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IS SHEEP DAIRYING A MORE SUSTAINABLE LAND-USE PARADIGM FOR NEW ZEALAND THAN COW DAIRYING?

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Abstract

New Zealand's economy is dependent on cow dairying's contribution of approx. $7.8 billion to total GDP. However, it faces ratcheting pressure for more regulatory controls as the result of intense public scrutiny of its environmental footprint, predominantly relating to water supply and quality. Sheep dairying is being heralded as a potentially profitable export industry with a significantly lighter footprint while capitalising on the longstanding skills and infrastructural base of a historic, national sheep farming industry. Yet, there is limited definitive information available as to whether sheep dairying can/ does deliver its promise with regard to environmental and other benefits. This paper explores a range of literature/data that outlines the benefits of sheep comparative to cow dairying in the New Zealand context and compares findings to those of an ongoing, commercial research project (Charing Cross Sheep Dairy) established in 2011 in the Canterbury region. It also explores benefits to communities, and animal welfare.

Keywords: Sustainability; Sheep dairying, environmental footprint, land-use options

Introduction and background

At national and regional levels, concern is growing around the deteriorating quality and quantity of fresh water and soil pollution in New Zealand. Whilst the causes are manifold, cow dairy farming has come under the most scrutiny due to the high environmental footprint related to it (Baskaran, Cullen, and Colombo, 2009). In the 2013 *Water quality in New Zealand: Land use and nutrient pollution* report, Commissioner for the Environment, Jan wright asserts that between 1996 and 2008, Canterbury had the highest conversion rate to dairying with 122,500ha and resulting in a 27 per cent increase in nitrogen loads in that time. In Canterbury, irrigation is seen as a facilitator of the growth of dairying. Several new irrigation schemes are under development. The scale of the

irrigation investment and potential pollution puts Canterbury under the microscope of how it will manage its water and soil resources. This will be at the forefront of resource management across the country. Wright (2013) concludes "It is almost inevitable that without significantly more intervention, we will continue to see an on-going deterioration in water quality in many catchments across the country, particularly in Canterbury and Southland". Regulations are requiring land users to dramatically reduce their rates of nitrogen leaching into water. These regulations are impacting on current and future cow dairy farm system profitability. Dairying intensive areas struggle to find the quantity and quality of staff they need, and the resultant use of migrant labour is perceived to have negative impacts on many rural communities (Trafford & Tipples, 2012). The industry as a whole is also under critical scrutiny from animal welfare groups regarding poor animal welfare practices. Health concerns around cow's milk has led to a health trend away from cow's milk to alternative products (e.g. goat and alternative milks - oat and soy milk).

Farming sheep for meat and wool is a historical agriculture activity in areas like Canterbury but the returns for both are historically poor, volatile and challenging. So, many sheep farmers have converted to cow dairying (Diavoll, 2016). The question to be asked is why are vulnerable sheep businesses not instead converting to sheep dairying? They are prepared to change systems when they are profitable - this is demonstrated by the conversions to dairying. Sheep dairying appears to offer a more sustainable landuse option than cow dairying, but is it? This research examines the potential for sheep dairying to be a more sustainable option than other system options and includes the experiences Charing Cross Sheep Dairy, developed in Canterbury in 2011 as a commercial and research venture.

Sustainable development is a highly contested concept. The 1983 World Commission on Environment and Development (Brundtland Commission) defined it as: *"forms of progress that meet the needs of the present without compromising the ability of future generations to meet their needs*". (Report of the World Commission on Environment and Development: Our Common Future, 1983). This paper however, extends this definition to focus on a more dynamic, inspirational, business-level approach to reflect that decision making about changing to a new landuse system tends to sit at the corporate or family farm business level. Here it is mooted that *"Sustainability is a balance between the financial, human, and environmental. It is about living your values and acting with integrity, responsibility and generosity. It is about being in a community of*

discussion, dialogue and action – because no person or company is an island and everything is interconnected." (Sprinkel, nd).

Problem statement

Cow dairy farming is constrained by increasing environmental and social challenges and sheep farming by profitability. Is sheep dairying the answer to both situations?

Research questions

1. Is sheep dairying economically viable; can it compete with cow dairy systems?
2. Does sheep dairying offer a lower environmental footprint?
3. Does sheep dairying offer other benefits for farm businesses, farm owners, managers and staff, communities and consumers that make all the interconnected parts of the dairy value chain more resilient and sustainable?

Methodology

- Literature review conducted 2013/14
- Semi-structured interviews conducted with key New Zealand sheep dairy owner/operators and stakeholders (2013/14)
- Attended 2015 national Sheep Dairy Products conference, Massey University, New Zealand to assess interest in the industry and what issues delegates identified in developing an industry in New Zealand
- 2016 and 2019, bio-economic modelling comparing a sheep dairy farming system to a conventional dryland (i.e. non-irrigated) sheep meat and wool based farm system and a cow dairy farm system.
- The assumptions for the sheep dairy system and the cow dairying system is that they are System Three systems with ewes and cows wintered off the farm milking platform annually from the end of May to the start of September each year. Many dairy farmers in New Zealand and Australia use this system to maximise production (See https://www.dairynz.co.nz/business/the-5-production-systems). For all modelled farming systems, the same resource assumptions have been made, i.e. 200 ha farms size with dry matter production of 14.9 tonnes per ha (grown under irrigation) and 11 tonnes/ha grown on the dryland e.g. the conventional sheep system. The sheep dairy system modelled was a 'conventional' sheep dairy

system with all ewes planned to lamb in early August and being milked for 212 days. Lambs are foster reared artificially.

- 2012 to present-participant research component. The author and partner established a 200 ewe sheep dairy unit in Canterbury with the aim of identifying the range of opportunities and challenges in establishing a viable, environmentally and socially sustainable sheep dairy enterprise. This is the first sheep dairy in Canterbury since the 1960's. A secondary aim was to assess farmer, researcher and processor interest in a regional industry, but applicable across New Zealand.
- 2017 to present – added value unit developed on farm to convert sheep milk to high value products for sale on the domestic market- yoghurt, cheeses, and gelato.

Results

This section outlines the results of the bio-economic modelling of comparing a sheep dairy farm to a conventional dryland (i.e. non-irrigated) sheep meat and wool based farm and a cow dairy farm.

The desktop modelling exercise found that:

1.1 Conventional Sheep Dairy

This system assumes all ewes are lambing in August, at 180% and hoggets at 120%. All lambs are foster reared, weaned onto pasture in October and surplus lambs sold at the end of February for a margin over rearing costs of $50.The productive lactation period runs for 212 days for mature ewes and ewe hoggets were not milked until after the lambs were weaned and then only for 35 days to train them for the next season and limit lamb rearing costs. Each hogget produced about 20 litres worth of milk to the vat.

For the purpose of this project, milk production is set at a mid-point for New Zealand systems (see table 3). The largest New Zealand producer has stated that they achieve 1 litre per ewe per day whilst another, smaller producer, achieves 2 litres per ewe per day. At 1.42 litres per ewe for M.A. ewes, 1 litre for 2ths and hoggets at 0.47 of a litre per day, this model takes a reasonably conservative but achievable mid-range stance. International studies have shown that yields of 600 litres per ewe over 210 days are quite possible; over double of what are being modelled here. Additional bought in supplements, in the form of molasses and barley, are fed at the rate of 200 grams per day per sheep. Returns for milk solids are based on $18.34 per sheep milk solid (MS) and $6.5 for cow's MS. These values

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are currently a middle range of what is being achieved by producers in Canterbury in the 2018-19 season. Another indicative price is that of goat milk MS which is returning approximately $18 per MS to producers (New Zealand Goat Dairy Cooperative, 2018).

For all the tables and narrative $ measurements relate to the NZD.

Table 1. Conventional sheep milking performance.

Milking Performance				
	Litres per ewe	%MS	Kgs MS per ewe	Litres per day production
MA	300	12%	36.00	1.42
2th	220	12%	26.40	1.04
Hogget	85	12%	12.00	0.47

Table 2. Conventional Sheep Milking System Outputs

Sheep Milking system (Meat, Wool & Milk)					
		Units	Price per unit		
Ewes		1,634			
Hgts		540			
Rams		27			
Wool produced/sold		9,426	3.1		
Milk Solids produced/sold		48,340	18.3		
Lambs produced/sold (after replacements deducted)		3,049	110		
Cull ewes		333	125		
Total MJME consumed		29,169,713			
EBIT					**$ 589,876**

1.2 Cow Dairy System

To get a complete comparison, the dairy system modelled is a system 3 (cow) dairy farm, (non-lactating cows and replacements are grazed off the milking platform and limited amounts of feed are bought in to supplement feed grown). The result was the system produced considerably more milk solids than the sheep dairy system however with operating costs set at a conservative $4.2 per MS profitability was less than the sheep dairy system. Capital costs are considered to be similar for both systems.

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Table 3. Conventional Cow Milking System Outputs

Cow Dairy system					
	Units	$ per Unit			
Cows	658				
Replacements	296				
Bulls					
Milk Solids	265,059	6.5			
Calves produced/sold	414	75			
Cull cows	107	450			
MJME consumed	30,759,871				
EBIT					**$ 388,485**

1.3 Conventional Dryland Sheep (Meat and Wool Based) System

The final comparison was to a dryland sheep property such as what could be expected to be the original property for a sheep dairy farm prior to conversion and the addition of irrigation. Pasture production (MJME) are considerably less and the impact of drought both on production and prices can be disastrous although only a reasonable average year was modelled.

Table 4. Conventional Dryland Sheep System

Conventional Dryland Sheep (Meat &Wool Based)					
		Units	Price per unit		
Ewes		1388			
Hgts		486			
Rams		26			
Wool produced/sold Kgs		8131	3.5		
Milk litres		0			
Lambs produced/sold (after replacements deducted)		2153	135		
Cull ewes		283	140		
MJME consumed		22,814,647			
EBIT					**$ 156,969**

Even though as in all cases a component for management was included in the farm costs the dryland systems profitability was well down on the sheep dairy system and is exposed to considerable risk.

1.4 Returns on Capital Outlaid

Table 5 shows the return on capital invested, based upon irrigated and non-irrigated Canterbury land values (Colliers 2018) and a component for livestock.

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Table 5 Investment Returns

Returns on Capital		
	Outlay	Return
Sheep dairy	$10m	5.9%
Cow dairy	$10m	3.9%
Dryland sheep	$5.3m	3.0%

2.1 Environmental benefits

This research focuses on whether sheep dairying offers a viable alternative new landuse in the Canterbury environment as a means to profitably utilising irrigation water without having major impacts on water quality. Does it provide the *"paradigm shift in farming practices for New Zealand to become environmentally sustainable",* as indicated by the Parliamentary Commissioner for the Environment in 2013 (Wright, 2013). Certainly, pastoral systems are under increasing scrutiny to justify their environmental sustainability. Nutrient loss (P and N) from sheep is known to be lower than from cows because there is less concentration in the individual urine patch (Canterbury Development Corporation, 2015). While these assumptions will need to be reviewed in relation to the more intensive management systems and stock types used for sheep milk production, Blue River Dairy believe that their loss of Nitrogen is approximately half that of cow systems (ibid). In comparison to cows, sheep do not have the same leaching effect because they have a lower volume of urine. Cows produce 10L/m2 and sheep produce 5L/m2 (Magesan, White, & Scotter, 1996). In a trial, Magesan et al., (1996) found nitrate leaching levels of a sheep grazed on ryegrass and clover pasture did not increase compared to a similar pasture from which hay was cut and there was no stock access. A comparable study (Haynes & Williams, 1993, cited in Canterbury Development Corporation, 2015) with similar soil types, measured the effect of leaching from dairy cows and found that the leaching levels increased five times for a pasture grazed system with cows than without.

Environment Canterbury [ECAN] is the regional regulatory body for environmental policy, practice, compliance and enforcement of rural water quantity and quality in Canterbury. ECAN controls the supply of irrigation water in Canterbury to ensure that water is not over-allocated and is managed well, via a monitored water consenting process (Environment Canterbury, 2019). It has developed the Canterbury Land and Water Regional Plan. It outlines rules for farming activities relating to nutrient management which as perceived as the greatest threat to water quality. Its rules are aimed at "maintaining current water quality and prevent further increases in nutrient losses until the

catchment limit setting process is finalised". The majority of Canterbury dairy farms need a land-use consent to farm. Each of these farms also requires a Farm Environment Plan (FEP) to identify and manage environmental risks and constrain current nitrate leaching and reduce levels into the future. Early estimates find that for dairy farming in particular, the total amount that they will be permitted to leach will be about half what they are at present. This will require a reduction of 2/3's by 2022. (ECAN policy for Selwyn /Waihora catchment – a vulnerable dryland catchment where Charing Cross Sheep Dairy is located). Audited Farm Environment Plans are mandatory in all catchment areas. This will mean either the adoption of less intensive farming systems or further investment in mitigation techniques to allow them to continue to produce at current or higher levels. "For new development of irrigation capability sheep milking could offer an alternative which both meet the N leaching requirements of the regional plan and the return on investment targets of investors" (Greer cited in Canterbury Development Corporation, 2015).

Griffiths (2015: 9), suggests that while dairy sheep could be less intensive on the land and better from an environmental perspective, New Zealand needs to run the Overseer™ a nutrient budget used to assess farm compliance over current industry case studies to see the extent they meet the requirements for a consent to operate. In some areas of New Zealand where nitrate levels are at capacity, sheep dairy could produce a more viable return for the land and reduce environmental impact at the same time". As part of the consent process a comprehensive farm environmental plan (FEP) had to be created for the 200-ewe study farm to satisfy the local regional authority (Environment Canterbury [ECAN]. (Environment Canterbury [ECAN], 2015). A major part of this was assessing what the nitrate leaching component of the farming system to water is. For new land use changes such as traditional sheep to cow dairying (as this was considered) already operating below 15kgs N per ha leached have to stay at or go below that level. If a land The author and partner developed a 200-ewe unit (CCSD) and completed an FEP. For its 10ha milking platform in conventional pasture, it assessed the N leaching is at under 15kg Nitrogen per hectare. In Canterbury, most cow dairy farms are struggling to get below 35kgN. CCSD achieves this by adopting a wintering-off policy when the ewes are not being milked past mating. This system removes the sheep from the platform for approximately four months at a time when rainfall is increasing and the potential to leach 'surplus' nitrates is more likely.

2.2 Farm business resilience/ succession planning

Family farms are viewed as at the "cornerstone of New Zealand farming", they tend to have generational perspectives on land ownership but often struggle to pass their land onto their children without a burden of debt for themselves or the successors. Past**,** Federated Farmers National President Bruce Wills said that farm succession was a significant challenge for New Zealand agriculture. He asserts that the biggest contributing factor to succession is profitability. Farming families interviewed for this research concurred that *"If you have a profitable farm, business succession is a lot easier"*. (Profitability critical for farm succession, 2014).

Sheep dairying offers a new income stream, either as a new conversion or complementary unit. Farming families interviewed for this study indicated that sheep dairying appears to offer an attractive succession option – as either a profitable new venture for themselves or their children. This system allows farming parents who traditionally move off farm into retirement to remain on farm, enjoy their home, farm environment and stay connected to their communities. Alternatively, children who would normally leave the farm, can remain there, have autonomy and run a profitable and complementary new venture. As it has a lower set up cost compared to say cow dairying, there is less risk for all parties and it enables equity to be built up to invest in other investment options, on or off farm by providing a profitable pathway. Resolving succession challenges by developing a sheep dairy complementary to their existing businesses allows families to stay in and contribute to their communities and may reduce rural drift.

1.4 Social responsibility

Community Supported agriculture (CSA).

Conceptually, CSA consists of a community of individuals who pledge support to a farm operation so that the farmland becomes, either legally or spiritually, the community's farm, with the growers and consumers providing mutual support and sharing the risks and benefits of food production (DeMuth, 1993). While there was no financial contribution to the financial security of Charing Cross Sheep Dairy, three neighbouring properties provided access to their land to add extra scale to the pastoral platform, some for a financial return but also to control the pasture length and so reduce potential fire risk, to provide landscape amenities with ewes and lambs in their paddocks to give a more rural ambience to their lives. Others wanted to reduce the extent of mowing their orchard paddocks and

reduce their pollution footprint. For CCSD, it provided an extra set of eyes and ears to spot problems with animals e.g. lambing.

Labour quantity and quality issues

Internationally and nationally, sheep dairy operators indicate that women employees are particularly attracted to their businesses, because the scale of the milking plant, and animals suits them better than cow dairying. They report that female staff are more attuned to the nature of the animals. Cow dairying struggles to be an employer of choice because of poor working conditions, social isolation, management and communication challenges, resulting in many regions using migrant labour to sustain their businesses (Tipples & Trafford, 2011; Tipples, Trafford & Callister, 2010). The majority of dairies visited had full and part-time female staff managing the milking and doing a wide range of farm work related to the dairy. This opens the opportunity for many rurally remote women to get employment and experience in a dairy industry.

Animal welfare issues

Persistent and vigorous pressure is being applied to cow and goat dairying in New Zealand over the issue of post kidding and calving 'wastage' where calves born are surplus to farmer's replacement needs and market wants. Traditionally they have been euthanised on farm or sent as four-day old calves for slaughter. Media presentations about these practises has achieved negative media attention and resulted in government oversight through animal welfare codes of practice (Tulloch & Judge, 2018). Ewes tend to produce multiple litters and with sheep dairying there is a market for surplus lambs and although returns have traditionally been quite poor for growing-on lambs, the market has lifted significantly in the past year. Thus, lambs can produce an additional profit stream and add resilience to the farming system.

Discussion

The modelled research indicates the potential for sheep dairying to be viable, responsible and sustainable. The big question is whether on a promise of profitability, financiers, sheep and dairy farmers will invest in sheep dairying. While there are several reasons they should, there are significant challenges.

The cow dairy industry has already 'sunk' considerable capital into the business, some of which would be difficult to recover and therefore add to the capital costs and further erode returns on investment. For these reasons and the lesser cash returns provided cow dairies are unlikely to convert. The only factor that may potentially lead to this would be if the regulations around environmental factors force cow dairy farmers out of that industry into sheep. Given the importance of cow dairying to the country this is unlikely to occur, but it is likely to reduce the number of conversions into cow dairying.

Convincing investors to finance sheep dairy enterprises appears to be a challenge. The 1997 DSANZ report stated that of all the ingredients required for a viable milking industry capital could be the most limiting factor (Butcher, 1997). It expressed concern that as an "unproven" industry in New Zealand, "there may be reticence from financial institutions to fund on-farm development" (p1.1). Mike McGregor and Jan Cook who began sheep milking in the North Island in 2000 found that their plans were "greeted with scepticism when they sought funds for their proposal. "The banks didn't want to know. They said the risk was too high and the amount we wanted to borrow is too small" (Mike McGregor cited in Stevenson & Field, 2000). They borrowed money from a private rural finance advisory business - Fraser Farm Finance (ibid). Neudorf Dairy and Kingsmeade also indicated this was a problem in developing and expanding those businesses (Brian Beuke, May, 2013; and Miles King, June 2013, personal communication).

There is limited availability of New Zealand relevant information on which to make decisions for both investment and management. This is likely to result in reluctance by banks to provide capital for farms to invest in what could be a successful industry. Indonesian investment facilitated expansion of Blue River Dairy (Gower, 2013).

Both large meat processor the Alliance Group (Sheep milking discussed by Alliance, 2010), and Synlait Milk Ltd, a Canterbury dairy company have indicated interest in seeing a sheep dairying industry develop (Simon Causer and David Williams, personal communication, June 2013). This offers both farmers and the companies an opportunity to expand their business bases and a solution to the environmental challenges facing some cow dairying enterprises (Baskaran, Cullen and Colombo, 2009).

The most important requirement for developing a scale industry is a reliable processor/ product champion who has the capacity to invest in the product collection, processing and market development. For this pathway to be pursued a dedicated processor would need to become established with the aim of producing and marketing this product, and its

derivatives, onto the international arena. For a processor to achieve the critical mass required to be economic it has been suggested that 50,000 litres of milk would need to be supplied at least every two days. It is assumed that a market does exist; this is based upon the recent rapid expansion of Blue River Dairy into the milk powder market. Blue River has stated they believe the New Zealand industry could absorb 5 million sheep into milk production with no risk of over production (Canterbury Development Corporation, 2015). The expanding goat dairy industry into a similar market also underpins this premise. The New Zealand Dairy Goat Co-op is currently achieving $18 per kg MS for its suppliers. Two things need to occur to result in a viable sheep dairy industry. One is the establishment of a processor prepared to purchase milk at an economically viable price and the second is enough sheep dairy producers to supply the processor with enough milk to provide a reliable supply onto the market (S. Juby, personal communication, August 10th, 2014).

To gain farmer support clear positive signals would need to be sent out with a prescription indicating costs, returns and technical and genetic requirements and offer it as a complementary industry to the existing sheep industry. As of October 2018, there are three small scale sheep dairies in Canterbury – two supplying to cheesemakers and Charing Cross Sheep Dairy developing a small scale added-value business in the local market. While internationally much research into sheep dairying and milk production has taken place, very little of this is centric to New Zealand‘s high quality pastoral based systems. A program dedicated to the improvement of the genetic base would also be highly beneficial to a fledgling industry. The risks to participants would depend upon the financial investments required. For producers if they adopt a ‘low cost’ system then if at a future time the milk market was deem uneconomic then they could switch back to the existing meat market. For the processor the risks may be greater. This would depend upon how much of existing infrastructure can be directed towards a new enterprise and how confident they are in their market research. The biggest risk is likely to come from gearing up but not having the critical mass of producers required to support the new industry. Early indications with binding contracts are a necessary component for both processor and producers.

Conclusions and recommendations

This paper sought to answer the following three research questions

1. Is sheep dairying economically viable; can it compete with cow dairy systems?
2. Does sheep dairying offer a lower environmental footprint?

3. Does sheep dairying offer other benefits for farm businesses, farm owners, managers and staff, communities and consumers that make all the interconnected parts of the dairy value chain more resilient and sustainable?

Based upon the assumptions used, there is definite potential in and benefits for a sheep dairy industry in Canterbury and scalable to other regions. In terms of profitability sheep milking achieves an ROI on a capital outlay of NZD10 million of 5.9% compared to 3.9% for cow dairying on the same capital outlay and 3% for dryland conventional sheep farming albeit with a much lower capital investment. Of interest, is that for the sheep dairy system, non-dairy items (e.g. sheep meat and wool) contribute 31.4% to the total income whereas, in the cow dairy system, only 4.4% comes from non-dairy items (cull cows and bobby calves|). This indicates the strength of sheep dairying's multiple incomes streams in producing resilient profitability against volatile/poor milk returns.

There are already a number of farmers who are breeding milking sheep in anticipation of a scale processor providing tenable contracts. However, any investment will require clear market signals to develop further and a workable template to allow many adopters the confidence to proceed. Likewise, a large-scale processor will need a firm commitment from a critical mass before investing in infrastructure and marketing. However, if the signals from the processor are clear and positive enough it is believed there has been enough interest shown by existing and future farmers to indicate that a sheep dairy industry can take hold and be viable. Economics show that lamb rearing can be profitable, therefore sheep dairying could be beneficial to the meat industry. Likewise, there are considerable benefits to the environment and rural communities over cow dairying, however, more applied research is required to assess the issues impacting on the implementation of sheep dairy farming across Canterbury and New Zealand.

This paper is based on desk top analyses and the three year development journey of one small farmer, processor. The next and most valuable step is to do more researchers with farmers, processors and financiers to determine their perceptions and realities of stating sheep milking.

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