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What really drives dairy production systems: economic rationale or social and environmental responsibility?

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Abstract

There is a growing commitment in the primary sector to ensure a sustainable production base characterised by having long-term mutually reinforcing and beneficial effects on: food production, natural resource stewardship, environmental protection, and farming livelihoods. In the context of changing internal and external pressures on agriculture it is important to determine whether the dimensions of sustainability - economic, social, environmental - can be integrated successfully at the farm level. Having this knowledge is critical if we are to more fully understand the social and environmental consequences of changes in agricultural management. By understanding both the rationale of farmer's decisions, and their logical consequences, more effective management practices can be formulated. This paper summarises the approach to and results from interviews that were conducted with individual dairy farmers across the North and South Islands. These interviews were designed to determine attitudes and behaviour in terms of financial and environmental management, and social responsibility.

The results show that farmers work in agriculture because of their passion for the farming world and wider environment, the challenge and the satisfaction the job and industry provides, and the opportunity of running their own business. Profitability is the key driver of a farmers' business. Social responsibility is also a key factor to success, encompassing both an individual's own work-life balance and the management of employees. Finally, protecting the environment is a necessity understood by farmers. In allocating 100 points between financial viability, work-life balance and protection of the environment, financial viability came out as the most important factor, followed by work life balance and environmental management, each given equal weighting. In commenting on their allocation, farmers stated that if there is no business, then it becomes harder to focus on the other pillars of sustainability. However, many stated that in the long term, these priorities must change in order to consider all these issues with the same importance.

1. Introduction

Traditionally based on sheep and beef farming, New Zealand agriculture has seen major structural changes with the introduction of refrigerated shipping in 1882, the introduction of government support in the early 1900s and its subsequent removal in 1984. One of the more recent changes that has occurred is the conversion of many sheep and beef farms into dairy farms. Dairy production was traditionally based in the North Island, where 73% of dairy herds are located (LIC and DairyNZ, 2016). However, most of the recent growth in the dairy industry has taken place in the South Island where farm size, stocking rate and production levels are higher, with 27% of the herds but with 43% of New Zealand's milk solids production (LIC and DairyNZ, 2016). This intensification has been consolidated by a strong position in the processing and marketing sector with the formation in 2001 of Fonterra, a farmer-owned co-operative now owned by about 90% of New Zealand farmers. Collecting more than

15 billion litres of milk, Fonterra is responsible for almost one third of the world export dairy trade and is now ranked as the fourth dairy company in the world (Rabobank, 2014). Several key factors can explain the success in the development of dairy farming in New Zealand in addition to the adapted processing capacities. These include an all-grass farming system, high levels of research and development, and attractive market opportunities, originally with the UK (IUF Dairy Division, 2011). Today, New Zealand is the eighth largest world producer of dairy products and has become the largest world exporter of dairy products, with 95% of its production exported, mainly towards Asia, North America and Europe (Ministry for Primary Industries, 2016).

In spite of being a highly productive system, the New Zealand dairy sector is confronted by several issues that affect its future sustainability. This includes the lack of cheap and highly nutritive value feed and insufficient quantity of skilled farm labour (Clark et al., 2007). To tackle these problems, the industry has responded in several ways. First, because grazed pasture represents the major source of feed, pasture yields have been pushed to their maximum. This has been done through increasing the amount of nitrogen fertilisers spread on their pasture but also through introducing irrigation in the driest regions of the country, primarily Canterbury. In order to increase the milk yield per cow, many farmers have also increased their amount of supplementary feed given to their animals. Second, to enable economies of scale and the more efficient use of labour, the size of dairy herds have increased considerably over the past few years.

However, this highly productive system has been facing criticism because of increased environmental impacts (Baskaran et al., 2009). One of the major issues that has emerged is that related to soil and water quality. Indeed, because of fertiliser use and animal waste through dung and urine deposition a significant amount of nutrients, primarily nitrogen and phosphorus, can be lost to water sources leading to a decrease of surface and groundwater quality. Moreover as irrigation has increased, by 260% between 1985 and 2005, concerns over surface and groundwater levels have increased. Agriculture also accounts for 47% of the total greenhouse gases emissions in New Zealand and dairy farming makes a significant contribution, with methane coming from animals and nitrous oxide from fertilisers. Dairy farming is also often seen as a threat to biodiversity due to its pastoral landscapes with only pasture, livestock and fences. All these environmental issues linked to dairy farming have generated criticism of this industry.

Consequently, reducing the environmental footprint of agriculture and more particularly dairying has been one of the most important priorities in New Zealand. In 1991, the Resource Management Act was put in place by the government, requiring that local councils recognise the natural resource issues facing a region. The goal was to ensure that natural resources are sustainably managed in an integrative manner, and that any adverse impact on the environment is avoided, remedied or mitigated (Environment Foundation, 2015). Therefore, the New Zealand dairy system is now faced with the challenge of reducing its environmental footprint, whilst remaining economically efficient to maintain its substantial contribution to the New Zealand economy. However, these two concepts are not necessarily competitive, managing the economy may impact on the environment but maintaining environmental quality often enables a better economic performance (Pearce et al., 1989). Social considerations have to be included as well, not only because there is a responsibility of care for the highly mobile workforce required, but more generally because dairy farming has a role to play in the wider rural community. It is the challenge of producing adequate quantities of food that enables

farmers to make profit, while protecting natural resources, and improving the quality of life in rural areas (Schaller, 1993).

To reach these economic, environmental and social objectives, where continued growth in the global population and demand for food indicate that food production alongside environmental pressures are set to increase, requires policy and strategies that encompass both continued food production alongside environmental protection. To be successful, it also needs to be compatible with the motivations of the farming population.

Despite the drive for productivity and consequent intensification of agricultural systems, it has long been established that the behaviour of farmers is not driven solely by the economics of profit maximisation, and that many different values, beliefs and objectives influence their decisions (Gasson, 1973). Decisions made by farmers on farm are key determinants affecting changes in land-use (McGregor et al., 2001) and there is now considerable qualitative evidence that farmers also make land-use decisions in response to a variety of non-profit objectives (Cooke et al., 2013). Explicit models of farmer behaviour continue, however, to focus purely on the contribution of profit to utility (Janssen and van Ittersum, 2007), not altogether surprising given that farming is a business activity. Furthermore, a consistent theme is that farmers act in a decision environment with multiple and often conflicting objectives, but the inevitably complex decision making process is not easily incorporated within land-use models (Willock et al., 1999). Nevertheless, increasing our understanding of farmers economic, social and environmental values, and how these influence their decision-making in response to diverse policy, economic and technology signals is required if we are to identify sustainable agricultural practices and policy for the future (Sutherland et al., 2008).

This paper reports on a series of pilot study interviews examining attitudes and behaviour towards financial and environmental management, and social responsibility, to elicit the underlying economic, social and environmental values that influence the decision making process, and to determine whether the dimensions of sustainability - economic, social, environmental - can be integrated successfully at the farm level.

2. Methods

A series of seven pilot interviews were conducted with individual dairy farmers across the North and South Island, to determine attitudes and behaviour in terms of financial and environmental management, and social responsibility. Farmers were specifically targeted to represent a range of management structures, farming experience, farm size and farm system to give a good representation of the entire New Zealand Dairy system.

The main characteristics of the seven farmers and their farms are detailed in Table 1. The farmers' profiles demonstrate a reasonable representation of the dairy industry. There are two owners, two sharemilkers and three managers. There are also various ranges of farm size, with farm areas from 150 ha to 5,500 ha, and with a number of mixed-age cows from 220 to 8,500. The number of full time equivalent staff varies as well, with between two and 54 people working on farm. Even if some farmers have more experience in farming than others, the years spent on their current farm is quite low for most of them. On average, the four farms on the South Island are bigger than those in the

North, which is consistent with New Zealand dairying in general. Five farmers out of seven supply the biggest co-operative of New Zealand, Fonterra, whereas two supply private dairy companies, Synlait and OpenCountry. In addition, nearly all the systems defined by DairyNZ are represented.

Table 1: Characteristics of the seven farmers interviewed

Job role	Owner	Manager	Sharemilker	Manager	Manager	Sharemilker	Owner
Years in farming	25	7	17	9	9	25	45
Years on this farm	25	5	3	2	1.5	9	6
Farm location	Wellington	Wellington	Manawatu-Wanganui	Canterbury	Canterbury	Canterbury	Southland
Farm size	380 ha	400 ha	200 ha	150 ha	5,500 ha	310 ha	600 ha
FTE staff	2	7	2.5	3	54	6.5	6
Dairy NZ System	2	5	3	3	Between 3 and 4	3	3
No. mixed age cows	220	920	335	625	8,500	900	800
Milk supplier	Fonterra	Fonterra	Fonterra	Fonterra	Fonterra	Synlait	OpenCountry

The interviews were based around a series of open ended questions designed to provide a general appreciation of sustainable farming in New Zealand. The questionnaire was divided into five sections.

In the first section, general background information on the farm and farmer was confirmed, including the farmers' job role, education and length of farming experience, the farms' location and size, amount of labour, the Dairy NZ system that best defines the farm, livestock number and cropping.

In order to understand the attitudes and values held by farmers towards issues related to production, environment and people, each farmer was then asked to provide and rank their reasons for being farmers and the objectives they set for their business. They were then asked to consider how these feature in their decision making process.

In the next three sections, questions were focused on each pillar of sustainability – economic, social and environmental.

First, the farmers were asked to describe their economic situation, and also their impression of the level of the milk payout, alongside strategy for input sourcing. Questions then focused on future strategy, specifically income generation or cost reduction, and other sources of income on and off-farm. These questions were designed to establish the level of economic stability within their farming system.

Second, the farmers were asked questions about the interaction that they have within both the farming and non-farming community and their quality of life. These questions were designed to

establish an understanding of the strength of working and community relationships in their locality and their management of work-life balance.

Third, the farmers were asked questions about their management of the environment and the specific environmental issues that they try to manage. The first question was designed to determine whether their reasons for managing the environment was because of personal conviction or in order to meet regulatory requirements. Later questions were designed to focus on any specific issues not addressed by the first set of questions. These included soil and nutrient management, water use and protection, strategies for the control of weeds, pest and disease, waste management, and attitudes towards biodiversity.

In the final section of the questionnaire, questions were focused on the trade-off between these three pillars. The farmers were first asked about their thoughts on the role of agriculture in New Zealand and then about their vision of sustainability. To conclude the interview, farmers were then asked to allocate 100 points between financial viability of the farm, work life balance and the farms environmental management in terms of the importance thy would give to each.

In terms of the logistics of undertaking the interviews, four were conducted by phone, including all of those in the North Island, and three were conducted on farm. These interviews took between 30 minutes and one hour and 20 minutes, with responses recorded at the time of the interview. The results from each interview were then summarized in a table according to the categories of the questionnaire, in order to compare the findings, to extract the key ideas and to pull out the main similarities and differences. The results from the interviews are presented in the following section.

3. Results

Broadly speaking, the role that agriculture has played in the economy of New Zealand is recognised by the respondents. They see the industry as a "global farm that helps in feeding the world". They are also conscious of the responsibility they have to produce "healthy and sustainable food for the country and for the world" and the related role they have in protecting the environment. They see the negative public perception of the industry as to some extent valid and recognise that this has to be taken into account. However, they also find it frustrating that efforts to manage the environment are being made "without receiving any credits for that work", in part due to a lack of communication between the increasingly separated rural and urban populations. The respondents also see that the environmental regulations that are imposed are necessary and logical, even though in some cases they may be difficult to comply with. In this respect, there is frustration around lack of consultation. However, one respondent stated that it is the farmers' fault because they did not "sit around the table to negotiate". Consequently, the key challenge for the future will be in finding moderators between "idiot farmers and idiot policy-makers" that will connect these two entities so that a constructive and effective debate can be facilitated.

Reasons for farming and objectives for the farming business

In explaining their reasons for becoming a farmer, what emerged was the passion for farming and the wider environment, the challenge of the job itself and the satisfaction that it brings. For the

owners and sharemilkers there was also the opportunity of running their own business and building up wealth within that. For the managers it was the potential future opportunity for their own business and, to some extent, the autonomy they have in their current role.

Moving on to their objectives, their businesses seem to be mainly driven by profitability and economic performance. Most of them also mentioned sustainability concerns as one of their main objectives, they want a system that is productive in the long term, resilient and environmentally friendly. Taking care of their livestock and employees represents a major concern for these farmers alongside taking into account public perception towards their management of environmental issues. There is also recognition that their work-life balance has to be managed, with the desire to spend time with their families. For sharemilkers and managers, meeting the owner's objectives is also a high priority.

To measure the success in achieving these objectives, the respondents mainly rely on their financial performance. However, they use different ways to measure it, some of them would only have a look at their profit, some would "sit around a table" with the accountant and some would use benchmarking to compare with others. Nonetheless, financial performance is not the only way to measure success. It is recognised that the well-being of themselves and their staff is important and the amount of time spent in non-farming activity can be a way of measuring success.

In making changes, the measure of success and the most important driver is again financial return for these respondents but they also bear in mind the environmental impacts of this change. In parallel, managers and sharemilkers brought up the social consequences that a change can have, such as the capacity of attracting and retaining staff but also the capacity for saving time. Speaking more generally, there is recognition that a change is successful if all the objectives can be met and if "everybody sees a benefit, environment, animals, staff, and owners". As an example, one of them recently decided to shift to once-a-day milking in autumn to fulfil several objectives, animal welfare, easier for the staff and more economic due to being able to produce for a longer period.

To meet their objectives and to be in agreement with the values they held, decision-making is a critical process. When asked about the factors taken into account in the decision-making process, what most came out from these respondents is the environmental impact of this decision. The majority also mentioned financial implications as one of the key drivers in making these decisions, and the impact of these decisions on their staff, as well any implications for cow welfare and animal health. Public perception was also mentioned as a factor taken into consideration. Finally, discussion with owners is an important part of the decision making process for sharemilkers and managers.

All of these considerations, however, depend on the type of decision. For day-to-day decisions, they would take into account the weather and the stage of the year, whereas for strategic decisions, long-term effects on business, staff and environment are the more important factors.

In this section of the interview, it was evident that farmers keep in mind the three pillars of sustainability in their objectives and in their decision-making process. However, it is also evident that the most important issue for them remains the economic one that "drives everything".

Financial performance

Profitability is seen as the key driver of the farmers' business. The farmers interviewed were all reasonably optimistic about milk payout going forward after a number of difficult years and consider their business as financially stable and secure. References were made to the importance of resilience and the need to benchmark.

In terms of strategy, for most respondents, there was a strong emphasis on farming expenses. Even though the majority had already reduced their costs in preceding years, most were still seeking further reductions. The reductions sought related to repair and maintenance, animal health and fertiliser application by paying more attention to detail and through the use of benchmarking. The cost of wintering cows was also a focus.

The potential for increasing income was primarily focused on ways to increase milk production through better feed, grazing, and irrigation efficiency. There was also some emphasis on trying to reduce income volatility through establishing better milk supply contracts.

The majority also had other sources of income. Although, their productive activity remained highly focused on milk production, some had other productive activities on their farm both livestock and cropping enterprises. There were also activities outside the farm gate, for example, investment in rental properties and partners working off-farm, bringing in a second less fluctuating and therefore potentially less risky income.

The financial return overall was considered the basis of their business that drives everything else. With a good financial situation, these farmers could then focus on other issues.

Social responsibility

Social responsibility was seen as a key factor to success. Three main areas emerged as the areas of importance. Their own work-life balance and social interactions, responsibilities to their employees in terms of their work-life balance and integration into the rural community, and responsibilities to their livestock with particular emphasis on animal welfare.

Interaction that farmers have in their business with different organisations and individuals is a way to obtain information, aid decision making and improve business performance. All of the respondents had some form of social interaction. Other farmers and neighbours were the main source of exchange for them, and represent an easy way of getting practical information. Most of the respondents used independent farm consultants for a wide range of different issues including financial, stock management and, for the larger farms, sourcing of labour. The respondents also exchanged with their customer and suppliers, mainly in the area of milk production but also for feed and fertilisers. In addition, managers and sharemilkers also have regular contact with the farm owners who are seen as an integral part of the decision-making process.

All of the respondents were involved in different kinds of group-based activities. This includes attending major industry events, for example those organized by Dairy NZ or the South Island Dairy

Event. Moreover, most of them are also part of smaller groups that are particularly relevant to their situation and their own system. For instance, one who shifted to once-a-day milking is a member on a once-a-day group, whereas the wife of another one is involved in "Women in Dairying". One of the managers also attends an operations manager farming group.

All of the respondents were also involved in non-farm activities, some closely linked to the sector, for example one has a role in Federated Farmers, others are linked to the outdoors lifestyle with activities including fishing, hunting, or mountain biking, and membership of gun clubs. Spending time with their family is also a priority for the majority.

In terms of time spent at work, this differed between the respondents. The owners felt that the amount of time that they spent at work was about right. Sharemilkers and managers stated that they probably spent too much time working, although this is currently accepted as part of the job. In the same way, owners felt that they can take time off now quite easily whereas sharemilkers and managers, even though they do make the effort to take some time away from work, felt that they had less flexibility to do so.

All respondents recognised the issue and the importance of managing their work-life balance. To some extent taking time off depends on the stage of the year, but even in busy periods such as calving, taking a few consecutive days, and in less busy times, consecutive weeks is possible for most of them. There was also recognition that taking time off also depends on the stage of their career. It can be difficult at the start of their career but gradually can become easier to do so, "short term pain for long term gain". However, they are all aware of how important managing work-life balance is, and try to incorporate this in their objectives and plans.

Labour management was also seen as an important component of the farm system by the respondents, more so with those that had a large workforce, but also with the other respondents. The key priority was for the well-being and the integration of their staff, particularly where their workforce is comprised primarily of foreign workers. The respondents highlighted the role they have in integrating their employees into the community even going as far as to treat them as "extended family", recognising that this is beneficial in minimising staff turnover and thus also improving labour efficiency.

Similarly, all of the respondents saw animal health and welfare as important priorities. For some, their reason for being a farmer was their "passion for animals", for others they saw their role in looking after their livestock as an important objective and factor in decision making, such that any changes they planned to make to the business should benefit their livestock.

Environmental management

Protecting the environment is a necessity that was understood by the respondents and they were conscious of the role they have in managing this issue. There was also recognition that the "environment belongs to everybody" and that their role extended beyond that of simple environmental management and protection to one of being of "guardians" or "custodians of the land they have" for the next and successive generations. One of their objectives was to leave the

land in a better shape than when they took it on themselves so that the next generation could also benefit from it as a productive resource. The respondents said that they do take public perception and new regulations into account, but these are not the main reasons why they try to manage their environment: as fishermen, hunters and “guardians of their land”, adopting environmentally friendly ways of farming was a key component of their own personal convictions.

On their farms, the respondents stated that the main problems they have to face are related to nitrate leaching and water pollution, although other issues such as loss of biodiversity were also important. To tackle these issues, several measures have been taken by the respondents.

The impact of dairy farming practices on soils and water quality are reasonably well understood by farmers. To tackle this problem, the majority of the respondents pay particular attention to the damage that the livestock can do to their pasture and other crops if not appropriately managed. To reduce potential damage, the time spent on paddocks is actively managed and animals are excluded from wet soils. Reducing stocking rate is also an option that is used, through reducing livestock numbers or increasing land area through purchase or lease. All of the respondents have also taken measures to manage their nutrient application, not only for environmental reasons but also because it represents a significant expense item. The emphasis is on reducing the amount of fertiliser applied, focusing on both timing of applications and dose, making use of precision technology and variable rate applications. Soil testing is also used as a key element of developing their nutrient management plan. To improve nitrogen efficiency and to reduce nitrate leaching, some of the respondents have also incorporated plantain and clover into their pasture.

Effluent management is another area that requires management. In this area, all the respondents have taken some measures. As with fertilisers, the respondents focus on the careful timing of the application of these effluents. To be able to do this, there is a need to ensure adequate storage capacity of the effluent. Moreover, to avoid the risk of losing effluent from the pond into soils, some have installed lined storage ponds.

The respondents have also taken several measures related to water management. All of the respondents that have wetlands and waterways on their land have fenced off these waterbodies, have made sure there are margins alongside their waterways, and most have done or will do some planting alongside these.

Water use for those with irrigation is also actively managed for both environmental and economic reasons. Different techniques to increase water use efficiency are being implemented including precision and variable rate application.

Actively managing for biodiversity is also a consideration. A number of the respondents have been planting trees and hedges over the last few years and are still considering doing more. A key reason is for aesthetics, but they also see advantages in providing shelter for animals, improving the overall ecosystem and reducing nitrate leaching. A number of the respondents also have native areas on their farm that are actively managed by themselves and/or other organisations with the aim of preserving local biodiversity, with some previously cleared areas also being restored to native planting.

Waste management was the final area mentioned with the emphasis very much on recycling where possible and if necessary the use of specialised recycling firms.

As a conclusion to the interviews, the respondents were asked to allocate 100 points between financial viability, protection of the environment and work-life. The results are shown in Table 2.

Table 2: Importance of the three pillars according to the respondents

Job role	Owner	Manager	Share milker	Manager	Manager	Share milker	Owner
	25	7	17	9	9	25	45
Percentage importance attached to each pillar							
Farm size	380 ha	400ha	200 ha	150 ha	5,500ha	310 ha	600ha
Financial viability	50	60	50	33	33	33	33
Work-Life balance	40	10	25	33	33	33	33
Environmental management	10	30	25	33	33	33	33

Financial viability came out as the most important pillar for a number of the respondents. According to these respondents, if there is no business, then it becomes harder to focus on the other pillars. There was, however, comment that without due regard to the other pillars the business would not be viable and that to some extent focusing on financial viability would take into account both social and environmental responsibilities.

In terms of work-life balance there was recognition that perhaps too much time could be spent working rather than on leading a more balanced lifestyle. One respondent noted that for some farmers, farming is both life and work, with a further respondent stating that some farmers need to be particularly careful with this approach as many with a strong business become unhappy with their personal circumstances. One respondent also noted that the low weighting to work-life balance was the current situation to allow focus on building an asset base and that in future this would change.

The comment that priorities would and should change over time was made by a number of respondents. This was particularly in relation to work-life balance and how this had changed from the past to their current situation, and also how this would also change in the future. It was also made in relation to environmental management. Where a lower weighting was given to environmental management, it was mentioned that in achieving financial viability and work-life balance that environmental management was a key element to both. Good environmental management is of benefit to the other pillars, and thus if the other priorities were working well then good environmental management was also occurring.

It was generally agreed amongst all respondents that, in the long term, equal importance should be given to all three areas, financial, social and environmental.

4. Conclusion

Using a series of interviews with farmers across New Zealand the study found that for all respondents, profitability and financial performance remains the basis of their system and their first objective. Motivations and priorities, however, differ slightly between business type and size and stage of life, with different emphasis on financial priorities, social responsibilities and environmental management. Nevertheless, all respondents recognised that social and environmental responsibilities are key areas that have to be integrated into their objectives and decision making.

Those respondents with a large workforce were particularly conscious of their responsibilities towards their employees, and for all respondents' management of their employees and their own time in terms of work life balance and social interactions within and outside the business are seen as crucial to business performance.

Environmental management is also important to them. They are aware of the impact of their practices on the environment and understand the necessity for regulation, but feel better coordination between policy makers and farmers would be beneficial for reducing environmental impact further. They also recognise the lack of understanding between rural and urban populations and are frustrated by the criticism they face. They would like to see better communication achieved in terms of promoting what they do positively for the environment.

The interviews were designed as a pilot for a wider study and with a limited sample size and potential bias of respondents it is important to treat these results with caution. Nevertheless, the respondents can be considered as representative of the major dairy farming systems and farm ownership structures, and in terms of stage of life, and as such the interviews have merit in providing both an overview and useful insights towards farmers' behaviour concerning key financial, environmental and social drivers.

Overall, they recognise that financial viability, and social and environmental responsibility are of equal importance, and that although the emphasis may be on the financial, due regard must be given to the other two areas in order to achieve the first.

In answer to the question, "What really drives dairy production systems: economic rationale or social and environmental responsibility?" it is evident that it is a combination of all three, and that one cannot be attained without the other two.

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