe to shear the sheep. According to the IFA, it costs €8/ewe to present a complete fleece to a trader when the cost of other jobs, such as packing and dagging, are factored in. There are huge changes required in the perceived value of sheep wool for this to become a profit centre for sheep farmers. (IFA, 2023)
- The report indicated that a scouring plant is required for all initiatives bar fertiliser or horticulture sectors. However, it is not deemed feasible in Ireland due to a lack of scale, environmental concerns and capital investment involved.
- Even with a scouring plant, it is deemed that the percentage of the annual clip that is suitable for use in the high-value and high-profile textiles industry is very low. Most other market opportunities are less likely to return tangible value to the farmer.
- The other key aspects which are relevant to sheep milk are:
    - Establish an All-Island "Irish Grown" Wool Council to oversee the industry.
    - Creation of a Wool Hub where various academic researchers and commercial entities can collaborate (Agile Executive, 2022)
- Since the report was published, DAFM has set up a wool council and provided € 30,000 in further funding.

Appendix: Current Irish sheep dairy participants:

Velvet Cloud – Mayo	Cratloe Hills - Clare
Elizabeth Bradley – Carlow	Knockalara – Waterford
Sheep Milk Ireland – Tipperary	Proper Dairy – Tipperary
Cais na Tire – Tipperary	Blues Creamery - Tipperary
Cashel Farmhouse Cheesemakers – Tipperary	Toonsbridge - Cork
Ballyhubbock – Wicklow	Corleggy - Cavan

Appendix: Assaf Genetics- showcasing milk volumes of over 1000L/ewe



GENEALOGÍA

MADRE			VG	PADRE			VG
PB 122065*			95	MA 120132*			82
Abuelo Materno	VG	Abuela Materna	VG	Abuelo Paterno	VG	Abuela Paterna	VG
MVP060028*	58	PB 111075*	63	FA 079950*	98	MA 080059*	88

(*): Ascendiente certificado por análisis de ADN; BASE GENÉTICA 2011

	Lactación	Días	L 150D	L Total	% Grasa	% Proteina	Ext. Seco
MADRE:	3	357	668.9	1024.3	4.89	4.28	
ABUELA M.:	2	282	710.84	1127.37	5.48	4.89	
ABUELA P.:	2	271	607.02	913.04	6.39	4.83	

Appendix: NZ Sheep milk farm economic model

WAIKATO FARMING OPERATIONS	SHEE
Income	
Net milk sales	$687,6
Wool	$12,25
Ewe culls	$12,00
Surplus sheep sales	$116,22
Dry ewes	$7,500
TOTAL INCOME	$835,6
Farm Operating Expenses	
Animal health	$20,18
Breeding expenses	$10,09
Livestock recording	$1,261
Dairy shed expenses	$10,09
Shearing	$7,063
Silage made	$30,27
Purchased feeds	$80,72
Livestock freight	$1,514
Other freight	$2,018
Urea	$13,23
Fertiliser and lime	$20,14
Cropping and re-grassing (operational 10%)	$11,508
Weed control and spraying	$20,14
Rates	$9,625
Salaries – farm manager	$78,46
Salaries – casual labour	$83,69
Cost of rearing male lambs	$12,48
Cost of rearing female lambs, including labour	$83,24
Cost of finishing female replacements/ewes	$52,46
Surplus ewe lambs to finish or trade on (on farm)	$4,162
Repairs & Maintenance (land, buildings, plant, machinery)	$33,95
ACC	$4,964
Insurance and accountancy	$5,200
Professional Services	$5,247
Vehicle fuel	$4,036
Electricity	$15,135
Office administration, internet and communication	$2,523
TOTAL OPERATING EXPENSES – Avg. 10-year incl. CPI	**$623,**
Gross Profit	
GROSS PROFIT – Avg. 10-year	**$212,2**
GROSS PROFIT/hectare	**$3,85**

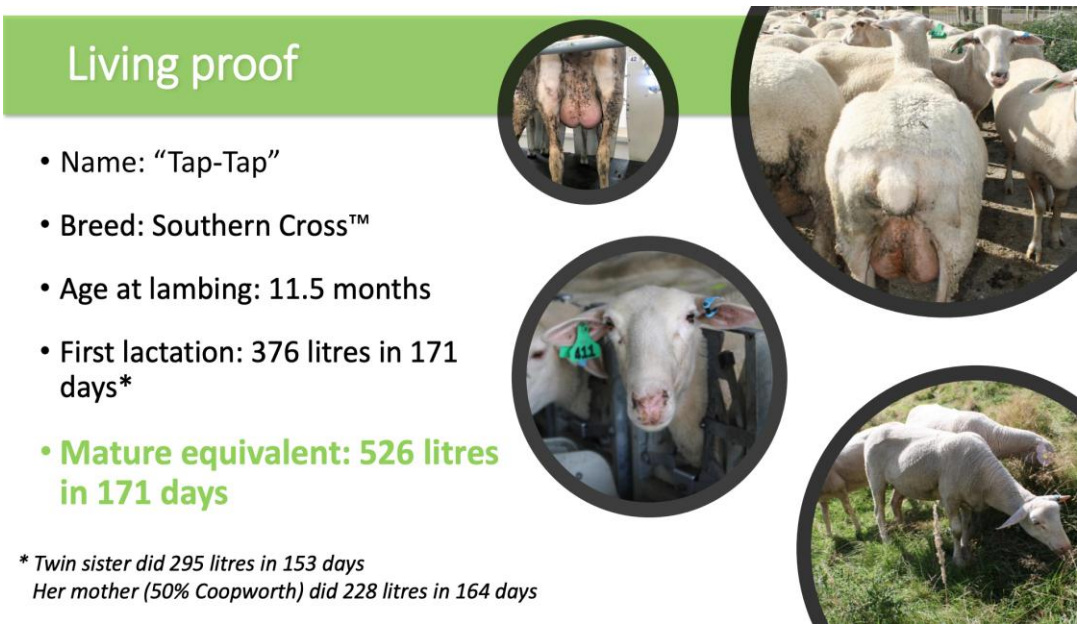
The model is based on the following assumptions:

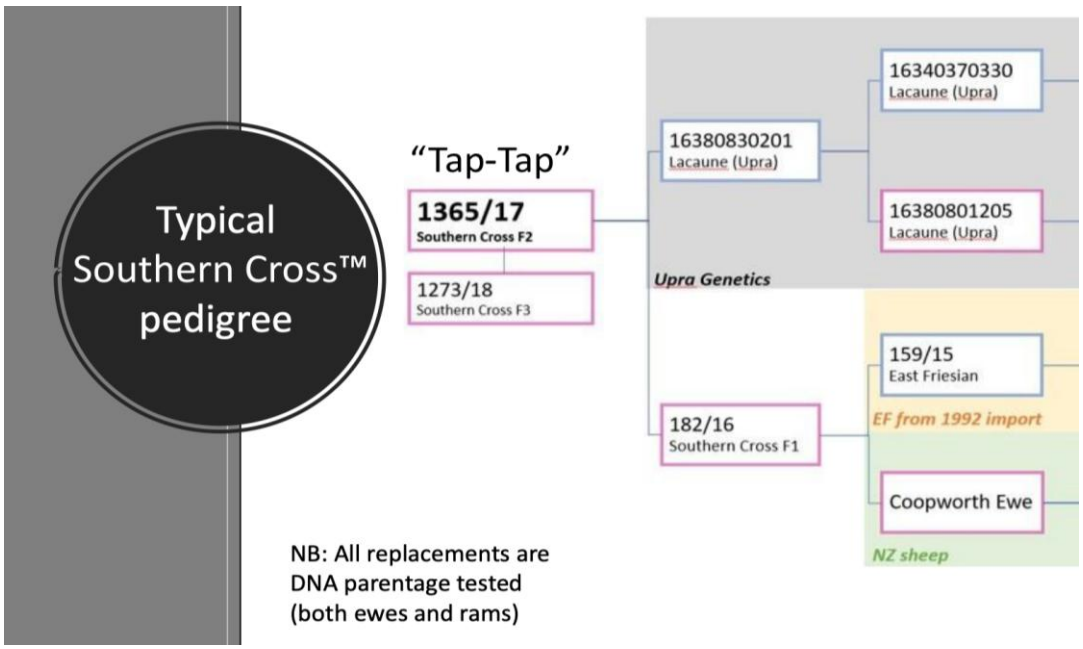
- Farm location: Waikato
- Farm size: 55 hectares
- Number of milking ewes: 1,000
- Farm system: pasture outdoors grazing
- Pasture harvested per annum: 14,000 kilograms of dry matter
- Lambing rate: 165% with a 50% male to female ratio
- Lambs are reared artificially (by hand).
- Flock replacement rate: 35%
- Wool sales: $2.50 per kilogram
- Sale of ewe culls: $120 per head
- Sale of surplus hoggets and dry ewes: $150 per head
- Average milk production per ewe: 250 litres per year
- Total milk production 250,000 litres per year
- Total solid content of milk produced: 17.3%; total milk s produced: 41,520 kilograms
- Pay-out: $15.90 per kg milk solids
- Development Capex: $500,000
- Cost to purchase sheep: $500,000
- Farm debt: not calculated into model

(New Zealand Food Innovation South Island, 2020)

Appendix: Maui breeding programme: "Tap-Tap"

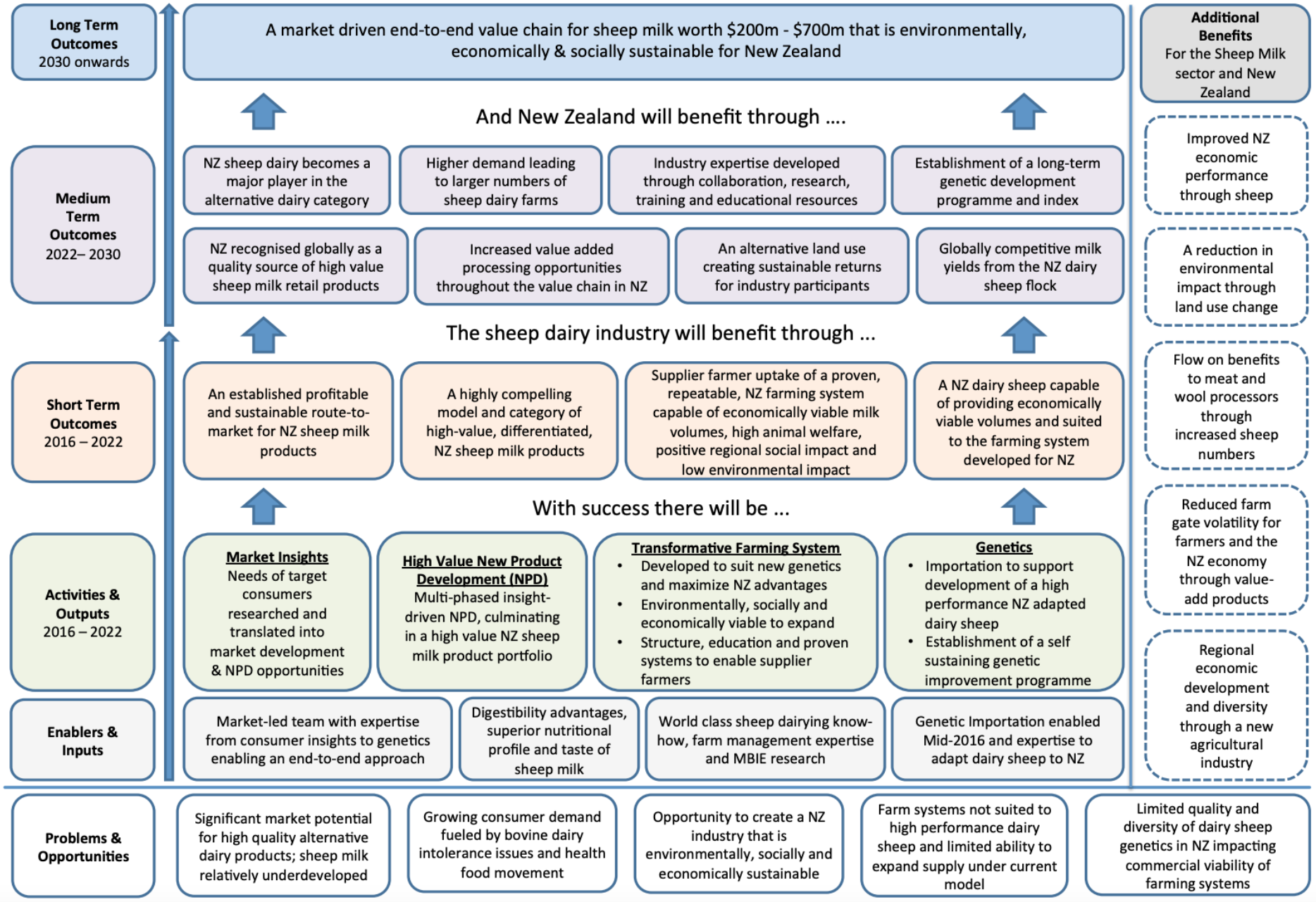
This shows the ability to convert meat sheep to dairy sheep in 2 years





Outcome Logic Model: Sheep – Horizon Three

PGP Programme 2016 - 2022



Appendix: NZ Sheep dairy innovation model (MPI, 2016)

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19. Plain English Compendium Summary

Project title	Creating alternative primary agri-food industries; The feasibility of establishing a large-scale sheep milk industry in Ireland through collaboration and co-operation
Scholar	Brendan Crosse
Address	Windmill, Cashel, Co. Tipperary
Phone	+353879404820
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Objectives	To conduct a report on the feasibility of establishing a sheep milk industry in Ireland and present the case for public and private stakeholders
Background	Ireland has a large sheep meat industry that is struggling for viability and has a market problem, where consumption has dropped per capita in its main export markets. The European sheep milk sector has a supply problem, where its faces many challenges such as climate change and rural depopulation. The theory is that Ireland can pivot its sheep sector to meet the growing demand for sheep milk products.
Research	Through his Nuffield Ireland Scholarship, the author travelled extensively across Ireland and EU to meet industry participants across all stages of the supply chain. The author also travelled to Japan and America. The author also undertook comprehensive desk research to underpin these findings.
Outcomes	The author identified that there is a significant, scalable sheep milk industry that Irish farmers can establish. Sheep milk can work efficiently in Irish conditions and that existing expertise and infrastructure in Ireland can be leveraged. The author recommends 4 key areas as next steps for the industry – establishment of a stakeholder working group, a demonstration farm, access to medium scale processing and building a differentiated product for the market.
Implications	To succeed, the industry will require a strategic plan involving public and private stakeholders to access the capabilities and capital required.