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Perceptions of Sustainability of Dairy Support Land Farmers

M.R. Bennett
M.C. Pangborn
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Research Report No. 329
October 2012

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Perceptions of Sustainability of Dairy Support Land Farmers

A Case Study Investigation

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Key Terms

Dairy Support Land (DSL): Land that provides support to the MP by wintering cows, growing forage, pasture for silage and raising replacements.

Dairy Support Services: Feed or grazing related services that cannot be provided by the milking platform pasture. Dairy support services include winter cow grazing, grazing of replacements, silage making, grazing of lactating cows and grazing of carry over cows.

Milking Platform (MP): An area of land used to graze cows that are producing milk. The MP is usually intensively managed with pasture production, pasture quality, fertility and irrigation monitored and controlled.

Runoff: The word ‘Runoff’ is a commonly used term for DSL with almost all of those interviewed referring to their DSL units as ‘runoffs’.

Summary

This project investigated the business, environmental and social sustainability of dairy farms that include dairy support land (DSL).

Seventeen farmers were interviewed during the winter of 2008 using Yin's case study method (Yin, 2003). The interviewees were selected from a list provided during two focus groups meetings with rural professionals prior to the main body of the research.

DSL farmer's perceptions of sustainability are primarily defined by separation into factors internal to the farm system that are easy to control and external factors that are difficult to control, which they are very concerned about. While in a few cases, DSL was actively involved in business growth, as with sharemilkers leasing DSL for example, those interviewed saw that the primary roles of dairy support land are to achieve self-sufficiency and protect the dairy farm from external factors. Division into economic, environmental and social sustainability is nevertheless useful in understanding farmer goals with DSL.

Dairy farms are vulnerable to externalities because of high fixed costs. The ability of DSL to manage externalities relates to the quantity of feed grown and the relationship between cow condition and milk production, and therefore feed grown is perceived as the most appropriate measure of performance. Economic indices, such as the ability to minimize or control costs, are seen as a crucial, but secondary considerations. All of those interviewed believed that the addition of DSL enhanced the economic sustainability of the dairy system and provided a mixture of clearly defined cost savings and intangible benefits. There is an acceptance that the addition of DSL has potential to introduce new risks to the system.

For dairy support land to be environmentally sustainable, it must be well resourced. On a fully resourced DSL unit, there will be time to plan and carry out essential tasks and environmentally important developments such as riparian fences and stockwater systems are likely to be in place. Knowledge is effectively a resource problem; it costs time and money to gain and a lack of knowledge will lead directly to problems just as with under-investment in other kinds of resources. If the DSL unit is not fully resourced it will become a liability to the overall system as the supply of feed becomes unreliable, cows calve in poor condition and dairy farm staff and management are overextended. Problems were more evident on leased blocks where there was no arrangement with the landowner to address structural issues, or insufficient time to benefit from invested capital.

Many saw that it is not only possible to farm in an environmentally sustainable manner without resort to uneconomic developments or production losses but that good husbandry practices lead to both positive economic outcomes and positive environmental outcomes. Examples include good grazing management, nutrient budgeting and using fertilizer appropriately, using eco-N and using appropriate tillage methods for the situation. Negative environmental effects are often linked to failure to perform economically. Many interviewed believed that practices that bring environmental and economic drivers into line should be a focus of extension by universities, regional councils and industry organizations.

There is recognition that addition of DSL may result in increased pressures for managers as they are required to take responsibility for ensuring DSL tasks are planned and executed well and must supervise staff on the DSL as well as the MP. Managers need to be aware of the demands that the addition of DSL or operating for 12 months place on staff, and failure to address problems with staff is likely to result in economic losses and further stress for the manager. On the other hand, dairy farm systems that include DSL can manage the increased reliance on staff by making

the farm a better place to work in terms of job variety, skill and career development and other benefits. And this can help address external social factors such as staff shortages. Difficulties in obtaining staff and rising compliance costs are seen as significant and difficult to control external threats to the future sustainability of dairy farming.

Thus while all those interviewed saw that economic, environmental and social sustainability were compatible and achievable with intelligent application of resources including physical resources such as feed and machinery, management time and knowledge, and capital developments, part of the role of the DSL is to protect the MP from variations in climate or the feed market. When forced to choose between the sustainability of the DSL component of the business and the sustainability of the MP component, the sustainability of the MP will always come first.

While rural professionals involved in the focus group meetings were strongly of the view that commercial separation between the MP and DSL, and use of separate management structures, commercial drivers and formal monitoring systems were important for sustainability, this appeared to be dependant on conditions at the site and most of the farmers interviewed felt that these were not essential for the DSL to reach its full potential to support the farming business. Most did agree that planning and attention to detail in critical tasks such as crop establishment and grazing management are vital to success. Planning is important to avoid wasted resources and ensure tasks are done properly and on time, and those interviewed were prepared to spend a lot of time planning and designing good systems.

While some of the technical details were seen as being different between cases – the relative benefits and costs of all–grass systems vs crops, for example, or the need for transition feeding, whether or not DSL may assist with reduction or elimination of inductions – and there are particular management considerations in different circumstances – dryland vs irrigated blocks, adjacent vs distant DSL, and so on - the case studies demonstrated that the fundamentals of sustainability and practice remain constant across a variety of soil and climatic conditions in Canterbury and Southland. Relative scale, not absolute scale, climatic conditions or soil type appears to be the key determinant of how DSL is used. Canterbury dairy systems are relatively more intensive than Southland systems, but amount of feed grown, controlling costs and protecting MP production are the key drivers in both regions.

There appeared to be some difference in Southern Southland. Although it is possible to achieve sustainable outcomes with DSL, the tendency for farmers to convert DSL to MP suggests that the best economic use of land in this region may be milk production.

Keywords: dairy support land, perceptions of sustainability, practice, managing externalities, Yin's case study method.

Chapter 1
Introduction

Many dairy farmers rely on dairy support land (DSL) to control feed supply and graze cows over winter. Some industry observers (consultants, academics and farmers) have argued that the inclusion of DSL in an intensive dairy farm system often results in problems as management and other resources are over-extended (Davis, 2005; Thorrold, 2000). Possible negative outcomes include a loss of management focus on the dairy farm, neglected DSL, sub-optimal crop or pasture yields, environmental damage and poor financial performance (de Wold, 2006).

Furthermore, observers have suggested that DSL allows farmers to transfer environmental problems to the DSL, rather than dealing with them on the milking platform (MP).

There are very few documented investigations into the problems that occur with DSL and how to solve them, and little hard data on the way DSL sustainability varies across types of DSL or across regions. In fact, there is little academic literature dealing with DSL issues at all. A combination of knowledge of commercial farm systems and insight from a depth of professional experience makes the popular literature a valuable resource in understanding DSL systems and management to gain insight into, and evaluate, current problems and issues (Davis, 2005; Smith 2003; Cottier; 2000; O'Conner 2003).

1.1 The purpose of dairy support land

Wet, cold conditions and low pasture production mean that in the South Island, dairy cows are generally grazed off the MP for 60-70 days over winter (Cottier, 2000). Grazing off is intended to protect the MP's soils and pastures from damage, maintain cow condition and ensure an adequate supply of feed for the start of lactation and a productive milking season. Because of the relationship between cow condition at calving and production, many farmers have chosen to acquire DSL so as to manage grazing off themselves and gain direct control of cow condition over winter.

Activities on DSL range from wintering cows to extending lactation, rearing young stock, producing supplements and otherwise supporting the needs of the MP and in some cases the addition of enterprises such as cash cropping or bull beef (O'Conner, 2003, Richards, 2006). The relative size of DSL may determine the range and scale of enterprises that the land can support; in the study by Richards (2006) in Canterbury, DSL ranged from 40 per cent to 100 per cent of the MP area.

In New Zealand pastoral systems, winter is the most sensitive period of the year from an environmental point of view. Higher rainfall and soil moisture, plus lower pasture growth rates increase the potential for pugging and soil damage, nutrient leaching and runoff. It is thus quite understandable to assume that environmental damage and sustainability issues may arise. It has also been suggested (Cottier, 2000, de Wold, 2006) that the costs of operating DSL is a lot higher than many farmers appreciate and that economic sustainability is also an issue.

It seemed to us that that the way successful DSL farmers perceive sustainability and how their views relate to practice would be valuable in better understanding sustainability issues and appropriate practices within dairy farming systems that include DSL.

1.2 Sustainability

Concepts of sustainability vary over time, from one observer to another and are heavily dependent on context. The difficulty in defining 'sustainability' or understanding the variety of definitions, perspectives, constructions of knowledge and values associated with this term is illustrated by the range and breadth of definitions generated by previous studies examining attitudes to the sustainability of New Zealand agriculture:

Rauniyar & Parker (1998) have defined sustainability of farming as follows:

> *'Sustainable farming encourages economic development and productivity whilst maintaining natural resources so as to ensure that future generations have the same production opportunities.'*

As part of their study which included an exchange forum involving farmers, scientists and policy advisors, they go on to say:

> *'The (participants) agreed that the six components of sustainability be clearly defined as:*
>
> *a) Soil characteristics (good structure, stable, fertile, uncontaminated, and low level of erosion);*
> *b) Water quality (clean, abundant, affordable, good fresh water habitat and low coliform, P and N content);*
> *c) Farming with animals suited to the land (physical and reproductive traits, profitability);*
> *d) Plant attributes (right species, stable plant community, low toxin levels, nutritious pastures and appropriate seasonal growth);*
> *e) Social/community indicators (happy farm families, supportive community, accessible services and improved means of communication); and*
> *f) Economic factors (long term profitability/viability, profitable markets and affordable land)'*

Later, Saunders & Cumberworth (1993) provided the following:

> *'MAF defined the characteristics or goals of sustainability as the use of practices that maintain or enhance:*
>
> - *The ability of people and communities to provide for their own social well-being.*
> - *The economic viability of agriculture.*
> - *The natural resource base of agriculture.*
> - *The ecosystems influenced by agricultural activities.*
> - *The quality and safety of food and fibre.'*

It is apparent that the concept of sustainability covers a wide range of concerns or areas of interest and that the word 'sustainability' can mean many things depending on the context of the discussion or goals of those involved.

1.2.1 Sustainable economic returns

While ownership of DSL may have been a cheap means of purchasing winter feed in the past (Cottier, 2000), appreciation in land prices mean that this may no longer be the case and it has been argued that the true cost of feed produced, not control should be the primary concern in choosing among winter feed options:

'The underlying consideration for the success of a dairy farm runoff is the cost of the opportunity provided measured in money, time and resources.'

-O'Conner, 2003

In other words the view of rural professionals and observers is that to be successful, DSL must provide services more cheaply than could be achieved by alternative means, i.e. purchase on the open market, and indices of DSL performance should be designed with this in mind.

This view is in contrast to that of farmers interviewed by Richards (2006), who were satisfied with the economic performance of their farms and believed that the value of control over the way cows are fed and costs of feeding contributed to the sustainability of the overall farm system. In other words control of DSL had benefits beyond the value of feed grown: *'Control was king, cash flow certainly wasn't'* (Richards 2006). Thus, the motivation for purchase of dairy support land is very often to reduce production risk to the farm system by controlling the feed supply over winter and early spring, rather than profitability.

1.2.2 DSL in winter

Wintering is carried out on all DSL and control of winter feeding is central to the decision to include DSL in the dairy farming system. The objectives of wintering are to re-build udder tissue, restore body condition and grow a healthy foetus (Cottier 2000).

Many DSL farmers winter cows on crops, a relatively cheap and nutritious source of winter feed. It has been suggested that for wintering to be successful, a cow must be offered 14.7 kg DM/day made up of 50-60 per cent forage crops and 30-35 per cent silage plus hay and straw (Nichol, Westwood, Dumbleton and Amyes, 2003). Although crops are known as an excellent way of carrying feed into winter, a number of problems commonly occur including poor rumen adaptations to a change of diet, nitrate poisoning, poor utilization and soil damage (Beare, White and Wilson, 2006). These authors found that conventional and minimum tillage of crops significantly increased the likelihood of soil damage under subsequent grazing, with no-tillage giving the best results in terms of preservation of soil structure under winter cow grazing.

Wintering methods and the severity of problems with wintering vary across the South Island with the sustainability of particular systems or practices closely related to soil type and climate (Drewry, Littlejohn and Paton, 2000). For example, in Southland it appears that wintering on crops can strain farm resources such as labour as well as creating a risk of soil degradation and contamination of waterways (de Wold, 2006). In Canterbury, free drained, light soils are better able to support wintering, but problems with crop pests can be severe and some argue that grass wintering is a preferable option (Davis, 2005).

1.2.3 Environmental impacts and compliance costs

Rising costs of production and declining commodity prices prior to the volatility of the last four years, have created a driver for ongoing agricultural intensification, which can in turn create tension between economic sustainability and environmental and social sustainability (Parker, 2004). Environmental impacts of agriculture often involve non point source pollution, which is hard to monitor and control (Rhodes and Willis, 2000). Fears over the impact of agricultural intensification, combined with a lack of clear or definitive evidence of the actual degree of effects have led to concern over the impact of intensive agriculture.

The OECD have suggested that although the New Zealand agricultural sector is one of the least polluting in the world, the trend towards increasing intensification combined with political action means that the New Zealand public has become very concerned about the environmental impacts of primary production (OECD, 2001). Public and political pressure is being applied to address the environmental impacts of agriculture with measures being taken by both government and industry bodies.

In New Zealand, the focus of popular concern and environmental regulation is the contamination or depletion of water resources (Brodnax, 2006, Smith, 2003). This situation has come about because indicators of water quality are easy to measure relative to other environmental indicators (Saunders & Cumberworth, 1993) and because of the extensive linkages between land use activities and declining water quality.

The Dairying and Clean Streams Accord (2003) outlined an explicit and clear description of environmental best management practices for managing water quality and includes targets for when they will be adopted by industry. The accord defines environmental best practice for farm races, culverts or bridges; effluent treatment and discharge; nutrient management to minimize losses; and protection of wetlands.

The concepts of best practice as defined by the accord are supported by a range of scientific work and technical literature, (Di & Cameron, 2004; Drewry, Littlejohn & Paton, 2000; Houlbrooke et al, 2003). Houlbrooke et. al. (2003), for example found that dairy farming can lead to eutrophication of waterways and there may be a need for appropriate management to control and reduce these effects.

Other scientific tools such as developing and executing nutrient budgets and application of nitrification inhibitors have developed to the point that they can be effective in controlling nutrient loss. Nutrient budgeting software can be used to predict N, P and K loss over an ever-increasing range of soil types and conditions (Edmeades, 2006), and nutrient budgets are now required by many regional councils and the Fonterra supplier co-operative.

Although the ongoing growth of dairy farming and the associated expansion of DSL farming means there is potential for increasing environmental impacts and escalating compliance costs, it appears that the situation can be controlled if there is a will and a means to do so. The sense of community and collective responsibility that has allowed dairy farmers to meet the challenges of collective marketing, processing and innovation may also be applicable to the challenge posed by environmental impacts and legislative or market related impacts that could result (Saunders & Cumberworth, 1993). As the risks of environmental compliance costs increase and management tools and knowledge improve, it is believed that dairy farmers may be able to act as a group to keep environmental impacts and associated compliance to an economically feasible level.

1.3 The aim of the project and research questions

The aim of this project is to examine how successful farmers perceive the sustainability of DSL and the way that this applies to practice across locations and types of DSL.

It appears that DSL plays an important role in dairy farmer's attempt to achieve a sustainable farm system (Richards, 2006). The prominence of DSL, along with the current dependence on non-farmers for knowledge of DSL practices, justifies further investigation into the way farmers perceive and address sustainability issues.

Building a theory from the experiences and perceptions of farmers will help create a more balanced and rigorous understanding of the sustainability of dairy farm systems that include DSL. It is hoped that examining the perspectives of sustainability of DSL farmers, why they choose to use DSL, and what they believe needs to be done to achieve success will create an improved understanding of DSL management.

The research questions are designed to ensure the project effectively achieves these research aims. The questions are:

1. What are the perceptions of sustainability of farmers who use DSL to achieve business, environmental and social goals?
2. How do perceptions of sustainability of farmers who use DSL to achieve business, environmental and social goals relate to practice at the case study site?
3. How do perceptions of sustainability and the relationship to practice vary across groupings or regions?

1.4 Research approach

Data was collected and analysed using Yin's Case Study Method (Yin, 2003). This method was chosen because of the need to understand perceptions of sustainability and practice in the context of the conditions and constraints unique to each dairy farming system. The method also allows the researcher to draw on prior knowledge and industry experience while providing a rigorous mechanism to prevent assumptions and bias intruding into data collection and analysis.

Case study interviews were done at 17 case study sites at various locations around the South Island. Successful DSL farmers were chosen to ensure case studies where strategic decision makers thought about and tried to achieve a sustainable farm system.

A preliminary framework regarding appropriate perceptions of sustainability and practice for DSL was developed during two focus group meetings with rural professionals. The mechanics and application of Yin's method (Yin, 2003) and the reason for using it in this situation are discussed in the following section. Section 3 contains a summary of the focus group meetings and this is followed by a description of the derivation of the case study protocol. The results section is divided into three parts; perceptions of sustainability of DSL, the relationship between perceptions and practice at the case study sites, and an investigation of how perceptions of sustainability and practice vary across different types of DSL. The last section includes a discussion and conclusion. The 17 case descriptions, pictures referred to in the discussion and the case study protocol are included in the appendices.

Chapter 2
Methodology

2.1 Introduction

Yin’s case study method uses an evolving scheme of theoretical propositions and a case study protocol to guide research preparation, collection and analysis of evidence, and to maintain validity and ensure that as much relevant evidence as possible is extracted at the case study sites. As the case studies proceed, the theoretical propositions evolve and change to better reflect what is found at each case study. This is followed by collation and analysis of the data using a variety of techniques to ensure a thorough investigation of the topic and identification and examination of the central themes of the study

It is important to keep in mind that the goal is not to create knowledge that can be generalized, but to achieve ‘theoretical generalization’ or improved insights; the intent is to improve knowledge that already exists rather than to dispute the burden of proof in the sense of the scientific method.

Yin’s method has been criticised on the basis that the theoretical propositions that form the basis of the study inevitably introduce existing bias or reversions to orthodoxy that have no place in qualitative research. However in many professional fields (such as medicine and agricultural systems) it is impossible to understand data at a case study site without substantial prior knowledge. The application of Yin’s method allows for the influence of bias or orthodoxy, and offers a means of examining data available in light of existing knowledge.

2.2 The rationale for using Yin’s method

The need to examine contemporary phenomena in their real life context, with a focus on ‘how’ and ‘why’ questions, the complexity and variety of DSL systems, and the significant prior knowledge required to comprehend the data at case study sites meant that Yin’s Case Study Method was seen as an appropriate instrument to investigate successful DSL systems (Yin, 2003).

2.2.1 The philosophical basis of the research

With case studies it is important to address the philosophical basis of the research, particularly because the method has been criticized as inferior to, or less rigorous than, other methods (Yin, 2003). Thinking about the philosophy behind the research is helpful in developing rigorous methods or frameworks for collecting and analysing data and improving the research outcome.

Phenomenology

The purpose of case studies is to investigate phenomena in their real world context. In this study the phenomena of interest is successful application of DSL to improve the sustainability of intensive dairy farming systems. The goal of the investigation is to better understand this phenomenon and the conditions and behaviours that allow it to occur.

Phenomenology is the study of real world happenings with the experiences or perspectives of those involved as the focus of data collection:

> *'Phenomenologists focus on the social construction of the life-world, emphasizing that people's actions can only be understood when they are situated in the taken-for-granted meanings and routines that constitute the everyday world.'*

-Liamputtong and Ezzy (2005)

In other words the best source of knowledge of a phenomenon comes from the knowledge or perspectives of those who experience it. Thus the focus of investigation in this case is farmer's experiences with DSL, their perceptions of sustainability and how these perceptions relate to practice at the case study site. The purpose of the study is to achieve improved understandings and insights derived from the experiences and perspectives of those involved; it is not to generate an external and independent recipe of best practice for sustainability.

Positivism and Yin's case study method

Yin's Case Study Method constitutes a positivist research method because it involves a search for evidence for and against pre-determined propositions. In social science, positivist researchers believe that knowledge can be built by constructing and testing hypothesis about relationships in the social world, much as the scientific method can be used to form and test hypothesis in the physical world.

Some qualitative researchers have criticised this approach because they believe those who use positivist methods may fail to identify how their perception of reality is influenced by social constructs. In other words positivists may fail to capture meanings and interpretations that are essential to understanding social systems, and may distort the knowledge or perspectives of the researched through the lens of the preconceived notions and prejudices of the researcher (Liamputtong and Ezzy, 2005).

Yin's Case Study Method uses rigorous procedures to avoid skewed data collection or biased interpretations that can arise from using a positivist approach. Development of a set of theoretical propositions and rival explanations precedes, and evolves with, the study and constitute a formal statement of theory that induces the researcher to 'bracket their assumptions' (Liamputtong and Ezzy, 2005) so that they see the social world that is the subject of the study as clearly and objectively as possible. The set of theoretical propositions are the genesis for a case study protocol that ensures that a maximum range and depth of pertinent evidence is gathered at each case study site.

The combination of quantitative and qualitative traditions, using rigorous procedures to reconcile a positivist method with interpretive approaches to situations and data collection, makes Yin's case study method difficult to use, but very useful in certain situations. This method is useful when an explanation is being sought for an observed phenomena or when substantial training or professional knowledge is required to understand the data at the case study site.

2.2.1 Investigating perceptions of sustainability of DSL

The 'application of DSL systems where farmers achieve business, environmental and social goals' was considered a suitable phenomenon for investigation using Yin's Case Study Method for a number of reasons:

- As a component of a farm system, the phenomenon takes place in a real life context within a physical, economic, historical and social setting.
- The impact of the external environment on the dairy farming system means there is an overlap between the phenomenon and the context in which it occurs.
- The research questions relates to how or why questions *'being asked about a contemporary set of events over which the investigator has little or no control.'* (Yin, 2003)
- Dairy farming systems that include DSL form a distinct unit of analysis that can be reconciled with the situation of the cases and the research questions.
- At each case study site there was an opportunity to gather a range of supporting evidence that is relevant to the study; besides interviews with participants, evidence collected included documents, photographs, direct observations and archival records.
- A certain level of knowledge is required to understand the evidence at the case study site, which means that the method used has to have a means of incorporating existing knowledge while minimising bias. This set of prior knowledge could also be expressed as a series of theoretical propositions and rival explanations (Yin, 2003).

Not only did the research problem satisfy the criteria for the use of Yin's Method, but it also appeared that it would be difficult to properly address the research problem using other qualitative methods because existing understandings of sustainability had to be examined and compared at the same time as the phenomena was investigated. Investigations where prior knowledge must be considered during the research are more appropriate for investigation using Yin's Case Study Method than other methods which are not designed to actively build links between existing knowledge and the perceptions and experiences of those immersed in the phenomena.

2.3 The research design

The research design is the logical framework that guides the research process:

'The main purpose of the design is to avoid a situation in which the evidence does not address the initial research questions.'

-Yin (2003)

In other words the purpose of the research design is to help ensure that the research questions are addressed in the most effective way possible within the resource constraints of the study.

The steps in the research design are:

1 Formulating the Research Questions
2 Establishing Units of Analysis
3 Formulating a Set of Theoretical Propositions and Rival Explanations
4 Formulating a Case Study Protocol
5 Doing a Pilot Case Study and Collecting the Data
6 Analysing the Evidence
7 Composing a Case Study Report

2.3.1 Formulating the research questions

The research questions are formulated to ensure the scope and direction of the project follows the aim of the research and makes effective use of time and other resources. As noted previously, research questions for this study are:

1. What are the perceptions of sustainability of farmers who use DSL to achieve business, environmental and social goals?
2. How do perceptions of sustainability of farmers who use DSL to achieve business, environmental and social goals relate to practice at the case study site?
3. How do perceptions of sustainability and the relationship to practice vary across groupings or regions?

2.3.2 Establishing units of analysis

Correct identification of the units of analysis begins with careful consideration of the goals of the project and the appropriate topics or areas of interest to generalize to. It is important to take account of the nature of the research questions, the issues and the kind of information sought (Yin, 2003).
Farmers purchase or lease DSL in order to ensure a sustainable dairy farm system (Richards, 2006), and as a result it is necessary to take account of the dairy farm as a whole when considering the sustainability of DSL. Thus it appeared that there was a hierarchy of units of analysis and that the most effective strategy was an embedded multi-case design.

The unit of analysis was therefore defined as dairy farm systems that include DSL. The embedded units of analysis were the DSL units and the interviewees (usually strategic decision makers).

2.3.3 Formulating a set of theoretical propositions

Theoretical propositions are a formal statement concerning the phenomena under study drawing on previous knowledge and experience of the researchers or others familiar with the area. Every theoretical proposition is paired with a rival explanation to form a 'dyad'. The proposition dyads are the basis for the case study protocol and are important in clarifying the focus of data collection and analysis:

'The establishment of propositions improves and clarifies the focus of the research questions and defines which kind of information should be collected from the unit of analysis.'

-de Moura (2002)

The act of defining and writing out a set of initial theoretical propositions induces the case study investigator to consider all aspects of knowledge or accepted theory relevant to the topic and write them out in a methodical and operational manner. In this way the theoretical propositions act as a filter between existing knowledge and the process of data collection and analysis.

The theoretical propositions are also a mechanism of formation and gradual improvement of theory (a feature of a multi-case research design). By systematically clarifying and defining the focus of the study the propositions assist the researcher to rigorously examine the evidence at the cases study sites leading up to and during the case studies:

'The establishment of the propositions gives structure to the empirical work and guides the data gathering phase…'

-de Moura (2002)

As the researcher explores the phenomenon, alternative or additional explanatory schemes may emerge and new propositions established, which in turn inform further work.

Finally, the propositions create a record of changes or insights that arise as the case studies are carried out; as part of maintaining a chain of evidence, changes to the propositions that occurred during the study are noted in section 4.

2.3.4 Rival explanations

A rival explanation is an alternative statement of relationship or causality that is (thought to be) mutually exclusive with a theoretical proposition: *'…if one explanation is valid the other cannot be.'* (Yin, 2003).

Rival explanations work by informing the design of the case study protocol, thus ensuring that as well as searching for evidence for a particular proposition, the case study investigator also searches for evidence for alternative explanations. When properly applied, the rival explanations enhance the internal validity of the study during preparation, data collection and analysis.

Rival explanations were used to enhance both literal replication and theoretical replication in this study. Literal replication refers to the formation of an initial theory, while theoretical replication refers to testing or examining this theory across a range of case study sites:

- Rival explanations enhance literal replication by enhancing the internal validity of the results: *'The cross-case results may be stated more assertively'* (Yin:2003)
- Rival explanations enhance theoretical replication by aiding in the search for supporting evidence for variation in patterns of evidence across additional groups of case studies.

2.3.5 Formulating a case study protocol

The case study protocol is the set of instructions that aids the researcher in achieving effective data collection and maintaining rigour through all stages of the case study investigation. The case study protocol includes:

1. An introduction to the project and a statement of purpose of the interview as well as a copy of the research questions.
2. The scheme of theoretical propositions and rival explanations that are the focus of the case study.
3. Instructions for organising or preparing for the case study interview.
4. The definition of the units of analysis found at the case study site.
5. Instructions for carrying out the interview, including an interview guide, a list of observations to make and documents to ask about.
6. Instructions for activities to carry out after the interview, including transcribing, analysis and reflective examination of the scheme of theoretical propositions and possible modifications to the case study protocol.

A sample case study protocol is included in Appendix A.

2.3.6 Ensuring high quality case studies

There are a range of issues that need to be addressed if rigorous, high quality case study research is to be produced. Most problems can be avoided by addressing construct validity, internal validity, external validity and reliability (Yin, 2003).

2.3.6.1 Construct validity

'Construct Validity' refers to the quality of the data collected. It is maintained by enacting strategies to achieve maximum objectivity and depth in data collection and analysis. In this study, construct validity was maintained by following a case study protocol, using multiple sources of evidence and establishing a 'chain of evidence'.

The case study protocol

The case study protocol is a guide to the interview process that accompanies the case study investigator to each study site. The case study protocol is meant to maintain rigor while providing an ongoing reminder of procedures that should be followed to maximize the effectiveness of data collection, analysis and presentation.

Multiple sources of evidence

A number of relevant sources of evidence were available; these included interview transcripts, direct observations, photographs, documents and archival records. The various sources of evidence used are discussed in section 2.4.1.

The chain of evidence

Maintaining a chain of evidence refers to the task of maintaining a coherent link between the case study protocol, evidence gathered at the case study site and evidence presented in the case study report. If an effective chain of evidence is maintained, those reading the case study report should have no difficulty in linking the findings of the study with evidence gathered at case study sites. Measures taken to maintain a chain of evidence are further discussed in the case study protocol in Appendix A.

2.3.6.2 Internal validity

'Internal validity' refers to the quality of analysis, inferences or insights that arise from the data. To achieve a high level of internal validity, the researcher must consider the full range of evidence and ensure that inferences are of the highest quality possible:

> *'Is the inference correct? Have all the rival explanations and hypothesis been considered? Is the evidence convergent? Does it appear to be airtight? A research design that has anticipated these questions has began to deal with the overall problem of making inferences and therefore the specific problem of internal validity.'*
>
> -Yin (2003)

Any research design must anticipate these questions and deal with the overall problem of making inferences and the consequent problem of internal validity.

Analytic strategies undertaken to maximize internal validity included relying on theoretical propositions, addressing rival explanations, developing case descriptions, pattern matching, and coding.

Theoretical propositions

Theoretical propositions help preserve internal validity by defining the questions and relevant enquiries to be made at each case study site so as to collect information of a kind that helps address the questions of the study. Theoretical propositions also act as an information filter, in that they assist in maintaining rigour in the context of knowledge held prior to commencement of the study.

Rival explanations

Rival explanations are alternative hypotheses or statements of relationship that are mutually exclusive with the theoretical proposition that they are paired with. They help maintain internal validity by forcing the case study investigator to look for contrary evidence and to consider the implications of all the evidence collected for every proposition at every case study site.

Developing case descriptions

Case descriptions are based upon focussed reflections written in the form of a case study journal in the hours and days following each case study interview. They are useful in maintaining internal validity because they are a record of how the evidence that arose in each case study related to or influenced the theoretical propositions at the time of data collection.

Case descriptions also play a key role in maintaining a chain of evidence (Yin, 2003). A case description provides a means by which those reading the case study report can examine the source of a particular piece of evidence and the circumstances under which it was collected, and the way that this related to the original questions in the case study protocol.

Case descriptions were also used to maintain construct validity. Subsequent to the interview, each interviewee received a case description and was given a chance to correct any misrepresentation or inaccurate data. The complete set of case descriptions including a description of their relationship to the evolving scheme of propositions at the time of the study can be found in Appendix B.

Pattern matching

Pattern Matching is the process of searching for groups or typologies within the case study sites. Two types of pattern matching were done; pattern matching across all of the case study sites and pattern matching across the various types or categories of case study sites (comparing the evidence generated at case study sites in Canterbury with that from Southland for example.) A description of the way that pattern matching was applied in this study can be found in section 2.5.2.

Coding

The software package QSR NVIVO 7 was used to code the manuscripts from the case study interviews. The purpose of coding was to assist in the task of looking for patterns in the data and to enhance internal validity by ensuring that all relevant evidence was accounted for. A further description of the role of coding can be found in section 2.5.2.

2.3.6.3 External validity

External validity is a measure of the extent to which the findings of a study can be generalized to other, similar situations. In preparing, carrying out and analysing case studies it is important to keep in mind that the goal of the data collection is not theoretical generalization (creating a theory that can be generalized to other sites), but analytic generalization in which insights or aids to understanding are generalized to other sites:

'Case studies are generalizable to theoretical propositions and not to populations or universes'

-Yin (2003)

In other words, although case study findings cannot be generalized to the whole population in the same way that scientific results can, they can prove very useful as a source of theory and insight into situations beyond those examined at the case study sites.

2.3.6.4 Reliability

Reliability refers to the quality of the overall methodology:

'The objective is to ensure that if a later investigator followed the same case study all over again, (they) would arrive at the same findings and the same conclusion.'

-Yin (2003)

Apart from a good research design, with appropriate units of analysis and thorough investigation of rival explanations, achieving reliability requires a good record of how the case study was planned and carried out; this is achieved through the case study protocol and case study data base.

2.4 Pilot case studies and data collection

2.4.1 Types of evidence collected

Evidence available at the case study sites included structured interviews, direct observations, pictures, archival records and documents. Collecting more than one type of evidence is useful because it aids the researcher in comprehending the farm system and generates additional ideas and insights, (Cresswell, 1997).

Interviews were of central importance with other types of evidence used to enhance understanding of what was said or to indicate possible avenues of enquiry.

Interviews:

The large number of case study sites and the high value of the time of the interviewees meant that the most practical kind of interview was a short focussed interview:

'…in which a respondent is interviewed for a short period of time; an hour for example. In such cases, the interviews may still remain open-ended and assume a conversational manner, but you are more likely to be following a certain set of questions derived from the case study protocol.'

-Yin (2003)

Thus the interview guide included in the case study protocol consisted of a list of specific questions designed to extract the maximum amount of evidence from the case study site in the limited amount of time available.

In order to ensure good quality verbal evidence it is necessary to attempt to understand DSL sustainability issues and how they affect practice from the perspective of those responsible for DSL:

> *'…a good listener hears the exact words used by the interviewee, captures the mood and affective components, and understands the context from which the interviewee is perceiving the world.'*
>
> *-Yin (2003)*

In other words, the results can be improved by attempting to understand events from the perspectives of those experiencing them.

While interviews with key individuals are a very useful source of evidence, it is essential to keep in mind the limitations of verbal reports. Interview data is influenced by the competence of the interviewer or those being questioned and will also be influenced by the perceptions of those being interviewed.

Documents:

Two farms (1D) and (2B) had been the subject of media reports and relevant documents were available. These documents were valuable in that as well as corroborating the evidence gathered directly at the case study site, they provided an alternative perspective on the dairy farming system. As with any documents it was important to remember that these were written interpretations of another investigator with a particular purpose distinct from that of this investigation (Yin, 2003).

Archival records:

Most of the case study sites had archival records available. Typically these were working records that the interviewee referred to in daily operations and were therefore very useful in understanding what was happening on the DSL.

A farm map was collected at most case study sites, with other records such as nutrient budgets and feed plans available at times. Farm maps provide a representation of soil types, layout, paddock size, issues related to distance, location of streams or water-races and irrigated or dryland areas. In this way farm maps are important to the contextual understanding of the farm system and may also assist in forming directed and purposeful probes at the time of the interview.

At some case study sites, archival records also acted as indicators of a certain level of organization or a level of resources applied to DSL operations and tasks; the presence of a winter feed plan for example is good evidence that the strategic manager estimates the feed available and allocates it to various mobs or classes of stock for the winter period.

Direct observations:

The fact that all of the case study interviews were done on farms (most interviews took place as the interviewer accompanied the farmers around the DSL unit) meant that there were opportunities to make extensive direct observations, both of the interviewee and of the physical farm system. Direct observations provided a valuable enhancement of the interview data, with observations such as the physical aspects of the DSL, the stock, feed available and development done, providing a valuable source of complimentary evidence as well as informing inquiries or probes made during the interview.

Pictorial evidence:

In most cases a large number of photographs were taken. However there were two instances where the interviewee was short of time and there was no opportunity to visit the DSL during or after the interview, with the result that no pictures were taken. The main role of the photos was to aid in recollection at a later date and to act as evidence for observations made at the case study site.

2.4.2 Selection of case study sites and sampling

The case study sites were chosen from a list of dairy farm businesses generated at the conclusion of focus group meetings with rural professionals carried out prior to the study and described in the next section.

A total of 17 case study investigations were done. This number was seen as appropriate because of the range of proposition dyads that had to be investigated and the inclusion of theoretical case samples (comparisons to generate new data) to examine various types of DSL across regions in the South Island.

The total of 17 case study sites were across 4 case studies:

- An initial set of six case studies in Canterbury. (Case Study 1).
- A further three case studies in Canterbury (Case Study 2).
- A set of five case studies in Southland (Case Study 3).
- A further set of three case studies in Southland (Case Study 4).

During the first set of case studies in Canterbury, the primary activity was literal replication (generating an initial theory), while the primary activity during the subsequent set of case studies was theoretical replication (searching for contradictions to the initial theory) across DSL units with identifiable characteristics.

The theoretical cases were intended to add richness or new dimensions to the theory and to enhance validity as the theory is tested across categories or variables:

'The aim of theoretical sampling is to maximize opportunities to compare events, incidents or happenings to determine how a category varies in terms of its properties and dimensions.'

-Strauss and Corbin (1990)

In other words, examining groups of cases with particular characteristics assisted the development of robust theory of sustainability and practice on dairy support land. Categories examined through theoretical sampling included: distance between DSL and MP, land tenure, dryland DSL, the use of forage crops, absolute scale and scale relative to the MP, and regional or climatic differences.

2.4.3 Carrying out pilot case studies

Two pilot case studies were done prior to continuing to the main part of the research. The purpose of the pilot case studies was to refine the set of theoretical propositions and case study protocol so as to ensure an investigation that would result in the research questions being properly addressed.

At the conclusion of the pilot case studies it was decided that the evidence gathered was of sufficient quality and depth that the pilot cases could be included in the wider study. The results from the pilot case study sites form part of case study 1 and are included as case study sites 1A and 1B.

2.5 Case study interviews

After a break of one week after the pilot case studies to examine the evidence gathered and the implications for the theoretical propositions, the remainder of the case study interviews were done over a four-week period. The procedures followed at the case study sites are described in detail in Appendix A.

The results of the case study investigation are presented in section 5. A set of case descriptions can be found in Appendix B.

2.5.1 Difficulties that arose during data collection

Practical problems with data collection:

The majority of interviews took place while accompanying the interviewee around the case study site in a farm vehicle, which had potential to result in problems with quality of the voice recordings or in tracking the interview. These issues were managed by being aware of, and reacting to, ambient noise and having a questionnaire with tick boxes to help keep track of the information covered despite distracting conditions.

Problems relating to the methodology:

Yin's Case Study Method demands time consuming and repetitive procedures during preparation, data collection, analysis and write-up. Care must be taken to ensure that a balance is achieved when doing case studies and that excessive rigour does not impede or stifle analysis or result in excessive time taken to complete the investigation.

In this study there was some difficulty in balancing the need to get interviews done quickly with the need to ensure a rigorous treatment of the data. The decision was made to do the interviews quickly so as to make sure all of the case study interviews could be completed before the onset of calving. Completing the interviews quickly also helped prevent cross contamination in small communities like Lumsden for example, where all of those interviewed were acquainted with each other. More time between interviews (the interviews were done one day apart) would have allowed more time to review insights that were occurring and incorporate them into the scheme of propositions and/or to modify the case study protocol to better search for evidence for them, or to allow a search for alternative rival explanations.

2.5.2 Analysing the evidence

The two major analytical techniques used were developing case descriptions and pattern matching.

Developing case descriptions:

The case descriptions are a way of analysing how the evidence at the case study sites relates to the propositions at the individual case level. The case descriptions (and associated reflections and insights) were an important part of the evolution of the scheme of proposition dyads and ongoing alteration of the case study protocol. Because of their importance to the case study process, the case descriptions were done as soon as possible after each case study interview. A full set of case descriptions can be found in Appendix 2.

Coding and pattern matching:

Once the case study interviews were completed, the case study evidence was coded and pattern matching done. Pattern matching is a process of analysing how the evidence at the case study sites relates to the propositions across different kinds of case study site. Pattern matching may also serve to enhance the internal validity of the study. In this study, pattern matching was used in two ways; to further investigate the central issues of the study (literal replication) and to examine differences between the different types of case study site (theoretical replication)

Once the data had been coded, proposition tables were created as an aid to discerning patterns in the data and in maintaining a chain of evidence.

Chapter 3
The Focus Groups

Yin's case study method requires development of a set of theoretical propositions regarding the phenomenon under study. These may be developed from prior knowledge of the situation on the part of the researcher or through discussion with experts in the field. In this case, two focus groups discussions were organised, one in Canterbury and one in Southland, to build an initial theory of sustainability and practice on DSL. The focus group participants were primary industry consultants and other rural professionals with experience with DSL systems. A secondary goal of the focus groups was to locate case study sites where the phenomena of interest (DSL systems where farmers achieve business, environmental and social goals) could be found. This section presents the results of these groups.

3.1 The focus group method

A focus group is a moderated, in depth discussion where a small number of respondents collectively address a number of questions on a topic about which they are well informed. The range of issues, the match between the topic of investigation and the target population, the need for a depth of knowledge as well as clarity of purpose mean that focus group discussions were seen as appropriate to the current situation (Liamputtong and Ezzy, 2005). In focus groups, context is utilized to provide:

> *'deeper consideration of issues as differing viewpoints are weighed and considered during a process of evolving a collective response.'*
>
> -Waldegrave (2005)

In other words focus groups use the group setting to explore the issues, compare experiences and stimulate reflection.

Focus groups are a useful tool in understanding primary industry consultant's perceptions of DSL management because:

- It is desirable for focus groups to cover a maximum range of issues.
- It is desirable for focus groups to allow exploration into new areas of discussion if this is helpful in understanding the topic or addressing the research questions. (Liamputtong and Ezzy, 2005)
- Focus groups are useful in exploring knowledge and experience.
- Focus groups are useful where interaction and group construction of meaning is considered beneficial.
- Focus groups are inexpensive compared to other methods. (Bryman, 2001)

DSL units are heterogeneous with a range of situations and sets of enterprises and practices that can lead to success. As a result there is a variety of knowledge and experience relevant to DSL and the opinions and perceptions of consultants are expected to be complex and to be heavily influenced by experience and situation. Thus, the ability of focus groups to generate a 'joint construction of meaning' (Bryman, 2001) is useful as a way of addressing complexity and balancing diverse perceptions.

3.2 Carrying out the focus groups

The goals of the two focus groups were:

- To generate an in-depth discussion of the sustainability issues with dairy farm systems that include DSL.
- To generate a group concept of best practice.
- To create a list of DSL farms that exhibit aspects of this group concept of best practice.

A set of focus group guidelines was provided to each participant and is shown in exhibit 1.

The moderator attempted to act in a way that generated the highest quality data possible and to 'stimulate the participants to actively engage the topic' (Liamputtong and Ezzy, 2005) while taking a low-key role and monitoring verbal and non-verbal behaviour. Care was taken to ensure the discussion was focused and yet free enough that a thorough examination of ideas occurred. Points of disagreement became a focus of further examination. The moderator had to be sensitive to variations in opinion and explored apparent disagreement to examine the basis for the differences.

In order to ensure internal validity, the participants were provided with a report and asked to provide feedback in the weeks following the focus group interview.

3.3 Focus group results

At both sites a well focused group discussion occurred and at the end, a group generation/examination of knowledge emerged. The grouping of experts allowed ideas to be examined in depth; a reflective discussion of the sustainability of DSL systems took place and a collective idea of best practice was defined, with areas of lack of knowledge or difficulty identified. The following summarises the main points of discussion at each focus group.

Exhibit 1: Focus group discussion guidelines

Focus Group Discussion Guidelines

The recent expansion of dairying in the South Island (and associated use of DSL), rising concern over environmental impacts and greatly increased opportunity cost of assets have led to increasing interest in the sustainability of dairy farmer's use of runoffs. The objective of this discussion is to examine as a group the issues around the sustainable management of runoffs. Please consider the following issues.

1. Return on Investment:

- Variety of enterprises: wintering cows, heifer grazing, bull beef, cash crops, silage.
- Contribution to the primary business: control of feeding over winter, rearing of young stock.
- Sensible set of enterprises: fit with resource demands of milking platform, capabilities of staff/management, gaining income without compromising milk production.

2. Achieving a Sound Farm System:

- Cover type and rotations and yield: swedes, kale, triticale, green feed, pasture.
- Soil degradation/preservation: seed bed preparation, stocking rate, type of cover, climate, soil type.
- Utilization; change of diet, stocking rate, positioning of breaks.
- Quality and quantity of feed.
- Animal health: mastitis, rumen adaptations to change of diet.
- Interactions and synergies between enterprises on runoff e.g. potatoes and heifer grazing.
- Coordination between runoff and milking platform.
- Labour and management: human factors, spending winter 'holiday' moving cows through mud.

3. The Farmer:

- Goals of ownership: control, risk management, tax avoidance, investment.
- Managing conflicts/synergies with the milking platform.

4. Environmental Protection:

- Potential legislative interference.
- N and P leaching: effluent management, soil type.
- Runoff: pugging, riparian strips, mole drains.
- Aquifer depletion: water allocation, politics.
- Increase in weed and pest infestation.
- Motivation to address environmental issues: cost/benefit, interpretation of those measuring compliance.

5. Creating a Sampling Frame.

- Please identify a set of farmers who demonstrate aspects of best practice as discussed in the just-concluded discussion.

3.3.1 Focus Group 1: Canterbury

3.3.1.1 The rationale and purpose of support land

The decision to buy dairy support land (DSL) is a choice to manage production risk either by ownership of support land, or by developing relationships with graziers and other outside parties.

Most farmers are motivated by a need for control of the cost of feed and the ability to manipulate the feeding of individual cows (when to dry off, when to bring them back).

Good reasons for owning DSL

- Facilitating farm succession; creating meaningful but separate roles for both the older and younger generation.
- Risk management in situations where ownership of DSL genuinely alleviates that risk, for example when there is a particular shortage of DSL in the district with consequent insecure market for grazing and supplements.
- System 3 and above[1] in a poor supplement supply situation where there is fierce competition for supplements.
- When large quantities of feed need to be bought in (System 5 farm or winter milk farm).
- When it is a good investment decision in the context; subdivision potential, shares in an irrigation scheme, conversion potential or allocated water that can be moved to the MP.
- When it augments the farm in some way or fulfils some critical need, for example the purchase of free draining land for wintering, controlling lactation days in spring, being able to milk off the DSL at critical times.
- When beyond the farm gate conditions make it a good idea.

Poor reasons for owning DSL

- Premising purchase of land on the assumption that future capital gains will exceed the cost of capital (Speculation).
- Tax minimisation; 'We've got to buy more land to keep the tax down.'
- Attempting to achieve control of feed supply on a non-irrigated block; true control is almost impossible to achieve on dry land.
- Trying to get somewhere without full consideration of other options. For instance as a path to ownership of a dairy farm or older farmers using it to progress out. It is important to carefully consider what purchase of DSL will achieve and whether there are more economically efficient ways of achieving the objective.

[1] This refers to the classification of dairy systems (1 to 5) by Hedley & Kolver (2006) according to the degree to which brought-in feed contributes to total feed supply; system 3 and above are those with the highest contributions of brought-in feed.

Good practice when buying DSL

- Gain a thorough understanding of the risks/opportunities associated with the land; water, fertilizer, pests, fencing, drainage, layout, synergies with the MP etc.
- The DSL unit should be as close and as accessible as possible to the home farm.
- The DSL unit should be the right scale to fit into the system or large enough to justify a dedicated management and staff structure (around 200ha).
- The DSL unit should have attributes (accommodation, soil types, microclimates, etc) that compliment the dairy farm.
- There should be due diligence prior to purchase. Ideally operational costs, ownership costs and synergies with the MP are carefully worked out.

Alternatives to DSL ownership

Leasing DSL: The focus group participants believed that leasing is less cost effective and more risky than owning DSL. This is because lease land can often be very expensive (up to $600 per hectare per year) and often has low fertility. The situation is worse with short-term leases, where there is not enough time to benefit from even minimal development expenditure such as improvements in fertility.

Using a Grazier: Graziers are normally sheep and beef or arable farmers and are often highly skilled in drystock farming or cropping. There have been problems in the past, but graziers are now much better at meeting the needs of dairy farmers. Successful relationships with graziers are based upon good communication of expectations with frequent monitoring and involvement by the owner of the animals.

3.3.1.2 Productivity, costs and the farm system

Scale

If the DSL is significantly smaller than 200ha, it should be adjacent or very close to the MP and the spread of labour resources, infrastructure, location of the dairy shed and so on must be such that synergies and cost savings can be captured.

With appropriate management and a complementary set of enterprises, adjacent DSL can be very effective in creating a sustainable dairy system. Even though small, adjacent areas of DSL can be very effective, there is a danger that farmers will try to make a small area of land do too many things; combining silage, heifers and wintering cows on a small dryland block for instance.

Adequate resources

There is often a lack of recognition of the resources required by DSL. Management in particular needs to be well resourced and ideally the DSL unit is large enough to justify a dedicated management structure.

The needs of the DSL must fit in with the capacities/capabilities of staff, machinery and other resources. Adding DSL to a dairy farm can put a lot of strain on the farm system; labour and machinery may be over-extended and the farmer usually has a knowledge gap that must be filled before they are able to achieve optimal performance. Time management is always an issue. Even if problems with time and resources are resolved, the physical characteristics of the DSL block may mean that it is incapable of supporting the range of enterprises required; heifers on dry land for example.

Focus group participants believed that to be effective, dairy support managers must either be dedicated to the dairy support block or make it their number one priority. They must also enjoy the variety and challenge presented by the increased complexity and range of activities and tasks. Required skills include managing environmental impact, feed budgeting and supplement production. Management must be capable of doing the necessary monitoring and technical tasks that added complexity demands. Some of the best DSL farmers do dairy support as a business.

Knowledge and awareness

A good knowledge of the capabilities of the system, resource supply and demand and the split of costs between the MP and DSL all need to be gained if true control is to be achieved. Farmers often underestimate the amount of technical knowledge that is necessary when they add DSL to the system.

It seems there is a lack of awareness of the true cost of achieving control of feed supply on owned DSL. For example, farmers may count debt servicing as the principal cost and neglect costs linked to DSL enterprises such as fertiliser, irrigation, spraying and monitoring. Often there is a lack of transparency between DSL and MP and costs are lumped together with MP costs. Treating DSL as an independent economic unit with transfer pricing of shared resources will create an accurate understanding of the costs of the DSL unit.

Irrigation

Irrigation is essential to achieving reliable feed supply in Canterbury. Without irrigation, it is very difficult to control feed supply with pasture and potential applications of DSL are greatly limited to crop based systems. The high opportunity cost of ownership is a real difficulty with irrigated DSL and the dilemma of DSL farming in Canterbury is that irrigation is required to achieve true control, but that the best economic use of irrigated land is grazing lactating cows, not DSL farming.

Heifers and young stock

Difficulties in balancing feed demands as well as the need to understand technical aspects of stockmanship mean that in most cases it is better to have a grazier rear young stock and use the DSL for a more flexible enterprise.

Young stock require a year round supply of good quality feed and good stock management, in most places in Canterbury irrigation is necessary to achieve this. Feed conflicts are likely to result in a decision to sacrifice young stock in order to maintain MP production. Heifers may go short of feed when grass is cut for silage, when pasture is saved in autumn for feeding wintering cows or when cows stay on the support land for too long in spring.

Crops vs grass

All farmers want to winter on grass, but in most cases, the most economically sustainable solution is a mixture of crops and pasture. This is because all grass wintering systems are exposed to risks of snow and a dry autumn, either of which will be disastrous if there is no backup feed available. Grass wintering requires large supplement reserves (harvested from the large pasture surplus that occurs) and 100 per cent irrigation to ensure winter feed supply. A forage crop-grass rotation allows cows to have a good diet, avoids the expense of making large quantities of silage, reduces risks, and sets up a sustainable cropping rotation.

3.3.1.3 Environmental protection

Awareness and motivation

Environmental best practice is well understood and there is growing adoption and acceptance of it. Furthermore the collective sense of community of dairy farmers means that the majority are motivated to achieve environmental best practice:

> *'When the community starts to take ownership of an issue, that motivation to protect the environment becomes a reality.' Phil McGuigan.*

In Canterbury, the farming community are being encouraged to develop a mentality that they need to work together to improve the image of the industry.

Achieving technical understanding

Although there is an awareness of environmental issues, a lack of technical knowledge means that the solution is not always clear. Often an economically feasible and effective solution will be available, but it will not be taken up, as the farmer is unsure of how to apply it or how much it will cost. The focus group participants believed that the solution is to get people involved, so that they can see what their neighbours are doing and to find practical ways of addressing problems that work for the whole community.

To understand the dynamics of environmental impact, it is necessary to examine the historical context of the farm system. The timing of development and information available at the time are often at the heart of environmental problems when they occur (for example border dykes on free draining soils, or stock water systems that were designed for sheep and allow stock to stand in water courses.)

In looking for solutions, farmers also need to understand what is happening in the catchment as a whole, what the catchment can sustain and how this relates to the enterprises it supports. This kind of understanding is best achieved by a cooperative relationship with local authorities and community ownership of environmental issues.

The best indicator of catchment health is stream health and this is the focus of most currently applied best practice guidelines.

Rhetoric is deceptive and unhelpful

The rhetoric around the environmental impact of dairy farming causes a lot of bad feeling and anxiety about the future. Farmers feel that their efforts to comply and do the right thing are unappreciated and ignored by the media and other power brokers. For example the reported 52 per cent of farmers non-compliant in Environment Canterbury monitoring of effluent disposal included those who were non-compliant in only one aspect.

Environmental compliance and DSL

Currently, DSL in Canterbury is not closely monitored and there is little incentive to change, but it is anticipated that this situation will not last. Nitrate leaching from grazed forage crops has not yet been flagged as an issue for example. In fairness, the Clean Streams Accord should be extended to include all DSL, regardless of whether it is owned by a dairy farmer.

The focus group participants believed that farmers need to continue to be politically active, both to ensure that DSL farmers continue to address the collective issue of environmental protection and to educate the public about what is being done.

3.3.2 Focus Group 2: Southland

3.3.2.1 The rationale and purpose of support land

The motivation for purchase is usually control of wintering costs and quality of replacements, however true control is often more difficult and expensive to achieve than is initially anticipated. A poor understanding of the real costs and difficulties involved can lead to an addition of DSL that disadvantages the overall business.

Justifying the ownership of DSL

- The addition of DSL may lead to better utilization of farm resources; for example on adjacent DSL, pasture can be transferred directly rather than being made into silage.
- When there is a specific need, for example organic farmers who need to winter their cows on an organic block to maintain organic status.
- If it is cheaper to grow feed on a DSL block than to buy feed and pay for grazing; this is a function of crop yields, pasture production and market conditions.
- It may be that it is impossible to find a grazier that can provide the mixture of flexibility, involvement and monitoring that are essential if wintering/rearing heifers is to be successful.
- If a real gain can be made, for example until recently in Southland cheap rundown farms have been purchased by dairy farmers and broken in at a low cost, this was successful because wintering cows is an excellent way of breaking in land and expenses incurred are tax-deductible.

Negative outcomes with DSL

Successful utilization of DSL comes at a high cost in terms of time, labor, maintenance and knowledge of technical aspects. Owning a DSL block can result in farmers taking their focus off the dairy farm, as management resources are over-extended. Labour can also be overextended ('a lot of work gets done after tea.'). Overall, negative outcomes are becoming less prevalent as farmers become more educated about DSL management.

Alternatives to DSL ownership:

Leasing: The focus group participants saw leasing DSL as a very expensive way to buy feed and lacks the advantages conferred by ownership: '*Land price, lease price and profitability are all out of kilter.'* Even though land costs $8000/acre and lease land is $250-$280 per acre (for dairy land), it is still better in most cases to buy land, as (depending on capital gain and interest rates) the amount of money required to lease land is often sufficient to service the debt on a DSL block. In considering leasing DSL, it is also important to take into account the poor state of many lease blocks and issues with repairs and maintenance.

Using a Grazier: There are a number of dairy farmers who would be better off to be less ambitious and use a grazier for wintering and young stock. Graziers are improving in skill and quality of service because dairy support is significantly more profitable than sheep farming and most graziers are motivated to retain grazing contracts.

A good relationship with a grazier comes down to communication, monitoring and involvement. A good grazing agreement is essential for success. Things to get right include: Having a c/kg DM contract to minimize conflict, having the dairy farmer agree to check the animals every week, cows being dosed with Cu, I, and Se before they are grazed off. Above all there must be clear expectations as to what both parties must do.

Sharemilkers

Sharemilkers have a different involvement with DSL to farm owners. Sharemilkers often buy DSL to diversify their portfolio, they also use DSL blocks in ways farmers might not; for rapidly expanding cow numbers, for example. In cases where the reason for purchase is not clear, sharemilkers might be better to diversify their portfolio by investing in an equity partnership (a combination of cows, land and shares.) or investing outside the rural sector (commercial properties for example). As with farm owners, success with DSL begins with disciplined analysis of what the purchase will achieve and how much it will cost.

3.3.2.2 Productivity, costs and the farm system

Adequate resources

Strain on staff, machinery and other resources is the central issue with DSL. Ideally the DSL block should be large enough to justify an independent management structure or be adjacent to the MP with an appropriate expansion in management capacity to allow for this. In either case, someone must be responsible for the DSL block.

Without a dedicated structure and/or adequate resources there will be excessive strain on staff and machinery, poor time management, poor synergies/coordination and poor pasture management. Furthermore, the range of enterprises, work over winter and time spent travelling can be a real issue with labour. Dedicated management, staff and resources also makes it much easier to treat the DSL as a separate enterprise, so that the true cost of feed grown on DSL is known.

Knowledge

Technical knowledge, knowledge of the costs and knowledge of the current state of the system are all essential to success. The ability to incorporate the large amount of knowledge involved is a second reason why sustainable farming of DSL requires a dedicated management structure.

The increasing success of DSL farmers in recent years is associated with improved knowledge and technical skill: *'a lot of education has gone on.'*

A poor understanding of the true cost of DSL enterprises is still very common, this is linked to a failure to treat DSL as an independent unit.

There is virtually no monitoring of productivity; very few people weigh heifers and grazing management is by set stocking, which often causes feed conflicts in autumn. Monitoring is better when there is a dedicated person on the DSL, dedicated dairy support farmers are also good. Monitoring of crops is limited to weighing the crop in mid April followed by a visual measurement in May. Many farmers do not know how much they are feeding cows on crops, with the behaviour of cows used to dictate when or how much to feed.

Adjacent DSL

DSL adjacent to the MP allows flexibility and efficient use of resources. *'If you manage it well, it can be really, really good.'* Good integration with the right infrastructure (in the right place), adequate resources and technical skill can result in real efficiency gains; eg. milking off DSL results in better pasture management with more grass eaten directly and less spent on making silage. Very often the capacity of the dairy shed becomes the key constraint following purchase of adjacent DSL.

Complementary enterprises

The set of enterprises has to complement the MP. A bull beef unit can be very successful as there are many opportunities to minimize costs (calves, milk, etc). Once calves are reared or R1 bulls grown, there are a lot of options; fatten, lease etc. It must be realized that more management capability and resources will be required. Finally the scale must be appropriate; some farmers make the mistake of trying to make a small block do everything.

Intensity

It is believed that lower intensity means that DSL is less pressured than in Canterbury (50 per cent of the MP area is needed for wintering and replacements). However it is thought that this will change as more dairy conversions go on and that the limited supply of DSL will become an issue.

DDE

Given the amount of soil ingestion that occurs over winter, it is surprising that DDE is not more of a problem. It is thought that this is due to there being a good level of awareness around the issue and a lack of DDE on DSL. DDE is an issue in good, well run farms where there was the money to buy it. In contrast, DSL is often on poorer land or rundown farms, where there is little or no history of DDE.

Cropping

Common practice is now three years in crop (Swede, Kale, Kale) followed by grass. Declines in yields from soil damage, weeds and disease are a concern. Preparation is essential for achieving good yields, however in practice, lack of time often results in the crop residual sitting after grazing and all crop preparation tasks happening the week that the crop is planted. Thus, even though high yields are essential to good economic use of DSL, lack of focus on crop preparation means that they are often not achieved. Good preparation consists of spraying off the grazed crop and ripping to aerate the compacted, wet and anaerobic soil. It is also a good idea to calculate N, P and K needed to achieve higher yields.

Avoiding soil damage

Direct drilling will result in less pugging in year one, but there will be more problems with weeds and pests the following year. The choice to direct drill will depend on the situation.

Back fencing will intensify pugging as more cows will be in the same place at the same time and lower order cows will be forced to move more often.

It also seems that soil damage is worse on higher yielding crops, which may also be a function of grazing time or grazing management.

Weeds and pests

Weeds and pests associated with brassicas can be a problem on DSL, with wild turnip and dry rot the two biggest issues. Overall weeds and pests are an increasing problem, although the problems are not considered to be as bad as Canterbury where DSL is more pressured.

Oilseed rape can also be a problem; oilseed rape looks identical to wild turnip, but it is high in Ca and can cause milk fever. If oilseed rape is present in a crop, cows require mineral supplementation.

Dry rot can be devastating to a second crop of Swedes. Yields can potentially be reduced to 3.5-4 tons/ha, with undesirable effects on cows, in addition to under-feeding.

Shepherds purse is less common, but can result in expensive spraying costs. Ideally shepherds purse should be controlled at sowing.

Grazing management on crops

To get good utilization from crops it is helpful to feed twice a day, have long, narrow breaks and avoid situations where cows are sinking into the mud. A 40:60 fibre:brassica ratio is considered to be ideal for digestion, but 30:70 mix is more common. Practically, it is difficult to measure how well a crop is utilized or how much has been fed to cows. Also, subordinate cows tend to get a different diet to dominant cows as dominants get first go at balage and the best of the crop.

Adaptation to change of diet is particularly difficult as cows adapt to nitrates over time, therefore it is better to gradually increase the proportion of crop in the diet. In practice, this adaptation does not happen and cows are put into 100 per cent crop as soon as they arrive, as there is no room in the paddock: *'700 cows arrive off the truck in one day and what do you do?'* The abrupt change of diet results in poor performance in the first couple of weeks: *'Cows do nothing for the first ten days.'*

Further problems with logistics arise from the practicalities of feeding silage and hay in muddy conditions, which means farmers are often locked in to a high cost balage/crop system.

Best practice is to do a feed transition and introduce fiber or a gradual change of diet as the cows dry off, this is achieved by putting them on grass initially and moving them on and off grass after that. Supplementation with Se, Cu, Ca and Iodine must also be done.

Wintering

Wintering on crops with balage is the most common method in Southland. Non-traditional wintering methods include self-feed silage stacks with grass and herd homes.

Wintering with a self-feed silage stack

Self-feeding silage stack and grass appears to be a viable wintering option in Southland. With self-fed silage stacks it is important to make sure the stack is prepared correctly. High quality silage is wasteful as the cows do not get enough fiber for real efficiency. Really well compacted silage can be a problem too as the cows can't get it out, they tunnel under it and the overhang falls on the hot wire. A moderately compacted medium chop silage is ideal.

Wintering in herd homes

Herd homes have been promoted recently as an alternative to the expense and environmental damage associated with traditional wintering. As with self-fed silage stacks, the economics are as yet not completely clear. Existing work does not take into account the cost of containing and spreading effluent and increased risk of Mastitis.

3.3.2.3 Environmental protection

Awareness and motivation to change

There has been a great increase in awareness of environmental issues over the past five years and dairy farmers are now motivated to enact change once there is a scientific basis for doing so. Most farmers are aware of the need to keep cows out of creeks and the potential for legislative interference is understood, though there are a few notable exceptions.

Motivation to change stems from the need to identify and address environmental issues before they come to the attention of Environment Southland. Very often a violation will be reported to Environment Southland by a neighbouring sheep farmer. This is a consequence of the proximity of sheep farms and dairy farms and antipathy between the two communities: *'They love to call up Environment Southland.'* In other words rivalry and avoidance of penalties are the motivating factors, community pressure less so.

Nutrient leaching

Nutrient leaching into the water table is potentially a much bigger problem than effluent and run-off. The volume of water means that high flow rates dilute nutrients and effluent that get into waterways but nitrates and other pollutants in ground water are long term issues that will not go away with the next flood.

Managing nitrogen

Not much nitrogen (N) is used on pasture on DSL, though more is used on crops with 80-200 units of N going on at sowing and unknown amounts leached during grazing. On pasture the drive for high ME means that the focus is now on grazing management and the N that is used goes on 'little and often', resulting in less N lost to the system, better utilization and less damage to water resources. Many farmers have been experimenting with nitrification inhibitors.

Tile drains

The replacement of tile drains is also justifiable on DSL, if not yet widely practiced. Tile drains are recognized as a real issue for DSL, often this is a historical problem with drains installed on what were originally sheep farms that are too shallow for cows. Older drains are often broken or blocked and it is standard practice for tile drains to be replaced as part of a dairy conversion.

Soil erosion

Erosion is an issue with mud and movement of water, it is difficult to avoid some degree of erosion or soil runoff in Southland. There has been a slow uptake of riparian strips as they are not regarded as being particularly effective in the Southland climate. In places, the volume of water and mud, combined with tile drains means that phosphorous and fine particles get into waterways no matter what is done. The situation is better where soils are more suitable (mostly northern Southland).

Catchment issues

Most farmers are unaware of, or are not concerned about, interactions within catchments. Even so, negative impacts on catchments is a real issue, particularly with certain heavy soils on which it is impossible to run a dairy farm and avoid significant catchment contamination.

Soils

Most farms have a combination of soil types and soil conditions. Stocking rates, contour and climate are all relevant to the way that soil responds to winter grazing by cows. Some soils are inappropriate for grazing cows in winter and should not be used for DSL. Good information on soil types and appropriate management of them can be found at Venture Southland/Topo Climate.

The future:

It is expected that environmental issues will continue to grow in importance in the future as the regional council is relatively aggressive and the wet winter means that there will always be problems of mud and water associated with dairying.

Environment Southland has been becoming less helpful and more focused on control by punitive measures in recent years. The approach is changing from the council giving out the information to the council demanding compliance without suggesting how this might be achieved.

Currently Environment Southland are very focused on managing dairy effluent and silage stack seepage, however in future it is expected that the conditions under which effluent can be spread and effluent storage will become important.

3.4 Summary and comparison of focus group results

This section summarises the findings from both focus groups and the key differences between the two.

3.4.1 The rationale for purchase of DSL

- The focus group participants believed that success with DSL begins with disciplined analysis of what the land purchase will achieve and how much it will cost. Furthermore this purchase needs to be justified by a goal or objective that cannot be achieved in another way at less cost.

- In most cases, the rationale for purchase of dairy support land (DSL) is control of feed supply, controlling the length of lactation for individual cows and quality of replacements.

- The decision to buy DSL is effectively a choice to manage the risk of ineffective or costly wintering through control of DSL rather than by managing relationships with external parties. A good understanding of the true cost of achieving control must be gained to avoid erroneous purchase of DSL.

- At the time of purchase there must be a very clear idea of exactly what will be achieved by DSL ownership. DSL ownership should not be seen as a way to ‘get somewhere’ but should fulfil a need that cannot be met more cheaply in some other way; this applies for both dairy farm owners and sharemilkers.

- Only a very few farmers monitor productivity on DSL.

- The high cost and undeveloped state of lease blocks means that leasing is in most cases a poor proposition.

3.4.2 Environmental issues with DSL

There has been a great increase in environmental awareness over the past five years and most farmers are now motivated to make substantial investments in environmental protection, especially if there is a scientific basis to the practice. Examples of good environmental practice include; fencing off streams, re-doing tile drains, applying nitrification inhibitors and efficient use of nitrogen.

3.4.3 Achieving success with DSL

- It is important to address issues associated with the strain that the addition of a DSL unit can put on the resources of a dairy farm. Shared resources such as labour, machinery, and management time and knowledge must be adequate and in many cases it is necessary to have a dedicated management structure in place.

- The set of enterprises should fit the capabilities of management and the capacity of the piece of land being farmed. Replacement heifers for example require a steady supply of good quality pastures as well as close attention to grazing management and stock related tasks.

- Farmers often underestimate the knowledge that must be gained if they are to be successful with DSL. Both technical knowledge and knowledge of the resources and limitations of the land are often lacking when DSL is first added to a dairy farm system.

- Farmers may also underestimate the commitment of resources and decision making required with the result that poor crop establishment and low utilization lead to poor DSL performance.

- When wintering on crops, farmers should attempt to feed a balanced 40:60 fibre:brassica ratio, however a 30:70 ratio is more common.

- The costs and environmental impacts of the various types of wintering (self-fed silage stack, grass and silage, crops and silage, crops and balage on heavy soils, use of ‘herd homes’ etc) have not been well researched.

3.4.4 Types of DSL

- The sustainable models appeared to be a fully independent unit or a smaller, adjacent block that fits in with and compliments existing farm systems and resources. Dairy support as a business can also be very successful.

- The best DSL blocks are large enough that they can be run with dedicated management and resources, separate labour and machinery with separate accounting, they should stand alone as a business. Without this there is likely to be poor decision-making and enormous strain on staff.

- Adequately resourced adjacent blocks of any size can be very successful, but they need to be integrated with the MP (integrated decision making capacity, labour, machinery) with a mix of enterprises that produces synergies and reduces costs.

3.4.5 The role of graziers

Many dairy farmers who attempt to do wintering and youngstock on DSL would probably be better to pay a grazier to provide these services. The performance of graziers is improving and the principles of a good grazing relationship are simple and are now well known.

3.4.6 Key differences between Canterbury and Southland

Canterbury

- The dilemma of DSL in Canterbury is that true control is very difficult to achieve without irrigation, but the best use of fully irrigated land is generally grazing lactating cows.
- Fundamental differences in capacity, patterns of production and management requirements mean that it can be very difficult to integrate dryland DSL with the MP.
- The ideal wintering scenario is a mixture of forage crops and pasture with supplements in reserve in case of snow. At least some crops are necessary because of the risks of snow or a dry autumn (on dry land).
- In most cases, feed conflicts and capacity constraints mean that it is often better to have a grazier rear young stock.
- The main environmental issues are aquifer depletion and water contamination. Environmental awareness and compliance is driven to some degree by peer pressure and group action from other dairy farmers in the same community and there is a good prospect that farmers will continue to deal with existing issues in an economically feasible manner in future.

Southland

- Compared to Canterbury, dairy farm systems are lower intensity (950 MS/ha vs 1150 MS/ha) with DSL less under pressure.
- Lower cow numbers and similar management requirements in the MP and DSL mean that there is relatively more freedom in Southland and that the focus group participants were optimistic of farmer's ability to run a DSL unit effectively.
- The Environmental issues are high rates of nutrient leaching and runoff during wet winters. It is believed that community tensions and an increasingly punitive local authority will make it harder for farmers to address environmental issues in an economically feasible manner.

Chapter 4
The Theoretical Framework

4.1 Introduction

A preliminary set of propositions and rival explanations (proposition dyads) was developed following the focus group meetings and before carrying out two pilot case studies. These were then further developed and/or refined after the pilot cases and before the main series of case studies. This section provides a summary of the pilot case study results and then describes the derivation of the set of proposition dyads which form the initial theory.

4.2 Summary of results of pilot case studies

4.2.1 Perceptions of sustainability

The interviewees at both pilot case study sites believed that DSL was very valuable with intangible benefits over and above the opportunity cost of support services provided. This view was in contrast to that of the focus group participants who believed that the intangible benefits of DSL were not justified by the risks and cost of ownership. The divergence in views between rural professionals and farmers over the value of including DSL in dairy farming systems and of how that value should be measured warranted further investigation.

There was evidence at both case study sites that stakeholders are willing to invest in environmental sustainability. Pilot Case 1 introduced the concept that the most desired practices are those that bring commercial drivers and environmental/social drivers into line. Examples of practices that do this include nutrient budgeting, riparian protection and maintaining pasture quality.

It became apparent that social sustainability should be investigated as a separate issue: The measures taken to avoid issues with social sustainability at Case Study Site 1A and the consequences of not paying sufficient attention to it apparent at Case Study site 1B indicated that social sustainability should be included in the examination of sustainability of DSL systems.

4.2.2 Practice

Planning and Resources: Both farmers interviewed in the pilot case studies invested substantial time in planning and developing effective systems. It appeared that the ability to act as planned and on time is most likely to be limited by resources, either in terms of management time or having the staff or machinery on hand to carry out time-critical tasks as required. Building systems to ensure that DSL tasks are carried out to a high level required adequate allocation of resources and/or systems that did not require high capital inputs.

Knowledge: Both pilot case studies illustrated how knowledge and the ability to use it to advantage played a role in success with DSL. It was clear that knowledge had a value and that if farmers did not possess it when they acquired DSL, they would have to be prepared to suffer losses until they gained it or else to pay for the services of others who had it.

Inductions: Neither farmer used inductions to manage calving because they did not see them as necessary if stock were well fed and there were good herd genetics. The DSL also allowed farmers to avoid culling empty cows.

Transition Feeding: The evidence generated by the pilot case studies supported the view that transition feeds were a vital part of DSL management. Farmer 1A fed a transition diet and Farmer 1B believed that avoiding the metabolic issues of feeding crops and dispensing with the extra time required for transition feeding was an advantage of an all-grass system.

4.2.3 Types of DSL

Leased DSL: Pilot Case 1 included a leased DSL unit. The interviewee believed that leased DSL could be very successful as long as capital inputs were controlled. The success of leased DSL contrasts with the numerous problems with leased DSL mentioned during the focus groups.

Adjacent DSL: Although it seemed that having DSL adjacent to the MP could be useful, evidence at both pilot case sites suggested that it was not a key variable in achieving an effective or sustainable DSL system.

Dryland DSL: The pilot case studies produced contrasting views over the value of dryland DSL in Canterbury. In Pilot Case 1, it appeared that small areas of dryland could be very beneficial if they were adjacent to intensive grazing areas (irrigated DSL or MP). On the other hand at Pilot Case Study 2 there was good evidence that the introduction of irrigation had transformed a marginal piece of land into a highly productive unit.

Soil Types: There was evidence at Case Study 1A that under winter cow grazing, light soils require care to avoid permanent production losses just as heavy soils do.

Scale: The pilot case studies produced contrasting views over the relationship between absolute scale and the value of control provided by DSL. Farmer 1A believed that the vulnerability of the system to external factors is related to absolute scale and that larger dairy systems have a greater requirement for DSL, while Farmer 1B believed that all Canterbury dairy farms should have a DSL unit, regardless of scale.

Forage Crops: The view of focus group participants was that forage crops play a positive role in DSL systems because they enable farmers to graze more cows on a given area at lower risk. This was supported by evidence at Pilot Case 1 where it appeared that the use of crops had enhanced economic returns while potential environmental impacts associated with grazing forage crops in winter were contained.

Pilot Case 2 provided a coherent body of evidence that wintering on grass gives cost savings and metabolic benefits equivalent to the financial benefits of including crops in the DSL system.

Theoretical propositions and rival explanations developed before, and refined during, the pilot case studies are described below. These are addressed in three sections, reflecting the research questions described previously; theoretical propositions and rival explanations relating to perceptions of sustainability are followed by those relating to practice and to varieties or types of DSL.

4.3 Perceptions of sustainability

The proposition diads addressing questions concerning perceptions of sustainability are listed in Exhibit 2.

The topic of sustainability of dairy farming systems that include DSL is complex with multiple dimensions and understandings that may vary from one situation or stakeholder to another. Dividing sustainability into economic, social and environmental aspects, as is often done in the literature, may be a useful aid to investigation, analysis and description as it breaks the discussion down into manageable units. On the other hand, farmers may not categorise things in this way and it may be difficult to establish distinct separations between these topic areas; Richards (2006) noted that farmers are more concerned about the factors they can control and those they cannot, a point that was reinforced by the pilot case studies. Proposition 1.1 addresses this question.

Focus group participants believed that there are major problems with the economic sustainability of DSL with wasted resources and poor returns on investment leading to poor commercial returns and financial loss on DSL systems. This view was in contrast to that of farmers interviewed by Richards (2006) who believed that the ability to control how feed is grown and supplied to the MP was at least as valuable as the financial returns gained from services provided by the DSL.

In both Pilot Case 1 and Pilot Case 2, the DSL was seen as an indispensable part of the farm system with benefits well beyond the opportunity cost of feed grown. The disagreement between rural professionals and farmers over the economic sustainability of DSL is the subject of proposition 1.2.

Exhibit 2: Propositions referring to perceptions of sustainability:

1.1	Theoretical Proposition: The most useful framework for understanding DSL farmer's perceptions of sustainability is created by separation into economic, environmental and social aspects Rival Explanation: The most useful framework for understanding DSL farmer's perceptions of sustainability is created by separation into issues internal to the farm systems and issues external to the farm system
1.2	Theoretical Proposition: The addition of DSL will enhance the ability of the dairy farm to manage internal and external economics factors. Rival Explanation: The addition of DSL will impede the ability of the dairy farm to manage internal and external economics factors
1.3	Theoretical Proposition: Commercial returns are the most appropriate measure of economic performance of DSL. Rival Explanation: In measuring the economic performance of DSL, feed grown is a better measure of economic performance than commercial returns.
1.4	Theoretical Proposition: It is desirable for DSL to act as an aid to business growth, either as a development tool or as an investment. Rival Explanation: It is undesirable for DSL to act as an aid in business growth; DSL should be used to attain self-sufficiency by managing production risks and controlling costs.
1.5	Theoretical Proposition: DSL units are not fully sustainable unless there is an independent business structure with commercial drivers in place. Rival Explanation: Sustainable outcomes can be achieved without commercial drivers and/or a separate business structure as long as costs are kept under control.
1.6	Theoretical Proposition: The addition of DSL will enhance the ability of the dairy farm to manage internal and external environmental factors. Rival Explanation: The addition of DSL will impede the dairy farm in managing internal and external environmental factors.
1.7	Theoretical Proposition: The addition of DSL will enhance the social sustainability of the dairy farming system. Rival Explanation: The addition of DSL will impede the social sustainability of the dairy farming system.
1.8	Theoretical Proposition: The cultural gap between the rural and urban communities and associated political action is a threat to the future sustainability of dairy systems that include DSL.

	Rival Explanation: The cultural gap between the rural and urban communities and associated political action is an opportunity for the future sustainability of dairy systems that include DSL
1.9	Theoretical Proposition: For economic sustainability to be achieved, the DSL must meet a specific need that cannot be met in any other way.
	Rival Explanation: A specific need is not necessary for a given area of DSL to be sustainable.
1.10	Theoretical Proposition: Some sacrifice of the economic, environmental, or social sustainability of DSL is inevitable if the goals of protecting the MP and maintaining cow condition over winter are to be achieved.
	Rival Explanation: Sacrifice of DSL can be avoided if management and conditions are appropriate.

Focus group participants also suggested that it was essential to consider commercial returns in assessing the performance of DSL and that economic sustainability could not be achieved unless the DSL was profitable in a business sense. The view that economic sustainability is best measured by commercial returns is not consistent with the comments of farmers interviewed by Richards (2006) who found that achieving control of feed supply and the way feed is offered is the central concern of farmers who include DSL in a dairy farming system. This question is the subject of proposition 1.3

The Canterbury and Southland focus group participants had differing views as to the appropriateness of using DSL as a means of business growth. The Southland focus group believed that with care and diligence and the right circumstances, DSL could be used successfully in a business growth role, by breaking in rundown farms and in expansion of the MP area over time. This view was in contrast to that of Canterbury focus group who believed that DSL provided poor returns relative to other tools for business growth such as equity partnerships in dairy farms. They believed that many DSL purchases were driven by an assumption that land prices would continue to rise and that investment in DSL would not provide competitive business returns. Proposition 1.4 addresses this issue.

Focus group participants believed that failure to consider financial returns was a common source of inefficiency or unnecessary cash losses on DSL. At the Canterbury focus group, there was a strong argument that independent accounting and commercial drivers were essential for DSL to reach full potential. The collective opinion of focus groups was supported by evidence collected during Pilot Case 1, where the interviewee believed that business or commercial drivers were an essential element of sustainable DSL farming. This is addressed in proposition 1.5.

Parker (2004) argued that agricultural intensification leads to environmental impacts of a kind that are difficult to monitor and control and that increasing environmental compliance costs are inevitable. This view was in contrast to that of the focus group participants who believed that intensification does not necessarily lead to increased environmental impacts and that most farmers do a reasonable job of farming in an environmentally sustainable manner. However, they saw that the behaviour of a few farmers had discredited the entire dairy farming community and that some farmers used DSL as a way to export environmental problems.

The focus group participants also believed that attempting to control environmental impacts by imposing penalties on farmers was of limited effectiveness in creating real, long-lasting change. They thought that it is better to take a cooperative approach based on consultation, shared information and community driven behavioural change. Proposition 1.6 explores whether addition of DSL enhances farmers ability to manage environmental factors or makes the situation worse

There was some evidence in the literature of the social impacts of inadequately integrated DSL (de Wold, 2006), but it was not until Pilot Case 2 that it became clear that social impacts may be a central issue for dairy systems that include DSL. At Pilot Case Study Site 2 the interviewee had successfully used DSL to achieve high levels of performance at a low cost, but had found that his dairy farm had become very difficult to manage because of an inability to find quality staff. Thus it appeared that the addition of DSL may have created pressures that led to failures in other aspects of the overall system. The apparent importance of social considerations in the sustainability of DSL at both pilot case study sites merited investigation and is explored in proposition 1.7.

There was a difference in views between the Canterbury and Southland focus groups over the role of external community factors in the future sustainability of DSL systems. The Canterbury focus groups believed that there was a good prospect that farmers will be able to combine community action and common sense with low cost solutions to keep environmental compliance risk to an acceptable level in future. This was in contrast to the Southland focus group, which believed that cultural differences were resulting in difficulties for dairy farmers, with potential regulation of DSL activities a particular area of concern. Proposition 1.8 was created to explore the issue of the cultural gap between urban and rural New Zealand and how this would affect DSL sustainability.

The Canterbury focus group suggested that in terms of achieving sustainable farming of DSL, it is much easier to justify the expense and potential risks if the addition of DSL helps address some specific need that cannot be met in any other way. Examples of specific needs included securing grazing or supplementary feed in regions with a shortage of providers of support services, or winter milk farmers who require large amounts of supplements and grazing off for several months each year. Even though specific needs were only mentioned in one focus group and not at all in the literature, the possible involvement of specific needs in the decision to acquire or retain DSL was considered interesting enough to warrant investigation at the case study sites. This is included in proposition 1.9.

The focus group participants believed that much of the concern around the sustainability of DSL arises from a tendency for farmers to neglect (either deliberately or inadvertently) DSL operations in order to maintain focus on the MP. Willingness to sacrifice DSL to prevent problems on the MP also seemed to be a feature of both pilot case studies. The role of DSL in taking on some of the environmental burden of the intensively farmed MP appeared to justify investigation in proposition 1.10.

4.4 The relationship between sustainability and practice

Propositions regarding the relationship between perceptions of sustainability and practice on DSL are listed in Exhibit 3.The focus group participants believed that DSL units are often under-resourced as strategic decision makers underestimate the amount of material or decision-making input required.

Exhibit 3: Propositions regarding the relationship between perceptions of sustainability and practice:

2.1	Theoretical Proposition: Sustainable outcomes cannot be achieved unless the DSL is well resourced. Rival Explanation: Sustainable outcomes can be achieved even if the DSL is not well resourced.
2.2	Theoretical Proposition: When DSL is included in a system it is helpful to have policies in place to attract the right staff. Rival Explanation: When DSL is included in a system it is not necessary to make an effort beyond what would be required for a dairy farm without DSL.
2.3	Theoretical Proposition: A well-supported management structure is not enough to achieve sustainable outcomes with DSL; a dedicated management structure is required. Rival Explanation: A well-supported management structure is enough to achieve sustainable outcomes with DSL.
2.4	Theoretical Proposition: Acquiring technical knowledge is not a resource problem but rather a matter of experience and ability to implement. Rival Explanation: Acquiring technical knowledge is a matter of resources either in terms of allocating time and money to acquire it or of hiring the services of those who possess it
2.5	Theoretical Proposition: Planning is crucial to sustainable farming of DSL. Rival Explanation: Planning is not necessary to achieve sustainable farming of DSL.
2.6	Theoretical Proposition: Timing and attention to detail are essential to achieving sustainable outcomes with DSL. Rival Explanation: Under some circumstances, timing and attention to detail are not essential to achieving sustainable outcomes with DSL.
2.7	Theoretical Proposition: Control and measurement are crucial, there needs to be a formal program of monitoring so that there is control of pasture and animal condition. Rival Explanation: A formal monitoring program may not be necessary if the operations manager has a high level of awareness of what is happening in the system.
2.8	Theoretical Proposition: The use of graziers impedes or has impeded the sustainability of dairy farming systems that include DSL. Rival Explanation: The use of graziers enhances or has enhanced the sustainability of dairy farming systems that include DSL.
2.9	Theoretical Proposition: External relationships are important in creating opportunities for the business. Rival Explanation: External relationships are not important in creating opportunities for the business.
2.10	Theoretical Proposition: DSL farmers are able to apply environmentally sustainable practices without sacrificing other aspects of sustainability. Rival Explanation: In most situations, farming DSL in an environmentally sustainable manner will require expensive and comprehensive changes to exiting systems.
2.11	Theoretical Proposition: If cows are wintered on forage crops, transition feeding is necessary to ensure cows do not lose condition or suffer health problems at the start of winter. Rival Explanation: Transition feeding is not always necessary to ensure success with crops on DSL.
2.12	Theoretical Proposition: Inductions are essential to achieving a profitable farm system, even with DSL. Inductions are an important management tool that helps achieve a compact calving and low empty rates. Rival Explanation: Inductions are unnecessary as long as cows are properly fed, cow genetics are good and the technical aspects of mating are done well. The ability to avoid inductions is one of the benefits of control of DSL.

Adequate resources are key to achieving a sustainable DSL operation. The consultant's view was partly contradicted by both of the pilot case studies where there was ample evidence that machinery, staff, appropriate development, management time and management capability were appropriately allocated and that a sustainable farm system had been the result. Proposition 2.1 is designed to check this issue.

Evidence gathered at the Pilot Case 2 suggested that the lower level of supervision on DSL systems means that they may be more vulnerable to problems with incompetent or unsuitable staff, and that dairy farm systems that include DSL require either better staff, or more supervision and training. Further investigation into the possible link between the addition of DSL and changing requirements or vulnerabilities related to staff is explored in proposition 2.2.

The Canterbury focus group participants argued that DSL systems benefit greatly from having a dedicated management or business structure in place and that the possibility of having a dedicated management structure was an advantage of larger scale DSL systems. The benefits of an independent business structure and dedicated management were supported by evidence from Pilot Case 1. In this case it appeared that dedicated management was an aspect of the resources allocated to the DSL and that it was one of a number of things that had to be in place for DSL to perform at a high level. Whether this is necessarily the case is explored in proposition 2.3.

The focus group participants believed that a lack of technical knowledge is often a cause of unsustainable outcomes on DSL systems and that farmers commonly underestimate the amount of knowledge required or the amount of time it will take to bring their knowledge up to an appropriate level. Technical knowledge relevant to DSL systems includes knowledge of cropping, soil management, supplement production, raising replacements in addition to technical knowledge of grazing management and animal health required to run a dairy farm.

The pilot case studies illustrated how knowledge and the ability to use it to advantage played a role in DSL success. It appeared that the kind of knowledge that was demonstrated came from real world experience that takes time to acquire. Whether knowledge is a resourcing issue or is simply a matter of time and experience is explored in proposition 2.4

During the focus groups, planning was identified as crucial for success with key DSL tasks such as movement of cows to and from the dairy farm, crop preparation and establishment, and silage harvesting. From considering the pilot case study data, it appears that the ability to act as planned and on time is likely to be limited by resources, either in terms of management time or having the staff or machinery on hand to carry out time-critical tasks when required. This is explored in proposition 2.5.

Following on from the discussion of the importance of planning, the focus group participants noted that timing and attention to detail are also important to achieve high crop yields and good quality pasture necessary to successfully prepare DSL for winter. This view was supported in the Pilot Case Studies. It appeared necessary to examine the importance of timing and attention to detail separately in the wider study, through proposition 2.6.

The focus group participants believed that there was often a lack of basic monitoring on DSL. In Pilot Case 1 a formal program of control and measurement of all parameters relating to growing and supplying feed was seen as necessary for success, particularly when a manager was responsible for the DSL. This was in contrast to Pilot Case 2 where a persuasive case was made that skilled owner-operators on blocks of a smaller scale may not need to do formal monitoring, particularly if there is some management related reason for them to be in every paddock every day.

The presence of contrary evidence suggests a need for further consideration of the role of monitoring in DSL sustainability; this is included in proposition 2.7.

The literature, the focus group results and the pilot studies generated conflicting evidence as to the value of using graziers or other third parties to supply dairy support services. The focus group participants were sceptical of the indirect benefits of DSL and believed that the addition of DSL often creates more problems than it solves and that many would be better to use a grazier. This view was in contrast to that of farmers at the pilot case studies who believed that relying on graziers for support services introduced unacceptable risks. This apparent contradiction in evidence is examined in proposition 2.8.

External relationships emerged as an issue during both pilot case studies. In both cases, the DSL unit had derived significant benefits from relationships built up over time with other farmers in the community. Pilot Case 1 (Farm 1A) had gained an opportunity to secure a favourable lease agreement (thus allowing expansion of the dairy farming system), while case study farm 1B had secured strategic grazing with neighbouring farms at times when the DSL was not able to provide enough feed. How important are external relationships is ensuring a sustainable system? Proposition 2.9 explores this question.

Evidence collected at Pilot Case 1 suggested that environmental sustainability is intrinsically linked to achieving a sound farm system. Pilot Case 1 also introduced the concept that the most desired practices are those that bring commercial drivers and environmental/social drivers into line. Examples of practices that achieve this include nutrient budgeting, riparian protection, good grazing management and applying eco-N. The idea of bringing environmental and commercial drivers into line is interesting and somewhat at odds with the popular view that economic imperatives are often in conflict with good environmental practice. This is addressed in proposition 2.10

Beare, White and Wilson (2006) argue that changing diet from pasture to forage crops needs to be carefully managed to avoid health problems with poor rumen adaptations to change of diet or nitrate poisoning. This view was supported by the focus group participants who believed that forage crops could cause metabolic problems for cows and that transition feeding is necessary to avoid loss of cow condition and issues with animal health.

The interviewees at the pilot case studies also supported the view that transition feeds were a vital part of DSL management. Farmer practice on this is explored in proposition 2.11

The practice of induction is not sustainable in the long term because of public concern for animal welfare. It is considered relevant to DSL management practice because it is part of mating management, the success of which relates to control of feeding of cows and cow condition, one of the intangible benefits of DSL identified by Richards (2006). Both of the pilot case study farms used their DSL to achieve control of cow feeding and cow condition necessary to achieve acceptable fertility without inducing cows and to care for the higher numbers of empty cows that can be a consequence of a non-induction policy. The views of other farmers on this issue is explored in proposition 2.12.

4.5 Sustainability and practice across types of DSL

One of the objectives of the research is to determine whether perceptions of sustainability or practice on DSL varies with type of DSL or region. Propositions listed in exhibit 4 are designed to identify any differences.

The focus group participants believed that it is difficult to achieve sustainable outcomes with leased DSL because of the high costs and inability to benefit from all but the most basic developments. This is in contrast to evidence generated at Pilot Case Study 1 where leasing DSL appeared to have resulted in the release of capital for investment in other areas, while still allowing the farm owner to achieve control. Proposition 3.1 explores issues associated with leased DSL.

The importance of proximity to the sustainability of DSL was first noted during the focus group meetings. Advantages of an adjacent situation include improved work quality for management and staff, more efficient use of resources, optimisation of lactation length, development opportunities in terms of expansion of the milking platform and the possibility for strategic grazing from the dairy farm.

Exhibit 4: Perceptions of sustainability and practice across types of DSL and regions

3.1	Theoretical Proposition: It is difficult to achieve sustainable outcomes with leased DSL. Rival Explanation: Sustainable outcomes can be achieved with leased DSL as long as capital inputs can be kept to acceptable levels without threatening economic, social or environmental sustainability.
3.2	Theoretical Proposition: Sustainable outcomes are easier to achieve with adjacent DSL. Rival Explanation: Most or all of the benefits of adjacent DSL can be achieved with detached DSL if other aspects of management are right.
3.3	Theoretical Proposition: Dryland DSL areas do not have the potential to achieve economic, environmental and social sustainability. Rival Explanation: Sustainable farming of dryland DSL can be achieved in the right situation.
3.4	Theoretical Proposition: To be sustainable, DSL should be on light, free-draining soils that can easily support winter cow grazing. Rival Explanation: Under the right circumstances heavy soils can be sustainable as DSL.
3.5	Theoretical Proposition: In considering appropriate management practice on DSL it is important to consider the absolute scale of the overall system. Rival Explanation: Relative scale is a more important determinant of the appropriate approach to DSL sustainability than absolute scale.
3.6	Theoretical Proposition: Forage crops hinder economic, environmental and social sustainability. Rival Explanation: Forage crops enhance economic, environmental and social sustainability.
3.7	Theoretical Proposition: Differences in climate and intensity mean that the fundamental issues of DSL sustainability vary between Southland and Canterbury. Rival Explanation: Despite differences in climate and intensity, the basic issues of sustainable farming of DSL and fundamentals of good practice are the same in Southland and Canterbury.
3.8	Theoretical Proposition: It is very difficult to resolve environmental and commercial drivers with DSL in southern Southland. Rival Explanation: With appropriate soil management, development, practices or land use it is possible to resolve environmental and commercial drivers on DSL in southern Southland.

The pilot studies generated some evidence to support the ideas expressed during the focus groups. The interviewee at Pilot Case 1 appreciated the fact that the DSL was adjacent to one of the dairy farms, but believed that the large scale and independent business structure meant that detached DSL could capture the same benefits if it were some distance away. Pilot Case 2 demonstrated that with careful management, good planning and good grazing management, most of the benefits of an adjacent block could be achieved with a detached DSL unit. Proximity of the DSL is explored in proposition 3.2.

Dryland DSL also emerged as an issue in the Canterbury focus group. Participants believed that in Canterbury, unpredictable rainfall and high evapo-transpiration mean that it is difficult to achieve sustainable outcomes with dryland DSL. In Pilot Case 1, there was evidence that small areas of dryland could be very beneficial if they were adjacent to intensive grazing areas (irrigated DSL or MP). This was in contrast to Pilot Case 2 where there was good evidence that the introduction of irrigation had resulted in greatly improved economic use of light land in Canterbury. The uncertainty over the sustainability of dryland DSL is further investigated in proposition 3.3.

Focus group participants believed that DSL should be on light soils that can withstand the pressure of intensive cow grazing in winter. This view was supported at Pilot Case 1, where the farm had been specifically chosen for use as DSL because it had light free draining soils that would perform well under the pressure of grazing cows over winter. It is also of interest that the farmer had chosen not to establish a DSL unit adjacent or close to his farm because he believed that a detached DSL unit with light soils was more sustainable than adjacent DSL with soils that would be damaged by winter cow grazing. This apparently critical role of soil type is the focus of proposition 3.4.

Scale emerged as an issue during the pilot case studies. Pilot Case 1 generated evidence that larger dairy systems have a greater vulnerability to external factors and therefore a have a greater need for DSL. The potential effect of scale as a factor influencing sustainability of DSL, particularly with respect to absolute vs relative scale is interesting and is considered in proposition 3.5.

Forage crops enable DSL systems to transfer more feed to winter and thus winter more cows than could be achieved with pasture alone. Against this, problems with crop pests, cow diet changes or soil degradation can be severe and in some situations grass wintering may be a preferable option (Davis, 2005). The focus group participants believed that forage crops play a positive role in DSL systems because they enable farmers to graze more cows on a given area at lower risk. This was supported by evidence at Pilot Case 1 where the use of forage crops gave enhanced economic returns while potential environmental impacts were contained. Pilot Case 2 provided evidence that grass wintering can give cost savings and metabolic benefits for cows equivalent to the financial benefits of including crops in the DSL system. The conflicting evidence over the value of using all-grass systems vs crops is investigated in proposition 3.6.

The literature suggests that wintering methods and problems with wintering vary across the South Island with the sustainability of particular systems or practices closely related to soil type and climate (Drewry, Littlejohn and Paton, 2000). The focus group participants observed that Canterbury dairy systems have relatively higher stocking rates and higher production with the DSL under more pressure than those in Southland. How much difference does this make in terms of the issues facing farmers in different regions? Proposition 3.7 explores the differences between Canterbury and Southland.

Anecdotal evidence gathered at Case Study Sites 3A, 3C and 3D suggested that DSL practices and appropriate approaches to sustainability were very different in Southern Southland where heavy soils and reliable rainfall result in a reliance on very high yield forage crops to balance poor utilisation as crops are treaded into the mud. The emerging evidence that the fundamentals of DSL practice in southern Southland may be different justified further investigation through addition of proposition 3.8.

Chapter 5
Results

This section presents the results of the research and describes the applicable evidence generated at the case study sites. The main source of evidence is the comments of farmers with pictures and observations used as secondary sources. Results are discussed in three sections:

- Perceptions of Sustainability
- The Link Between Sustainability and Practice
- The Various Types of DSL

5.1 Perceptions of sustainability

The purpose of the first part of the study was to investigate the perceptions of sustainability of DSL farmers who achieve business, environmental and social goals.

5.1.1 Internal and external factors

Theoretical Proposition: The most useful framework for understanding DSL farmer's perceptions of sustainability is created by separation into economic, environmental and social aspects Rival Explanation: The most useful framework for understanding DSL farmer's perceptions of sustainability is created by separation into issues internal to the farm systems and issues external to the farm system

During the analysis, it became clear that the investigation into farmer's perceptions of sustainability of DSL was not completely served by separation of the topic into the areas of economic, environmental and social sustainability. Farmers see sustainability in their own terms that are distinct from externally imposed concepts such as 'environmental sustainability'. For example, several farmers mentioned that they believed that DSL was a great improvement on previous land use. They saw that by using the land more responsibly they were fulfilling their obligation as farmers and leaving the land better than they found it:

'We are guardians of the land and I think good farmers are good guardians of the land and we all aspire to be good farmers.' [1C]

In other words those interviewed saw their external obligations in terms of stewardship and responsible use, a concept that may be inconsistent with terms that external stakeholders use to describe the environmental obligations of farmers.

It appears that farmers who acquire DSL do so in order to manage external variables by turning them into internal variables. It is this attitude to external variables, and the attempt to manage them that defines farmer's attitude to sustainability of DSL:

'Elsewhere I know that last winter, stock just got sent home. They just ran out of feed, they didn't keep it together when the snow came, the fences went down and the crops got trampled and so on… 'here's ya cows back'. [1B]

In other words farmers feel threatened by external variables and acquire DSL to manage them, and the effect of the inclusion of DSL is to alter the profile of external variables. The effect that DSL has on the risk profile of the business, which variables can be managed and what needs to be done to achieve this is key to understanding how farmers perceive the sustainability of dairy systems that include DSL.

As the farmers interviewed saw it, there are two relevant aspects of sustainability; those that they are potentially able to control and those that they cannot. Factors that farmers believe they can control with DSL include feed supply and environmental impacts. Factors that farmers feel are difficult to control arise primarily from the impact of environmental compliance costs and staff shortages:

> *'With future things, the biggest thing in the area that I farm is the water restrictions, I mean water dictates everything, especially with dairy pasture, there's soil moisture, then there's grass, then there's cows in milk, if one of those falls out of place, then it's not going to be sustainable. I don't want to see what some people are proposing, I don't want to see all these fights and stuff, money thrown around stupidly.' [1E]*

> *'There's another 35 dairy farms in Southland this year, so if they attract 2.5 staff per farm, so that's maybe 75 extra staff… that you need on the farm. Next season there's talk already of another 60 dairy farms in Southland, so 2.5 staff, that's 150. Where are they going to come from?' [3A]*

Considering sustainability from alternative viewpoints such as economic, environmental and social sustainability is still useful because the topic of sustainability is so broad. It also gives an alternative perspective from which to examine the way that DSL farmers attempt to transform external variables into internal variables:

> *'I think you can be an efficient and economic farmer and be environmentally sustainable at the same time, I think all that can be managed and I'd like to see that be managed because I think that Canterbury's a great area to farm in.' [1E]*

Thus it appears both ways of examining farmer's perceptions of sustainability are valuable in understanding the topic. The issue of sustainability is very complex and applying multiple frameworks to it helps break the topic down into manageable elements.

Summary of evidence on Proposition 1.1

- DSL farmer's perceptions of sustainability are most accurately defined by division into internal factors that are easy to control and external factors that are difficult to control.
- DSL farmers are very concerned about factors that they cannot control using DSL.
- Reduction of the topic into categories such as economic, environmental and social sustainability is also useful in understanding farmer goals with DSL and how farmers attempt to use DSL to internalise or control external factors.

5.1.2 Economic sustainability

Theoretical Proposition: The addition of DSL will enhance the ability of the dairy farm to manage internal and external economics factors.
Rival Explanation: The addition of DSL will impede the ability of the dairy farm to manage internal and external economics factors

As noted earlier (section 4.3) many commentators believe that the cost of services provided by DSL is much higher than most farmers realise and that many DSL are uneconomic. However, those interviewed were all of the view that the addition of DSL enhanced the overall economic sustainability of the system. They were happy with the performance of the DSL component of their systems and believed that using DSL to provide grazing or feed inputs created more benefits at a lower cost than relying on external suppliers:

'Last year we had our best spring ever right after the so-called toughest winter. We had things pretty right. This farm had nothing left to give in a feed sense, but the dairy farms were protected. We coped with a major snow event and we had the best spring with the highest production we've ever had. And we've done that economically too, our financial performance is on-budget, we are pretty happy with it.' [1A]

All of those interviewed believed that the net cost of inputs to DSL was less than the cost of buying the services provided on the open market, even when there were substantial costs associated with the DSL:

'You work something up, spray it, work it, fallow it and you assume that all the weeds will germinate, so you drill new grass into it and you get throttled by the weed invasion and that just seems to be the way it is. It becomes expensive but I keep in the back of my mind if I graze all of my cows off an average of ten weeks say, just say 500 times 15 dollars is $7500 dollars a week times ten weeks; it becomes a lot of money.' [1D]

At all of the case study sites, DSL provided intangible benefits beyond savings in grazing and brought in feed. Intangible benefits include enhanced MP production from better cow feeding over winter, preventing damage to MP pasture in early spring and avoiding exposure to a volatile and uncertain feed market:

'300-400 kgs per hectare would directly relate to your runoff management. The average is over 1700 kilos per hectare, there might be a hundred bales goes from here and that's it. 1300's not bad, a lot of people are happy to be doing 1300 a hectare. I wasn't. I would get about that without a runoff, it drops you back to joe average… empty rates speak for themselves, kilos speak for themselves, not buying in feed speaks for itself as well.' [1B]

While all of those interviewed believed that the DSL was very beneficial, there was an acceptance that the addition of DSL brought new risks to the system. Negative outcomes commented on by the interviewees included underperformance of the DSL unit and loss of management focus on the dairy farm:

'I am being forced to bring in feed from outside, I'll bring in palm kernal and cows will have to go away grazing despite the fact that I'm paying for the runoff. So potentially my runoff is in fact quite high cost in terms of what I am putting into it and getting back.' [1D]

Case 2B was an exception to the prevailing view that the inclusion of DSL provided intangible benefits that could not be captured in any other way. The interviewee believed that it was possible to achieve all of the benefits of DSL from brought in services but that it could be very costly to do so. Therefore, the decision to acquire DSL was mostly cost driven:

Case Example: Managing External Factors without DSL

Case study site 2B is a large dairy farm system consisting of a 1400 cow and an 800 cow MP supported by three DSL blocks totalling 484ha in area. The case is notable in that the larger MP achieved production of 2040 milk solids per hectare, the highest production of any of the case study sites.

Simple resilient systems help avoid problems or mistakes while keeping the management focus on the MP. The DSL and MP are adequately resourced with plenty of staff and machinery. It is interesting to note that 100 hectares of recently acquired, adjacent land was immediately included in the milking platform rather than being used to provide support services.

The case contained evidence that while DSL is very useful in managing the cost of wintering and other feed inputs, it is not necessarily the key to achieving high milk production. Prior to purchasing DSL, the risk of poor feeding and loss of cow condition in winter was managed by building relationships with graziers, by feeding supplements to control cow condition at the end of the milking season, by taking responsibility for feeding and care of grazed off stock over winter and by purchase of additional feed inputs as needed. In this way external risks could be sufficiently controlled that high production of almost 2000 milk solids per hectare could be achieved without DSL.

The DSL was acquired to achieve control of the cost of wintering, something that the owners believed they were unable to do with graziers. They believed that they were able to winter stock at approximately the same cost as grazing off, but that they would be less vulnerable to market fluctuations or cost over-runs.

Since purchase of DSL, the farm has continued to slowly increase production. However this may be as much a result of ongoing refinement of existing systems as inclusion of DSL in the farming system.

Summary of evidence on Proposition 1.2.

- All of those interviewed believed that the addition of DSL enhanced the economic sustainability of the dairy farming system.
- DSL provides a mixture of clearly defined cost savings and intangible benefits.
- There is an acceptance that the addition of DSL has potential to introduce new risks to the system.

5.1.3 Assessing the performance of DSL

Theoretical Proposition: Commercial returns are the most appropriate measure of economic performance of DSL.

Rival Explanation: In measuring the economic performance of DSL, feed grown is a better measure of economic performance than commercial returns.

A number of the farmers made statements to the effect that feed grown was the key variable in the success of DSL. The rationale for this is that large amounts of high quality feed must be grown to ensure cows are fed properly and that costs are controlled:

'(Owners name) was achieving very high yields on this farm of up to 20 ton… so if we can do that on (newly acquired DSL unit) we can carry so many more cows and it turns out to be cost effective.' [4B]

The success of a new practice or management decision was normally framed in terms of the amount of feed that could be grown in a specified period. With making the decision to irrigate part of the DSL for example:

> *'We know that if it goes dry when you are seeding the crops; you give that crop a good start and it's huge… and the water helps with the bugs and everything as well. We can pay for a pivot easily in two years with that 65 ha under crop. Easily.' [3D]*

While quantity of feed grown was generally seen as the key driver, farmers were very aware of the need to save costs and would strive to achieve low cost DSL operations, in fact the ability to farm at low cost was seen by many as one of that advantages of DSL ownership:

> *'Apparently Southland's average is $2.83 per kilo of milk solids, well the season that's just been, we reckon we're $2.12… My goal is to get under $2.00. I reckon I can put quite a bit of that down to doing what I am doing (on the DSL).' [3A]*

Summary of evidence on Proposition 1.3.

- Most farmers assess the performance of an area of DSL in terms of quantity of feed grown, rather than economic indices such as profit or return on investment.
- The best measure of the ability of DSL to support profitability and the most appropriate measure of DSL performance is the quantity of feed grown.
- The ability to minimize or control costs is seen as a crucial, but secondary consideration.

5.1.4 Self sufficiency or business growth?

Theoretical Proposition: It is desirable for DSL to act as an aid to business growth, either as a development tool or as an investment. Rival Explanation: It is undesirable for DSL to act as an aid in business growth; DSL should be used to attain self-sufficiency by managing production risks and controlling costs.

Although self sufficiency in support services was the primary purpose of all the DSL systems examined, it became clear that in the right circumstances, it was appropriate for the DSL to be involved in the expansion of the dairy business as well.

Where strategic decision makers were content for the time being to use the DSL to ensure a stable and sound farm system, the value of avoiding reliance on others for properly delivered support services was seen as greater than the value of an expansion of the milking business once additional costs are taken into account. In comparing the benefits of DSL with the capital investment in shares, cows and a newly upgraded shed for example:

> *'Oh course I would have had to buy more stock and more shares associated with the shed. So what we decided to do was to become more self-sufficient so it would give me more control of what I was doing. So if we did get into a drought situation or something like that, I could ride it a bit easier if you know what I mean. Fully stocked up, having to rely on all supplement getting bought in, I am more reliant on or vulnerable to climatic conditions. Whereas now, I'm not servicing quite so much debt, and I'm a bit more self contained and I can handle it, if a bad spell comes along, it's not so much of a problem.' [1E]*

Other farmers were active in using DSL as an intermediate phase in conversion to a dairy farm, by gradual development of soil fertility or drainage for example. It also appeared that using the DSL to grow the dairy farming business was a more common practice in Southland. This was due to lower dependence on irrigation, which facilitates gradual expansion of the MP area, and the ongoing growth of the dairy industry in Southland.

DSL was used as an intermediate stage as part of a continuing program of expanding the MP area…

> *'We want to milk off this 50 hectares one day. And we want to buy that 250 acres there and there's another 100 acres come in here and we'll be able to milk 900 in each shed, but I would put a 60 bale in the new shed, you know a bit bigger anyhow.' [3D]*

Or as a development phase, breaking in run down farms:

> *'When we took it over, it had two grass paddocks, the rest was all like that, we root raked it and cropped it and we are just going around it now, doing it again, it's usually winters about 2000 cattle. I was just saying to (owner) the other day that we could convert this here to a dairy farm, you've got all that flat up through there.' [3E]*

It seemed that some DSL units had shifted from a business growth role to achieving self-sufficiency as the farm system matured. One such system was farm 4C:

Case Example: Transition from Business Growth to Self-Sufficiency

Farm 4C is a 256 hectare DSL unit that provides all support services to a 157 ha MP as well as year round grazing for a number of dairy beef heifers and steers. The DSL will meet the grazing needs of 500 MP cows over winter and calves, in-calf heifers and beef progeny through the season. Approximately 400 tons of feed will be transferred to the MP as silage.

The role of DSL has changed over the life cycle of the farm business. As a sharemilker, farmer 4C used leased DSL to grow his herd naturally over time from 400 to 940 cows, as well as ensuring control of winter grazing and feeding of replacements. He also saw control of support land as very valuable at this time because it allowed him to utilise staff and machinery all year rather than for ten months, as do many sharemilkers.

Eventually farmer 4C purchased and converted a farm near the DSL unit, at which point the DSL became less focussed on facilitating growth and more focussed on creating a self-sufficient farm system. Currently, farmer 4C has no plans to expand the system further as he does not want to go over 600 cows and incur what he sees as the unnecessary management pressure of running a large-scale dairy system.

Summary of evidence on Proposition 1.4

- It appears that using DSL to grow the business and to achieve self-sufficiency are compatible and highly desired goals.
- Achieving self-sufficiency was the primary business goal at most of the case study sites.
- At some case study sites DSL was actively involved in business growth and it appeared that leased DSL could be very helpful for sharemilkers.

5.1.5 Business structures

Theoretical Proposition: DSL units are not fully sustainable unless there is an independent business structure with commercial drivers in place. Rival Explanation: Sustainable outcomes can be achieved without commercial drivers and/or a separate business structure as long as costs are kept under control.

The literature review and focus group meetings with consultants gave strong support to the notion that a separate business structure with genuine commercial drivers was essential to achieving economic sustainability with DSL. It was surprising therefore that 16 of 17 interviewees indicated that financially derived commercial drivers were not necessary to achieve economic sustainability with DSL.

With the exception of case 1A, there was a consistent theme across all of the case study sites that separate business structures were not necessary or helpful in achieving a sustainable farm system. The comments of farmers reflected this:

'We all trade as a one.' [1B]

'If you think of it as a separate business then you take the focus away from this job (milking cows), I sort of try and think of the whole thing as a big overall picture.' [3C]

'It's all run under the one.' [3E]

At three case study sites in Northern Southland the interviewees believed that the DSL and dairy farm should be able to function as independent farms even if separate commercial structures were not in place. Transfers of feed or stock between the MP and DSL indicated either inappropriate stocking rates or insufficient attention to grazing management. In other words, separation of feed and minimization of costs was perceived as a valid driver for practice, even though separation in terms of commercial drivers or costs was not. Minimising feed transfers will ensure there is enough supplementary feed to properly feed cows through all months of the year…

'…the grass that's on the runoff stays on the runoff for the wintering system. Any silage that was made on the dairy farm stayed on the dairy farm and went into shoulder production.' [3C]

…and reserve feed for youngstock:

'If I can keep to that 400 hectares, it means I can afford to graze my R2s and R1s on the runoff, so it is solely self sufficient farm, and a bit more, like we graze that extra 550 cows here, so it makes it a bit of income as well.' [3D]

The interviewee who asserted the importance of commercial drivers was unique in that he was a primary industry consultant hired as a managing director (Case 1A). All other interviewees were either farm owners (14 case studies) or farm managers responsible for DSL (2 case studies). As a result, the benefits of having a separate commercial structure remain unclear but it re-enforces the finding that rural professionals and farm owners have different ideas of appropriate management practices and goals for DSL systems.

It may also be that a certain set of conditions must be present in order for a separate business structure to be feasible. Commercial drivers do not appear to be necessary on leased land for instance as a commercial driver is automatically imposed by the need to pay rent and other fixed costs, nor do they appear to be relevant for small systems or DSL units adjacent to the MP.

The one case study site where formal commercial drivers were in place was a large scale DSL unit in Canterbury.

Case Example: The Benefits of Imposing Commercial Drivers

Farm 1A is a newly developed 440 hectare dairy support unit, adjacent to a large MP. This block winters 3000 cows as well as grazing 300 carry over cows and 2500 calves and providing lactation extension silage to the MP.

Case Study 1A was interesting in that there was coherent evidence supporting the proposition that separate business structures or separate commercial drivers would enhance the sustainability of DSL. Farmer 1A believed that for a DSL unit to reach full potential, it must be treated as a separate business with *'a life of its own.'* For this to happen there must be a separate commercial structure for the DSL unit with commercial drivers in place. Farmer 1A believed that only when a DSL unit is treated as a separate farm with good equipment, good management and good staff would it be possible for DSL operations to be carried out to a high level of excellence and truly sustainable outcomes achieved. This farmer saw it as essential practice for any DSL system large enough to support the required independent structure: *'Put commercial drivers right in from the word go. It's a business not a service.'*

Case study site 1A had a set of characteristics shared by no other farm in the study and this may account for the lack of true commercial drivers at other case study sites. This DSL unit was stable in size and tenure and was large enough to support a separate staffing structure. The tendency for DSL to be either leased or developed into MP and the relatively large size of farm 1A meant none of the other case study sites had this combination of land security and scale.

Summary of evidence on Proposition 1.5

- The appropriateness of commercial drivers or other separations between DSL and MP depends on conditions at the site.

- While a separate business structure seems to be a good idea, in most situations it was not seen as necessary for a DSL unit to reach full potential.

5.1.6 Environmental sustainability

Theoretical Proposition: The addition of DSL will enhance the ability of the dairy farm to manage internal and external environmental factors.

Rival Explanation: The addition of DSL will impede the dairy farm in managing internal and external environmental factors.

The evidence collected at the case study sites suggested that DSL systems are likely to enhance the environmental sustainability of a dairy farming system so long as appropriate infrastructure, development and land use are in place. All those interviewed were aware of environmental issues and supported efforts to minimise the impact of the DSL system on the environment:

'Yeah, it's really important (to farm owners), really important that they keep stock away from water ways, really you know. They are quite high performers, but they do look after the environment…' [4B]

Farmers were confident that the environmental impact of the systems they were responsible for was under control. At sites where negative impacts were apparent, this was seen as a temporary phenomena that those interviewed intended to address.

Those interviewed did not accept that wintering cows was intrinsically bad for the DSL blocks that they were responsible for. They believed that wintering on DSL is comparable to wintering on other kinds of livestock farms with similar risks and similar action required to prevent environmental impacts:

'We are not polluting the waterways, they are all fenced off, the soil structure tends to hold up fine, it's not easy to damage. And you've gotta remember that Southland's been wintering stock for a hundred years, it's not like it's a new phenomena.' [3C]

It is interesting that the four case study sites where problems were reported related to lack of resources, or else lack of development or structural problems on leased DSL. On leased DSL there are often short timeframes in which to recover invested capital. This may result in a lack of investment in infrastructure or inappropriate land use and increased vulnerability to environmental problems. Where the DSL is inadequately drained for example:

'It's pretty good here, but just down the hill you'll see the difference… (Plates 1 & 2: Mud 1-2) We ended up feeding them more because we lost so many square meters that were under water.' [4B]

When they occurred, environmental problems were linked to a lack of resources allocated to the DSL, either as a lack of structural developments such as drainage and appropriate stock water systems, or machinery that was inadequate to the job. Case study site 4A for example demonstrated how inappropriate or insufficient machinery could result in severe problems with damage to soil structure and nutrient runoff over winter:

'…(the sharemilker) was doing backfencing, he was doing a good job that way, but his machinery was completely inadequate, it was the travelling backwards and forwards that did the damage and we were struggling to get onto that ground in the spring, compared with this other farm where this fella had bigger machinery, bigger silage wagons, had made less trips and we could get on to that ground in the spring a lot quicker.' [4A]

Summary of evidence on Proposition 1.6

- DSL will enhance the environmental sustainability of the overall dairy farm system as long as necessary infrastructure and other resources are in place.
- Problems tended to occur on leased blocks where there was no arrangement with the landowner to address structural issues or insufficient time to benefit from invested capital.

5.1.7 Social sustainability

Theoretical Proposition: The addition of DSL will enhance the social sustainability of the dairy farming system. Rival Explanation: The addition of DSL will impede the social sustainability of the dairy farming system.

There was evidence of both positive and negative impacts of DSL on social sustainability. Operations managers may be overextended as staff management becomes more complicated or there is a lack of time to properly plan and carry out DSL tasks. There may also be a loss of focus on the dairy farm:

'(Dairy farmers) are very good at milking cows, (but) they are not necessarily all that good at planning and doing all the other stuff they've got to do with a runoff… it will take the focus off the diary farm and that is their core business, not the runoff.' [1C]

The capabilities of staff may become more of an issue when DSL is added. The need for staff to work unsupervised made DSL systems more vulnerable to incompetence or mistakes made by staff. Incompetent or inexperienced staff may put extreme pressure on already over-extended management who find that they have to directly supervise the dairy farm at all times as well as manage the DSL:

'I just sold my dairy farm because my staff pissed me off… Just had three bad ones in a row mate, three years in a row, they've just… I spent more time in the cowshed than my staff, this last year anyways.' [1B]

At the beginning of winter, the complexity of changing staff over from milking cows to feeding cows on the DSL can be very stressful for staff and management:

'The first year I found it bloody stressful, a lot of work. I sort of had to be there the whole time to learn what stuff ups they were going to make and what I would have to tell them.' [1C]

The addition of DSL results in less supervision of staff and vulnerability to economic losses as mistakes are more likely to go unnoticed:

'It's not like on the dairy farm where if there's a stuff up, a dozen people will see. It will probably happen at night when there is no one there. And having it set up so if it does have a cock up its not a big cock up. Putting two fences up instead of one, that sort of thing.' [1C]

As well as underfeeding or neglecting to feed cows, incompetent staff will create unnecessary pressures for management, as they have to deal with staff problems instead of carrying out other essential duties:

'(He) starved cows, he didn't move them, he'd roll the reels up and leave them sitting in the paddock… cows'd eat them… I would give him instructions, right it on paper; shift them so many meters. I'd go round for a look, he hadn't fed them. We had an arbitration meeting, two or three of them, in the end they said we'll give you two weeks pay, we don't want you back… it was just a real struggle.' [3E]

Some systems appeared to be more vulnerable to social factors than others. It appears for instance that larger systems (over 700 cows) may be particularly problematic, especially if there is no one besides the operations manager responsible for DSL:

'I have had troubles with a runoff before, it was a bigger place, 1200 cows with a runoff next door and I just found it hard to manage both effectively… one got looked after and the other got neglected or the runoff got looked after and the management of the dairy farm got neglected. I think a lot of it for me was people management.' [1F]

Case 1D was an example of a situation where the farmer was aware of how the inclusion of a DSL unit affected staff and management and acted to ensure that the DSL assisted rather than hindered staff management:

Case Example: Capturing the Social Benefits of DSL

Farm 1D is a 260ha DSL unit, the majority of the farm is hill country, with a small 30ha flat irrigated by a centre pivot. This DSL unit supports the grazing needs of 500 dairy cattle through winter and 171 calves, 150 in calf heifers, and 60 beef cattle for the rest of the year. The DSL unit is adjacent to the milking platform, which makes it easy to get onto the block. Staff satisfaction and staff quality figures greatly in the management priorities of farmer 1D:

'The goal is to have high quality staff who share the same sort of vision that I do… who want to achieve things for the sake of achieving them, not just for the sake of their own financial satisfaction or financial gain….'

Farmer 1D believes that he has derived substantial benefits from the culture of professionalism he has created in his workplace, he has never had to deal with drug use and believes that his reputation as a decent employer *'helps greatly in finding staff.'* By addressing the drivers of social problems, and focussing on what the DSL can contribute to social sustainability, Farmer 1D has prevented most of the negative effects that can occur as DSL is added to a farm system.

The DSL contributes substantially to the social sustainability of the overall system because it provides a healthy and enjoyable working environment for staff, both in terms of being a pleasant environment to work in and in terms of providing job variety for staff. This farmer also believes that the inclusion of DSL in the farm system allows him to be actively involved in the dairy industry while staying clear of the dairy farm, both to allow his manager to work independently and to slow down and move closer to town as he gets older.

Summary of evidence on Proposition 1.7

- The addition of DSL will result in increased pressures for managers, as they are required to take responsibility for ensuring DSL tasks are planned and executed well and supervise staff on DSL as well as the MP.

- Failure to address problems with staff is likely to result in economic losses and severe stress for the operations manager.

5.1.8 DSL and external social factors

Theoretical Proposition: The cultural gap between the rural and urban communities and associated political action is a threat to the future sustainability of dairy systems that include DSL.

Rival Explanation: The cultural gap between the rural and urban communities and associated political action is an opportunity for the future sustainability of dairy systems that include DSL

The cultural gap between rural and urban New Zealand is creating problems because it leads directly to external risks that dairy farmers are unable to control. Nine farmers expressed the belief that the inability of dairy farming as an industry to manage external factors was already leading to significant problems and that it appeared that existing difficulties would become worse in future. The external factors of concern were the poor public perception of dairy farmers (and the compliance costs that result), and the increasing difficulty that farmers have in finding competent staff.

In the context of the substantial investment that DSL farmers are prepared to make to gain control of potentially harmful external impacts, it is interesting that some of the most emotive comments related to the inability of farmers to manage sustainability issues that could not be controlled by investing in DSL:

'… there needs to be a general realization among farmers that image is… massive, that central plains scheme down there is struggling mainly because it can't get past the image of dairy farmers, greedy dairy farmers making more milk, making more money and as a result plundering the rivers and polluting the water supply with all the babies in the future will be born blue. And that's the perception and as long as… farmers have just got to wake up to that.' [1D]

Those interviewed were also very concerned about the threat of staff shortages. Many believed that they had very little control over the supply of good quality staff and that the rapid growth in the dairy industry combined with a failure to effectively address systemic issues meant that things would probably get worse in future:

'There's another 35 dairy farms in Southland this year, so if they attract 2.5 staff per farm, so that's maybe 75 extra staff that you need on the farm. Next season there's talk already of another 60 dairy farms in Southland, so 2.5 staff, that's 150 staff. Where are they going to come from?' [3A]

Even though there was a range of negative comment about the role of external factors in the sustainability of dairy farming systems, there was considerable evidence that DSL might help. Adjacent DSL in Canterbury might be used to manage water restrictions for example:

'If we do get on water restrictions, I can use the runoff right next to the dairy farm to come on and graze and, you know we do get early spring feed off it and you know I am not so reliant, with drought' [1E]

There was evidence across several case study sites that the addition of DSL to a dairy system creates a better work environment:

'I am reliably told by farm advisors that it just adds another dimension for the staff and that the benefits of that outweigh the disadvantages. It's absolutely stunningly beautiful up there on a day like today, it's beautiful, you can see for miles, it's just different.' (Plate 3: Italian) [1D]

Overall it appears that external social factors are a key vulnerability of all dairy farm systems and that the addition of DSL has potential to help reduce this vulnerability. Farm 3C was an example of a farm system where the farmer was proactive in managing external factors that would normally be beyond the scope of DSL management:

Case Example: Proactive Management of External Factors

Farm 3C is a 160 hectare DSL unit supporting an adjacent 255 hectare dairy farm. This unit is used for wintering 800 cows, 200 calves, 200 heifers, 40 jersey bulls. Soils are a mixture of stony soils (stony loam) and heavy soils (silt). The DSL and MP are self-supporting with minimal transfer of feed as silage or grazing.

Farm 3C has invested in DSL development and relationships to gain as much control as possible over external factors. The farmer uses DSL to control feed supply and the way cows are fed as well as the risk of environmental compliance costs and vulnerability to poor quality staff.

Farmer 3C sees it as important to prevent unnecessary nutrient loss and soil runoff. To this end stock grazing forage crops are back fenced while those wintering on grass are carefully managed to ensure there is minimal damage to pasture. All stream boundaries are fenced with tussocks planted, a development that was done by the landlord as part of the lease agreement.

Even though dependence on staff is an issue; *'It's not getting any easier to employ staff'*, Farmer 3C believes that the DSL has potential to create benefits for the whole system. The DSL provides opportunities for staff to learn new skills or carry out a variety of jobs. Although the inclusion of DSL creates new pressures for management, there are opportunities to share management jobs and to take more of a strategic management role; *'They (the herd managers) will be responsible for plate metering, heat detection and I will take a step back.'*

Summary of evidence on Proposition 1.8

- External social factors such as staff shortages and rising compliance costs are seen as a significant and difficult to control threat to the future sustainability of dairy farming systems.
- There are limited options for managing these external factors using DSL. DSL can provide job variety and opportunities for staff to progress and regulations can be anticipated and managed.

5.1.9 Specific need

Theoretical Proposition: For economic sustainability to be achieved, the DSL must meet a specific need that cannot be met in any other way.

Rival Explanation: A specific need is not necessary for a given area of DSL to be sustainable.

In some cases there was a perceived specific need that could only be met by inclusion of DSL in the system. Specific needs included the need to protect heavy soils on the dairy farm in spring and the need to manipulate stocking rates and supply large amounts of supplements on winter milk farms. All of those interviewed believed to some extent that the need for control, to have secure winter cow grazing and control of cow feeding over winter was a specific need. There was also some evidence that specific needs became more acute as the absolute scale of the system (the number of cows wintered) increased.

Dairy farms with a predominance of heavy soils are vulnerable to soil damage and have a specific need for DSL to ensure cows are kept off the MP for the entire winter:

'When you damage that Warterton Clay Loam, you can pug it bad and it just goes sour, it does not grow, there'll be that period where it's as slow as anything. If I had a good Spring and plenty of feed and I didn't have this area where I could bring them off, if you get a wet September, you'd be stuck in October kind of thing.' [1E]

Winter milk farms require DSL to supply supplements and to adjust stocking rates on the MP:

'The dairy farm itself is 120 hectares and it's heavy soil, and I need something for the winter time, they need to go away from the farm, on light ground or stonier area.' [2C]

The need to ensure cows are fed properly was seen as a specific need by many of those interviewed:

'I believe that it's critically important to have cows calving at condition score 5. And if I have my runoff that's one way of ensuring it.' [1D]

There was evidence that absolute scale had some relationship to specific need with large systems relatively more exposed to difficulties with relying on others for winter grazing:

'If we suddenly lost this and we had to go find winter grazing for 3000 cows, that would be extremely difficult, whereas if we had only 500 cows, you'd find a hole somewhere, spread them round or whatever.' [1A]

Summary of evidence on Proposition 1.9

- Many of those interviewed believed that the DSL fulfilled some specific need that could not be fulfilled in any way other than the inclusion of DSL in the system.
- Specific needs included the need to protect sensitive soils and pasture on dairy farms with heavy soils and the need of winter milk farmers for large amounts of supplements and to graze off for several months each year.
- Many saw that DSL was the only way to achieve sufficient control of cows feeding and that control at least to some extent qualifies as a specific need.

5.1.10 Sacrifice of DSL sustainability

Theoretical Proposition: Some sacrifice of the economic, environmental, or social sustainability of DSL is inevitable if the goals of protecting the MP and maintaining cow condition over winter are to be achieved.

Rival Explanation: Sacrifice of DSL can be avoided if management and conditions are appropriate.

Although sub-optimal outcomes did occur on DSL at times, this seemed to be accepted as part of using DSL to ensure the MP can continue to function at a high level despite severe weather events that may occur in winter or spring:

'Our spring's the worst time when we can do damage on the farm, we can damage a lot of pasture on the farm in spring, so this area is what you call a sacrifice area… but I think we make up for it in spring when we can fully feed the cows and get them off to a good start, I've got plenty of grass in front of me and I can just walk the cows back to the dairy platform.' [1E]

Economic sustainability may be sacrificed to ensure cows are fed well…

> *'I won't accept my cows calving at 4.5 because it's been a tough year. And even if things are very dry on the runoff and underperforming, I will spend money to enhance it, palm kernal going up the hill and all that sort of thing. It does allow me to achieve the parameters and protecting the dairy farm.' [1D]*

…or because of a lack of viable options for transferring feed to winter:

> *'Well, we are sacrificing it you see, we knew this would happen. It's probably going to get worse. This is instead of a swede crop.' (Actually appears worse, especially near the pit, see Plates 4 & 5: Self Fed Stack 1-2). [3B]*

Sacrifices may also be made to secure support services or maintain goodwill beyond the bounds of the DSL component of the business:

> *' A lot of people would have (broken the grazing contract), they would have said 'nah, we've got a lease block, we don't need you.' We just don't operate like that… so yeah we've got an expensive winter because we are paying the grazing and we are paying the lease cost over here.' [3C]*

The tendency to sacrifice the sustainability of the DSL means that the state of the DSL may be an indicator of the sustainability of the overall system. It seems likely that if the system is under pressure, economic loss, environmental damage or management overwork will become evident on DSL and thus indicate systemic problems that may not yet be evident on the dairy farm.

Summary of evidence on Proposition 1.10

- Part of the role of the DSL is to protect the MP from variations in climate or the feed market.
- When forced to choose between the sustainability of the DSL component of the business and the sustainability of the MP component, the sustainability of the MP will always come first.

5.2 The link between sustainability and practice

The second objective of the study was to investigate how perceptions of sustainability inform practice. For DSL business and sustainability goals to be achieved, DSL systems need to be well resourced, DSL tasks must be planned well, and sensitive tasks need to be carried out on time and attended to properly. These three factors applied at every case study site, although their relative importance varied from one site to another. For example the interviewee at case study site 1A assigned a great deal of importance to ensuring the system was fully resourced, while at case study site 1C, the prime focus of attention was planning. Case 3D is an example of a case study site where attention to detail had made the difference and allowed the system to reach potential.

5.2.1 Well resourced DSL

Theoretical Proposition: Sustainable outcomes cannot be achieved unless the DSL is well resourced. Rival Explanation: Sustainable outcomes can be achieved even if the DSL is not well resourced.

There was strong evidence that having enough resources allocated to DSL is the key to achieving a balanced and sustainable farm system. Adequate resources are fundamental to planning, saving costs, managing staff, feeding cows properly and managing environmental impacts. In the context of DSL, 'resources' includes physical resources such as fertilizer or machinery, management time or time taken to learn, and structural developments done on the DSL.

It is necessary to have the appropriate staff, machinery and structural developments so that staff and management are able to carry out important tasks effectively:

> *'If you talk about best practice, people have got to have gear to carry out irrigation well, feed cattle well and do the job to a very high level. Unashamedly we want to make a profit. The words we use; we want a sustainable property. We'll carry half a labour unit more than we might be able to get away with just so it is sustainable.' [1A]*

Control of cow condition and protecting the MP requires additional feed reserves in case of climatic events over winter:

> *'Our budgets seem to be 'we've got enough', not 'we've got more than enough'. I'm a conservative farmer, grown up with a hay barn full of hay basically, even if you don't need it.' [1C]*

Resources must be allocated to monitor and address problems as and when they occur. A small application of resources at the right time may be necessary to prevent a greater cost later. An example of this is extending the life of pastures by using a direct drill to repair patches of pasture in early spring:

> *'And what we do in the spring is I drive around with my maps and I put a cross on anywhere I think that we need to go with a direct drill and drill a bit of grass into it. Any areas where it got really wet one night and they've muddied up a strip, I've marked it and they'll come and they'll direct drill that strip instead of doing the whole paddock.' [3E]*

The concept of adequate resources extends to development on the DSL. Developments essential to ensuring a sustainable farm system include good fencing, pasture renovation, stock water systems and drainage. Good fencing with backup generators will ensure control is maintained even if power is cut off over winter:

> *'You have to have power on your fences, you have to have stock control with that many stock here in the winter. We have a generator here to keep the fences and stock water going. If you have a bunch of cows get out and just trash… ten days feed, you can't get it back again. Control is vital; good fencing, good power.' [1B]*

Pasture renovation can greatly increase the productive potential of the kind of rundown farms that are often acquired for use as DSL:

> *'Some of these leases we've had off sheep farmers, one there we've wintered 1200 cows on it for the last 2 years, before that, they were wintering 300 sheep, we just dumped the lime on it, we direct drilled it…' [3E]*

An appropriate stock water system is important to ensure stock have water, prevent damage to soils and pasture and keep cows out of waterways:

> *'We've still got all sheep troughs and stuff around here so, it's going to be all fixed up.' [observed a water trough designed for sheep that had been broken by heifers, resulting in severe mud and damage to pasture around the trough]. [2B]*

In southern Southland, drainage was important to achieve sustainable DSL by maximizing productive potential while reducing environmental impacts:

‘That land that’s not drained properly, you’ll have far more pugging problems, far more issues with the soil structure.’ [4A]

At some case study sites, success was achieved not so much by application of adequate resources as creating systems that allow goals to be achieved with low resource inputs. Case 1F was an example of a case study site where minimal resources were applied to maximum effect:

Case Example: Success with a Low Input DSL Unit

Farm 1F is a 127ha dryland DSL block supporting spring grazing and some winter grazing for a 184ha irrigated dairy farm. This is an all grass system based on silage and strategic grazing from the dairy farm in late spring and autumn.

Farm 1F is notable in that external conditions are managed with very low inputs of material or management resources, and simple systems allow the strategic manager to make the best of small area of dryland DSL, while keeping the main focus of management on the dairy farm.

The adjacent situation is most useful in spring, as the hilly DSL and flat dairy farm compliment each other; if it is cold or dry, there is good utilization on dairy farm and if it is wet, feed will become available on the DSL. As a result there is always somewhere the cows can go in spring without threatening milking pastures and money can be saved by grazing the DSL directly instead of making silage: *‘It’s fresh grass, its high ME and more valuable than bought in silage.’*

Even though the DSL area is only able to support the wintering needs of half the cows, the DSL is still seen as very valuable in managing the risk of poor grazier performance because the cows are away for only part of winter (or half the cows are grazed at home for all of winter) and the DSL allows control of cow feeding in late Autumn and Spring. Control is achieved by making sure cows are in good condition at the start of winter, having all cows home 2 weeks before calving, and by working closely with graziers.

In adapting to the dryland situation, Farmer 1F has adopted enterprises that he believes allow the DSL to function well in a high risk environment without putting pressure on other parts of the system. The combination of supplement production and wintering cows works well because it confers the flexibility required when some support services needs are acquired on the market.

Having a simple system, with land shut up for silage for most of the year also means that external factors are controlled while the focus of management remains on the milking platform.

Summary of evidence on Proposition 2.1

- Intelligent application of resources is fundamental to success with DSL systems.
- In the context of DSL, ‘resources’ extends to physical resources such as feed and machinery, management time and developments done.

5.2.2 Appropriate staff

Theoretical Proposition: When DSL is included in a system it is helpful to have policies in place to attract the right staff.

Rival Explanation: When DSL is included in a system it is not necessary to make a effort beyond what would be required for a dairy farm without DSL.

The case study sites generated consistent evidence that the addition of DSL increases dependence on the capabilities of staff. Systems with DSL are more vulnerable to mistakes made by staff and furthermore, staff must learn more as they are required to perform a greater range of tasks. To help manage difficulties with staff, DSL systems can be used to create an environment that will attract and retain the kind of staff required. The need for more capable staff is a resource problem as good staff require better pay and benefits.

Having good staff allows managers to have more time to take care of planning and other tasks related to the DSL:

> *'I've had the same staff stay on for two years, which is awesome because they know my system, they know how it works, I know their limitations and I know what they are capable of. So I can leave them in charge and I know what they'll do at home, which will free up a bit more of my time. So I can spend a bit more time (on the DSL).' [3A]*

Several of those interviewed prefer to recruit staff who want to get somewhere in a business or personal development sense:

> *'They are there because they want to be there and they want to learn, but then having them move up through the system. Someone who wants to progress and then try and help them and teach them about our ways of doing things so they can learn and take something from here to their next management job.' [3A]*

Spending a little more on staff, good work conditions, paying staff well and ensuring there is enough time off seemed to result in improved performance and good staff retention:

> *'Milking cows, if you do it properly, she's hard yakka, especially winter milking, you're going right through, like last year, jeeze she was hard going, everyone just bit the bullet and got through, you've got to treat them right, pays not everything, yeah we pay them well, give them all the time off you can really.' [2A]*

While some are willing to spend more on staff, they are likely to expect better results as well:

> *'My tractor driver is on $20 an hour, which I don't mind paying because he looks after the gear, washes his tractor, he greases it regular, the last tractor driver I had was a young fella. He wrecked so much gear, it was unbelievable...' [3E]*

The presence of DSL and general increase in the scale of the system may facilitate the creation of structures that allow staff to progress within the farm system, for example by giving staff the opportunity to take charge of the dairy farm as the operations manager oversees the whole system:

> *'Our goals in staff management is with that other farm, that's 260 cows down in Invercargill, I am sort of, every person I am trying to groom up so they are good enough to run that farm down there by themselves… But it's to get them up to that level, so if something ever happens to (name) I can just say does anyone want to go and work on that farm down there? And usually, if I've done my job right here, they are screaming out and saying "Yeah, that's the next step in the chain."' [3C]*

Summary evidence on Proposition 2.2

- There is recognition that management need to be aware of the demands that the addition of DSL or operating for 12 months place on staff.

- The best staff are those that want to grow and develop personally.
- Dairy farm systems that include DSL can manage the increased reliance on staff by making the farm a better place to work in terms of job variety, skill and career development and other benefits.

5.2.3 Management structures

Theoretical Proposition: A well-supported management structure is not enough to achieve sustainable outcomes with DSL; a dedicated management structure is required.
Rival Explanation: A well-supported management structure is enough to achieve sustainable outcomes with DSL.

There was mixed evidence for the best way to prevent management overload on DSL systems. At some case study sites it appeared that a well-supported management structure had allowed management to function at a high level despite the addition of DSL. At other sites there was evidence that a dedicated management structure with specific individuals responsible for DSL was the only way of preventing problems with management.

There was consistent evidence that well supported management was very important in creating a sustainable system:

'The new manager has been told very clearly that one of the expectations is that [name] is carried along with him. [Name] is as skilled up as possible, it will make the new manager's job so much easier to deliver. The new manager can carry on having three days off a fortnight right through calving and everything, it means we all have summer holidays and with a second man we can do that seamless thing.' [1D]

Delegation and spreading responsibility appeared to be important in helping operations managers cope with being responsible for both the DSL and MP. By having experienced staff in charge of portions of the operation such as winter grazing, the dairy shed or young stock for example:

'I've realized that I've gotta step back from somewhere and I've got two herd managers coming in this year and they'll be responsible for half of the day to day running of the dairy unit, like the plate metering, the cows on heat, things like that, which I've been sort of doing virtually all by myself, with them doing it occasionally, and I try to say 'you guys step back, I'll oversee it and oversee this block as well.' Just with the size of things.' [3C]

A dedicated DSL manager appeared to be useful on some larger systems:

'My personal opinion is that farms with big runoffs should have a runoff manager, they should have a separate person in charge of the runoff and not expect the dairy farm manager to run everything…' [1F]

Despite extensive questioning on the subject, the need for a dedicated manager on DSL remained unclear. In cases where there appeared to be problems with management overwork it was not clear if the imposition of a dedicated management structure would have solved the problem or if there were deeper systemic issues such as a lack of quality staff that would need to be resolved first.

Summary of evidence on Proposition 2.3

- It does not appear that dedicated management is essential to achieving sustainable outcomes on all DSL.
- However, it appears that a dedicated management structure may be necessary in some circumstances, for example on some larger systems.

5.2.4 Knowledge

Theoretical Proposition: Acquiring technical knowledge is not a resource problem but rather a matter of experience and ability to implement.
Rival Explanation: Acquiring technical knowledge is a matter of resources either in terms of allocating time and money to acquire it or of hiring the services of those who possess it.

In an ideal situation all necessary knowledge and experience will already be possessed by the management staff. However this is not always possible, particularly when the system is changing or DSL is added for the first time. Successful DSL farmers are active in expanding their knowledge base with resources expended on time talking to other farmers, consultancy fees and conducting trials.

Ideally, the necessary technical knowledge will already be possessed by those in charge of DSL when it is acquired:

'We were lucky in that we had our joint venture partner who knows how to grow crops. He knew about seedbed preparation and all those things…' [1A]

At some farms, willingness to methodically and purposefully expend resources on developing knowledge appeared to have been important in achieving a sustainable farm system. Case 3A was an example of situation where time spent thinking and consulting with others had led directly to success in a situation where the local climate had made it very difficult to achieve success with conventional methods:

Case Example: An Innovative Approach to DSL Management

Farm 3A is a 141 hectare dairy support farm with all of the farm area in grass. 41 hectares supports the grazing needs of 150 in-calf heifers and 100 hectares supports winter grazing of 560 milking platform cows. Farm 3A is unique among the Southland case study sites in that it relies completely on grass to grow and transfer feed to winter.

The main limitation of this farm is the period of hot, dry winds that comes at the end of spring every year. These winds make crop establishment very risky and can cause soil loss and may have long-term impacts on production. Farmer 3A believes that wintering on grass allows him to grow more feed with better utilization and better feeding than would be possible with a crop-based wintering system in these conditions.

Secondary advantages of an all grass system include the ability to graze all youngstock on the DSL, a better working environment for staff in winter and much lower incidence of silt runoff into streams. Also, the ability to avoid transition feeds and to precisely measure how much cows are fed is believed to enhance MP production in spring as long as good quality grass can be carried through to the end of winter.

By taking an innovative approach, questioning orthodoxy and thinking carefully about what will work in the context of the features of his farm, Farmer 3A has created what he believes is a great improvement in the sustainability of his DSL system:

'I thought 'there's gotta be a better way to do it, if they can all grass winter in the North Island, we can all-grass winter down here, so I basically went and spoke to a heap of people that were doing it and then the biggest problem… the biggest thing I got back from those guys was that it didn't work, one was not having

high enough energy feed late in winter, that was the biggest issue, the cows did really, really well up until about the middle of July and then they just crashed. So, I looked at why they were crashing and the reason why they were crashing was not high enough energy feed, so then I went to grass seed reps to find out how I could go all grass and still have high enough energy feed going in. And that was when I come up with the Feast idea and started chasing that…'

Summary of evidence on Proposition 2.4

- Knowledge is effectively a resource problem, it costs money and time to gain and a lack of knowledge will lead directly to production losses just as with under-investment in other kinds of resources.
- Gaining knowledge requires management time as managers take time to learn about or try new practices.
- Gaining knowledge often requires money, either as consultancy fees or the risk of financial loss as practices are implemented with incomplete knowledge.

5.2.5 Planning

Theoretical Proposition: Planning is crucial to sustainable farming of DSL.
Rival Explanation: Planning is not necessary to achieve sustainable farming of DSL.

Planning appeared to be fundamental to success on even very simple DSL systems. Planning is subordinate to resources because time to plan is in itself a valuable resource, furthermore failure to plan will lead directly to unnecessarily wasted resources as the farmer finds other ways to ensure cows are fed properly and that the MP is protected.

For DSL to function properly, key activities must be well planned:

'We've done the budgets, we're organized, we know how much feed's there we've got it worked out as to how much they're supposed to get; get them there. It's easy to say 'oh we've got to hang around one more day to get them tagged or whatever.' That should all be bloody done before they are dried off, not once they're dried off. That should all be figured out so there's no bloody time wasted. Planning, planning's the key to a runoff. [1C]

DSL operations, particularly when combined with those on the MP can be complex. At several case study sites, multiple jobs or enterprises required an excellent grasp of the operational plan, on a DSL system with a beef policy in place for example:

'(after the cows go back to the dairy farm for calving), we'll bring bulls around and self feed the rest of the silage to the bulls; because they do really well on it… in the spring. And then the bulls will finish the stacks while we're building up a bank of feed around there for them. And then starts the bulls putting on weight and they'll finish any grass that's here. Then we go round with a direct drill and we drill the paddocks again, any muddy spots… and then 'cause we can't cut any of this for silage, (due to large stones on surface) we cart it to here. And we stack it here, then we fence round these, then we graze with the heifers etc until the end of January, then we shut it up, so it has February, March, April till we are grazing it in May again.' [3E]

Several farmers mentioned the time and energy they put into planning, the time they spend thinking about their farms, looking around and consulting with others:

'I spend a lot of time thinking about things and then I get in with my contractor and him and me work on our crops, our grasses. It's important to get our grasses right at the end, but I mean crops too, because we need every blade of bloody grass or every swede down there.' [3D]

Planning for success with DSL extends to devising simple but effective systems that ensure resources are used well…

*'You really have to figure out what works best for you with your own systems and how you want to run it. If you want to be here 8 hours a day you can, no dramas, or you can get your s*** together and do something.' [1B]*

…for example designing wintering systems in a way that ensures cows are fed well while making the best use of staff time:

'I talk to a lot of guys I know and how hard is it, you get a good plan and systems going and it works quite well. We are finished feeding our cows by bloody 10 o'clock at the latest. Uhm last year we were down to an hour and a half, it was so simple, down to that block there, straight lines and it worked very good, wee bit slower this year.' [3D]

Summary of evidence on Proposition 2.5

- Planning is very important to avoiding wasted resources and ensuring tasks are done properly and on time.
- Those interviewed were prepared to spend a lot of time planning and designing good systems.

5.2.6 Timing and attention to detail

Theoretical Proposition: Timing and attention to detail are essential to achieving sustainable outcomes with DSL.
Rival Explanation: Under some circumstances, timing and attention to detail are not essential to achieving sustainable outcomes with DSL.

There was strong evidence that timing and attention to detail was important to success with particular key tasks or key areas of management. Areas that appear to require attention to detail include crop establishment, maintaining pasture quality in spring and soil protection. There was also evidence that a lack of attention to detail would lead to losses as resources are expended for sub-optimal results.

Timing and attention to detail is the key to achieving excellent results:

'The difference between 1200 a hectare (and 1000) … it doesn't cost you anymore to do it… it's just through getting little things right.' [3A]

There are certain tasks that require a high level of attention for short periods, the application of fertiliser for example:

'Make sure urea gets put on right behind those cows, that's why I like having my own spreader, so as soon as those cows come out of that paddock that machine's going in there. We're not losing a days growth, it's getting into that system a day earlier, you know what I mean?' [3D]

In systems that rely on crops it is very important to pay attention to detail at the time of crop establishment:

'The swedes are all ridged (Plate 6: Ridged Swedes) it is conducive to growing bigger swedes which cows do utilise better than a whole lot of wee dudes. They don't waste as many by standing on them. With ridging them you do get better utilisation, you are normally guaranteed at least an average crop' [4C]

With grass, it is important to monitor quality and quantity to ensure adequate feed is transferred to winter:

'You've got to have your timing right to make sure you've got enough feed here through the winter. Early autumn is crucial and that leads in from your summer. Pasture quality and quantity, if you haven't got that right by the 10th of May, then you are not going to.' [1B]

Attention to detail was also important to avoid damage to soils and pasture; to be aware of soil characteristics, stocking rates and soil moisture and respond appropriately. Strategies to protect soil and pasture included backfencing with portable troughs…

*This is where cows have been wintered, there's been a lot of back fences put up there and that ground there is absolutely spot on. No problems whatsoever. You don't see a whole lot of tracks there from machinery, we use silage, not balage, but he uses fairly big machinery to pull the silage around. You can see he's got back fences up. (Plate 7: Post Grazing). *Post grazed soil to have an appearance and texture as if it had been worked up, rather than pugged. [4A]*

…and feeding silage out in ways that avoids pasture damage:

'We try to feed the silage as thin as we can on the paddocks… and don't feed against the fences, because if you feed against the fences, all the cows want to stand there and they will muddy up and you don't want to have to go round all the fence lines with the direct drill.' [3E]

There was extensive evidence that a lack of attention to detail will lead to losses. Examples included a missed silage cut leading to a paddock being damaged by grassgrub…

*'... for some reason the silage contractor forgot to do this one paddock and grassgrub just love long grass (Plates 8 & 9: Grassgrub). When the beetles are flying they lay their eggs in the tall grass.' *Observed pasture that had been almost completely killed by grassgrub, with root mass completely consumed. [1C]*

…and a lack of time to do proper preparation leading directly to poor crop yields:

*'Slightly better crops here, we are doing about 12 tons. (Plate 10: 12 ton crop *Observations indicate that this may be an optimistic estimate) They put this crop in with the intention of being a 25 ton crop from what I understand, it wasn't double sprayed and it was put in when conditions weren't ideal (too wet).' [4B]*

Case 3D was an example of a system where the focus of attention to detail was on controlling costs. Farmer 3D believed that a little care taken with grazing management or monitoring contractors is needed to save greater costs later:

Case Example: Attention to Detail to Control Costs

Farm 3D consists of a 400 hectare milking platform with 423,000 kg MS total production and DSL areas that winter 2000 cows; 360 calves and 350 heifers grazing year round and 2500 tons of silage is made every year.

A new operations manager has improved many areas of practice, which provides an opportunity to compare past practice with current (improved) practice. Farmer 3D has focused on achieving a low cost operation with a focus on maximum benefit for minimum inputs.

Good grazing management with grazing to low residuals and short rotations has contributed greatly to improved production; *'They said you could never graze more than 1200 cows on here, we have 2000 cows plus young-stock… it gets so far and it just stops, you could leave it for a week and it wouldn't do anything, you've just got to be on a short (25 day) round.'*

Disciplined grazing to low residuals is very important to maintain quality and avoid wastage and/or running out of feed. Even though there is a large amount of land available Farmer 3D restricts the MP area to 400 hectares so as to guarantee there is enough grass to feed young-stock and reserve feed for wintering. Care is taken with herbicides to avoid loss of clover (if pasture is productive, the silage chopper will kill thistles) and to avoid grazing heavy soils in wet conditions.

Farmer 3D also believed that it was important to have the right resources or relationships in place to ensure tasks are done well and on time. For example, investment in a fertilizer spreader was justified as it ensured nitrogen is applied in the exact amounts and at the exact time that it is needed. Spending a small amount of time in monitoring contractors as they work and building relationships with good/reputable contractors were also seen as important to avoid (potentially very expensive) mistakes with new grass or crops.

Summary of evidence on Proposition 2.6

- The key tasks relate to controlling the process of growing and transferring feed to winter.
- Forage crops require timely and thorough preparation at the time of crop establishment.
- Success with grass depends on maintaining pasture quality and pasture yield.

5.2.7 Monitoring and awareness

Theoretical Proposition: Control and measurement are crucial, there needs to be a formal program of monitoring so that there is control of pasture and animal condition.

Rival Explanation: A formal monitoring program may not be necessary if the operations manager has a high level of awareness of what is happening in the system.

There was consistent evidence that a formal monitoring program is not necessary if there is sufficient management skill and experience in place…

> *'You just look at the paddock, they are all different size paddocks so you have to be on the case, but we don't measure it. It's just a matter of being on the ball all the time.'* [2A]

…or where there is a reason for management to be in every paddock every day:

> *'(With K-Line irrigation) As a management tool, you're in every paddock every day and you know where every blade of grass is.'* [1B]

Even though most did not do formal monitoring, those interviewed appeared to be highly aware of what was happening on the systems they were responsible for and observation combined with action was quite important, particularly with winter grazing:

> *'A guy comes round here and checks all these fences at about 4.00 in the afternoon, 1 or 2 come round, fences, checking on cows, make sure they are happy, I think ah the eyes and ears are an important thing, cows soon let you know.' [3D]*

Indicators were often used. The state of hay feeders as an indicator of cow appetite for example:

> *'That's how the feeder should look at this time, a little bit of hay left. (Plate 11: Waiting to be Fed)' [3E]*

Another indicator is the performance of (low cost) whole crop silage crops as a measure of soil health following winter grazing:

> *'Come October the paddock, will be sown into barley; and we grow good crops of barley, so while it might look bad, we don't think it is a big effect.' [4A]*

When formal monitoring was used, it was often in support of professional farm managers who may be less familiar with a particular farm system than farm owners:

> *'A lot of measurement goes on. Crop measurement. Scales on the silage wagon, silage is tested.' [1A]*

Summary of evidence on Proposition 2.7

- It appears formal monitoring program is unnecessary where farmers are very familiar with their systems.
- Monitoring appears to be useful where management is less familiar with the DSL system.

5.2.8 Achieving success with graziers

Theoretical Proposition: The use of graziers impedes or has impeded the sustainability of dairy farming systems that include DSL. Rival Explanation: The use of graziers enhances or has enhanced the sustainability of dairy farming systems that include DSL.

Relying on a grazier to supply crucial support services was perceived as risky by all of those interviewed. Perceived risks included exposure to volatility in the price of grazing, potential high costs of bought in feed if the grazier does not have enough feed on hand or cows come home early or financial losses as cows calve in poor condition.

Graziers are perceived by many as incapable of providing a level of care that dairy farmers require:

> *'The last 5 years, (owners names) have wintered their own stock with the runoff and it's only this last winter that they've sent cows away. And it's the first time that they've been unhappy with the way that they are putting weight on.' [4B]*

Graziers may fail to grow enough feed with the result that cows are not fed properly…

'Well there wasn't enough feed there when you sent your cows, had youngstock out grazing and… I could starve them for free myself, why pay someone to not feed them properly?' [1B]

…and even when there is enough they may fail to look after cows properly:

'I had some stock out grazing, one of the reasons I own my own runoff; the bulls got in with them, the guy ran the bulls with them, then he tried to abort the cows. It was just a stupid decision to be honest,… the damage is done; eight winter milkers.' [3C]

Although there are risks involved in using graziers, a number of those interviewed used graziers for some dairy support services, with many seeming satisfied with results. It appeared that using graziers will only result in sustainable outcomes if the risk of relying on graziers to supply support services can be managed.

Communication and involvement are absolutely essential in achieving successful relationships with graziers:

'You've gotta communicate with them and you've gotta go check on your stock. It doesn't matter how well you know the grazier, you still go and have a look.' [3C]

Building trust and developing a professional and honest relationship is also important. This applies to both the behaviour of the grazier…

'Basically they've got to be fed well and you have to find a grazier whose honest and feeds them what you pay them to feed them. Why can't a grazier be relied on to do a proper job?' [1C]

…and the dairy farmer:

*'...you don't s*** on people otherwise it comes back to haunt you. A lot of people would have done, they would have said 'nah, we've got a lease block, we don't need you.' We just don't operate like that… so yeah we've got an expensive winter because we are paying the grazing and we are paying the lease cost over here...' [3C]*

It was important to ensure graziers had the technical skill and the ability to grow enough feed and look after cows:

'They (graziers) need to have experience grazing cows, they need the right soil and the right setup to graze cows and to have an understanding of the stock.' [1E]

It also appeared that there was no such thing as a bargain with grazing and that it is often necessary to pay a bit extra to ensure a quality result:

'It's costing me $16 a head to truck them from Invercargill up to here, but it's worth paying that over the $6 I pay if they are going just down the road because I know who I am dealing with. It's cheap. The cows come back in good order.' [3C]

Ideally the grazier is willing and able to control results and can accept some responsibility for risk management:

'I think you need to have a good understanding with the grazier, he's a good stockman and I think we're lucky to have that because last year when it got hard going in the snow and that like he had to feed out balage and when the cows destroyed half a break, we actually… he was quite happy to give them another break and when they did come back it was about ten days early but he'd fed them well and they come back still in good condition.' [1E]

Small, adjacent areas of DSL also appeared to be effective in managing this risk of using graziers, allowing either the wintering of some cows at home or wintering of all cows for part of winter. It is much better to have some DSL and partial control than no control at all:

'Some years we've had uhm 300 cows here all winter then bought them home and calved here and other years we've had all the cows away over June, then they all come back in July, so it's the same thing really, 300 cows for all winter or 600 here for half the winter. And then they're all here from August through to early October really.' [1F]

Thus, on one hand it appears that using graziers presents a risk so severe that it justifies large investments of time and money in DSL, while on the other it appears that there are reliable methods by which these risks can be contained. The conflicting opinions over the value of using graziers may justify more research into how farmers can achieve success with graziers.

Case study site 3B was a grazing farm that provided winter grazing for dairy farmers. The perspective of graziers was interesting because it allowed a comparison of the perspectives of sustainability of graziers with those of dairy farmers who use DSL.

Case Example: A Grazier's Perspective

Farm 3B is a dairy support business that mixes dairy grazing with sheep farming. Stock wintered include 1100 cows, 150 rising one year old heifers, 4600 ewes and 1400 mated hoggets. There are three blocks in the system; A home (owned) block (900 acres) which supports silage making and winter grazing of ewes, a hill block (800 acres) from which they buy sheep grazing in summer and a lease block (600 acres) which is used for winter grazing of cows and year round grazing for sheep and dairy heifers.

Grazing dairy cattle suits sheep farming because it compliments feed supply and labour, and because the income from dairy grazing is steady, dependable and low risk. On a sheep farm there is a peak in feed demand in spring as lambing begins, with lower demands through the rest of the year, thus dairy grazing works in well because it utilizes the feed grown and saved in autumn. Grazing dairy cows also improves labour utilization because it goes on in winter when the sheep operation requires little input. Finally, the income streams from sheep and dairy grazing compliment each other, with the income from dairy grazing depending on a different set of economic fundamentals to sheep farming, thus reducing the exposure to market risk.

Farmer 3B believes that honesty and good communication are important to preserve a good reputation with dairy farming customers. The basic principle of relationships applies to treating the grazing stock, leased farm and staff with care and respect; *'He (the dairy farmer) gets what he wants, we do a good job of them so, his cows are going home in good condition. None of us want to see skinny hungry cows just for the sake of profit.'*

Summary of evidence on Proposition 2.8

- It is necessary to actively manage the risk of relying on graziers for support services.
- Communication, involvement and trust are key to managing the risk of using graziers.
- Small areas of DSL close to the MP can also be very helpful.

5.2.9 Managing external relationships

Theoretical Proposition: External relationships are important in creating opportunities for the business.
Rival Explanation: External relationships are not important in creating opportunities for the business.

Good relationships with the community are relevant to the discussion on DSL because they are helpful in acquiring the right kind of land for a DSL unit. It can be difficult to acquire an appropriate DSL unit because supply is limited and there are often very specific requirements; the prospective DSL unit must be of a suitable size and proximity relative to the dairy farm with soils that can withstand the pressure of winter grazing dairy cows. Not only is the supply of DSL limited, but DSL units are often leased, which again requires a good relationship to achieve success.

With leased DSL, relationships are important to ensure developments actually are done…

'The owner did it when we came here, it was part of the lease agreement. Fence off the streams.' (Plate 12: Stream Protection) [3C]

…as well as to ensure the lessee and the land are respected:

'Some people would (lease DSL) and just go in and do their winter feed and leave it… there is a cavalier attitude out there which is really hard, money, money, money…' [4A]

In some cases it appeared that adherence to a certain set of values and good neighbourly relations had resulted in opportunities for growth. In one case the behaviour of farmers and the way they treated the land had led to an opportunity to secure a good lease agreement with opportunities for collaboration:

'It's about how we conduct ourselves, he liked the look of how we were doing things. If we had to put it together quickly I am not sure if we could have pulled it off. We had a selling point with how we conducted ourselves on the farm next door, it happened that we said 'hey, you've go the same kind of farm as me, why don't we do some business?'' [1A]

Good communication favoured both parties and allowed DSL to be properly developed:

'There was 50 hectares down the road, we both put in tenders for it, but because he had the farm next to him and was related to him, he got the farm. Then he came back to us and said 'I am just buying this as an investment for me and my family' I want to lease it to you. And I said well I want to buy some of it if I am going to put an irrigator on it. At least one circle that the irrigator runs on, so we did that….' [1E]

Relationships with neighbours may also create opportunities to buy land on favourable terms. At one case study site the interviewee's commitment to building relationships and being on good terms with his neighbours allowed him to continue to grow his farm over time even though he lived in an area where farm land was in short supply:

'Then in 1990 this 80 odd acres was offered to us for $335000 with a house and everything; real nice house. We were just talking to my neighbour one day and he said 'I'm thinking of selling my farm' and I went over that night and bought it...' [2A]

Summary of evidence on Proposition 2.9

- External relationships are valuable in creating growth opportunities for the business, particularly where blocks suitable for DSL are in short supply.
- Relationships are built by taking good care of the land and by making an effort to get to know neighbours.
- Relationships are important to ensure leased blocks are developed properly with a fair distribution of costs.

5.2.10 Bringing environmental and commercial drivers into line

Theoretical Proposition: DSL farmers are able to apply environmentally sustainable practices without sacrificing other aspects of sustainability. Rival Explanation: In most situations, farming DSL in an environmentally sustainable manner will require expensive and comprehensive changes to existing systems.

All of the farmers interviewed were positive of their ability to achieve environmentally sustainable farming without sacrificing economic or social sustainability. Examples of observed practices that resolve economic and environmental drivers include good grazing management, having appropriate developments in place, using fertilizer appropriately, using nitrification inhibitors, and using tillage methods appropriate for the soil type.

Some farmers saw that effective grazing management, maintaining pasture quality and fully utilising pasture had secondary benefits such as less use of nitrogen and suppression of pasture weeds from more frequent silage cuts:

'I suppose if you are making good quality grass paddocks, you get the silage chopper on and you don't have thistles.' [3D]

The ability to resolve environmental and economic drivers is impeded if appropriate developments (stock water systems or drainage) are not in place. Appropriate stock water systems are essential to control pasture/soil damage and waterway pollution:

'We haven't got a water scheme on so we are struggling to get water. It's got water races, so we have just sorta got to let the cows have that because that's where the water is.' (Observed cows forced to walk through paddocks to access water where they were able to stand in the water race) (Plate 13: Leased Block) [3E]

Installing tile drains on DSL increases the productive potential of the ground while reducing water-logging, runoff and nutrient loss over winter:

'That land that's not drained properly, you'll have far more pugging problems, far more issues with the soil structure.' [4A]

Careful management of fertiliser and nutrient inputs avoids wasted fertilizer and nutrient loss into aquifers or streams. Nutrient budgets, timing of fertiliser application and the use of Eco-N were all discussed. When properly used, nutrient budgets allowed farmers to optimise fertiliser use while preventing environmental contamination:

'But with doing (nutrient budgets), I could see how you get a benefit out of it by seeing what you put on and seeing where it's all going, and whether you're putting too much on or not.' [3A]

Fertiliser needs to be applied at the right time:

'The timing of fertiliser is important too. You can't put it on when it's pissing down.' [3A]

When applied correctly, eco-N improves pastures while reducing losses of nitrogen to the environment over winter:

'With putting on eco-N we are getting very good results, it's getting better every year.' [4A]

Appropriate tillage methods were important to minimize costs, safeguard crop yields and pasture establishment, and to avoid unnecessary use of sprays. In the right situation, minimal tillage will result in reduced cultivation costs and a more resilient soil structure:

'We direct drill everything now. It's just the work aspect is a lot less, with getting the ground prepared to go into brassicas, we done the spraying, direct drill, and then coming from the crop to grass the preparations minimal depending on what weather we've had while we were on the crop, we can show you a paddock down here with cows on and there's very minimal pugging.' [3B]

Summary of evidence on Proposition 2.10

- It is possible to farm in an environmentally sustainable manner without resort to uneconomic developments or production losses.
- Failure to perform economically is linked to negative environmental effects.
- Good husbandry practices lead to both positive economic outcomes and positive environmental outcomes. Examples include: good grazing management, having appropriate developments in place, using fertilizer appropriately, using eco-N and using appropriate tillage methods for the situation.

5.2.11 Transition feeding

Theoretical Proposition: If cows are wintered on forage crops, transition feeding is necessary to ensure cows do not lose condition or suffer health problems at the start of winter.

Rival Explanation: Transition feeding is not always necessary to ensure success with crops on DSL.

During the case studies there was conflicting evidence over the value of transition feeding or gradual dietary change from grass to forage crops.

Some of those interviewed were convinced that a transition feed was necessary while others (one of whom achieved very high production) believed that the benefit gained did not justify the additional work and complication of transition feeding, particularly at a difficult time of year when staff are trying to get used to working on the DSL.

Several farmers practiced transition feeding in the belief that if they did not do so they would experience losses from nitrate poisoning and other dietary problems.

Nitrate poisoning was a particular concern:

'Nitrate poisoning is an issue, we've just had a problem with a heifer, she slipped a calf, we think it was nitrate poisoning. There can be problems with the kale, again it's an issue with slowly getting them used to it so they don't gorge.' [1C]

With diet changes, swedes seemed to be more of a problem than kale:

'Feed transitions are quite important, particularly with swedes. More so going from brassicas onto grass. You would spend a lot of trouble… going on to brassicas is a biggie.' [4C]

The evidence that the transition feed should be carefully managed was inconsistent; there are case study sites where a productive and sustainable farm systems was achieved without transition feeding. This applied both in Canterbury…

'We haven't got the time and probably the facilities to that, nor the grass, so it was straight from grass onto kale and away they go. We've actually never done a transition feed, believe it or not. I know. I am sure there is some benefits of it, but at the end of the day, we still do 540 solids a cow, we do big production per cow. And I think the secret too is to get the cows on kale early' [2B]

…and Southland:

Q: 'Do you do a feed transition onto kale?

A: 'No, we put them straight on. We don't have any problems with them.' [4A]

The conflicting evidence over the value of transition feeding means that management of dietary change may be an interesting focus for further investigation.

Summary of evidence on Proposition 2.11

- There was conflicting evidence over the value of transition feeding.
- More research could be done around the management of the dietary change at the start of winter.

5.2.12 Induction

Theoretical Proposition: Inductions are essential to achieving a profitable farm system, even with DSL. Inductions are an important management tool that helps achieve a compact calving and low empty rates.
Rival Explanation: Inductions are unnecessary as long as cows are properly fed, cow genetics are good and the technical aspects of mating are done well. The ability to avoid inductions is one of the benefits of control of DSL.

There was disagreement over the value of inductions with some farmers seeing it as essential to induce if the MP was to reach full potential, while others believed that the addition of DSL made it unnecessary to induce because of the scope to feed cows properly and ability to carry over dry cows

Some farmers saw that the pressure that the cows are under to produce milk means that it is difficult to avoid inductions and still continue to maintain acceptable fertility levels:

'Last year because we were expanding we left the bulls in quite a long time, but (the empty rate) was down at 5.5 per cent.

Q: 'Without inductions?'

A: '16 per cent, which is why we induce basically..' [3D]

Others saw inductions as unnecessary if cows and youngstock were fed properly:

'Just feed them vitamin G; good stuff. Heifers touch wood, I've been south seven years and I haven't yet had an empty heifer. So there ya go, high fertility herd.' [1B]

The farmers who were attempting to eliminate induction saw the ability to use DSL to control feeding as a valuable aid in achieving low empty rates:

'If we can feed our cows better… cows aren't changing diets, so we're not having any transition off and on to grass, so the cows are basically still getting the same all the time. So by doing that we are cutting out our metabolic problems and the induction cows was one reason to get rid of them… I get sick of in spring time dealing with a cow that we shouldn't be, and why are we dealing with that cow? Because we've inflicted it, inflicted it by not feeding our cows enough through winter, or not having our cows in good enough condition at calving, or through needling that cows and inducing her, so it's not natural…Yeah… there's only one way to make money and that's to feed your cows properly.' [3A]

The role of DSL on an induction-free farm bears further investigation, particularly in light of possible future restrictions on non-medical inductions and the effect that this might have on the role or importance of DSL systems.

Summary of Evidence on Proposition 2.12

- There was conflicting evidence of the role of DSL in avoiding or minimizing inductions.
- Some of those interviewed believed that even with the feed security provided by DSL, inductions were essential to getting the most out of the farm system.
- Others believed that the presence of DSL gave enough control that inductions were no longer necessary to achieving a sound farm system.

5.3 The various types of DSL

The third objective of this study was to examine perceptions of sustainability and practice across various types of DSL.

Dividing DSL into categories led to a more rigorous and informative understanding of how farmers perceived and responded to sustainability issues because it created a way of examining the same problem from different perspectives, in other words to achieve 'theoretical replication' (Yin, 2003), and develop a stronger theory to address the research questions.

Categories of DSL examined included:

- Leased DSL
- Adjacent DSL
- Dryland DSL (in Canterbury)
- DSL on heavy and light soils
- Scale
- DSL with and without forage crops
- DSL in Canterbury and Southland
- DSL in southern Southland

5.3.1 Leasing or buying DSL

Theoretical Proposition: It is difficult to achieve sustainable outcomes with leased DSL. Rival Explanation: Sustainable outcomes can be achieved with leased DSL as long as capital inputs can be kept to acceptable levels without threatening economic, social or environmental sustainability.

Leasing appears to be a very common practice with 11 of 17 farmers interviewed having at least some involvement with leased DSL. It appears from evidence collected at the case study sites that farmers are able to achieve control of feed supply using leased DSL, and that as long as care is taken to ensure the cost of leasing is less than the cost of ownership that it will bring financial benefits as well.

Leasing is an attractive option in the current land market, where the cost of leasing DSL is lower than servicing an equivalent debt, and avoiding the expense of land purchase will free up equity for investment elsewhere. Furthermore, leasing DSL makes sense for dairy farmers because they already have a substantial capital investment in a dairy farm, cows and shares so leased DSL units compliment the capital-intensive dairy business in a financial sense. At the case study sites visited, the primary limitation of leasing was the short timeframe involved, and lack of capital inputs or unrecoverable investment that may result.

At the time the case studies were done, the cost of leasing appeared to be less than that of servicing a debt:

'At the moment because I lease a runoff and leasing is a lot cheaper than servicing a debt, it costs me $220 an acre so it costs me… 50 hectares, 32-33000 dollars a year, as a leasing option its good, if I owned it I would be looking at 1.2-1.3 million, so to service the debt on that you are probably looking at 100-110000 dollars to service that.' [1E]

There was a range of evidence at the case study sites that in the right situation and with an appropriate lease agreement, farmers can use leased DSL to manage external factors while keeping capital investment to acceptable levels:

'We are paying grazing off for the cows for wintering of those and the youngstock and the runoff ends up still cost effective when you work it out. It still makes sense to lease the runoff at $200 an acre, put the crops in and do it yourself and you get control.' [4B]

Although leasing DSL presents many advantages, there was evidence that leasing can cause problems for the overall sustainability of the system. Insufficient resources or lack of acknowledgement or communication about exchanged resources seems to be at the heart of problems with DSL lessees. Most problems arose from lack of environmentally focussed development or disagreement about which party should pay for what:

'…I am very cautious about investing money in (the leased DSL). (Owner) is always very keen that I be doing lots of things, but I always feel that it is me spending money to develop his property and there is no sort of realization that it might have improved, etc. When I took over I remember one of the paddocks was all tussocky and weedy ragtoppy rubbish and I improved it out of sight.' [1D]

With a poorly worked out lease agreement, the farmer may have no way to recoup capital investments on the DSL and there may be no opportunity to benefit from invested capital. For example at one case study site the farmer had paid for the development of a leased block, but when the farm came on the market, he was not recognized for the inputs of resources and trust he had made as a lessee:

'…and he thought we'd pay this ridiculous price. This here was completely and utterly bare land, no power, no water, no buildings, not even a hayshed and he was wanting us to pay more than a full running dairy farm with a shed, houses, cows, water supply, tracks (but probably not shares) and he wanted us to pay more than that.' [4A]

Alternatively, farmers may choose to do minimal investment in the DSL with the result that environmental protection related developments are not done and the DSL unit does not reach it's full potential. Stock water systems designed for sheep and problems associated with them were common on leased blocks:

'These cows they have to come over here to get water, to this race here, pain in the arse. We are actually just at the moment in the process of putting a water scheme in here, into every paddock.' (Plate 13: Leased Block) [3E]

Leasing and practice

All of the farmers who used leased DSL maintained that to be successful they had to be very careful with capital inputs and that to achieve success, they had to balance the need to get the best out of the land with the reality that they may not have time to benefit from any investment done. In an ideal situation, all necessary developments are done prior to the farmer taking on the lease.

It appears that a good relationship is more likely to lead to a long term agreement or the kind of lease terms that satisfy both parties; there should be an agreement at the onset of the lease as to which party is responsible for capital inputs or improvements and how much they will be paid for doing so:

'Everythings gotta be signed, it's all got to be ticked off and agreed beforehand. You can't go back later on and change if you get different ideas.' [4B]

In cases where there was no clear agreement or understanding of which party would pay for improvements, a lack of development appears to have been the result. For example in cases 3E, 3B, 2B and one block at case study site 1E, fertilizer applications and re-grassing were done, but fences and stock water systems remained as they were at the beginning of the lease.

Examples of leased DSL where adequate development was done were farm 2A, farm 1B and farm 1C. At each of these case study sites, some development was done prior to taking on the lease and/or the lease terms were such that the lease block could become part of the long-term plans for the business.

Case 4A illustrated some of the vulnerabilities of leased DSL:

Case Example: The Vulnerabilities of Leased DSL

Farm 4A is self-contained dairy system with an area of 592 ha that supports the grazing needs of 1500 cows for 12 months of the year. This area includes 105 ha of leased land.

The DSL area acts as a development stage between run down land with unreliable drainage, and high production dairy pasture. Development consists of re-doing all tile drains, followed by one or two winters with kale, barley for whole crop silage followed by annual or perennial ryegrass (MP pasture). Incremental development enables drains to be done at low cost, and suits the sharemilkers on the property as it allows them to grow their herds without changing jobs or purchasing large numbers of cows at once.

Attention to detail and the right things being done at the right time appeared to be key to success at this case study site. Grazing management over winter was important with Farmer 4A being careful to back fence and avoid driving tractors on paddocks any more than necessary. Tasks related to soil health were done effectively and on time; paddocks are grubbed immediately after the forage crop is grazed, the next crop is not sown until the paddock is dry.

However, a poorly developed relationship and inability to recover invested capital has meant that the leased portion of farm 4A was never re-drained. As a result there have been ongoing problems with drainage and failure for the land to reach economic potential as well as unnecessary environmental impacts. In view of his experiences Farmer 4A would not lease DSL in future.

Summary of section 5.3.1

- Leasing DSL allows farmers to control support services inputs and grow their business without the expense of land purchase.
- Leasing DSL compliments the capital intensive dairy farm.
- Good relationships with the land owner and a clear lease agreement that fully describes which party is responsible for capital improvements is fundamental to avoiding environmental or economic problems with leased DSL.

5.3.2 Proximity

Theoretical Proposition: Sustainable outcomes are easier to achieve with adjacent DSL.

Rival Explanation: Most or all of the benefits of adjacent DSL can be achieved with detached DSL if other aspects of management are right.

Adjacent DSL

It appears to be easier to achieve sustainable farming on DSL that is adjacent to the MP. Marginal areas of land too small or of insufficient intensity to be viable as an independent DSL unit were still viable if adjacent to larger intensive grazing units or MP areas. Adjacent DSL areas were valued because of the ability to capture cost savings and to protect the MP at key times (When grazing would result in soil damage and runoff for example). Furthermore, although small, adjacent areas may not be able to provide all necessary support services or winter grazing, the partial support they provide appears to greatly reduce the risk of relying on graziers for support services.

Detached DSL

Although there were many apparent advantages of adjacent DSL, it did not appear to be critical to achieving a sustainable farm system. If the right systems are in place, detached DSL units can also contribute greatly to sustainability. There was however, some evidence that actual distance from the MP was related to the ability to achieve an effective DSL unit:

> *'Location is a big thing. Being able to get there in a tractor in 5 minutes, or if you go there and you forget the pliers and you think oh s***, I forget those pliers, I'll go get them, I'll fix this fence now, whereas if you are ten k's away whatever, 'oh bugger it', you walk past and believe me, it will come back to haunt you if you don't fix that fence or fix that gate.' [4C]*

Strategic grazing and manipulating stocking rates on adjacent DSL

The ability to move individual cows off the DSL as and when they dry off or calve was a valued feature of adjacent DSL blocks:

> *'If we haven't got enough cover on our dairy farm, we'll calve on the runoff, walk the cows back, where normally if you're grazing off. You've got how many hundred cows arriving on your doorstep, which is fine if you've got the grass growth, if you haven't got the grass growth… you'll need to do a whole heap of things...' [3C]*

At several case study sites, strategic grazing on adjacent DSL was used to save costs by avoiding feeding supplement on the dairy farm and protecting the milking platform pastures at key times. Strategic grazing to help manage water restrictions…

> *' if s*** happens, we run out of water or something, we bring the cows over to graze at certain times.' [1C]*

…or save money on supplements either in spring…

> *'It's more important to us through spring. They can milk longer on the dairy farm, then when they do calve we don't have to feed silage to them because the stocking rate is less on the dairy unit.'[1F]*

…or during feed shortages in autumn:

> *'I pulled these young cows outta here and we sent them down here (the runoff) on once a day. They ate that area right up to here, then it rained, and then they went back to their own area, and it needed that grazing that March to get it ready for winter. Then that was all set for winter so it was quite good. That's not bad grass actually down there now (See Plates 14 & 15: Lower DSL 1-2).' [3D]*

The desirability of doing strategic grazing on adjacent DSL was not universal. In several adjacent DSL situations in Southland, the use of adjacent DSL for strategic grazing off the MP was seen as undesirable because of the possibility of interference with DSL operations. Feed transfer to the MP was seen as indicative of problems on the milking platform; either failure to utilize pasture properly or a stocking rate that was too high.

'I come in here with the intention of never using anything else. I am milking 1200 cows, 3 to the hectare, there's your 400 hectares. If I can keep to that 400 hectares, it means I can afford to graze my R2s and R1s on the runoff, so it is solely self sufficient farm, and a bit more, like we graze that extra 550 cows here, so it makes a bit of income as well.' [3D]

Adjacent DSL and specific needs

At some case study sites there were specific needs that were fulfilled by adjacent DSL. For example at one case study site, there was a specific need of protecting heavy clay soils on the dairy farm in spring:

'When you damage that Warterton Clay Loam, you can pug it bad and it just goes sour, it does not grow, there'll be that period where it's as slow as anything. If I had a good Spring and plenty of feed and I didn't have this area where I could bring them off, if you get a wet September, you'd be stuck in October kind of thing.' [1E]

Managing the risk of using graziers

At two case study sites, small areas of adjacent DSL were used to actively manage the risk of using graziers:

'…some years we've had 300 cows here all winter then bought them home and calved here and other years we've had all the cows away over June, then they all come back in July, so it's the same thing really… 300 cows for all winter or 600 here for half the winter.' [1F]

With small areas of adjacent DSL there is also the option of grazing on the MP in winter if conditions are right. Case 1F was an example of a situation where although the MP and DSL were adjacent they complimented each other because they had very different characteristics:

'If it's wet we don't get very good utilization of the runoff and we are going through more feed or more area, so if that's happening we can then bring the cows down to the dairy farm some of the paddocks we got stony paddocks and they won't pug up too bad and in spring they will grow again. Whereas if it's frosty that grass isn't growing very well down here and we do want to stay away from the dairy farm and we can utilize the runoff paddocks.' [1F]

Some adjacent DSL areas were used in a development role, by expanding the existing MP area over time. In light of the tendency of owned adjacent DSL areas to become part of the MP, it is perhaps not surprising that many of the adjacent DSL areas were leased.

The use of adjacent DSL as part of a development phase was observed in two case study sites in Southern Southland and related to ongoing drainage and pasture development:

'This farm here is milking 1000 cows. It has the potential to probably milk 1200 cows when my development stage is finished. So at the moment, it's dairy farm with a runoff only for wintering cows…' [4A]

Some farmers also reported that adjacent DSL areas were very useful in re-grassing the MP area:

'But we're coming into the platform, that's why I want to get those paddocks fixed up… cause that's where the money is really to get good grasses on there.' [3D]

Case study site 1E was an example of a case study site where excellent use was made of a limited area of adjacent DSL:

Case Example: Excellent Use of Adjacent DSL
Case study site 1E is a 181ha dairy farm with 86 hectares of adjacent DSL. The dairy farm milks 540 cows in total, producing 250000 kg MS (1500kg MS/ha, 457 kg MS/cow). 200 cows, and 170 heifers graze at home over winter with 340 cows wintered with a grazier. Farmer 1E has chosen to invest capital in adjacent DSL to achieve self sufficiency with more control rather than in upgrading the dairy shed with more cows and more Fonterra shares. The adjacent situation provides security in terms of securing future support services as well as providing for possible future water restrictions. Case 1E is an excellent example of the use of small, adjacent areas of DSL to get the most out of the dairy farm, achieve control of support costs and reduce capital inputs. The adjacent support land allows control of cost of feeding cows in late winter via strategic grazing of milking platform cows through August, September and October, while at the same time protecting MP pastures if it is wet. Cost savings come from feeding grass directly rather than as silage in spring; *'As soon as you harvest anything, it is going to cost you 20c/kg DM'*. Farmer 1E uses the DSL areas to give him control over cow condition going into winter and to reduce the time the cows are away, reducing the grazing bill and giving control of cow feeding in the last two weeks before calving. The DSL also provides a fall-back position if the cows come home early.

Summary of Section 5.3.2

- While adjacent DSL is valued by those who have it, it does not appear to be essential to achieving sustainable DSL.
- There are some farms with specific needs that require adjacent DSL, for example farms that have soils that are vulnerable in spring.
- Adjacent DSL units are more effective if they have characteristics that compliment the MP and allow cost savings.
- Small leased areas of adjacent DSL can provide control without a large capital investment.

5.3.3 Dryland DSL

Theoretical Proposition: Dryland DSL areas do not have the potential to achieve economic, environmental and social sustainability. Rival Explanation: Sustainable farming of dryland DSL can be achieved in the right situation.

Dryland DSL with very different characteristics to the intensive irrigated MP is a phenomena of dairy farm systems in Canterbury. Dryland DSL is lower in intensity and more variable than irrigated DSL. The case study interviews indicated that dryland blocks should be adjacent to intensive (irrigated) areas to be economically effective.

In Canterbury, high evapotranspiration and low rainfall mean that dryland areas are less productive and more unpredictable than the highly controlled, high intensity irrigated areas. This means that systems with dryland and irrigated components require very different management styles, sets of skills and expectations of performance, with resulting complication for those in charge of DSL. This is in contrast to Southland where the MP and DSL are often very similar both in performance and the type of knowledge required for success.

Dryland either limits or creates options depending on how it is set up and what farmers attempt to do with it. For example, Farmer 1F believed that although options were limited with dryland, it still made a positive contribution to the system because it was acquired and managed at a low cost and gave him a lot of flexibility with feeding and stocking rates on the MP area.

Farmers that used dryland DSL believed that they were able use it in a sustainable way as long as they had some means to compensate for the unpredictable production; in several cases, forage or silage crops were used to manage the unpredictability of dryland DSL:

> *'It was a very run down sheep farm, we've gone through a lot of dryness so it doesn't look all that flash, but we have taken off some big crops of whole crop and in the 13 months we've grown 28 ton on dryland, which is quite unbelieveable.' [2B]*

In cases where the strategic decision maker had not found a way to manage unpredictability, an unsustainable situation resulted:

> *'The year when there was no feed at the runoff it certainly was down, no one had feed… That went back to a dry autumn, again a reason to come to an irrigated runoff; you can guarantee your feeding.' [1C]*

The flexibility that dryland offered was mentioned as an advantage by other farmers, however this was only in situations where the dryland was adjacent to a larger intensively farmed irrigated area:

> *'It adds flexibility and we think this is only a gut feeling that this dryland (and it's easy for us because we rent this at a low price), economically that this is quite beneficial to us. So having some dryland is not a bad thing.' [1A]*

It is notable that six out of seven dryland DSL areas were complimented by equal or larger areas of irrigated DSL which helped spread risk and created synergies. The adjacent situation meant that DSL complimented the MP (or intensive irrigated DSL) at crucial times. Advantages included availability and utilisation of feed or protecting valuable intensive grazing areas during weather events:

> *'By standoff and by spreading the load and so forth, during rain events we will stand them off on dryland… thus preventing soil damage…' [1A]*

Summary of Section 5.3.3

- The inherent unpredictability of dryland needs to be managed.
- Dryland is more likely to be sustainable if it compliments the dairy farm in some way.
- In most cases dryland blocks adjacent to intensive irrigated areas are more likely to be economically effective.

5.3.4 DSL on heavy and light soils

Theoretical Proposition: To be sustainable, DSL should be on light, free-draining soils that can easily support winter cow grazing. Rival Explanation: Under the right circumstances heavy soils can be sustainable as DSL.

Farmers prefer light, free draining soils for use as DSL, but it appears sustainability can be achieved with heavier soil types as well. All soils must be managed properly and resourced well to prevent damage to soil structure or nutrient runoff.

Soil types and sustainability

There was evidence that light, free draining soils were more appropriate for DSL and easier to manage when wintering cows:

'The soil type creates advantages in that it is a very light soil and I bought it for wintering dairy cows… I specifically targeted light, free-draining soils when I was looking for a runoff.' [1B]

Although light soils are easier to manage, heavy soils can be economically and environmentally sustainable as DSL if they are managed properly. On heavy soil types in Southland for example, it appeared that tile drains were important to keep soils dry and practices such as back-fencing and careful use of machinery helped prevent excessive pugging at the time of grazing. Following winter, heavy soils will require careful renovation and cultivation at the right time to maintain and improve rather than further damage soil structure.

It appears that light soils also require careful management in winter to avoid economic losses and environmental impacts. On light soils in Canterbury for example:

'A lot of Eyres and Lismores with some areas of Chertseys and Templetons running through it. Chertseys are good for crops. All of these soils need to be carefully looked after in wet weather.' [1A]

In some places, having heavy soils on DSL was actually seen as a benefit. For example in Northern Southland, a mixture of light and heavy soils was seen as an advantage, because it made it easier and cheaper to supply feed all year round:

'It's quite good you have three types to work with which makes it a lot easier.' [3D]

Although farmers were successful with a wide variety of soil types, there was anecdotal evidence that in some parts of Southern Southland, there were soils that were not suitable for wintering cows.[2]

'There are some soils you can't winter cows on… heavier soils down Edendale way…'[4B]

Soil types and practice

[2] Following the collection of anecdotal evidence of regional differences, we attempted to find case study sites in Southern Southland. We met with limited success as most farmers we contacted had ceased DSL farming and had chosen to graze their cows with graziers over winter.

Whatever the soil type, success depends on adequate resources to ensure key activities are planned and carried out at the right time. Planning, doing things at the right time and a high level of awareness were all important to success with soil management:

'…when it comes to early spring, we go in with a big grubber and grub it when it's quite wet, let the air into, to let the water drain away…Then we plough it, but you never plough it unless it's dry. I am a great fan of ploughing, but if you plough it when it's wet, you are ploughing that stinking stuff under, it will just stay there, it won't dry out, and then you might have some dry soil that you ploughed up and put on the top, but if it's wet underneath, and then you plant barley on it, the barley will near enough die out… the barley is a crop; any cereal crop will tell you how healthy your soil is.' [4A]

Resources that might be applied to prevent soil damage include having appropriate stock water systems, drainage and minimizing the use of machinery over winter (having the right machinery).

Silage wagons and tractors need to be of an appropriate size to avoid unnecessary trips across the paddock…

I had one sharemilker last year who had not the right machinery, he arrived with a tractor that was about 40 years old, completely incapable of doing the job of feeding out silage to cows on that property in the wintertime. He had a silage wagon that was far too small, and he was making far too many trips backwards and forwards, backwards and forwards… and he absolutely hammered the ground, and it wasn't the cows that were doing it, he was doing backfencing, he was doing a good job that way, but his machinery was completely… inadequate.' [4A]

…and balage can be organised so that the tractor only needs to go on every few days:

'The bales are all sitting the year and (name) the tractor driver will set bales out where I want them 4 or 5 days in advance, so they are all there.' [4B]

As with DSL in other locations, the right developments are necessary to ensure DSL reached full potential at the same time as environmental impacts are controlled. Appropriate stock water systems seem to be helpful:

**Observed sheep farm-style trough, has obviously been leaking for some days as water has partially flooded the paddock... 'Yeah it must have been leaking for days, like the bloody paddock is really, really wet, it's just a dog basically. They are going to have to keep an eye on those troughs when they are shifting them.' [3E]*

Good drainage systems appear to be very effective in enhancing the sustainability of DSL on certain heavy soils in Southland:

'We grew a crop of Kale in here before it was drained properly and it didn't grow all that good a crop, so we drained it then put another crop of kale in it, the second crop… was far superior to the first crop; normally it's the other way around. Now this has been mole drained.' [4A]

Problems resulted where the DSL had not been fully developed or resourced:

*'Pretty wet in there.' (Plates 1 & 2: Mud1 and Mud2) *Observed extensive mud and pugging on post-grazed crop. [4B]*

Summary of Section 5.3.4

- With good practice, most soil types can be used for intensive winter grazing.
- Some soils in Southern Southland appear to be unsuitable for wintering cows and therefore of limited use as DSL.
- All DSL units, whatever the soil type need to be managed and resourced properly for sustainability to be achieved.

5.3.5 Scale

Theoretical Proposition: In considering appropriate management practice on DSL it is important to consider the absolute scale of the overall system.
Rival Explanation: Relative scale is a more important determinant of the appropriate approach to DSL sustainability than absolute scale.

Scale relative to the MP is a key determinant of how DSL is used and managed while absolute scale is not. While relative scale is not critical to the sustainability of the DSL or what is done with it, it does to some extent determine how the DSL is managed or the vulnerabilities that occur. Relative scale will also determine the enterprises that are carried out on the DSL with priority given to wintering dairy cows, an enterprise that is critical to MP production and profitability.

Absolute scale does not appear to be a key factor in either land use or the overall sustainability of the system:

'If it was twice the size, it would be the same, it's your management and how you operate it really. It's about control rather than size. It wouldn't matter how big you were, your stock would still be behind wires. You would control the same way, your grazing management would be the same.' [1B]

In absolute terms, small DSL units suffer from the same problems and constraints of lack of resources and management overwork as small units.

'Instead of growing 80 acres we were growing 160, 150 acres. Certainly at certain times of year, getting ground ready and getting crops in there was more pressure put on… You might not have that weekend off, instead of 2 days on the tractor doing ridging, you might have 5 days or something.' [4C]

Absolute scale may relate to appropriate management structures:

'My personal opinion is that farms with big runoffs should have a runoff manager, they should have a separate person in charge of the runoff and not expect the dairy farm manager to run everything.' [1F]

Although absolute scale is not related to the sustainability of DSL enterprises, there was a perception that with large dairy farm systems, it becomes difficult and dangerous to rely on the market for all support services or even to manage feed shortfalls and that these systems may have more of a driver to include DSL:

'If we suddenly lost this and we had to go find winter grazing for 3000 cows, that would be extremely difficult, whereas if we had only 500 cows, you'd find a hole somewhere, spread them round or whatever.' [1A]

Case Study Site 3E illustrated the similarities and differences between large scale and small scale systems:

Case example: Absolute Scale is Not a Key Variable

Farm 3E is a large scale, dispersed dairy support and dairy system wintering 6000 cows equivalents made up of 2200 of the farm's own cows, 2000 cows belonging to other farmers, 1000 bulls as well as young stock equivalent to 800 cows. The farm is undergoing continuous development and expansion with new DSL areas being purchased or leased as opportunities arise. This case study site was interesting because of the focus on pragmatic business growth, integration of the various classes of stock and the involvement of DSL in acquisition of or

breaking in run down or undeveloped farms.

Despite being much larger than other DSL systems in the study, the fundamentals of practice are the same. The key driver of DSL management is control of feed supply and there is the same need to fully resource the system and plan well to achieve success. The rapid growth, large scale and dispersed nature of the individual blocks demand simple but effective management systems. The main priority is ensuring that all grass is utilized at the right time and
that animals are well fed while minimizing costs. There is no separate accounting of costs for the DSL and MP components.

Case 3E illustrated how large systems can take advantage of business growth opportunities and may be more accepting of or less vulnerable to risk compared to smaller farms. They are also able to achieve economies of scale with rural services such as contractors, consultants and fertilizer companies. With large systems the exposure to external factors and thus the driver to include DSL may be more acute.

Summary of Section 5.3.5

- Absolute scale does not appear to have a major effect on the way farmers perceive sustainability or use of DSL and relative scale, not climatic conditions or soil type is the key determinant of how DSL is used.

- It appears that large systems may have a greater driver to acquire DSL in an attempt to manage external factors.

5.3.6 Comparison of grass based and forage crop based systems

Theoretical Proposition: Forage crops hinder economic, environmental and social sustainability.
Rival Explanation: Forage crops enhance economic, environmental and social sustainability.

Although farmers favour wintering on grass, forage crops allow them to winter more cows on a smaller area and helped manage the risk of being unable to grow and transfer enough feed to fully feed cows in winter.

The relative viability of crop or grass based systems depended on local conditions. On dryland Canterbury DSL for example, it does not seem to be viable to rely on grass for winter feed, while in parts of Northern Southland, the summer dry means that it can be very difficult to grow good crops and that grass may be a better option for winter feed:

'Well basically in November it just blows like buggery up here eh. And that's when you're trying to do all your cultivation you see trying to get your Swedes in. You're losing all your topsoil at the same time.' [3A]

Any wintering method can result in negative environmental impacts such as soil damage or runoff to waterways. Grazing management over winter and developments such as drainage were a more important determinant of impacts on the soils than the kind of forage involved. For example on pasture near a self-feed silage stack:

'This paddock will have to be re-done. I just don't know what we'll do with it next, because we can't do it here again, it's too destructive, we might be able to do it for another year' (Plates 4 & 5: Self Fed Stack 1-2) [3B]

Grass wintering and sustainability

The advantages of wintering on grass are improved control of feeding, the ability to avoid diet changes and possibly enhanced spring production. Secondary advantages include simpler management, cost savings and synergies with other enterprises such as youngstock grazing and silage making.

It appears that all grass DSL units require less input of resources and management time than systems that involve forage crops…

'There are no crops. Because I've got other kinds of stock here, heifers and so on, the amount of time that the ground is out for. A mob of 200 heifers at 7 bucks a week and then in 25 days I do it again, if put in a crop I can't, its out for five months maybe longer. I winter my cows on there for 30 days, well if you work out your sums, you're better off to run your grazers through it, plus its easier to manage and most of the pastures are all new and while I was toying with the idea of putting it into permanent crop, it's just as easy to put it into permanent pasture again.' [1B]

…there may also be improved synergies with other enterprises:

'I think that in the end it is better for me to do all grass because I have the area already for the beef… and uh I make silage again. I think it works, I do not have to shift them twice a day, I don't have hassles with the other feed.' [2C]

Another advantage of using grass is that it appears to be easy to make objective measurements of how much cows are being fed:

*'…if you get a drought at the wrong time, you'll only grow a 7 to 8 ton crop and everyone will say; 'there's 10 tons in there' well it's not it's a load of s***, they are normally 2-4 ton lighter than what everyone reckons.' [3A]*

An all-grass diet avoids the need to do a feed transition, which is better for cow health:

'No nitrate hassles or crop problems because I use grass.' [1B]

There may also be ongoing benefits in terms of improved cow production in spring, however it is unclear whether the reported enhanced production is due to improved cow health or the high level of utilization and control of feeding that occurs with cows strip grazed on grass:

The first year we increased spring production by 24 per cent on the previous season, the second season I fine tuned it and we did it better and we did 24 per cent more again and then last season we cocked it up and we run short of feast which was our late winter feed and I started getting skinny cows and we dropped by 30 per cent. That's a real major.' [3A]

Grass systems are also more exposed to the inherent variability of dryland, with the potential for feed deficits and liabilities for the whole system:

'Even though it's very lightly stocked, it puts a lot of pressure on the whole system because all of a sudden you've stopped growing grass.' [2B]

Grass wintering and practice.

Ideally all-grass systems are irrigated, thus mitigating the risk of relying on one type of forage for winter feed. Irrigation will also allow maximum control over pasture growth and pasture quality. Grass wintering is likely to involve other enterprises such as youngstock grazing or bull beef which need to be integrated with the overall system.

It appears to be important to offer high quality feed to the end of winter and it may be necessary to select grass species accordingly:

'You've gotta have a real high energy feed going into them late in winter because the calves so big and the stomach's so small, they've gotta eat high energy so they don't basically go skinny. And when they go skinny they go skinny from the inside out. You'll turn up one day and they'll just be toastracks. And that just turns into hell. So that's why I've sown all this out in Feast.' [3A]

Forage crops and sustainability

Forage crops facilitate the transfer of large amounts of high quality feed to winter and give an improved risk profile relative to all grass systems. The main difficulties with crops are the costs involved and dietary issues that can occur with cows:

With forage crops, the system will have two sources of forage to provide winter feed, with two distinct critical times (establishment for forage crops and autumn for grass).

With the involvement of crops there will be more feed carried through to winter…

'This is dryland kale and we've done quite a lot of dryland kale over here, we get at least an eight ton crop each time, no matter how dry it gets'. [2B]

…improved risk management…

'…trouble is, we get an autumn that you can't count on sometimes, if you knew you were going to be growing 50 (kg drymatter) a day through March-April, you could set it up quite easily to winter on grass, but you can't count on it and if you don't get it you will be forced to be grazing some off.' [3C]

…and an improved ability to manage grazing in winter:

'Cropping proved to us that in the most adverse winter we could get through and up the ante.' [1A]

Forage crops and practice

For success with crops, measures must be taken to maximize crop yields and to minimize the impact of cows on the soil.

Timing of implementation and attention to detail appear to be crucial because of the sensitivity of crop yields to crop preparation tasks. Crop preparation tasks need to be carried out properly and at the right time to maximize yields and utilisation…

> *'The swedes are all ridged… the drill moulds up the soil, the lighter sowing rate, it keeps them… it is condusive to growing bigger swedes which cows do utilise better than a whole lot of wee dudes. They don't waste as many by standing on them. With ridging them you do get better utilisation, you are normally guaranteed at least an average crop… it's a more reliable way of growing swedes.' [4C]*

…or to avoid losses:

> *'Oh, I reckon probably 6-7 ton and it was shaping up to be 12 ton… because I know that paddock, we didn't get it right, we were running late probably and put disks through it, and didn't plough that one, that was the last paddock we ate off last winter and the contractor had been, he had ploughed it all and then gone.' [3D]*

It appeared that with good practice, forage crops can be grazed in a range of situations while avoiding mud, soil runoff and damaged soil structure. Practices such as proper drainage, small mob sizes, back-fencing and using machinery appropriate for the situation all appeared to be effective in reducing the amount of mud:

> *'This is where cows have been wintered, there's been a lot of back fences put up there and that ground there is absolutely spot on. No problems whatsoever… you don't see a whole lot of tracks there from machinery, we use silage, not balage, but he uses fairly big machinery to pull the silage around. You can see he's got back fences up. (Plate 7: Post Grazing).' *Observed the post-grazed soil to have an appearance and texture as if it had been lightly cultivated rather than pugged. [4A]*

Summary of Section 5.3.6

- Wintering on grass is believed to be better for animal health, is easier to manage and fits better with other enterprises such as grazing young stock and beef. But it only works financially if production from grass approaches that of an equivalent area of forage crops in the same conditions.

- Forage crops help manage risk. Exceptions to this were a DSL unit in an area where early summer conditions make crop establishment difficult (Case 3A) and 100 per cent irrigated DSL where there is complete control over pasture growth (Cases 1A and 2C).

- Undesirable environmental impacts or production losses can occur under any wintering regime if soils and covers are not managed well

5.3.7 Comparison of DSL in Canterbury vs DSL in Northern Southland

Theoretical Proposition: Differences in climate and intensity mean that the fundamental issues of DSL sustainability vary between Southland and Canterbury. Rival Explanation: Despite differences in climate and intensity, the basic issues of sustainable farming of DSL and fundamentals of good practice are the same in Southland and Canterbury.

There was little evidence of differences in how farmers perceived sustainability and ideas of appropriate practice between Southland and Canterbury. The fundamental issues of sustainability and the type of practices required remained consistent across both areas. Those differences that were apparent related to rainfall, soil type, environmental concerns and intensity of production.

In both regions, farmers tended to measure the success of DSL (or new practices on DSL) in terms of the amount of feed they could grow. Resources and planning appeared to be essential to success at all of the case study sites. Furthermore, systemic issues were the same; both regions included case study sites where management overwork had led to problems, where DSL could either aggravate or help alleviate staff problems and farmers in both regions saw that the public perception of dairy farmers was driving increases in compliance costs.

Growing feed was the primary consideration both in Canterbury…

> *'Basically the most important thing on the runoff is getting winter feed crops in early enough that they get a chance to establish with the limited irrigation we've got here and the other (thing) is putting the right fertiliser on in the Autumn so we can build up our covers on the other end of the farm so we've got grass going into the winter… because feed is quite precious in the Winter. [1E]*

… and Southland:

> *'The crop didn't really perform how we wanted it to. It just didn't grow and it is only on average an 11 ton crop, which for round here is below average… Like (owners name) was achieving very high yields on (the previous DSL unit) of up to 20 ton. So if we can do that on this farm we can carry so many more cows and it turns out to be cost effective.' [4B]*

The main observable difference between Canterbury and Southland was one of intensity, with Southland dairy farms of relatively lower intensity than Canterbury dairy farms. This difference has the consequence of a decreased need for feed inputs and possibly a reduced exposure to the feed market in Southland. In Southland, lower overall intensity means the goal of DSL management related to efficiency; that all grass is utilized, that stock do not go short of feed and costs of feeding supplements are minimized. In Canterbury, the higher intensity of the MP means that there is also a strong driver to control the cost of support services.

***S*ummary of Section 5.3.7**

- In both Canterbury and Southland, amount of feed grown is the driver of success.
- Canterbury dairy systems are relatively more intensive than Southland systems, controlling costs and protecting MP production are the key drivers in both regions.

5.3.8 DSL in Southern Southland

Theoretical Proposition: It is very difficult to resolve environmental and commercial drivers with DSL in southern Southland.
Rival Explanation: With appropriate soil management, development, practices or land use it is possible to resolve environmental and commercial drivers on DSL in southern Southland.

After targeted investigation in southern Southland it became apparent that as with the comparison between Canterbury and Southland, factors besides geographic location were more important in determining appropriate land use or practice in any given situation. Heavier soils might require different development or management techniques but ultimately, as with DSL at all of the case study sites, sustainable management of DSL begins with a willingness to expend the resources necessary to ensure key tasks are done as planned and on time, that necessary developments are carried out and that staff and management are not overburdened.

There were some difficulties locating case study sites in the Southern Part of Southland with the result that only two case study sites (case 4A and case 4B) were included. The reason for a lack of case study sites was that several of the farmers suggested as being successful with DSL had converted DSL to MP production. It is also notable that DSL was being converted to MP at case studies 4A and 4B.

Summary of Section 5.3.8

- Although it is possible to achieve sustainable outcomes with DSL in southern Southland, the tendency for farmers to convert DSL to MP suggests that the best economic use of land in this region may be milk production.

Chapter 6
Summary and Conclusions

6.1 Perceptions of sustainability

The first objective of the study was to examine how DSL farmers think about sustainability issues. Sustainability is a broad concept with a range of interpretations and it became evident in the initial stages that 'sustainability' is too imprecise a term to describe the way that farmers think about the role of DSL. To manage the various interpretations or aspects of sustainability, the topic is framed in two ways; by division into the elements of economic, environmental and social sustainability, and by investigating attitudes to sustainability issues internal and external to the farm system.

The decision to acquire DSL is an economic one driven by the need to control external factors that threaten profitability. Farmers use DSL to manage variations in the feed market and the cost of grazing off, to control cow feeding and cow condition over winter, and to protect the vulnerable MP pastures in winter or spring. DSL may also be used to support complementary enterprises such as grazing replacements, silage production and dairy beef.

In the literature review and in the focus groups, rural professionals were critical of the view that DSL was the best way to manage external factors. The rural professionals also believed that farmers often had insufficient knowledge of the financial performance of DSL focusing only on the feed they could grow, but not how much it cost to do so in real terms. Other options such as grazing off or buying in feed may be just as effective, be less costly and put less pressure on staff and management. While this study did not determine that control of DSL is the best way to manage externalities, the dairy farmers interviewed believed that dairy farms are highly exposed to external factors, and that containing them requires substantial investment of money, time and other resources.

Those interviewed believed that feed grown is the most appropriate measure of DSL performance because it determines how effective the DSL will be in protecting the dairy farm from externalities. Even in cases where the DSL was run as a separate business with commercial drivers in place, the success of this practice was indicated by increased feed production and the ability to winter relatively larger numbers of cows, (while controlling costs). Furthermore, in cases where DSL had been less effective at managing risk (Case 1D and Case 4B for example), the primary indicator for such an event was poor crop yields, poor pasture production, or under-feeding of cows, not financial loss.

In some cases, specific needs drove the decision to acquire DSL. Perceived specific needs included the need to protect sensitive soils on dairy farms with heavy soils, and the need of winter milk farmers to graze dry cows for four to five months each year and to import large amounts of supplements.

Most of those interviewed believed that it was possible to use DSL in an environmentally sustainable manner and that it was reasonable to expect farmers to achieve this. The interviewees were interested in environmental issues that had a scientific basis and solutions that were affordable or could be brought into line with economic drivers. There was also a belief that not enough was known about the environmental impacts of DSL as well as some concern of the apparent willingness of local authorities to enact controls on the basis of incomplete knowledge. The credibility of the dairy industry was also an issue, with the actions of a few harming the image of all dairy farmers. Several farmers saw public pressure and compliance costs as long-term threats that needed to be addressed.

The addition of DSL may introduce social vulnerabilities as the system becomes larger and more dispersed and it becomes difficult to supervise staff all the time. Managers may also be over-extended as they have to manage both the dairy farm and DSL at the same time. On the other hand the DSL may create opportunities for increased job variety or responsibility for staff. In other words the addition of DSL will complicate staff management, but farms with DSL may also be more attractive to staff who want to learn and progress in the industry.

Since the primary role of DSL is to protect the profitability of the dairy farm, the sustainability of the DSL will be sacrificed in preference to that of the MP. There was evidence at several case study sites that economic, environmental or social aspects of sustainability had been sacrificed to ensure a high-functioning dairy farm business.

6.2 The link between perceptions of sustainability and practice

The second objective of the study was to investigate how DSL farmer's perceptions of sustainability relate to practice.

The goals of DSL management are to enhance the MP while avoiding unsustainable outcomes on the DSL unit. It appears that three main policies need to be in place: The DSL must be adequately resourced, DSL tasks should be planned well, and timing and attention to detail is necessary with key tasks.

In other words, adequate resources, planning, and timing and attention to detail should lead to a reliable supply of feed to the dairy farm without sacrificing the economic, environmental or social sustainability of the DSL, as illustrated in figure 1.

Figure 6.1: The relationship between practice and sustainability

Timing and Attention to Detail   Adequate Resources   Planning

Give control of…

Costs   Feeding   Impacts on Staff and Land

Leading to…

Enhanced MP   Protected DSL

Thus…

A Sustainable Farm System

Adequate Resources, Planning and Timing and Attention to Detail were apparent at all of the case studies, but their relative importance varied from one case study to another. Allocating adequate resources appears to be fundamental to sustainable outcomes with DSL as it is essential to success with other areas of practice.

Adequate resources

Adequate resourcing appears to be the key strategy to ensuring proper function of DSL. Resources are essential to ensure there is adequate machinery and that staff have time to execute DSL tasks properly. Furthermore, developments such as stream protection, drainage, re-grassing and appropriate stock water systems all help ensure a sustainable farm system by enhancing profitability and preventing environmental impacts.

Managers will need to spread their time between the DSL and the dairy farm and in most cases it is highly desirable to delegate responsibility to staff on the dairy farm or DSL. On larger systems there may be sub-managers who are responsible for DSL operations.

Resources extend to time taken to gain knowledge or investigate how to achieve the best results with a particular farm. This kind of analysis requires that the strategic decision maker has time to observe and to think about the positive features of the system and be willing to invest money in consultation or trials.

Under-resourced DSL will almost inevitably fail to perform as management is over-extended, there is insufficient machinery, or a lack of infrastructure developments to ensure the system can function at a high level. There is also likely to be loss of control of feeding with increased pressure on the MP business, uncontrolled environmental impacts, and pressure on staff and management. Since the purpose of DSL is to protect the system from external impacts and relieve pressure on the MP business, a loss of control effectively negates the entire benefit of the DSL enterprise.

Planning

Planning is essential to success with the two key DSL tasks; growing feed and ensuring cows are properly fed over winter. Tasks such as silage cuts and crop establishment, feed budgeting and managing cows all require careful planning if they are to be done well.

Time to plan is a resource with several farmers talking about the time and energy they spend thinking and making plans, as well as the involvement of rural professionals in key tasks such as feed budgeting and crop preparation. It can be difficult to find time to plan and carry out DSL tasks in spring, when silage making and crop establishment have to be carried out at a time when the MP is very busy.

Timing and attention to detail

It appears that timing and attention to detail are essential with certain key tasks such as pasture management, grass grub control, protection of pasture and soils over winter, crop establishment, fertiliser application and silage cuts. If these tasks are not carried out in the right way at the right time there are very likely to be direct economic impacts as reduced yields need to be compensated for by bought in feed or grazing off. For example at one case study site, poor timing at crop establishment resulted in what was intended to be a 20 ton forage crop becoming an eight ton crop. As a result, large numbers of cows had to be grazed off and the farmers had to pay both the cost of leasing DSL and grazing fees, with secondary costs as the inability to control cow feeding resulted in lower than usual cow condition in spring.

As well as having economic consequences, failure to carry out tasks at the right time may result in environmental impacts as additional fertiliser or sprays are used to ‘catch up’, or nutrient runoff as paddocks are cultivated or fertiliser is applied at the wrong time.

Other aspects of practice

Other aspects of practice that were less critical or else disputed or not universally apparent included:

- Having a high level of familiarity and awareness of the current state of their system
- Using graziers to provide some support services
- Actively managing external relationships
- Transition feeding to manage the dietary change onto forage crops
- Using DSL to manage inductions
- Acting to bring economic and environmental drivers into line

Farm owners who ran DSL believed they were familiar enough with their DSL and were on the land often enough that monitoring was not necessary. They were however highly aware of their systems and often knew *'where every blade of grass is.'* [1B]. Monitoring was favoured on systems with professional managers who may not be fully familiar with the system.

There were number of farmers who had been successful in using graziers to winter cows in the past. Achieving success with graziers was a matter of communication and involvement and it is important to make sure the grazier can grow enough feed to fulfil their contract and to ensure cows are fed properly. The only way to do this is to visit the grazier's farm frequently and to go there once a week when cows are grazed off. It is also important to attempt to understand things from the graziers perspective and to *'take the good with the bad.'* [3D].

Relationships with the community were reported to be very helpful in acquiring a block of land suitable for use as DSL. This is particularly the case with leased DSL units where good relationships help secure an appropriate lease block and lead to the kind of lease agreement that allows the DSL to be properly developed. Several of those interviewed believed that it was worthwhile to invest time and effort in *'being neighbourly'* [2A] even though there may not be any tangible benefit in doing so.

Some farmers were convinced that transition feeding was necessary to avoid problems with the dietary change onto forage crop, while others believed that transition feeding was not always helpful, especially with kale. The lack of consensus over the value of doing a transition feed indicated a lack of knowledge in this area and a possible avenue of future research.

Some farmers saw induction as essential if fertility and wasted animals were to be kept to acceptable levels, while others believed that the ability to ensure cows are fed properly and to carry over dry cows mean that the DSL enables them to avoid induction.

There were a number of farmers who saw that economically sustainable practice was often aligned with environmentally sustainable practice; installing stock water systems or avoiding treading damage for example. Those interviewed welcomed practices that bring environmental drivers and economic drivers into line and believed that they should be a focus of extension by universities, regional councils and industry organizations.

6.3 The various types of DSL

The third objective of this study was to examine perceptions of sustainability and practice across various types of DSL. Investigating different types of DSL with the same set of proposition dyads (initial theory) is a way of examining the same problem from different perspectives. Although there was a lack of apparent differences across the various types of DSL (with the exception of leased DSL), examining DSL from a variety of perspectives or categories was beneficial because it enhanced the integrity of the central inferences of the study; that external conditions need to be managed and that resources must be applied in a planned and controlled manner to deal with them.

Categories of DSL examined included:

- Leased DSL
- Adjacent DSL
- Dryland DSL (in Canterbury)
- DSL on heavy and light soils
- Scale
- DSL with and without forage crops
- DSL in Canterbury and Southland
- DSL in southern Southland

Leased DSL

11 of 17 farmers interviewed had at least some involvement with leased DSL. The advantage of leasing is that it allows control at a lower cost than owning land. The disadvantage is that there may be disagreement over who pays for developments on the DSL, or a lack of will to do developments, with the result that the DSL unit does not reach potential or that environmentally focussed developments are not done.

Adjacent DSL

Adjacent DSL areas were valued because of the ability to capture cost savings by strategic grazing of MP cows instead of feeding supplements and the ability to protect the MP at key times. Most of the adjacent DSL areas were either leased or part of an ongoing program of development or expansion of the MP. Small or low intensity DSL areas can be effective in situations where a detached DSL unit would not be. At two case study sites (1E and 1F), farmers used small, adjacent DSL areas to control cow condition, do some wintering and to save costs. Even though these areas were small (relative to the MP), they gave control and allowed the farmer to manage the risk of using outside parties to supply support services.

Dryland DSL in Canterbury

Dryland DSL is lower in intensity and more variable than irrigated DSL, but costs of ownership/lease are low. It is important to be sensible and have flexibility with dryland. The case study interviews indicated that dryland DSL units are most effective when they are adjacent to intensive (irrigated) areas. For example at Case Study Site 1F, a dryland DSL unit created cost savings and flexibility on the dairy farm for relatively low inputs of capital, management time and other farm resources.

DSL on heavy and light soils

Farmers prefer light, free draining soils for use as DSL, although it appears sustainability can be achieved with heavier soil types as well. Several farmers reported they had chosen land some distance from the MP because it had light soils that were suited to milking cows, which suggests that soil type is more of a driver of selection of land for DSL than proximity. All soil types must be managed properly to prevent soil damage and nutrient runoff.

Scale

While absolute scale is not a key determinant of appropriate enterprises and practice on DSL, scale relative to the MP is important. Relative scale, not climatic conditions or soil types is the key determinant of the enterprises that are carried out on the MP with priority given to wintering dairy cows.

DSL with and without forage crops

Farmers favour wintering on grass as it is less work and better for cow health, however forage crops give better economic performance as they allow DSL farmers to winter more cows on a smaller area and help manage the risk of being unable to grow and transfer enough feed to achieve a sustainable farm system.

There were four case study sites where farmers were committed to an all-grass system (1B, 1F, 2C, 3A). Each of the all-grass systems was on very light soils or in situations that were not optimal for growing forage crops, which meant that the annual production of a given area of pasture approached or exceeded that of forage crops. They were also personally overseen by the farm owner, with the owner doing much of the work.

DSL in Canterbury and Southland

Although there is some difference in the types of environmental concerns and intensity of production, overall attitudes to sustainability, business goals and strategies for achieving success with DSL appeared to be very similar between Canterbury and Southland. In both regions farmers tended to measure the success of DSL (or new practices) in terms of the amount of feed they could grow, and resources and planning appeared to be essential to success on all DSL blocks. Systemic issues were also similar; both regions included case study sites where management overwork had led to problems, where staff was an issue that DSL could either aggravate or control, and where the poor public perception of dairy farmers and the threat of rising compliance costs were mentioned as a key concern.

DSL in Southern Southland

Although it is possible to achieve sustainable outcomes with DSL in southern Southland, the tendency for farmers to convert DSL to dairy farms suggests that the best economic use of land in this region is milk production, not DSL.

6.4 Conclusion

DSL is one way of managing some of the external risks that dairy farmers are exposed to. Whatever means are used to manage external factors, time and money must be invested in risk management for the dairy farming system to be sustainable.

All of those interviewed believed that they were successful in using DSL to control external risks such as underfeeding of cows over winter and high costs of bought in support services. The farmers believed that environmental risks on DSL can be contained, however the inclusion of DSL often creates social issues that require active management.

Feed grown is the most effective measure of DSL performance as feed grown, not financial returns, determines the effectiveness of DSL in protecting the MP from external factors.

To successfully manage production risk while avoiding undesirable impacts on staff, management or the physical environment, specific policies need to be in place. The DSL must be well-resourced, there must be good planning, and timing and attention to detail is essential to success with key tasks.

There are a wide variety of DSL situations, but the fundamentals remain constant, and the same concept of sustainability and practice applies across all types of DSL, regardless of location or local conditions.

6.5 Implications of the research

This research has gathered a wide range of ideas and examples of good practice that other farmers will be able to use to improve their DSL systems. While the results cannot be generalized to form 'best practice guidelines', a range of insights have been generated and presented in a form that is useful to anyone with an involvement in DSL systems. Thus, it is hoped that the case studies presented here will enable farmers to more effectively identify and manage external factors.

The project also generated ideas for further research, these include:

- Investigation into the costs and benefits of using forage crops or grass, particularly the relationship between winter diet and spring production.

- The role of DSL in managing external social factors. Examples include the use of DSL to attract good staff and managing water restrictions by strategic use of summer crops on DSL.

- The importance of DSL in induction-free dairy systems. It appears that the improved control of feeding and ability to graze carry over cows means that DSL is helpful in managing without inductions.

- Achieving reliable results with graziers. There is evidence that DSL may not be necessary if relationships with graziers are managed well and that it may be cheaper to manage external factors by investing time and money in graziers than in DSL.

- The necessity of doing transition feeding from grass to crops. There was conflicting evidence over the value of doing transition feeding (a gradual dietary change from crops to grass), with some farmers claiming to achieve sustainable outcomes with no transition feeding and others of the view that transition feeding was essential to maintain cow health.

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Appendix A
The Case Study Protocol

1. Statement of Purpose

Examining DSL from the perspective of farmers; how they use DSL to enhance the sustainability of their systems, what they think needs to be done to achieve success and the issues that (even successful farmers) struggle with, will create an improved understanding of DSL management. By drawing a theory from the experiences and perceptions of farmers, it is hoped that this project will help create a more balanced and rigorous understanding of the sustainability of dairy farm systems that include DSL.

2. Research Questions

1. What are the perceptions of sustainability of DSL farmers who achieve business, environmental and social goals?

2. How do perceptions of sustainability of DSL farmers who achieve business, environmental and social goals relate to practice at the case study site?

3. How do perceptions of sustainability and practice vary across groupings or regions?

3. Field Procedures

3.1 Preparation

Farmers are to be contacted a total of three times. Initially, they will be contacted by phone to determine if they can participate and in which week they will be available, followed by a call a few days before to fix a date and time and finally a call the night before to ensure that they are still available.

Once farmers agree to participate in interviews, they will be sent a copy of the information sheet and consent form.

An 'interview bag' is to be prepared that contains all of the items needed during data collection, the contents of this bag are to be checked prior to each case study. The bag contains: a good road atlas, a notebook containing farmer's contact details and directions to farm, a voice recorder, spare batteries, a digital camera, copies of the case study protocol, information sheet and consent form and a notebook for writing down impressions or observations.

3.2 Carrying out the Interview

The interview is combined with a farm walk as it allows an opportunity to compare what the farmer is saying with what is actually observed.

During winter, most farmers check and administer stock related tasks on the DSL in the morning and it is preferable if the interview can be carried out during this time.

Accompanying the farmer as they work on the DSL provides a valuable opportunity to observe the farmer interacting with staff and/or with stock and to gain an understanding of how actions are carried out or controlled in the context of wider strategic goals.

Before doing the farm walk, it is a good idea to ask the farmer if they have documents or archival records that are relevant to or illustrative of the way they use DSL. Appropriate documents may include: farm maps, winter feed budgets and feed plans, consultancy reports, soil test reports and nutrient budgets and records of milk solids production on the dairy farm. It is better to ask about documents at the start of the interview as there will be less time pressure and talking about farm maps and records often works well as an ice-breaker.

A good way to begin the interview is to ask the farmer to give a general introduction of the DSL (runoff) and the way that it works in with the whole system.

3.3 The Units of Analysis

The unit of analysis is the dairy farming system.

The sub-units of analysis are the interviewee and the DSL unit(s).

3.4 After the Interview

After each interview it is necessary to spend several hours writing down impressions, listening to the interview and putting key pieces of evidence into context.

Consider the propositions in light of the just-completed interview: Are they descriptive enough? Do they provide an investigatory framework that was sufficient for full coverage at the case study site? If not, then the propositions (and the interview guide) require careful modification before the next interview.

Once each series of interviews is completed, a case description will be written up and the interview will be coded. At a later date, the case description and interview data that was coded (i.e. those fragments of the interview that are considered significant and therefore used as evidence in the discussion) are sent to the interviewee so that they have an opportunity to discuss or critique any comments that were made.

4. The Interview Guide

4.1 Verbal Statement of Purpose

Verbal clarification of what was wanted from the farmer was often necessary. This was in addition to a printed statement of purpose that had already been sent to the farmer prior to the interview:

'…this series of interviews is about talking to people who do well with their runoffs, who achieve their goals and enhance their dairy farms. But also what issues come up when people add a runoff to their system and some people do very well and some people sort of go to pieces. And what we are trying to do is talk to people who do well at least in terms of what they want to do with their runoff and talking about their experience and how it is for them.'

4.2 Checklist for Observations During Farm Walk

- ❑ Tracks: Condition, appropriateness of material for cows feet, access and layout.
- ❑ Shelter: Species, maintenance.
- ❑ Fences and Yards: Age and condition, appropriate size, access.
- ❑ Stock Water: Presence or absence of leaks. Appropriate for stock type.
- ❑ Waterway boundaries and crossings: Width, type of cover.
- ❑ Machinery: Condition and function of each.
- ❑ Irrigation: Type, damaged irrigators, banged up gateways, damaged wellheads.
- ❑ Drainage: Presence of surface water or pugging.
- ❑ Pasture: Condition, weeds, grazing residual, presence of mud or pugging.
- ❑ Supplements: Condition, storage situation, proximity to waterways.
- ❑ Crops: Yield, type, weeds, utilization.
- ❑ Stock: Condition, density, behavior, health.

4.3 Overview

How many runoff blocks are there in the system now?

- ❑ Number:
- ❑ Effective Area:

How many dairy farms do they support?

- ❑ Number of farms and effective area:
- ❑ Cows:
- ❑ How productive is the dairy farm?

For this block:

- ❑ Effective area:
- ❑ Proportion of leased land to owned land:
- ❑ Distance to the milking platform:
- ❑ Area of milking platform:
- ❑ Physical Aspects:

- Winter Temperature:
- Summer Temperature:
- Rainfall:
- Altitude:
- Topography:
- Streams:
- Major soil types:
- Covers: perennial pasture, Italians and crops:
- Stock:

4.4 Specific Areas of Interest

Infrastructure, Development and Maintenance:

- What development has been done?
  Probe: Drainage, Irrigation (What kind and why?)

- What was it like before development?

*Observe and discuss tracks, irrigation systems, fences, water ways, pasture, lanes, yards. Look at farm maps. Look at neighbouring farms.

Getting the Best out of the System:

- What are the positive features of the property?'
- Was it difficult to find a DSL block that suited you?

- What are the ways you use the runoff to boost production or save costs?
- What features of the property are restrictive?

- How productive is the runoff?
- 'How do the various soil types change through the year?'
  Probe: 'What are the implications for management/land use.'

- What is the impact of distance from the MP?
- How would/does being adjacent help you?

- Do you do dairy farm style pasture management? How often do you measure?
- In your view has the DSL reached full potential?

*Observe and discuss pasture (residuals grazed to, amount of feed available, weeds and old pasture, grass grub damage).

Dryland DSL:

- How do you integrate the different kinds of land?
- How do you get the best out of the dryland areas?

**Observe and discuss pasture and crops on dryland areas.*

Enterprises:

- What enterprises are carried out on the runoff?

Specific questions on enterprises: Lets talk about (feed barley) for a minute…

- How do you get the best out of (crops, carryover cows, bull beef, heifers) in your situation?

- What is the winter diet?
- What are the shortcomings of (swedes, heifers)?
- What things do you have to watch when you are doing (heifers)?
- What are some things you can do to grow good quality young stock at a low price?
- How much silage do you make?
- How much is exported to the dairy farm?
- How much silage do you have on hand at the start of winter?
- How do you get good quality silage? What do you do before/after making silage?

- What recent changes have you made in the enterprises you do on the runoff?
- Is there anything you plan to change with the enterprises you do or the way you do things?

Probe: Have you thought about (whole crop silage, like triticale silage?)

*Observe and discuss condition and location of silage stacks, condition and behavior of stock.

Staff and Machinery:

- *Preferably when near machinery* 'Could we have a look at the machinery?' *or* What machinery is there on the runoff?

Probe: How much do you use (that big topper)?

- What do you have to do to prevent problems or conflicts with machinery?
- What is the advantage of (K-line) irrigation? (What are the issues?)

- Who works on DSL over winter?

Probe: How about the rest of the year?

- What do they do there?
- What are your goals with staff management and how is this reflected in what you do?

- How much of your working time is spent dealing with the runoff?
- What else do you do?

Probe: Does this spreading of responsibilities affect how focused you are?

Probe: Has it ever led to you being overworked?

- How long have you been in charge of/managed this farm?

Probe: How is what you do different to what they did?

*Observe and discuss condition of machinery or staffing issues that may exist. If possible observe the interviewee during interactions with staff.

Economic Returns:

- What is the cost of production on the milking platform?

Probe: How much of a factor is involvement of a runoff in achieving this?

- ❑ Could you put a rough value on wintering and other runoff enterprises alone?

Probe: Does this cover the cost of capital?

- ❑ How much is production enhanced by what happens on the runoff?

Probe: What sort of things can you do?
Probe: Extending lactation?

- ❑ How about the value of intangible things like business growth and risk management?
- ❑ How expensive can it get if things don't go well on the runoff?
- ❑ Do you have a separate business structure or separate accounting for the runoff?

- ❑ What sort of timelines have you had with runoff block ownership?
- ❑ How is the runoff land involved with business growth?

*Observe and comment on the level of development and how this relates to the length of time that the DSL has been part of this business.

Leased DSL:

- ❑ How is getting the best out of a leased block different to getting the best out of an owned block?
- ❑ What do you find restrictive?
- ❑ What do you need to get right?
- ❑ Do you think leasing DSL create a commercial driver? Is this useful?

**Observe any features or limitations that might have been addressed if the DSL was owned rather than leased, examples might include: stock water systems, fences, pastures, waterway boundaries or lanes.*

Environmental Sustainability:

- ❑ What do you see as the environmental issues on the farm?
- ❑ What are your goals with environmental practice and how do you achieve them?
- ❑ Have you made changes or done development with environmental protection in mind?
  Probe: "What do you estimate is the cost of this?"
  Probe: (if appropriate) "Do you think that you have you done more than you have to?"
- ❑ Do you use eco-N?

*Observe waterway boundaries.
*Look at nutrient budgets and soil test reports.

Knowledge:

- ❑ How much did you have to learn when you (acquired DSL/started dairy support)
- ❑ What is an area you have gained knowledge about over the past couple of years? What is the process?

- ❑ In relation to farming your runoff, which rural professionals are most/least relevant?

Probe: How do ___ help you?
Probe: Does that mean you are not too worried about your ability to manage ___ ?
**Look at consultancy reports, grazing plans and nutrient budgets.*

Graziers:

- ❑ Do you use graziers? (For what and in what situation?)
- ❑ What do you have to do to make a grazing relationship work?
- ❑ Have you had problems before?
- ❑ Is it better for the dairy farmer or the grazier to do the work?

3.5 Calendar of Events

The calendar of events will at least in part be built up as part of the interview process. Use the following section as a guide to make sure all annual events have been discussed. Leave out questions that have already been addressed in the course of the interview. Finally avoid reference to months unless it is in the question; make the order and flow of questions as natural as possible without interrupting the train of thought of the interviewee.

<u>June:</u>

- ❑ When is drying off?
- ❑ Do you stagger drying off to maximize milk production from each cow?
- ❑ *Probe:* Would you consider it?
- ❑ Could you give a basic description of your wintering system?
- ❑ What are you targets?
- ❑ What and how much do you feed the cows?
- ❑ What do you have to be careful of?
- ❑ *Probe:* How do you manage feed transitions?
- ❑ *Probe:* How about wastage?
- ❑ How do you know how much feed there is in crop and pasture?
- ❑ How do you get the guys on the ground to feed that much?
- ❑ What sort of things sicken cows or kill cows and cause abortions?
- ❑ What do you do to prevent this?
- ❑ How do you fit non-wintering enterprises around the MP cows?

<u>July:</u>

- ❑ How is July different from June?
- ❑ What did you do last winter when it snowed?
- ❑ Has that changed what you are doing this year?
- ❑ How much feed is left over at the end of winter? (How much fat is in the system?)

<u>August:</u>

- ❑ When does calving begin?
- ❑ "Do you give special treatment to underweight cows?" (What do you do?)
- ❑ What is the empty rate?
- ❑ Do you induce?
- ❑ Look at: Farm records. LWG in winter, deaths, empty rates, spring production.
- ❑ Refer to observed variations in records: for example: spring production
- ❑ "What was the cause of this (relatively low or high year)?"
- ❑ "What difficulties did you face and/or overcome in spring?"
- ❑ "(How did that relate to events in winter?)"

<u>September:</u>

- What do you do with the just-grazed forage crops? Deep ripping, re-grassing, summer cereal crops?
- What other cash crops are involved?

October:

- When do you apply fertilizer? (What and how much)
- With the non-wintering enterprises (such as), are there particular times when feed conflicts occur?
- *Probe:* How have you managed this in the past?

November:

- When is silage cut?
- When do the various tractor-work related tasks occur?
- Do you have trouble with weeds?
- What do you spray for?; *fat hen, wild turnip, rape.*
- What else do you do to control weeds?

December:

- "When do you get crops in?"
- "What preparation gets done?" Tillage?
- What do you do on cropping ground after grazing?
- When do calves come on? What kind of care do they need? Who deals with them?
- How do you control how much they are fed?

January:

February:

March:

April:

May:

Finishing up calendar of events:

- When is timing of implementation particularly important on the runoff?

Probe: Has this been a problem in the past?

Probe (Yes): What happened? How do you prevent this happening again?

Probe (No): How do you avoid conflict?

- Apart from wintering, are there particular times of the year when the runoff really works in well with the milking platform?

- What are the keys to success over winter?

- Are there any things that are particularly high maintenance with this system?

3.6 Finishing up the Interview

- On the runoff are there any practices that you think may not be sustainable in future?

- What future events or trends do you expect to change the way you use your runoff?

Probe: What is the story with (___)? (How much do you think it could cost?)

- What are some sustainability issues about which there is a lot of talk, but that you believe will not have a great impact on your situation or the way you do things?

Clarification: I mean things that are smokescreens.

- Do you think that the image of dairy farmers is improving or getting worse? What is the driver for change?

- If you were buying and developing or leasing a runoff again, what would you consider doing differently?

- In terms of having an effective and sustainable runoff, is there anyone else you really admire?

- What do you like about what they do?

- Would I be able to use you as a reference to contact them?

- Is there anything you would like to add?

Appendix B
The Case Descriptions

Four sets of case studies were done.

Case Study 1: DSL in Canterbury

Case Study 2: Further investigation of DSL in Canterbury

Case Study 3: DSL in Northern Southland

Case Study 4: DSL in Southern Southland

In addition to the above divisions, several types of DSL were identified. The major types were:

Systems with leased DSL:	1A, 1C, 1D, 1E, 2A, 3B, 3C, 3E, 4A, 4B, 4C
Systems with adjacent DSL:	1A, 1D, 1E, 1F
Systems with dryland DSL:	1A, 1C, 1D, 1E, 1F, 2A, 2B (Only 1F was all-dryland)
Systems with heavy soils:	1E, 2A, 4A, 4B
Systems that are all-grass:	1B, 1F, 2A, 2C, 3A
Large scale DSL systems (wintering over 800 cows):	1A, 1C, 2B, 3C, 3D, 3E, 4A

B.1 Case Study 1: DSL in Canterbury

B.1.1 Case 1A/Pilot Case Study 1

Farm 1A is a newly developed 440 hectare dairy support unit, adjacent to a former DSL unit currently undergoing conversion to a dairy farm. Once completed this DSL unit will provide winter grazing for 3000 cows and grazing for 300 carry over cows and 2500 calves through the year. Approximately 25 per cent of feed grown is transferred to the dairy farms. The 310 ha irrigated area is on a 5-year rotation with 90ha in kale and 220ha in grass. The 130ha dryland area is in cocksfoot pastures and is not farmed intensively.

The primary activity on the DSL is wintering cows. The winter diet is a 50:50 mix of forage crop/grass and silage with 1260 tons of silage and 1260 tons of grass and crop on hand at the start of winter with 10 days worth of snow reserve silage. Other Enterprises fit in around wintering of cows, with calves sent away in May and silage cuts taken as surpluses occur.

Case 1A was notable in that the system was very well resourced, excellent use was made of leased DSL, and commercial drivers and a separate business structure had been successfully applied.

Perceptions of Sustainability

Economic Sustainability:
Farmer 1A believed that DSL needs to be included in the dairy farming system because graziers cannot be relied on to supply support services. He argued that the difficult winter of 2006 justified the view that it was not sustainable to rely on graziers to supply all support services, when the unwillingness of graziers to allow their own systems to be impacted led to losses on dairy farms:

'We delivered to the dairy farms, we drove the system to do what we had to do.'

Farmer 1A believed that the ability to control external risks was at least as valuable as the direct commercial benefit of enterprises carried out on the MP.

DSL has also facilitated business growth. Acquiring this unit has allowed conversion of an owned DSL into a dairy farm, thus expanding and growing the business.

Environmental Sustainability:
Farmer 1A believed that as long as the DSL system is well-resourced that it is relatively easy to bring environmental drivers in line with economic drivers because acting to avoid economic waste will often minimise environmental impacts as well. Examples of this included:

- Careful management of irrigation to prevent waterlogging and avoid unnecessary expense on electricity and depletion of the aquifer resource.

- Compilation and execution of nutrient budgets to prevent excessive application of fertilizer and minimize nutrient loss.

- The use of dryland areas as fenced standoff areas to maintain control and prevent loss of feed or soil damage during weather events.

The Social Impact of DSL:
Farmer 1A believed that the addition of DSL had potential to introduce difficulties for staff or management with flow on effects in terms of cows not being fed properly or high rates of management turnover.

Practice

The keys to success at Case Study Site 1A are adequate resources, a commercial business structure, careful use of capital, and management of external relationships.

Resources:
Adequate Resources are very important to achieving sustainability with DSL:

> *'In terms of practice we want to make sure that everything is set up right, the people have got good gear to do irrigation well and feed cattle well and do the job to a very high level. We want a sustainable profit. It's the same with our staffing, we carry half a labour unit more than you night be able to get away with so that the thing is sustainable.' [1A]*

Having enough resources is important. There needs to be enough staff and they have to have the right gear to be able to achieve excellence on the DSL and feed stock well.

Support for Staff:
Farmer 1A believed that the concept of resources extended to attracting and retaining the right staff. Staff need to be motivated to achieve excellence and ideally they will have the knowledge to ensure tasks are carried out on time and effectively for peak performance. Knowledge alone is not enough, there also needs to be the capability to execute that knowledge:

> *'You can talk about irrigation practice, it's the person who actually does good irrigation practice.' [1A].*

Attracting and retaining the right mix of staff requires that their needs are identified and met. To this end there is a progressive structure of career development and wealth building for staff.

Monitoring and Awareness:
A program of monitoring and measurement is in place to ensure the DSL manager feeds stock well; there are weekly pasture measurements, measurements of crop yields, a scale on the silage wagon and drymatter assessment of silage. Although measurement plays a key role in guiding and informing management, common sense is also important:

> *'We have a policy of walking through any mob late in the day and they are content, look at residuals, look at how they conduct themselves.' [1A]*

Business structures:
There was coherent evidence supporting the proposition that separate business structures or separate commercial drivers would enhance the sustainability of DSL:

> *'In the early days there's been an attitude that (the DSL) is here to support the dairy farms and we are now trying to give it a life of its own.'*

Farmer 1A believed that for a DSL unit to reach full potential, it must be treated as a separate business. Treating the DSL unit as a separate farm with good equipment, good management and good staff has resulted in DSL enterprises being carried out to a high level, the elimination of inefficiencies and sustainable outcomes: *'Financially it is running way ahead of last year.'*

Managing External Relationships:
Farmer 1A believes that their care and stewardship of the land over the years has been instrumental in securing a long term lease of a well resourced DSL block. In forming a good relationship with the landowner, farmer 1A has also gained access to this person's considerable knowledge and skills relating to forage cropping and dryland farming.

Features of Case 1A

Leased DSL:
Case Study Site 1A is an example of how leased DSL can form an effective compliment to intensive dairy farming systems. Leased DSL allows control of critical support services without the substantial capital inputs involved in purchasing DSL. Using capital wisely appears to have been a key to success with a leased DSL unit. When the farm was leased, the landowner agreed to take responsibility for all capital improvements.

The Advantages of Adjacent DSL:
Farmer 1A is very happy to have secured a block next door to the dairy farm as it creates advantages like allowing cows to calve on the DSL. However he made it clear that although synergies occur that the success of this unit is related to factors besides the adjacent situation.

Success with Dryland DSL
Dryland is useful in this situation because it is acquired at a low cost and synergies exist with the adjacent intensive grazing area. Having dryland means that a standoff area is available when the intensive DSL is too wet to support cows without soil damage and poor utilization. Furthermore, the inclusion of irrigated areas means that the system can manage the unpredictable feed supply from dryland, inherently flexible enterprises such as carry over cows and silage production are also helpful.

The Effect of Scale:
It appeared that vulnerability to market risk and thus the need to have control of DSL relates to scale:

'At our scale, being dependent on the marketplace is too high a risk… If we had to suddenly go looking for winter grazing for 3000 cows, it would be extremely difficult, whereas if we had 500 cows, we could do that.' [1A]

There are also economies of scale with a separate business structure.

The Use of Forage Crops:
Forage crops have been adopted as a winter feed over the past two years. The interviewee believed that this change had enhanced sustainability because it has allowed wintering of an additional 500 cows over the same land area and has increased the resilience of the system to climatic events. Cows fed on forage crops require a careful transition feed to prevent nitrate poisoning. Cows are also drafted into mobs based on condition so as to ensure they are fed appropriately.

B.1.2 Case 1B/Pilot Case 2

Farm 1B is an 80ha intensive dairy support unit which supports the grazing needs of 320 cows over winter and 400 heifers and calves through the year. The DSL unit is 100 per cent irrigated and wintering is all grass, it is 13 kilometres from the dairy farm.

The small scale of the system means that there are minimal lanes and a very simple layout of fences and shelter belts. Fences, stock water, yards and shelter all appear to be adequate. Some pugging damage around troughs indicates older style troughs may limit flexibility with grazing management. Pastures appeared lush but well grown in preparation for winter. Plant included a tractor with loader, a gun irrigator, a small drill, 2 utes, a farm quad and a K-Line irrigation system.

Wintering cows is the main revenue stream and the main benefit of the DSL in terms of contribution to the overall business with heifer grazing and calves fitting in around this. The winter diet is 6 to 8kg of grass and 4 to 6 kg of balage fed per cow per day. There are some feed reserves in case of climatic events over winter, but if there is more than 10-12 days of really bad weather such as the snow last year farmer 1A will find grazing for young stock elsewhere or buy in feed. Underweight cows are identified, prior to drying off, drafted out and run with the heifers.

Case 1B was notable in that a limited area of DSL was used very effectively at low cost. The dairy farm is fully supported while the combination of irrigation and grass allows control at low cost.

Perceptions of Sustainability

Economic Sustainability:
Farmer 1B believed that while heifer grazing and wintering gave good economic returns, that the biggest benefit of well managed DSL was the increased production potential of a well supported dairy farm:

> *'Every dairy farm should have a runoff for wintering, you get more kilos at a lower cost if you've got a runoff operating. I get over 1700 kg MS/ha, without (the DSL) I would be back to 1300 to 1400.'*

The DSL benefits the dairy farm because it allows the dairy farm to run at maximum potential with very little risk of external factors interfering with production:

- The DSL allows for a longer season as it allows the farmer to drop the covers on the dairy farm knowing it will be completely de-stocked over winter.
- There is no risk of damage to the vulnerable heavy soils on the dairy farm with production losses the following season.
- Calves leave the farm as soon as they are weaned which leaves more quality feed to get cows in calf and less wasted animals.

Farmer 1B believed that the grazing fees paid to external parties do not reflect the value of the service they provide in terms of management of risk and protection of the milking platform:

> *'I could starve them for free myself, why pay someone else not to feed them properly?'*

Environmental Sustainability:
Controlling environmental impacts is closely linked to controlling other aspects of the farm system, for example by planning ahead with grass growth so that it is not necessary to use large amounts of nitrogen fertiliser:

> *'Try not to get yourself into a hole then getting yourself out by using massive amounts of urea as some farmers do.'*

Farmer 1B would definitely consider the use of nutrient budgeting or eco-N, as with other new practice, his approach would be to carefully consider them in light of whether they make sense in his situation.

Farmer 1B believed that the rhetoric by pressure groups in the media was an extremely negative influence in that it created a negative public perception of dairy farming and was an impediment to real change, he believed that a positive approach was needed:

> *'Getting farmers together, looking at farms that are eco-friendly, that are producing well at low cost… to show it does work, it can be done and that it is economical to do it.'*

Farmer 1B believes that the way he uses DSL had led to an overall improvement of the system. Prior to development, this farm was a low intensity dry land sheep farm. Fertility and organic matter were low, P levels were between 8 and 14, with a history of poor grazing management leading to extremely low covers and soil erosion: *'It was a desert when I came here'.* Farmer 1B is proud of what he has done and believes that in terms of soil structure, fertility and economic use he has left the land in a better state than he found it.

Social Sustainability:
Although Farmer 1B had been very successful in achieving high milk production at low cost, the farm remained exposed to the labour market. An inability to find good quality staff had led to an unsustainable situation on the dairy farm, which Farmer 1B had to run at the same time as the DSL unit. Thus while the DSL offered protection in some areas, the dairy farm remains exposed to critical external factors.

Practice

Intelligent use of Resources:
The DSL unit achieved high performance at a low cost: the all-grass system is low maintenance as long as good grazing management is in place and using balage means that there is very little capital tied up in machinery. Although the system is low cost, the right resources still need to be applied in key areas. Strategic re-grassing is done in spring with the farmer's own drill and water and fertilizer are applied immediately after silage cuts for example. The DSL is also fully irrigated.

Planning:
Simple but effective systems appear to be the key to success. Apart from irrigation inputs are low with re-grassing done by drilling directly into the paddock and low fertilizer inputs (100 units of N).

Attention to Detail:
Close observation of pasture and good grazing management is important to success with an all-grass system. Good grazing management coupled with irrigation will ensure:

- A steady supply of quality feed to youngstock.
- Having enough quality feed on hand at the start of winter.
- Avoiding the need to use large amount of Nitrogen fertiliser to control feed shortages.

Feeding:
Fully fed stock and a high fertility herd lead to good reproduction and a low (4 per cent) empty rate without induction: *'I ensure my cows are the picture of health.'* Farmer 1B has not had an empty heifer in the 7 years that he has been farming in this location.

Features of Case 1B

Difficulties with Dryland DSL:
At the time of the interview I saw pictures of the DSL at the time of purchase that supported the comments that this land is not suitable for dryland farming and that irrigation combined with good management has led to greatly improved economic use of the land.

The Importance of Soil Types:
Farmer 1B specifically chose this farm because of the light free-draining soil that compliment the heavy soils on the milking platform: *'The two soil types compliment each other perfectly.'*
The heavy soils on the dairy farm are good for pasture production and irrigation efficiency as long as the soil is dry, once the soil is wet it becomes very vulnerable to treading damage.

The Effect of Scale:
Farmer 1B did not consider scale to be a particularly significant factor in runoff operations. Control, not size is the key to success with DSL:

'If you had 200ha, you'd still have control, you'd still have your stock behind wires… the size thing wouldn't make any difference whatsoever'

The interviewee indicated that if the scale were larger than 200 ha, that he would consider putting commercial drivers in place with a separate accounting of costs and fees paid for grazing on the support unit. A small scale DSL unit has the advantage that there is no need to employ outside labour and no need for formal pasture measurements, grazing plans, or other structures to ensure DSL tasks are carried out properly.

Success With an All-Grass System:
The advantages of an all-grass system are that it is low cost with pasture renewal for example done by drilling straight into new grass without cultivation. Irrigation and the ability to guarantee grass growth effectively manages the climatic risk. Grazing management is important to maintain pasture quality and build up enough feed for winter. Farmer 1B does not use crops because he believes that the amount of time the ground is out interferes with the grazing of heifers and calves.

B.1.3 Case 1C

Case site 1C is a leased 175.99ha DSL unit, providing support services to a 420ha/1360 cow dairy farm 2 km away. It is partially irrigated with 70.5 ha of spray irrigation, 71.07 ha of borderdykes and 34.42 ha of dryland. The small size relative to the dairy farm means that the only enterprises undertaken are wintering cows and silage to support wintering or extend lactation on the milking platform.

The farm is well developed with good tracks, subdivision and shelter. There are no houses on the farm. Extensive stores of silage (400 tons) and a large amount of hay (see Plate 16: Feed on Hand). Gates are not well positioned to move machinery, an issue with big silage wagons in winter. Some stock water comes from water races, which may impact on water quality. Observed some areas of borderdyke pasture heavily damaged by grass grub. Young stock appear to be on good quality, new pasture.

Wintering cows is the primary activity on this DSL unit. The aim of wintering is to have cows at condition score 5 at calving. Practices aimed at achieving this include a carefully balanced diet, drafting into mobs based on condition and maximum inputs of feed. Cows are fully fed with intakes of 12-14 kg per day. The winter diet is 50:50 Silage:Crop/Grass. The various cow mobs are fed different diets depending on condition. Lighter cows have a better diet: *'The highest ME in the skinniest cows.'* A transition feed is done onto crops over the first week of winter.

For the rest of the year, the farm is dedicated to the production of grass and maize silage, 500t of which is exported to the milking platform. The advantage of a silage-based system is that it is simple and means that the DSL requires minimal staff or management when not wintering cows.

Case 1C illustrated the importance of planning to success with DSL. It also demonstrated the way that inclusion of DSL can amplify existing social or management pressures with DSL.

Perceptions of Sustainability

Economic Sustainability:

The purpose of the DSL unit is to control cow feeding over winter and to protect cow condition which are essential to ensure good production on the MP.

Farmer 1C had some reservations about the financial returns on DSL and believed that many did not give enough consideration to alternatives to DSL ownership. This was particularly the case in the current environment of very high rural land prices, which had risen to a level that was harmful to the dynamism of the industry:

'The values that people are putting on farms are not sustainable.'

Environmental Sustainability:
Farmer 1C believes that with good information and prudent developments (such as diverting water races around dairy farms), environmental variables can be managed on dairy farm systems. He also believes that most farmers are motivated to act to address environmental problems if they know what the costs and benefits are:

'I think good farmers are good guardians of the land. We all aspire to be good farmers.'

Despite the belief that DSL farmers can achieve sustainable farming, Farmer 1C is very concerned about the poor public perception of dairy farmers. He believes that the negative image of dairy farmers will lead to a culture of avoiding compliance costs rather than addressing environmental problems in an efficient and effective manner:

'The public are going on a perception of fear. Dairy farmers are (destroying) the environment. Who says, how do you know?'

Social Sustainability:
The changeover from milking cows to wintering cows on the DSL can be very stressful for the dairy farm manager, it can take a long time for staff to get used to the change and climatic events like the snow in 2006 can be very disruptive: 'The snow stuffed the routine.'

It also appears that the lack of supervision means there is more of a vulnerability to poor quality staff on DSL: 'On the runoff, no one sees it go wrong.' Even though there are solutions (such as having people work in pairs with 'someone who can think' in each team), managing staff on DSL is an important issue.

Practice

Resources:
The DSL is well-resourced with machinery, a DSL manager and good technical support for the operations manager.

There is adequate machinery, which may be an advantage of scale: *'Because we've got two tractors and wagons, we can manage both places.'*

The runoff manager is responsible for ensuring that silage making and irrigation are done and that there is a good supply of feed at the start of winter. During winter, DSL operations, feeding out and staff management are overseen by the dairy farm manager.

The operations manager is very well supported with consultation and technical advice. One of the strategic decision makers is an experienced farm consultant and the runoff manager and dairy farm manager are also technically competent. A nutritionist helps with the winter feed plan and an HR consultant visits the farm regularly. The operations manager in turn ensures that he takes time to bring up and develop new staff and to give good support to 2ICs.

Planning:

'Planning and timing are the keys to a runoff, a lot of this stuff is not difficult to do if you've got the timing right.'

Planning is particularly important at the start of winter, as the operations manager has to oversee both drying off on the dairy farm at the same time as they prepare the DSL for the arrival of the cows and attempt to teach staff about what they will have to do on the DSL. In the past, problems that have arisen at the start of winter appear to have been driven by a lack of time for planning and implementation. The result has been a lack of direction for staff and it takes up to a month to 'get into a routine.'

Although the ability to plan appears to be very important for success with DSL, Farmer 1C believes that many farmers are not capable of planning DSL operations well and that the whole system suffers as a result: *'They think they can do everything, but they can't.'* The result will be an unsuccessful DSL unit, a sub-optimal dairy farm and an over-extended operations manager.

Attention to Detail:
Tasks that require attention to detail include silage cuts and sowing forage crops. Silage needs to be cut at the right time. Whole crop silage needs to be cut at the doughy/cheesy stage, while grass silage needs to be cut at 2500kg DM (11.5 ME). The goal is for irrigated pasture to produce 4

cuts of high quality silage per year. To help achieve this, urea is applied after silage cuts, which will assist pasture growth and aid tillering.

Features of Case 1C

Leased DSL:
The land is leased on a 3+3 lease, which means that there is little time to benefit from development done and care must be taken to avoid unrecoverable capital inputs. Even so, development that is deemed essential to economic success has been carried out; one border-diked paddock has been redone and a 6 ha storage pond is being built which will provide protection from water shortages and allow the manager of the runoff to irrigate as and when he wants to, not simply when ‘it comes down the race.’

Restricted invested capital can result in, environmental impacts, economic losses or restrictions that might not occur with an owned block. For example cows have access to water races on the farm, a situation that will persist because the water races supply water to cows and there is no economic incentive to invest in a modern stockwater system.

Dryland DSL:
All 34.42 hectares of the dryland is in kale. Although production is limited on dryland, kale yields and quality are dependable. Grass is no longer grown on dryland because climatic variability, grass grub and weeds have led to poor performance and high costs. The assertions about the prevalence of grass grub were backed up by observations of (irrigated) pastures that had been heavily damaged by grass grub. (See Plates 8 & 9: Grass Grub).

Light Soils:
Soils are very stony Lismore soils, which cope well with the pressure of wintering cows. A minimum of clay in the upper part of the soil horizon means that these soils are very resistant to pugging and recover well from damage incurred over winter even when very wet.

B.1.4 Case 1D

Farm 1D is a 260ha DSL unit. The majority of the farm is hill country, with a small 30ha flat irrigated by a centre pivot. This DSL unit supports the grazing needs of 500 dairy cattle through winter and 171 calves, 150 in-calf heifers, and 60 beef cattle for the rest of the year. There is 30 hectares of irrigated pasture on the flat with 55 hectares of Italian ryegrass, 22 hectares of kale and 153 hectares of cocksfoot pasture on the hill.

Most of the DSL is extensive hill country with some smaller paddocks where kale or Italian ryegrass are grown for winterfeed. Clay tracks on the hill become difficult to traverse in the wet with the result that the DSL may be difficult to access with tractors over winter. Two large tanks on the top of the hill provide reliable stock water. There is very little evidence of erosion, despite the clay hill being grazed by cows over winter. This DSL unit is adjacent to the milking platform, which gives good access for the owner operator and for staff in winter.

Case 1D was notable for the time, energy and resources devoted to managing all external factors, beyond control of cow feeding over winter.

Perceptions of Sustainability

Economic Sustainability

The purpose of the DSL is to protect the dairy farm, ensure cows calve in good condition and control lactation length. Even though the reliance on dryland means that feed supply varies, farmer 1D is happy with the ability of the runoff to achieve control of feed supply:

> *'That kale has not done well, there is only 4500kg drymatter, but that feed is mine, there is no one who is going to tell me that feed is getting expensive in the district and that I have to pay twice as much. It is mine.'*

Although there may be extra costs in dry years, control of feeding is maintained.

Environmental Sustainability:
Farmer 1D believes that achieving environmental best practice requires keeping up with shifts in perceptions of what is and is not acceptable: *'What was acceptable 10 years ago isn't now.'* Eco-N is used to minimize nitrogen loss and the use of Italian ryegrass and extensive old pastures means that cows are more dispersed during weather events.

In his view, farmers need to be aware of changing perceptions and be ready to deal with the implications of them.

> *'There needs to be a greater realization that we do have to tidy up our act because so much of what we do is being hampered by environmental concerns, green concerns and the negative perception of townspeople.'*

Social Sustainability:
Farmer 1D believes that the DSL enhances the social sustainability of the overall system:

> *'I appreciate that if I didn't have the runoff, I would be more focused on the dairy farm but I am reliably informed by farm advisors that having a runoff on the hill block just adds another dimension for staff and that the benefits outweigh the disadvantages.'*

The DSL contributes substantially to the social sustainability of the overall system because it provides a healthy and enjoyable working environment for staff, both in terms of being a pleasant environment to work in and in terms of providing job variety for staff:

> *'It's a fun runoff, shifting break fences on 45 degree slopes and so on… it keeps them fit for rugby, its good fun, its different.'*

This farmer also believes that the DSL allows him to be actively involved in the dairy industry while staying clear of the dairy farm, both to allow his manager to work independently and to change focus and move closer to town as he gets older.

Practice

Resources:
The involvement of large areas of dryland means that at times it is necessary to expend extra resources to achieve control. This cost is balanced by the low cost of leasing a dryland DSL unit.

Farmer 1D places a great deal of emphasis on education and building knowledge, both for himself and his staff. He believes in bringing people up through the system as an investment in the future of the business and the industry. Currently farmer 1D is bringing up a new 2IC who is being trained to share responsibility with the new manager, having sufficient staff resources is an important feature of social sustainability. He maintains links with Lincoln University, attends field days and discussion groups and reads often, he also involves his staff in these activities, taking them to conferences and accompanying them on farm walks.

Graziers:
Farmer 1D has had mixed experiences with graziers, with good results in some years and very bad results in others. The issue is not so much the cost of feed, but the loss of control of costs. In reference to a paddock of kale that has suffered badly in the drought, farmer 1D stated that even though the kale had performed poorly, it was still valuable:

'That feed is mine. Nobody can say it's gone up to $20 you can't have it because it is mine.' [1D]

Farmer 1D was critical of the commonly argued position that the key to good grazing relationships was a good grazing contract:

'They (farm consultants, stock agents) say its about professionalism, it's about contracts, its just not like that.' [1D]

Although the grazing relationship should be a cooperative one, it seems that it may become an exploitive relationship once feed shortages occur and graziers attempt to recover losses by using their leverage with dairy farmers to arbitrarily increase grazing fees.

Managing External Factors Beyond the Scope of DSL Management:
Farmer 1D was very supportive of staff and management and believed that investing in staff and creating a healthy work culture was very beneficial in terms of protecting the dairy farm from external impacts:

'The goal is to have high quality staff who share the same sort of vision that I do… who want to achieve things for the sake of achieving them, not just for the sake of their own financial satisfaction or financial gain… If I've got decent, honest, professional people, it creates a decent, honest professional culture and it conveys the same sort of image to the outside world.'

Farmer 1D believes that he has derived substantial benefits from the culture of professionalism he has created in his workplace, he has never had to deal with drug use and believes that his reputation as a decent employer *'helps greatly in finding staff.'* By addressing the drivers of social problems, and focussing on what the DSL can contribute to social sustainability, Farmer 1D has prevented most of the negative effects that can occur as DSL is added to a farm system.

Features of Case 1D

Leased DSL:
The advantages of leasing rather than buying DSL are that it allows control at much lower cost than full ownership and it frees up capital for investment in other areas. Leasing also effectively puts a commercial driver in place for the DSL. Finally the lease gives farmer 1D the freedom to seek better arrangements. If he no longer believes that a dryland DSL can give the control he needs he has the option of leasing or buying somewhere else.

The DSL is on a 5-year lease which restricts what can be done: *'I am very cautious about spending money on it.'* A real disadvantage of leasing (at least in this situation) is he will not get recognition for money or improvements done.

Adjacent DSL:
Farmer 1D believes that the adjacent situation allows simple and effective control of stocking rates on the MP and the length of the milking season. By drying off lighter cows early and doing strategic grazings off the MP, farmer 1D is able to maximize the length of the milking season, a difference that he believes equates to an extra 200 milk solids per hectare per year.

Dryland DSL:
This system relies on kale and Italian ryegrass to grow and carry feed into winter. For the first 4 years, the block did very well because the autumn rains on the hill country watered the Italian ryegrass with the result that there were covers of 4.5t/ha of quality feed at the start of winter. Despite early success, farmer 1D is unhappy with the way the dryland has performed recently: *'This year it has let us down very, very badly'* and is considering other options for future control of wintering.

With dryland, the considerable expense of weed and pest control and buying in supplements in bad years must be taken into account: *'That kale's been sprayed for aphids, diamondback moth, you name it, I've sprayed it, I've had helicopters up here…'* Even though costs are high, Farmer 1D believes that once he takes account of all the benefits (youngstock, wintering cows, protecting the milking platform and so on) that he is still better off than if the same services had been purchased on the market.

Crops on Dryland:
Crops (kale) appear to be very useful on dryland because they are a way of carrying good quality feed through to winter at low cost. The combination of fallowing and crops effectively means that moisture from spring is stored and used to grow feed being carried through to the following winter. Farmer 1D also believes that the leaves of kale effectively catch moisture from clouds and dew and can utilize this, and therefore work well on hill country. This assertion was supported by observations of kale grown on the hills and on the flat, the kale on the hill appearing to have around twice the yield of the kale on the flat.

B.1.5 Case 1E

Case study site 1E is a 181ha dairy farm with 86 hectares of adjacent DSL. The dairy farm milks 540 cows in total, producing 250000 kg MS (1500kg MS/ha, 457 kg MS/cow). 200 cows, and 170 heifers graze year round with 340 cows wintered off.

The DSL areas appeared well looked after with well-maintained fences, well-covered silage pits and extensive, but not excessively high shelter. There is a new stock water system (2-3 troughs per paddock) and a new center pivot on the DSL. Excellent kale crops were observed on one area of dryland DSL with over 10t/ha with high leaf:stem ratio.

The main roles of the DSL are to control the cost of feeding milking platform cows in late winter and spring and to help ensure cows are in good condition at the start of winter: *'If you haven't got them in good condition, then you've missed the boat.'* 200 cows are wintered on the property: *'a number we can manage if it does get wet.'*, rotating between the 36ha sheltered runoff and the dairy farm.

The cows need to get a diet of at least 12kgs DM/day over winter:

> *'You want their stomach to full capacity, when they come back to the herd as milking cows, you want them to be eating 16-18 kilos, the stomach has to be large enough and functioning well enough to do that.'*

A transition feed is done, the biggest concern being preventing empty cows and nitrate poisoning. In the snow of 2006, farmer 1E kept heifers on grass and saved the kale in case the cows came home early (which they did), this saved money and keeping the cows on kale protected the dairy farm and the rest of the DSL: *'We could avoid damaging pasture.'*

The other major enterprise is young stock grazing. Young stock need to be well looked after with a reliable supply of good quality feed. Heifers need care in winter as they do not adapt well to wet conditions. The heifers were badly affected by the wet winter of 2006 when they failed to reach weight targets, had a high empty rate and had trouble getting back in calf at mating.

Case 1E is notable in that the farmer has made a conscious decision to use adjacent DSL areas to become more self-sufficient rather than expand the MP area. In the long term the adjacent situation provides security in terms of securing future support services and providing a buffer against future water or fertilizer restrictions.

Perceptions of Sustainability

Economic Sustainability:
Farm 1E enhances economic sustainability by preventing economic loss from pasture damage in winter and spring, and controlling and reducing risks associated with cost of support services. Farmer 1E believes that he does not push the runoff as hard as he could, but this is acceptable because it creates options and ensures future sustainability.

The DSL ensures that the MP will continue to function at a high level despite abnormalities in the weather. *'You know you will be OK no matter what the weather does.'*

As well as managing the feeding of cows over winter, this farm fulfils a specific need of protecting the vulnerable soils on the dairy farm in late winter and spring.

Environmental Sustainability:
Farmer 1E believes that environmental sustainability is closely linked to the sustainability of the overall business, he is careful not to use too much nitrogen fertiliser at once and never uses more than 200 units in one season. He does nutrient budgeting and believes that done well it is an effective way of bringing economic and environmental drivers in line. He is considering using eco-N and is in communication with his neighbour who has been using it.

This farmer believes that the poor public perception of dairying is directly linked to the current difficulty in getting consents to extract water and the future threat of water restrictions, which will directly impact on milk production: *'If you haven't got water, you haven't got grass.'* He believes that the current situation is causing a lot of concern among people who have invested capital (and debt risk) in irrigated dairy farms… 'You've got to have good evidence.'

Farmer 1E believes that community involvement and learning from other farmers is very positive feature of the dairy industry:

> *'It's a good community to be involved in because people share a lot of information, it's a matter of getting out there and learning how people do things.'*

Farmer 1E is very positive about the ability of the dairy farming community to share knowledge and continue to adapt and change in future and believes that community action will be key to addressing community or environmental compliance issues.

Farmer 1E thinks that the adjacent areas of support land spread the nitrate loading of the farm and hopes that future water allocation reviews will take account of the fact that much of his farm is dryland, which reduces the pressure on the dairy farm in an environmental sense.

Social Sustainability:
The small scale of the MP and adjacent situation means that it is relatively easy for this farmer to monitor tasks carried out on the DSL. He also seems able to retain staff for long periods of time so they have become very familiar with the system and there is no need to have formal pasture measurement or grazing plans.

Practice

Resources:
The DSL is well-resourced with a new centre pivot and a modern stock water system on the larger DSL area. There is excellent shelter on the dryland wintering DSL area.

Staff are well supported. Farmer 1E believes that trust, giving people the benefit of the doubt and a willingness to invest in relationships, even though you know they are temporary is important to the success of this system. This attitude applies to relationships with staff, graziers and neighbours:

> *'You've just got to treat staff the way you like to be treated and hopefully you've got staff respect that and don't take advantage of that.'*

Farmer 1E uses incentives to encourage his herd manager to prevent waste, maintain residuals and meet production targets. The result is a motivated manager who has an interest in the performance of the farm: *'He treats the farm just about like it's his own.'*

Planning:
Planning is key to growing and harvesting feed. Farmer 1E appeared to have an excellent grasp of the operational plan and what had to be done and of what the critical variables were at any particular time:

> *'Basically the most important thing on the runoff is getting our winter feed crops in early enough that they get a chance to establish with the limited irrigation we've got here and the other stage too is putting the right fertiliser on in the autumn so we can build up our covers on the other end of the farm so we've got grass going into the winter. I think that's one of the most important things, because feed is quite precious in Winter so we've gotta make sure that through the autumn, you're getting everything right then so you've got those days of growth before winter. So when it comes to planting and of course stock condition, make sure your stock are in good condition going on to that feed and yeah. I think the most important thing on the runoff comes down to harvesting feed so you see the cost of it as you are harvesting good quality.'*

Timing and Attention to Detail:
There were a number of tasks that had to be done well and at the right time to ensure success:

- Cutting silage at the right time, good quality silage from good quality grass.
- Getting winter feed crops in on time so that they have time to establish with limited irrigation.
- Applying fertilizer on time in Autumn so that there are good covers going into winter.
- Getting cow condition right for winter.

Graziers:
Graziers are important to this farmer as the area of the farm and the soil types make it impossible to support all of the cows for all of winter.

Farmer 1E uses the DSL areas to gain control over cow condition going into winter and to reduce the time the cows are away. The shorter time away reduces the grazing bill and gives control of cow feeding in the last two weeks before calving as well as providing a fall-back position if the cows come home early.

Despite the often short-term nature of grazier relationships, farmer 2A believes that graziers need to be treated well. Relationships and trust are important: *'He looks after me so I look after him, I might need to send more cows next year.'* Graziers need to have the technical skill and the ability to grow enough feed to look after cows, farmer 2A believed that it was very important to make sure that graziers had this kind of skill before committing to a contract or relying on them. In choosing a grazier it is good practice to talk to someone who has grazed cows with them before, it also pays to use common sense: *'Look at the stock on his own farm.'*

Features of Case 1E

Leased DSL:

The DSL area is on a 9 year lease with a right of purchase. The term of the lease and right of purchase means that this farmer feels justified in investing capital in the leased land. Capital investments include new stockwater and lanes and an irrigation system. The lease works well economically and is *'much cheaper than servicing a debt'* (Around a third of the cost of owning an equivalent farm with no invested equity).

Getting this lease involved working out a good deal with the neighbour he leases off. A long term relationship with this person was instrumental in working out a practical lease deal, which included a long term lease, purchase of some land to put an irrigator on and a right of purchase.

Adjacent DSL:
Case 1E is an excellent example of the use of small, adjacent areas of DSL to get the most out of the dairy farm, achieve control of support costs and reduce capital inputs.

The adjacent DSL allows control of cost of feeding cows in late winter via strategic grazing of milking platform cows through August, September and October, while at the same time protecting MP pastures if it is wet. Cost savings result from feeding of grass directly rather than as silage in spring; *'As soon as you harvest anything, it is going to cost you 20c/kg DM'*. The area of DSL is large enough that in most years, farmer 1E can feed a diet of almost entirely grass in spring.

Success with Heavy Soils:
The soils on the DSL are a heavy Warterton clay loam. This soil needs to be protected during wet weather, careful irrigation (neither too little nor too much) and dense covers with a lot of clover to protect it from pugging or drying and setting hard on top. If soil damage occurs over winter it tends to set hard which means it is difficult to correct in spring. The best strategy is to prevent damage by spreading cows around or keeping them on DSL areas if it is wet. Once this soil sets hard, plant roots are not able to penetrate to utililise moisture and it needs to be ploughed, possibly planted with a crop and re-grassed to be restored.

Forage Crops on Dryland:
A rotation of grass and kale is the preferred way of utilizing dryland DSL. Kale grows well on dryland and works in well when pastures need to be renovated after soil damage or grass grub infestations.

Excellent kale crops were observed, with estimated yields of 10t per hectare with high leaf:stem ratio. Taking care with crops, fallowing, spraying, drilling, etc is worthwhile on this soil type with yields of 10t/ha achieved on dryland. Soverign kale is preferred because it is highly palatable and does not grow too high, which enhances utilization.

B.1.6 Case 1F

Farm 1F is a 127ha dryland DSL block supporting spring grazing and some wintering for a 184ha irrigated dairy farm. This is an all grass system based on silage and strategic grazing from the dairy farm in late spring and autumn.

The DSL is very dry with low covers for late autumn. The grass has not grown since it was cut for silage in summer and it is difficult to see the difference between re-grassed pastures and old pasture. There is good subdivision to aid grazing management with well-developed shelter. Most of the farm is north facing which will be helpful when weather is very cold, but will result in dryness. Silage pit and bales at the top of the hill are sensibly positioned to save climbing with a full load of silage in wet weather. There is a well- developed gravity fed stock water system.

This is a simple system based on silage and providing grazing to the dairy farm in late autumn and spring. Strategic grazings by milking platform cows continue through the milking season, depending on the covers on the dairy farm. Partial control of winter feeding greatly reduces the risk of relying on graziers for winter grazing. The system supports light cows in May and the entire herd from mid July until calving. The cows calve on the DSL and walk home. The winter diet is 12kg/day with a 2/3 grass and 1/3 grass silage diet.

Farm 1F is notable in that external conditions are managed with very low inputs of material or management resources. Simple systems allow the strategic manager to make the best of a small area of dryland DSL, while keeping the main focus of management on the dairy farm. Having a simple system, with land shut up for silage for most of the year also means that external factors are controlled while the focus of management remains on the milking platform.

Perceptions of Sustainability

Economic Sustainability:
The flat dairy farm and hilly runoff compliment each other, which creates flexibility, cost savings and control without the high capital costs of an irrigated DSL unit. The adjacent situation allows for substantial cost savings in terms of grazing on the runoff directly rather than feeding supplements. 'It's fresh grass, its high ME and more valuable than bought in silage.'

The DSL gives control at low cost. Lighter weight cows can be dried off early and grazed on the runoff which leaves more grass for cows that are still lactating late in the season, effectively extending lactation. As well as having the opportunity to control cow condition before drying off, farmer 1F is able to have all cows home at calving and to keep the pressure off the dairy farm during the crucial spring period.

Environmental Sustainability:
As a small dryland DSL based on silage production, stocking rates are very low, with a low level of environmental impacts. Farmer 1F believes that the science around nitrate leaching is being

done and that new techniques like eco-N and nutrient budgeting will have an important role to play in this.

Social Sustainability:
Having a simple system, with land shut up for silage for most of the year means that the focus remains on the milking platform cows all of the time. The runoff does not impose significant time or commitments by staff or management. Grass based wintering and the smaller number of cows at home over winter makes wintering manageable.

Farmer 1F believes that the smaller scale greatly assists people management. At a small scale it is easy to manage the cows and he can personally oversee where the cows are grazing, the condition of pasture and so on.

Practice

Resources and Planning:
Having a simple but effective system that achieves results with low inputs means that farmer 1F does not have to deal with the pressures or the complexities that other DSL farmers have. As a low intensity system, this farm does not require large inputs of resources, and money that might have been spent on wintering cows is spent on grazing fees.

Timing and Attention to Detail:
Farmer 1F makes 300 to 500 tons of silage annually, depending on how much rain there is in summer. 75 per cent of this is fed out on the MP. Timing of silage cuts is important to ensure the silage is good quality. Silage needs to be cut early and it is important to make arrangements with the contractor ahead of time: *'Book in early, I am usually his first customer.'*

Features of Case 1F

Adjacent DSL:
The adjacent situation is most useful in spring, as the hilly DSL and flat dairy farm compliment each other; if it is cold or dry, there is good utilization on the dairy farm and if it is wet, feed will become available on the DSL. As a result there is always somewhere the cows can go in spring without threatening milking pastures and money can be saved by grazing the DSL directly instead of making silage: *'It's fresh grass, its high ME and more valuable than bought in silage.'*

Even though the DSL area is only able to support the wintering needs of half the cows, it is still seen as very valuable in managing the risk of poor grazier performance because the cows are away for only part of winter (or half the cows are grazed at home for all of winter) and the DSL allows control of cow feeding in late autumn and spring. Control is achieved by making sure cows are in good condition at the start of winter, having all cows home 2 weeks before calving, and by working closely with graziers.

Dryland DSL:
In adapting to the dryland situation, Farmer 1F has adopted enterprises that he believes allow the DSL to function well in a high risk environment without putting pressure on other parts of the system. The combination of supplement production and wintering cows works well because it confers the flexibility required with a dryland farm.

B.2 Case Study 2: Further Investigation in Canterbury

B.2.1 Case 2A

Farm 2A is a high production winter milk farm with both adjacent and detached DSL areas. There are three areas of DSL: a 325 ha dryland block around 15km from the home farm, 73 ha of irrigated land adjacent to the home farm and a newly acquired 45 ha dryland block across the road from the MP. 700 cows are milked with 400 milked from August to May and 300 from June to February. The area of DSL is large enough to supply all support services needs to the MP.

The adjacent DSL appears to be well resourced with excellent lanes and high pasture covers in preparation for grazing by winter milk cows. The detached DSL is relatively lower intensity, with effective but low cost developments such as the use of deer fencing to expand the cattle yards. The system is well resourced in terms of machinery with two large silage wagons on the home farm and a smaller silage wagon on the detached DSL. There is also a stock truck to assist with the frequent stock movements from one farm to the other. On the dairy farm I observed a large amount of hay, balage and silage stored in preparation for winter, consistent with the comments that this farm feeds out 4000 tons of silage over winter. Near the silage pit was a low cost 'feed pad', consisting of a 200 metre line of concrete troughs with a platform of sawdust and crusher dust to keep cows out of the mud.

The winter milk cows require large amounts of supplementary grazing and supplement over winter. Thus the most important time for the adjacent DSL is winter and spring when supplements and strategic grazing are necessary to ensure cows are fed properly while the impact on the land is controlled. The most important time for the detached dryland DSL is from late summer to early spring when dry cows are moved away from the MP system. Farmer 2A also buys silage from neighbours as the opportunity arises.

Case 2A illustrated the increased exposure of winter milk farms to external factors. The perspective of winter milk farmers was useful because they have decades of experience with DSL and with running systems at a high level of intensity for 12 months of the year. Good genetics, fully feeding cows and awareness of social issues all contribute to a sustainable and profitable farm system.

Perceptions of Sustainability

Economic Sustainability:
The large amount of supplements fed and the need to graze cows off twice a year means that there is a specific need for DSL to guarantee a reliable supply of support services. This need was the driver for the purchase of DSL.

Farmer 2A has been on this farm for over 30 years and has benefited greatly from astute land acquisitions and has managed to continue to grow his farm over time even though proximity to the city has meant that many of his neighbours have subdivided and moved away. The ability to purchase adjacent land has depended to some extent on the relationships with neighbours that this farmer has invested in over the years.

Even though business growth had been rapid, this farmer is reluctant to increase cow numbers beyond 700, preferring instead to have a fully protected and self-sufficient system. Not only would the cost of a new dairy shed, Fonterra shares and bought in support services be substantial, but grazing management and accounting would be greatly complicated as more cows had to be managed.

Environmental Sustainability:
Farmer 2A was very confident that the control and ability to spread impacts meant that his farm was able to manage both environmental impacts or compliance aimed at preventing them:

'It wouldn't worry us (in an economic sense) because we would find a way around it'

The creeks on the wetter areas of the property are a concern for Farmer 2A. He is very aware of the need to keep runoff out of creeks, but at times the high water table and wet winter conditions mean that this can be difficult to control.

Social Sustainability:
Social sustainability matters to this farmer. As a fifth generation town supply dairy farmer he is aware of social pressures and impact on staff. He has deliberately set out to create the kind of farm that is able to retain staff for many years and be an attractive option for his children to take up for another generation.

The DSL makes a positive contribution to social sustainability with working on the DSL seen as a positive change for staff as it creates opportunities for job variety and skill development.

Practice

Resources:
The dairy farm and DSL are fully resourced with plenty of staff and enough machinery to ensure resource constraints are never an issue with getting things done well and on time. Doing winter milk means that cows have high feed demands, which must be met to avoid financial loss. For example there are two large silage wagons as well as several hundred tons of balage on hand to ensure that machinery breakdowns are never a cause of problems with cow feeding over winter.

Resources extend to areas beyond ensuring cows are fed well, for example problems with deaths and injuries during transport led to a decision to buy a stock truck.

Farmer 1D has excellent staff retention with staff that have been with him for thirteen and twenty years. Allowing people enough time off contributes to low staff turnover as is the improved work and social opportunities for partners and spouses of staff created by proximity to town:

'Doing winter milk is hard work. You've gotta treat them right, pay them well, give them time off.'

Relationships outside the farm system are also important in avoiding problems with the council and in creating opportunities. Avoiding issues is important because the farm is surrounded by lifestyle blocks and small farms: *'We keep talking to our neighbours to work out issues.'* Developing relationships with neighbours has created opportunities to continue the expansion of the farm and to harvest silage.

Timing and Attention to Detail:

The time of greatest stress on the system is spring when the home farm is milking 700 cows, the farm is depleted, possibly with damaged pasture, and supplement reserves are low. At the same time as the farm is under maximum pressure, paddocks have to be shut up for silage to ensure silage cuts are done early when grass is high quality and when a window exists to take three more cuts of high quality silage through the season.

With winter milk, high quality silage is absolutely essential to success. Economies of scale and good organization help with getting the silage chopper in when pasture quality is optimal.

Features of Case 2A

Success with Leased DSL:
The detached DSL block is on an Environment Canterbury lease, which limits options for intensification, however this is balanced by low rent. This lease is long-term lease (5 years, renewable) and the farmer is compensated for any improvements if he ever gives up the lease.

Adjacent Irrigated DSL:
The adjacent situation with the irrigated DSL allows cost savings as pasture is taken into winter and fed to winter milk cows.

Detached Dryland DSL:
The detached dryland DSL block is used for silage production and grazing cows between late summer and early spring. The dryland farm compliments the irrigated adjacent DSL because low production in dry years is balanced by high production and good utilization at the home farm. Ownership of a stock truck greatly simplifies stock movements, which means that farmer 2A is able to capture many of the advantages of an adjacent DSL system even though it is some distance away.

Success With Heavy Soils:
Farm 2A was specifically chosen for a dairy conversion thirty years ago because of soils that suit winter milk production. The soils are of a type that is heavy, and thus very productive, but very resilient to damage from cows over winter. This soil recovers well and even when it was transformed to a 'sea of mud' in the winter of 2006 it recovered very quickly and the farmer was able to drill grass in with minimal preparation. *'The repair jobs were amazing'*

B.2.2 Case 2B

Case study site 2B is a large dairy farm system consisting of 1400 cow and 800 cow dairy farms supported by three DSL blocks totalling 484ha in area.

The DSL areas have not been developed since purchase. While lanes and subdivision are good, a water system designed for sheep and deer is vulnerable to damage by cattle and there is some pugging around troughs. There is uneven watering (and uneven yields) on border-diked paddocks, with progressively lower kale yields moving away from the race.

The focus of DSL management is simple, resilient systems that help avoid problems or mistakes while keeping the management focus on the MP. The DSL and MP are adequately resourced with plenty of staff and machinery. It is interesting to note that 100 hectares of recently acquired, adjacent land was immediately included in the milking platform rather than being used to provide support services. At the same time as this has happened, the dairy shed has been upgraded so that only one person is required to milk cows and more cows can be milked without increasing the number of staff.

The MP has very high production of over 2000 MS/ha in the last season. The drivers of this high production appear to be high soil fertility and careful supplementation late in the season rather than support by DSL.

Case study site 2B contained evidence that while DSL is very useful in managing the cost of wintering and other feed inputs, it is not necessarily the key to achieving high milk production. The owners of Farm 2B have a highly pragmatic approach to use of capital and have experienced rapid business growth.

Perceptions of Sustainability

Economic Sustainability:
Achieving economic sustainability is not so much a matter of enhancing the MP as of control (not necessarily minimization) of the cost of feed supplied. Budgets indicated that the cost of ownership and running the DSL were about the same as the grazing bill, but that the farm would no longer be vulnerable to market fluctuations or cost over-runs. Thus DSL was not acquired to enhance and protect the MP as happened at many other case study sites. Since the addition of DSL, Farm 2B has continued to slowly increase production, however this increase may be as much a result of ongoing refinement of existing systems as actual inclusion of DSL in the dairy farming system.

Variation in the cost of wintering has been a real issue in the past:

> *'On 15th May there was only enough to feed 150 cows, even though we had a contract for 700… then we had snow which resulted in a lot of waste. We had to buy balage for 700 cows for the winter, it cost us a fortune.'*

The owners do not believe that including DSL in a dairy system is about enhancing or saving costs on the MP because there are economically equivalent ways to achieve these things without the high costs of DSL ownership.

When using graziers to supply winter feed, the owners of Farm 2B did the work themselves, which meant that the risk of underfeeding cows was the same. Grain is used to maintain cow condition and extend lactation at the end of the season so cows do not need to be 'trickled' to the runoff at the end of the season or given special treatment to get them in condition. Cows are calved on a calving pad ensuring that in early spring MP pastures are grazed solely by lactating cows.

The main benefit to the MP is in spring when cows can be bought back in groups rather than all at once as tends to happen with a grazier: *'The pressure it takes off the home dairy farm, dribbling cows slowly back to the farm'*

Environmental Sustainability:
The DSL is beneficial in an environmental sense because it prevents mud and other destruction on the MP and disperses the impact of dairy cows. If farmers are able to control wintering of cows they will also be able to control or take responsibility for the impact that they make over winter.

The interviewee believed that the unbalanced public perception of dairy farmers had to be addressed. Environmental and animal welfare problems occur in every industry, but it seems that public or media attention only focuses on dairying. He pointed out the example of the farm he recently acquired next to his dairy farm. Under the previous owner the farm had been badly neglected with appalling fertility levels: '*the soil was practically dead'* and sick animals. Recently the farm was shut down by the SPCA when it became part of Farm 2B. All of this on some the most productive dairy land in New Zealand. The interviewee believed that such comparisons often escape urbanites who indirectly hold legislative power over dairy farmers.

Social Sustainability:
The DSL has a positive impact on staff as they do not get overworked and it creates job variety:

> *(After replacing guns with a pivot) 'We were getting bored with 900 cows, everything was getting done. Going down to the runoff to shift fences and so on was a change, well within the staff capacity to do so.'*

Staff retention is very good; one staff member has been with him for eight years and another for five and all staff plan to stay next season.

Practice

Resourcing:
Adequate resources appear to be central to success with every aspect of the system. There is no point in making a substantial capital investment in DSL and then under-resourcing it so it fails to reach potential. An under-resourced system will also impact on the MP as the DSL fails to control external factors.

Staff are looked after, there are enough staff to ensure everyone gets a reasonable amount of time off. In all 13 staff are employed on the main farm, including a nanny and a calf rearer in spring. As a result this farm has *'better than average'* staff retention with all staff returning for another season.

There is a development program in place for DSL areas. Centre pivots will be installed on irrigated DSL in 2008. This will reduce labor inputs and result in more even watering. At the same time farmer 2B will remove deer farm fences and troughs and replace them with stock water systems and fences appropriate for wintering cows. The dryland DSL would suit conversion to an intensive grazing unit if an irrigation permit can be obtained. It has excellent free draining soils with good fertility and a structure that is highly resistant to pugging and compaction. The square shape means that it would suit irrigation by a single, large centre pivot.

Planning:
Rather than investing time and energy in extensive planning, the farm owners prefer simple systems that work. For example instead of going to the time and expense of feed budgeting on DSL, they prefer to keep things very simple by assuming that dryland DSL produces 6 tons of feed per year and irrigated DSL produces 12 tons of feed per year. They do not allocate feed, preferring instead to *'feed what is there.'* and use silage to make the cow diet up to 12 kilograms per day.

Simple but effective solutions maintain a focus on the dairy farm. Examples of such systems include investing in a centre pivot irrigator, broadcasting on oats as a cheap but quick winter feed, using high energy supplements to ensure cows are in condition at the start of winter, not doing a transition feed and not feed budgeting. They have never done a transition feed from grass to crops and still gets 540 milk solids per cow as they believe that as long as cows are fed enough, they do not require a transition feed.

Timing and Attention to Detail:
It is important to get crops in early; ideally they should be knee-height by the beginning of February. Getting crops in early is particularly important on dryland where crop growth relies on moisture retained in the soil or rainfall that must be utilized when it comes.

Features of Case 2B

Adjacent DSL:
There is no adjacent DSL in this system. It appears that the owners of Farm 2B can achieve many of the benefits of adjacent support land (business growth, flexibility, protection of the milking platform in spring and so on) by careful planning. Strategies to protect the dairy farm without using adjacent DSL include using grain to improve cow condition in autumn and having a specially constructed calving pad to contain springers and keep them off dairy pastures.

When 100 hectares of adjacent land was acquired recently it was immediately included in the milking platform rather than being used to provide support services. Rather than expanding the dairy shed, it has been upgraded (with automatic cup removers) so that only one person is required to milk cows and milking can go on much longer without increasing the number of staff.

Dryland DSL:
The dryland DSL unit appears to have made a good contribution to the DSL. The use of forage crops and whole crop silage has led to excellent production for dryland in Canterbury. Some areas of this farm have produced 29 tons of feed/ha in the 13 months prior to the interview. While crop yields are lower on dryland, this is partially offset by the improved utilisation (reduced trampling) and lower environmental impact with more dispersed stock.

Crops supply feed more predictably and with better control and less problems with pests (grass grub) than pasture. The unpredictability of pasture on dryland DSL is a problem because feed shortages will result in pressure on other parts of the system.

The low intensity dryland was also useful when the farm still relied on graziers for most winter grazing. In the winter of 2006 the cows came back early and were able to go on the dryland areas until the MP pastures were no longer vulnerable.

B.2.3 Case 2C

Case 2C is a small-scale winter milk farm with 120 cows milked through winter. A detached 62ha DSL unit supplies support services to a 100ha MP. Providing grazing for dry cows, young stock and dairy beef. There is also 20ha of attached DSL that supports calf grazing and supplies silage to the dairy farm. The DSL is 100 per cent irrigated, with the winter feed supplied by silage and grass saved from autumn. The detached DSL is 6km from the MP. Access is by a little used gravel road.

The DSL unit is well developed with good pastures and a simple layout. Pastures appear to be of excellent quality with 4000kg/ha and 'tight' covers. Post-grazed pastures are in good condition with no evidence of pasture damage or muddying. Conventional fences and gates allow control if the power is cut off. Large dairy farm style troughs are protected by gravel pads to prevent mud and pasture damage. Irrigation is by a towable centre pivot. Cows, youngstock and beef appear to be in excellent health and well settled for this time of day (late afternoon). Stock are divided into a number of smaller mobs to facilitate control. Silage has been fed out several days in advance to facilitate ease of feeding and minimise trips on to the paddock.

Case 2C is a simple low cost system with efforts taken to achieve a balance between financial returns and environmental and social impacts.

Perceptions of Sustainability

Economic Sustainability:
Farmer 2C is generally satisfied that the DSL has reached economic potential. He has control over how cows are fed and costs are under control. The main focus of management is growing enough feed to achieve business goals: *'The main thing is just to grow enough grass'* The DSL also fulfils the specific need of protecting the vulnerable dairy farm soils and guaranteeing that dry cows will not interfere with milk production over winter. The DSL allows the farmer to achieve a self-sufficient and low cost farm system:

> *'I prefer to have a few cows less and keep the whole system running. As soon as you feed out, it is a cost. You have to do it every day and it is not worth it.'*

Environmental Sustainability:
Farmer 2C believes that environmental drivers are compatible with commercial drivers. Simple systems and all-grass appear to make it easier to do this because pasture damage and inputs of fertilizer need to be controlled in order for there to be commercial success. For example this farmer is highly averse to creating mud, he believes it costly both in terms of repairs to pasture and distress and disease risk for cows: *'You get Mastitis and everything.'*

Social Sustainability:
A simple grass-based system means that the staff spend a minimal amount of time on the DSL and all feeding is done within 1-1.5 hours. This is important because doing winter milk means that staff are busy all year:

> *'We are working the whole year through, I can't have something here that I have to look after, I would quit milking. Why make it complicated?'*

Practice

Resources:
Rather than assigning large amounts of resources to the DSL, Farmer 2C has devised a simple system that achieves results at low cost. All-grass wintering and centre pivot irrigation means that this system is easy to resource. Grass allows the farmer to feed silage out four days in advance (in rows ahead of the breaks). Impacts on pasture are controlled which means there is minimal expense on pasture renovation.

The farm is well developed with a good stock water system and conventional fences and gates:

> *'You need good fences, otherwise you have got a big mess, drafting cows all day for what?'*

A centre pivot simplifies irrigation:

> *'Pivots give better watering and you can control the amount of water very easily… Normally I am on my own and I wouldn't have the time to move irrigators on my own.'*

He also believes that the centre pivot has environmental advantages:

> *'With the pivot you can really control the soil moisture and nutrient runoff.'*

Planning:
Avoiding forage crops and cultivation greatly simplifies the DSL and reduces the need to plan. The focus is on simple but effective systems. Routine is important:

> *'You need to be in a routine with the animals. Feed them at 10.00am and they should be settled down in the afternoon.'*

Attention to Detail:
Records and monitoring are a very important component of practice at this case study site.

> *'You need records, otherwise you lose track of things, how much they grow, you know very quickly if something has gone wrong, they are not doing so well.'*

Records include fertility, pasture quality, nutrient applications, fecal egg counts and liveweight gain records for all classes of stock.

Care is taken to graze to low residuals so as to maintain pasture quality and avoid waste. Eco-N is applied, but this must be done at the right time when residuals are low.

High quality grass leads to high quality silage. Inoculant is added to silage. The result is highly palateable and very nutritious silage. The comments on importance of attention to detail with silage making are supported by observations; the silage had a sweet smell with no signs of decomposition.

Grass grub is a significant issue with pastures on DSL. Attention to detail and monitoring is also important in managing grass grub:

> *'You need to look when you make silage or hay. In the paddocks that are bad, you need to go in with the cows and trample them, plus some bioshield and you don't have a problem.'*

Features of Case 2C

Soil Type:
This farmer selected DSL in this location because of the light-free draining soils, which suit wintering cows: *'It's a good area for wintering cows.'*

Grass Wintering:
Farmer 2C believed that the use of forage crops would introduce expenses and complexity that he is not prepared to deal with on a system of this scale:

> *'With forage crops its too complicated, when you have brassicas, staff have to come twice daily, it's expensive…If I have kale, I need machinery and I need contractors. I have to pay for all this, then I have to cultivate and re-grass in summer time.'*

If cows bag up early (as can happen on all-grass systems), Farmer 2C will simply begin milking them before they calve:

> *'When I see them bag up, I just milk them, you can't wait or you get Mastitis and everything.'*

B.3 Case Study 3: DSL in Southland

B.3.1 Case 3A

Farm 3A is a 141 hectare dairy support farm with all of the farm area in grass. Of this, 41 hectares supports the grazing needs of 150 in-calf heifers and 100 hectares supports winter grazing of 560 milking platform cows. The DSL is 24km from the dairy farm.

Pastures are a mixture of new grass and older cocksfoot type pastures that need renewing. Portable troughs with alkathene pipe appear functional but slightly fragile: *'On a bad day we'll do four ballcock arms.'* Trough breakage is an issue because it is a cause of pasture damage and mud. A side-feed silage wagon and tractor appear in reasonably good condition. There is a spare silage wagon on the dairy farm.

All grass wintering results in a simple, uncomplicated system. The system is low input in terms of labour inputs and money with excellent utilisation of feed. The non-use of crops and ability to avoid mud or transition feeds means that it is relatively easy to contain environmental and social impacts.

Farm 3A is unique among the Southland case study sites in that it relies completely on grass to grow and transfer feed to winter and achieves very low costs of production. A willingness to try new things and actively seeking new information has resulted in a unique system for this region.

Perceptions of Sustainability

Economic Sustainability:
The most important function of the DSL is facilitating high milk production at low cost. The ability to guarantee feeding and move cows to the MP at the right time both protects and enhances production.

The DSL has played a development role. The block was bought as undeveloped tussock several years ago and converted to pasture. If necessary the land could be further intensified by irrigation from an easily accessible aquifer.

Environmental Sustainability:
Farmer 3A believes that in environmental terms, his system is as sustainable as practically possible. He believes that the ability to minimise environmental impacts is a major advantage of an all grass system.

The combination of high cost, poor utilization and environmental impacts means that swedes are probably not sustainable in Southland in the long term: *'You've got a mud paddock, generally, there's a creek somewhere that it's going to flow into'*. There were also comments that the high costs of fertilizer and spray means that swedes are a very expensive way to supply winter feed to cows: *'there'd be nothing spraying a crop of swedes every six weeks… 800 kilos of triple super'*. Finally Swedes give inferior utilization to grass. In an ideal situation utilization would never be more than 80 per cent and in wet conditions it would be much less.

Social Sustainability:
The simplicity of an all-grass system helps contain social issues with the DSL, however time can be an issue in spring when there is a lot to do on both farms: *'I need another two hours in the day.'*

Farmer 3A believes that staff will be a major and ongoing issue in the dairy industry:

> *'Attracting and retaining staff in the dairy industry as a whole is going to become such an important thing in the future... 35 new dairy farms in Southland this season, talk of 60 next year. These farms will all need managers, where will they come from?'*

Practice

Resources:
Although the DSL is a low cost system, it is still important that appropriate machinery and labor resources are available to ensure key tasks are carried out on time. For example there are two silage wagons available (one on the DSL and one on the dairy farm) to ensure it is always possible to feed out.

Farmer 3A thinks that the purchase of a direct drill might be worthwhile because it would guarantee he could do repair jobs on pasture early in spring so that grass could establish in time for the late spring dry.

Farmer 3A believes that it is essential to invest in staff, even if they will not be around forever. He tries to make sure the DSL creates benefits for staff and attempts to make sure staff get to do a variety of jobs.

Resources have been important to setting up a system that works. Finding better ways to use DSL has involved a lot of time and energy thinking, observing and talking to other farmers about how they deal with all-grass wintering:

> *'I thought 'there's gotta be a better way to do it, if they can all grass winter in the North Island, we can all-grass winter down here, so I basically went and spoke to a heap of people that were doing it and then the biggest problem… the biggest thing I got back from those guys was that it didn't work, one was not having high enough energy feed late in winter, that was the biggest issue, the cows did really, really well up until about the middle of July and then they just crashed. So, I looked at why they were crashing and the reason why they were crashing was not high enough energy feed, so then I went to grass seed reps to find out how I could go all grass and still have high enough energy feed going in. And that was when I come up with the Feast idea and started chasing that.'*

Resources applied to develop the block well are clearly linked to containing environmental impacts: 'Having the creeks all fenced is awesome because your fertiliser is so much further away from the waterways.'

Planning:
The simple system means that the farmer spends less time on planning than he would if he used crops. It is notable that a great deal of energy went into setting up the system in the first place.

No pasture measurements are done, but a feed budget is done to calculate the 'feed block' for winter.

Farmer 3A avoids exporting or importing feed, this is done on both the dairy farm and the runoff to minimize costs and ensure there is good utilization of all grass.

Nutrient budgeting has optimised fertiliser use and increased awareness of nutrient loss.

Timing and Attention to Detail:
Over winter, farmer 3A protects pasture by closely monitoring the impact that cows are having on pasture and controlling stocking density accordingly. Other practices include ensuring stock are fed enough, moving stock every day and using a system of portable troughs so that stock are not walking up and down the paddock.

Low covers at the time of a wind event will result in pasture loss, for this reason it is important to do silage cuts as early as possible so that the grass can recover before it gets windy.

The moisture loss that occurs with periods of hot dry winds means that great care must be taken in timing of cultivating and re-grassing.

It is important to avoid applying fertilizer at the wrong time as fertilizer will be wasted and will wash into the creek where it will cause ecological damage:

> *'What's the point of spending $30,000 on fert and then turn round and having 100mm of rain? ...Straight in the creek.'*

Features of Case 3A

Soil Type:
Soils are light and stony which compliments the heavy soils on the dairy farm. Light soils are more suited to growing grass than growing forage crops in this climate: '*Riverbed with a bit of cover on it, it was bought for that reason.'*

All Grass:
The period of hot, dry winds that comes at the end of spring every year favours an all grass system. Wintering on grass will give more feed with better utilization and better feeding than would be possible with a crop-based wintering system in these conditions: *'With grass wintering and good utilisation we know what we are feeding them.'* Furthermore, avoiding the use of crops saves costs allowing Farmer 3A to achieve a low cost of production with costs per unit milk solid of $2.00 and $2.12 over the past two years.

Secondary advantages of going all grass include the ability to graze all youngstock on the DSL, a better working environment for staff in winter and much lower incidence of silt runoff into streams.

For success it is crucial to supply quality grass at the end of winter because the limited stomach capacity of cows prior to calving means that they need quality feed at this time. Farmer 3A has found that choice of pasture species is important with Feast ryegrass the best way to carry quality feed through to the end of winter. Grass grub is an issue that can be a very costly problem to address. The solution is to squash grass grubs with cattle or a heavy roller and to re-grass if damage is severe. Pasture needs to be rejuvenated at least every five years because the summer dry means that cocksfoot is dominant and will take over pastures in a few years.

Inductions:
Farmer 3A asserted that inductions are undesirable practice that causes sick cows and makes up for shortcomings in other areas.

> *'Why are we dealing with that cow? Because we inflicted it, by not having enough feed in winter and not having enough feed through winter and not having cows in good enough condition at calving, or through needling that cow and inducing her… it's not natural.'*

Although avoiding inductions has increased the empty rate, farmer 3A believes that by not doing inductions he avoids many hidden costs and introduces a driver for good practice. Cows need to be well fed through winter and spring for a non-induction policy to succeed: *'The only way to make money is by feeding cows properly.'*

B.3.2 Case 3B

Farm 3B is a dairy support business that combines dairy grazing with sheep farming. Stock wintered include 1100 cows, 150 rising one year old heifers, 4600 ewes and 1400 mated hoggets. There are three blocks in the system; A home block (364 ha) which supports silage making and winter grazing of ewes, a hill block owned as a joint venture (324 ha) from which they buy sheep grazing in summer and a lease block (243 ha) which is used for winter grazing of cows and year round grazing for sheep and dairy heifers.

The heavy soils and large number of creeks on the home block mean it is not suitable for wintering dairy cattle and mostly supports sheep over winter. It is lightly stocked over summer and is used for silage production to meet the feed demands of winter grazers. The low-lying situation and proximity to creeks will greatly limit future intensification of this block.

The lease block is used for winter grazing of dairy cattle and ewes. The light, stony soils of this block mean that this farm has low summer production, but is excellent for grazing dairy cattle in winter. The comments about soil type are supported by observations of the farm soil profile.

The hill block was recently developed and supports sheep grazing in summer, complimented by dairy cow grazing over winter. The sheep benefit from the increased fertility associated with dairy pastures, while the dairy cattle benefit from the elimination of weeds such as Ragwort.

Case 3B is important because it gives insights into the perspective of non-dairy farmers, both in technical terms in how they deal with DSL and how they relate to their dairy-farming customers.

Perceptions of Sustainability:

Economic Sustainability:
Grazing dairy cattle compliments sheep farming because feed supply and labour work in well and the income from dairy grazing is steady, dependable and low risk. On a sheep farm there is a peak in feed demand in spring as lambing begins, with lower demands through the rest of the year, and dairy grazing works in well with this because it utilizes the feed grown and saved in autumn. Grazing dairy cows improves labour utilization because it goes on in winter when the farm is quiet. The income streams from sheep and dairy grazing also compliment each other, with the income from dairy grazing depending on a different set of economic fundamentals to sheep farming, thus reducing the exposure of the farm to market risk.

Environmental Sustainability:
The interviewees did not believe that there was a significant difference in environmental impacts between combining sheep with dairy support and intensive sheep and beef farming. Stocking rates, the kind of stock carried and impacts on the land are all very similar. Actions taken to ameliorate the impact of stock on land included excluding cows from creeks, restricting cattle numbers on the vulnerable home block, and using direct drilling for pasture renovation and crop establishment.

Social Sustainability:
The combination of dairy support and sheep has improved the labour utilisation of the business:

'I wonder what the heck we did in winter now.'

The interviewees believed that relationships and reputation are very important to success as DSL farmers. Trust is seen as important. The basic principle of relationships seems to be treating the grazing stock, leased farm and staff with care and respect:

'He (the dairy farmer) gets what he wants, we do a good job of them so his cows are going home in good condition. None of us want to see skinny hungry cows just for the sake of profit.'

An open-minded attitude and relationship building have also contributed to business growth. The hill block is owned in a joint venture arrangement with a dairy farmer who wanted to buy and develop a scrubby hill block. This has worked well as it has allowed them to de-stock in summer and they now have ownership of a farm that has a combination of fertile, heavy soils and sheltered microclimate that make it a good prospect for a dairy conversion.

Practice:

Resources:
The complimentary nature of dairy support and sheep farming and synergies that result means that this system is relatively easy to resource. Practices that result in efficient use of resources include careful use of water races to supply water to stock and the use of direct drilling to save costs while reducing environmental impacts.

This year the farm has taken on an extra labour unit, reflecting the general increase in intensity that has accompanied the uptake of DSL farming.

It appeared that Farm 3B had benefited from an open-minded attitude and a willingness to invest resources in trying new things. Farm 3B was the first in the area to take on dairy grazers for example. Minimum tillage has been used for a number of years on Swedes. This year self feed silage stacks and whole crop silage are being tried for the first time.

Planning:
The complexities of integrating and creating synergies with the three blocks as well as with dairy farming customers meant that planning was very important to success. Farmer 3B is willing to invest a lot of time in planning, with mob sizes, yield per paddock and grazing plans carefully worked out:

'By spending that time planning how the paddocks are going to be grazed, we probably save a lot of damage to pasture.'

Staff are expected to participate in the planning process and the life of the farm. Everyone on the farm is encouraged to be intellectually engaged, as well as being an important source of knowledge or ideas: *'We are willing to get staff involved in working things out, learning, making decisions.'*

Attention to Detail:
Success with silage making, ensuring heifers meet weight targets and setting up the farm for the arrival of dairy cows all require attention to detail to be successful.

The lease block and home block rely on water races and creeks for stock water as the capital cost and maintenance issues mean that is it not worthwhile to install a stock water system. Thus, attention to detail is important to allow stock access to water while avoiding damage to streams. Direct observations of the water races supported the assertion of the farmer that careful placement of hot wires would exclude cows from creeks while still allowing them to access water.

Awareness:
Observing and responding to the spring flush is key to managing the feed demands of sheep and success with grazing management in spring. The spring flush needs to be managed well to maintain pasture quality, ensure good cuts of silage and ultimately to grow good pasture in autumn in preparation for the arrival of dairy grazers.

Features of Case 3B

Leased DSL:
The farmers believed that leased DSL was creating positive results. However they believed that the market price of leased land was now becoming very high and that it would be very difficult to make money on leased land if they attempted to replicate what they have done here.

Self-fed Silage Stacks:
The farmers have tried self-fed silage stacks for the first time this year. Experimenting with self-feeding was an outcome of poor results with swedes on light soils with yields of 8-9 tons/ha. The farmers believe that self-feeding silage has resulted in much better production (13 tons/ha with silage and grass), but suspect that severe soil damage occurs as cows spend a lot of time standing near the stack or walking to the break. There are also concerns around anaerobic soil conditions and the amount of nutrient leaching that goes on as cows congregate near the stack. Thus, while self-feeding is an improvement from an economic perspective (particularly on lighter soils), the farmers are unsure if it is a sustainable practice.

B.3.3 Case 3C

Farm 3C is a 160 hectare DSL unit supporting an adjacent 255 hectare dairy farm, used for wintering 800 cows and year round grazing of 200 calves, 200 heifers and 40 jersey bulls. Soils are a mixture of stony soils (stony loam) and heavy soils (silt). The DSL and MP are self-supporting with minimal transfer of feed as silage or grazing.

The DSL unit appears to be well organised with post-grazed pastures and crops in good order. There is a minimum of pugging or loss of pasture. Cows on grass have been shifted twice a day during snow to prevent them breaking through the surface and destroying pasture. Stream boundaries appear to have been particularly well protected with riparian strips with tussock on both sides of creeks.

The farm manager is very focussed on achieving excellence in his sharemilking job, while ensuring that other activities fit in around this. The DSL achieves goals with regards to youngstock and wintering and containing environmental impacts while the main management focus remains on the MP.

Farm 3C has invested in DSL development and relationships to gain maximum control over external factors, in addition to achieving control of feed grown and the way cows are fed, Farmer 3C also attempts to use DSL to manage the risk of environmental compliance costs and risk of being unable to find good quality staff.

Case 3C was in many ways a saturated case. It demonstrated perceptions of sustainability of DSL and basic ideas of good practice that were very similar to those encountered in early case studies in Canterbury

Perceptions of Sustainability

Economic Sustainability:
Farmer 3C believes that the DSL makes a very positive contribution to the economic success of the overall system, giving both control and positive financial returns:

> *'It still makes sense at $200/acre, put the crops in and do it yourself, you get control and you still come out ahead financially.'*

Environmental Sustainability:
Farmer 3C believes it is important to prevent unnecessary nutrient loss and soil runoff. Achieving this is a matter of resources in terms of appropriate developments and attention to detail with cow management over winter.

Social Sustainability:
Although dependence on staff and the ability to attract and retain them is an issue: *'It's not getting any easier to employ staff'*, Farmer 3C believes that the DSL has potential to create benefits in terms of job interest and responsibility for staff.

The inclusion of DSL means that the dairy farm system has become larger and more dispersed which creates new pressures for management. However the larger scale also means that there are opportunities to share management jobs and to take more of a strategic management role; *'They (2ICs) will be responsible for plate metering, heat detection and I will take a step back.'*

Practice

Resources:
For there to be control of feed offered to cows, the system must be adequately resourced in terms of additional staff and machinery to ensure key tasks are carried out effectively and on time.

The adjacent situation allows sharing of machinery. The dairy farm system has adequate machinery with three tractors, two silage wagons as well as a fertilizer spreader to ensure fertilizer is spread effectively and at the right time (immediately after grazing). A 'soil conditioner' (combination deep ripper, disk and roller) will be purchased later this year to address issues with soil compaction and lower than expected production on some heavy soils.

Farmer 3C believes it is important to have enough staff. Five people work on the dairy farm, plus a calf rearer over spring. The DSL also creates job variety for staff; *'A lot of farms employ a tractor driver but it means the staff never learn the whole system.'* It is important to ensure that staff have opportunities to learn new skills or carry out a variety of jobs.

Farmer 3C tries to get staff who have the capability to be farm managers so he can train them up. This has the benefit of taking the pressure off himself and greatly helps in management of other farms:

> *'If anything happens to (name) I will ask the 2ICs here it they want to go and manage it, and usually one of them will.'*

As the scale of the operation increases beyond a certain size, the management jobs have to be shared to control the pressure on the operations manager: *'You have to delegate, if you try and do it yourself, you just burn out.'* By delegating and increasing job variety for staff, the manager is able to reduce the pressure on himself.

Timing and Attention to Detail:
The most important time for timing and attention to detail is over winter. Farmer 3C believes that it is most important to be accurate with feeding, to maintain cow condition and minimize waste. To minimize soil damage, stock grazing forage crops are back fenced, while cows wintering on grass are carefully managed to minimize damage to pasture.

Late cuts of silage are acceptable on the DSL as silage is not exported to the MP and low ME silage compliments the high ME content of kale.

Graziers:
Relationships and reputation are important with graziers. Farmer 3C believes in sticking to grazing contracts, even if he will make a loss as a result. He looks after graziers who give good results and will truck cows long distances if he knows they are going to a reliable grazier and: *'The cows come home in good order.'*

To achieve success with graziers it is essential to communicate well and to check the cows every week: *'It doesn't matter how well you know the grazier'*. Graziers also need to have the right soil type and technical ability to grow feed. Finally it is important to be tolerant of mistakes and to deal with problems in a positive manner: *'Take the good with the bad and don't get too stressed about it.'*

Features of Case 3C

Leased DSL:

Farmer 3C believes that lease agreements are much better if the necessary developments, pasture, troughs, fencing, etc are either already there or done by the landlord as a condition of the lease agreement. In this case, the landlord did stream protection as a condition of the lease agreement.

Adjacent DSL:
During the milking season the MP and DSL are deliberately isolated in a feed sense to ensure pasture quality is maintained on both farms right through the milking season. This is done because light soils mean that it is relatively easy to avoid pasture damage on the MP in spring and maintaining pasture quality has become a key goal on both components of the system.

Soil Types:
There is a mixture of stony soils (stony loam) and heavy soils (silt). These two soil types compliment each other very well. The stony areas are excellent for wintering cows and for milking cows in spring, while the heavy soils retain moisture well and can continue grass production right through the milking season.

B.3.4 Case 3D

Farm 3D consists of a 400 ha milking platform with 423000 kg MS total production and DSL areas that winter 2000 cows, 360 calves and 350 heifers grazing year round. 2500 tons of silage is made every year.

Pasture is either grazed to a very low residual or has high covers ready for winter feeding. Very few weeds are apparent (an advantage of making a lot of silage). Little pugging was observed, even where cattle have been grazing on breaks during snow. Stock appear to be in good condition and content. They are active and curious, but not searching for more feed.

Over winter, 1380 cows are fed on crops and straw. These cows will be fed on silage with magnesium later in the season. 620 underweight cows and 350 in calf heifers are wintered on grass and silage. Less health problems and better feeding means that wintering on grass is preferred: *'we can pump the silage into them'*, but there is not enough area to do all cows on grass.

Case 3D is interesting because the new operations manager has introduced many improvements, which provides an opportunity to compare past practice with current (improved) practice. This case lends credence to the idea that strategic managers need to take time to intensively analyse their farm systems to determine how to get the best out of a particular piece of land in a particular situation.

Perceptions of Sustainability:

Economic Sustainability:
The goal of DSL management and thus the driver for practice is to use the DSL to achieve a low cost system:

> *'What I said to the guys, we probably could have done 430 solids this year, but I've said in our meetings and that, that I estimate if we could average 410000 for five years we would be doing fine, I think… on a low cost system… and that's what it is.'*

Farm 3D is a self-sufficient farm, with farmer 3D keeping to a 400 ha 'milking platform' because he can guarantee there is enough grass to feed young-stock and do wintering. He is taking on grazing (an extra 800 cows over winter, plus some young-stock) and could possibly do more. Young-stock actually add flexibility because they could be grazed off if feed runs short.

The ability to feed underweight cows or induction cows well is another benefit of control of DSL. It is particularly important to feed induced cows well to avoid sickness or deaths.

Long-term plans involve acquisition of nearby land and an expansion of the MP area, however for the time being the location and capacity of the dairy shed limits further expansion of the milking business.

Environmental Sustainability:
Farmer 3D believes that the farm system is sustainable in an environmental sense and that environmental drivers can be brought into line. Saving costs and preventing waste, maintaining pasture quality lead to a sustainable farm system. For example if grass is good quality, cuts of silage will be done in spring, which will eliminate pasture weeds and save using chemical sprays. Similarly, applying nitrogen immediately after grazing (not when the fertilizer truck comes ten days later) will mean that less fertilizer will be needed to achieve the same response. It will also help prevent a feed deficit, which will require more nitrogen applications to address.

Some areas of the farm are vulnerable to soil damage or soil compaction under crops.

> *'With the number of cows stacked on, there will always be some compaction, cows move 3-4 meters a day and you will hammer than area, by the last year (of the crop) it will be compacted deep in the soil profile.'*

Soil compaction is as much a matter of dealing with the consequences of past mis-management as it is of preventing soil damage.

Social Sustainability:
Farmer 3D thinks that staff shortages are an ongoing problem with any dairy system. He also believes that the inclusion of DSL increases vulnerability to staff shortages, but can attract staff as well:

I think people are seeing it now, but I think it's under-rated… people under-rate their staff, and don't probably treat them well enough… having a runoff or a self-contained system would mean you have a driver more so than if you had a platform. Like we had that guy that was in last night (for a job interview), he ah says he's interested in the youngstock…'

Practice:

Resources:
Farmer 3D believed that it was important to have the right resources or relationships in place to ensure tasks are done well and on time. For example investment in a fertilizer spreader was justified as it ensured nitrogen is applied in the exact amounts and at the exact time that it is needed. A soil conditioner will be purchased soon to address issues with compaction on ground coming out of crops.

Using resources well and saving costs is as important as ensuring the right resources are in place, with grazing management for example:

'We are not going to pump that stuff into them if we can utilise, eat that stuff. So it's important to get our covers right and the cows going right.'

Farmer 3D is careful with herbicides to avoid loss of clover. Productive pasture also helps control weeds as healthy grass will out compete weeds and thistles will be killed as a surplus results in silage cuts.

The farmer thinks about the way he manages things which affect staff. He prefers to hire people who want to get somewhere or develop a career. Hiring staff who like the farm is important: *'You've got to like the farm, like when I hire people to be herd managers or whatever, they have got to like this farm…'*

Farmer 3D is very active in investing in and testing new knowledge and new ideas:

'We do trials all the time; fert, nitrogen, deep ripping' New ideas being trialled this year include a magnesium applicator on the silage wagon and a 'Sumo' soil conditioner. Past trials have led to a number of insights:

- Crops need to have plenty of nitrogen to help deal with the stress of the summer dry.
- Older ryegrass (Kingston) grows more grass more reliably than anything else: *'It's harder, it handles the dry periods, if it gets dry, it just wrecks them.'*
- Eco-N is not a replacement for nitrogen. Farmer 3D estimates that this mistake cost him $15000 in lost production when he trialled it one year. Unlike many farmers, farmer 3D is still willing to try eco-N if he has better advice.

Planning:
Planning is essential to ensure there is enough feed going into winter. Providing 12 kilograms/day to 2000 cows plus 350 in-calf heifers for 70 days requires that there is a lot of feed on hand. In order to ensure that costs do not spiral out of control, all of this feed must be produced on the DSL.

There are two plans that are really important:

- A production plan to ensure that enough feed is available at the start of winter, while supplying a continual supply of quality feed to young stock.

- A feed plan detailing the feed offered to each class of stock, time spent in each paddock, daily ration and so on.

Attention to Detail:
Since the arrival of the new manager, improved grazing management with grazing to low residuals and short rotations has been one of the key drivers of much improved production:

> *'They said you could never graze more than 1200 cows on here, we have 2000 cows plus young-stock… it gets so far and it just stops, you could leave it for a week and it wouldn't do anything, you've just got to be on a short (25 day) round.'.*

Good grazing management consists of:
- Disciplined grazing to low (1450) residuals to maintain quality and avoid wastage and/or running out of feed; this is particularly important in spring.
- Avoiding grazing heavy soils in wet conditions
- Monitoring residuals and pasture production in all paddocks.
- Applying controlled amounts of nitrogen at exactly the right time. (At the start of spring, after silage cuts or grazing and after first grazing of new grass).
- Monitoring contractors as they work and building relationships with good/reputable contractors.
- Being careful with herbicides. The silage chopper will kill thistles as well.

Although the MP is intensively monitored, the DSL doesn't require this as long as the grass is harvested at the right time and the manager has a high level of awareness of the system. There is a need to be aware of what is happening in particular paddocks:

> *'I re-grassed it (paddock 8) and it was still not doing well, there were weeds in it, I just kept going back to it earlier (in the round), then getting the urea on it and it's a bloody good paddock now.'*

In other words, farmer 3D used disciplined grazing management to sort out issues with low production; re-grassing had not helped.

As well as having a grazing plan, it is important to monitor how much is being fed out. Crops need to be measured and ideally, there should be a scale on the silage wagon as well. Common sense is also important with a policy of checking on cows at the end of the day: *'fences, water, see if they settle, the eyes and ears are an important thing, the cows soon let you know.'*

Relationships with Contractors:
Building relationships with good/reputable contractors helped to avoid (potentially very expensive) mistakes with new grass or crops. It is important to have contractors come at the right time and it is also essential to monitor them or stay involved as they work. Getting work done at the right time is key; crops need to be sown as soon as possible after winter and silage has to be done right on time. Planning ahead is key to getting contractors in at the right time.

Comparison with Previous Management:
There have been issues with stewardship and management of pasture in the past, which gives an interesting basis of comparison with current practice. Thinking about the failures of the past illustrates Farmer 3D's concept of good practice in the context of conditions at farm 3D and the goals of achieving a low cost, low risk system.

Previously, grazing was not disciplined on the DSL, resulting in waste as the farmer had to mow in front of cows or feed out silage and apply extra urea to keep up:

'We've grown more silage here this year, than the place has ever made… he used to mow his grass in front of the cows cause they wouldn't eat it. He was out on a 40 day round, whereas we're sitting on a 25 day round; good quality grass. It didn't cost us money to mow it; and he fed silage as well, you know, not just mowing the hay, he fed the silage as well, so it's a big ahh cost.'

Mismanagement at re-grassing has meant grass has been unable to tiller out: *'When we ploughed it, you could still see furrows from five years ago.'*

Nitrogen was not applied at the right time: 'He's left it growing and then grazed it down, but he hasn't got the nitrogen on to make it tiller out.'

Contractors did not do a proper job with re-grassing: 'There's been a coulter missing and no one's worried about it.'

Features of Case 3D

Adjacent DSL:
Even though there is a large amount of land available Farmer 3D restricts the MP area to 400 hectares so as to guarantee there is enough grass to feed young-stock and reserve feed for wintering*:*

'*I come in here with the intention of never using anything else. I am milking 1200 cows, 3 to the hectare, there's your 400 hectares.*

Separating the two systems is a driver of good grazing management. In other words having to import/export silage is seen as a sign of inefficiency, either because feed is not utilized properly or the farm is over-stocked.

If I can keep to that 400 hectares, it means I can afford to graze my R2s and R1s on the runoff, so it is solely self sufficient farm, and a bit more, like we graze that extra 550 cows here, so it makes it a bit of income as well.'

Adjacent DSL is used to do aggressive re-grassing of the MP as while the 'milking platform' is kept self-contained, the MP paddocks may change from year to year. The adjacent situation also minimizes costs associated with time and money spent travelling to and from the DSL or moving cows.

If silage is imported to the DSL or milking platform or there is a lot of topping, it is a sign that pasture is not being grazed in a disciplined manner and that quality feed is going to waste.

While the MP and DSL are kept separate, the respective areas do move around. This works well as there is always a lighter mob of cows which milks once a day (OAD). Apart from being easier for lighter cows to get in calf, putting some cows on OAD allows cows to graze more distant areas and makes maximum use of the dairy shed.

Having a OAD mob also helps avoid the problem of cows walking long distances to graze more dispersed areas of the farm. Walking long distances is a problem because it puts cows under stress of lameness or mastitis and it puts staff under stress because they have to treat sick cows:

> *'Oh it is an issue, like we are pretty good on lame cows, but really it is a problem you know what they say about cows 'walking a kilometre losing a litre', you gotta lose milk outta them, they start getting sore feet, they're under stress, start getting Mastitis, it all does go into it, so… It puts staff under stress as well, they've gotta… treating lame cows and everything…'*

B.3.5 Case 3E

Farm 3E is a large scale, dispersed dairy support and dairy system wintering 6000 cows equivalents made up of 2200 of the farm's own cows, 2000 cows belonging to other farmers, 1000 bulls as well as young stock equivalent to 800 cows. The farm is undergoing continuous development and expansion with new DSL areas being purchased or leased as opportunities arise.

Pastures are well grazed with good residuals in most places. Where paddocks were not as well cleaned up, the farmer commented that he intended to come in again with a mob of bulls. Stockwater systems were a potential issue on some of the leased DSL. Stock have access to water races in places and there were problems with cows damaging sheep farm stock water systems.

Over winter, cows and in-calf heifers are offered at least 12 kilograms dry matter per day and are fed on either crops and hay or grass and silage. There are a variety of winter feed regimes including swedes, conventionally tilled kale, minimum tillage kale, kale undersown with Italian ryegrass, turnips undersown with Italian ryegrass, grass with conventionally fed silage and grass with self-fed silage.

The management of the DSL and MP over spring reflects the need to adapt to variable production and to utilize feed when it does grow. Disciplined grazing to a low (1450) residual is particularly important in spring. Bulls are used as a cleanup mob to finish off winter feed and help utilise the spring flush. Later in spring pasture surpluses are harvested and stored in a number of self-fed silage stacks.

The farm tends to dry out over summer with less feed available. Bulls go off (leased to dairy farmers). Forage crops are in by the end of December. The dairy farms will go partially Once-A-Day (OAD) over summer to help keep condition on lighter cows. Going OAD also allows farmers to milk off adjacent DSL areas. In autumn, DSL pasture is shut up for winter, bulls come back and are fattened on autumn growth to prepare them for sale.

This case study site was significant because of the focus on pragmatic business growth, the importance of planning to a large scale system and the involvement of DSL in acquisition of or breaking in large areas of run down or undeveloped farms.

Perceptions of Sustainability

Economic Sustainability:
Even though Farmer 3E believes that returns on investment for the DSL are very good, the main benefit of DSL ownership is the ability to control how stock are fed and thus to guarantee cow condition. The focus of management is growing quality feed and ensuring staff feed stock properly.

The farm is undergoing continuous development and expansion with new DSL areas being purchased or leased as opportunities arise. The activity of buying rundown farms at a low price and developing them as DSL has also created opportunities for expansion of the milking business. Farm 3E is in the process of converting one DSL block into a milking platform which will bring the total milking business up to about 3400 cows or 1200 hectares. As this goes on the DSL area is continuing to expand and grow with an aggressive program of leasing and buying DSL in the local area as it becomes available.

Environmental Sustainability:
Farmer 3E sees environmental sustainability in terms of stewardship of the land. He is less concerned about environmental impacts because (unlike many places in Southland) the DSL areas are all on light soils and the impact of cows is easy to control. He is proud of what application of resources and an enterprising attitude has achieved in terms of improving on previous land use:

> *'We have wintered 1200 cows on it for the past two years, before that they wintered 300 sheep, we just dumped the lime on it, we direct drilled it, it was really slow because of the rocks, we kept drilling it in Italian every year and put a self-fed silage stack on it…. All of northern Southland could be like this if they re-grassed it and put fertilizer on it.'*

These comments are supported by observations of neighbouring farms, which had low stocking rates, old and dead pasture, rotten hay and unfenced waterways.

Social Sustainability:
The scale and high proportion of DSL means that there is a high level of vulnerability to staff problems. This is in contrast to smaller systems where it is easier to assume control or monitor what is happening if managers or staff under-perform. Poor staff will wreck machinery, forget to shut gates or feed a mob of cows. Even experienced and mature staff will create problems, farmer 3E spoke of difficulties with an experienced manager who underfed stock, resulting in stock losing condition: *'He wouldn't feed the cows, he'd roll the reels up and leave them in the paddock, the cows would eat them…'*

Practice

Resources:
Investment in machinery, staff and appropriate developments are fundamental to achieving sustainable outcomes.

It is important that there is enough machinery and staff resources to ensure tasks are carried out on time and well. Farm 3E owns a Crosslot direct drill which allows targeted and timely re-grassing of pugged or muddy areas in early spring (before the late spring winds).

There is also a plan to purchase a fertilizer spreader to ensure even and timely application of fertiliser. The driver of this decision was a fertilizer truck malfunction, which resulted in over 600 hectares of uneven application (accompanied by uneven growth) in autumn. I observed the consequences of strips of yellowed grass and uneven crop heights at the time of the interview.

There is substantial extra feed available in case things go wrong in winter. Farm 3E budgets enough feed to winter an additional 1500 cows, which represents 25 per cent excess capacity. This feed is normally fed to bulls and carry over cows or else is held over to the following year.

It is important to invest in people and relationships even though the benefits are temporary and results are never guaranteed. Dealing with people on any level requires patience and adaptability; a willingness to *'take the good with the bad'*, a comment supported by observations during the interview where the operations manager appeared to invest substantial energy in motivating and communicating with staff. Farmer 3E believes that it is worthwhile to pay extra to keep good staff because problems (and economic losses) occur much less frequently when good quality staff are on the farm.

Farmer 3E believed that with detached DSL, there needs to be someone in charge of it for 12 months of the year. With this DSL system there is the scale to ensure that there is stock on the DSL that managers are kept busy all year round. DSL areas adjacent to MP areas do not require a dedicated manager if there are enough staff and machinery resources on the MP. The MP area tends to 'move around' or expand as paddocks are re-grassed, cows are added or the system adjusts to dry years.

Knowledge and learning for the manager and owners of farm 3E is a matter of keeping to basics while being open and analytical about new ideas. Practices that have been trialed recently include using Eco-N, Minimum tillage on kale paddocks and self-feeding silage stacks.

Planning:

Every activity on the farm follows a plan or a routine. The two essential tasks that require planning and communication to be successful are growing feed and feeding out to stock.

Making and communicating plans seems to be key to ensuring cows are fully fed over winter. The goal is to ensure cows are fed to capacity. Routine is important with all feeding out finished by 10:30am. Staff walk through all mobs at the end of the day to see if they are settled and observe cow behaviour and the contents of hay feeders before the cows are fed. Stock behaviour and other signs must be taken note of; cows should not be bellowing before they are fed and there should be a little bit of hay left in the hay feeder.

Cow condition is important over winter. Farmer 3E condition scores all cows with the consultant at the start of winter and divides them into mobs and designs a feed plan appropriate to calving date and required weight targets. During interviews, farmer 3E seemed very aware of stock condition and stock behaviour as well as having definite knowledge of cow health problems or deaths that had occurred so far (4 deaths and 4 slipped calves).

For the rest of the year planning, routines and communication are essential to integrate the various enterprises, maintain pasture quality and ensure enough feed is grown and stored for the following winter:

- Early calving along with grazing to a low residual to maximize utilization of feed grown between the spring flush and dry, windy period in early summer.

- Milking is OAD for the first 2 weeks until the spring flush begins. This is done to *'make sure we have enough cows in milk to utilize the huge spring flush'* and make sure that the first grazed pasture is ready for the silage chopper by October 15th so silage is done by the summer dry.

- Young stock may graze on the milking platform to help control pasture during the spring flush and maintain pasture quality through the season.

- Very little silage is fed out on the dairy farms in spring: *'It saves money and it means that tractors are freed up for other things like re-grassing on the runoff'*. Farmer 3E prefers to milk OAD rather than feeding silage as a way of getting through before the onset of the spring flush.

- Complimentary classes of stock such as beef bulls, carry over cows and ewes impart flexibility because they can adapt to variations in diet. They can go hungry over winter and clean up in spring when there is left over silage, grass or forage crops and residuals need to be kept under control. Bulls are leased to dairy farmers over the summer. This works well because there is a feed deficit on the DSL over summer.

- In autumn the beef bulls are fattened and sold and DSL pasture is shut up in preparation for winter. An inventory of feed available and a feed budget are done by a farm consultant.

Attention to Detail:
Diligent grazing management; grazing to low residuals (1450) on MP and DSL is a key aspect of management on this farm. Low residuals are important to manage the spring dry, maintain quality right through the season and save costs:

> *'We don't top anything, it's all got to be done by the animals… any surplus goes into silage…. Make sure the surplus is where the silage is because it's cheaper to cart it there.'*

These comments were supported by observations of recently grazed pasture. One paddock that had been grazed to 1600 or so was scheduled to be visited by a 'cleanup mob' (bulls or carry-over cows) before spring.

Features of Case 3E

Lease Blocks:
The short term of many of the lease agreements means that the lessee needs to be careful about capital invested in leased land. Ideally the landlord should pay for capital-intensive development such as cattle-appropriate stock water systems or riparian strips. If this is not done, the DSL is unlikely to be fully developed and an unsustainable situation may result as the land fails to reach productive potential or problems occur with inappropriate stock water systems.

Scale:
Case 3E illustrated the advantages and vulnerabilities of a large system. Large systems may be able to take advantage of business growth opportunities and can achieve economies of scale with the availability, quality and value gained from rural services such as contractors, consultants and fertilizer companies. On the other hand, large systems may be more vulnerable to difficulties with staff or managers.

Despite being much larger than other DSL systems in the study, the fundamentals are the same as at any other case study site. The key driver is control of feed supply and there is the same need to fully resource the system and plan well to achieve success. The set of enterprises and the way the land is used is similar to other systems with a large proportion of DSL such as Case 4C (a 440 ha dairy farming system) and Case 2C (a 182 ha dairy farming system). The main priority is ensuring that all grass is utilized at the right time and that animals are well fed while minimizing costs. There is no separate accounting of costs for the DSL and MP components.

Grass and Forage Crops:
All-grass wintering is seen as better for cows and is feasible in this system because the DSL area is double that of the milking platform. However all grass will never completely replace crops on this farm.

Crops play a valuable intermediate role in breaking in what were until recently run down farms. Cropping is effective as a way to make money out of land during the transition to DSL or MP pasture. Crops have not done well this year as a particularly dry summer meant that crops were slow to establish and weeds became a problem. Cows on crops get fed a diet of 6t of crop with 4t of silage and 2t of straw.

With grass, choice of pasture species is important. After trailing a variety of species, farmer 3E has found that a variety of older ryegrass species such as Kingston and Nui provide the best fit for the climate and level of intensity of this system. Some Italian ryegrass is planted. Italian ryegrass is good because it can maintain quality until the end of winter and is highly palatable.

Self feeding silage stacks:
According to farmer 3E the main benefit of self-fed silage stacks is that there is no need to run a silage wagon and tractor over winter, no running cost or capital cost and no risk of breakdowns. There are also lower trucking costs at harvest as the smaller stacks mean less distance to travel. The time to feed out is about the same as with a tractor and silage wagon. Having a large number of smaller stacks also allows a large number of smaller mobs, which helps control the amount of damage that cows do to pasture and aids cow management. The main issue with self-fed stacks is probably the concentration of nutrients as cows congregate at the face of the stack. The key to success with self-fed stacks is having a number of small stacks so that cow density is low enough and the break long enough that soil damage and nutrient loss is contained.

B.4 Case Study 4: Further Investigations in Southland

B.4.1 Case 4A

Farm 4A is a self-contained dairy system. The total farm area is 592 ha, with 1500 cows grazed right through the year. A detached 260 ha sheep and beef farm supplies silage and young stock grazing, enterprises that compliment stock trading activities associated with this farm.

The DSL acts as a development stage from poorly drained land with limited potential to high production dairy pasture. Development consists of re-doing all tile drains, followed by one or two winters with kale, then barley for whole crop silage followed by annual or perennial ryegrass

Now that the development is almost complete, the milking platform area and number of cows wintered will exceed the capacity of the home farm and a nearby farm has been purchased to supply support services and winter grazing.

Attention to detail and the right things being done at the right time were a feature of this case study site.

Perceptions of Sustainability

Economic Sustainability:
The adjacent DSL acts as a development stage between run down land with unreliable drainage, and high production dairy pasture. The advantage of incremental development, described above, is that it allows drains to be done at low cost, and the sharemilkers on the property to grow their herds without purchasing large numbers of cows or changing jobs.

Environmental Sustainability:
Farmer 4A believes that environmental best practice is simply a matter of running all aspects of the farm system properly: *'Everything is to do with management, it doesn't matter what regulations you have.'*

Farmer 4A believes that economic drivers are aligned with environmental drivers on this farm, tile drains and correct use of Eco-N are examples of practices that have both economic and environmental benefits. Tile draining means there is no issue with keeping cattle out of creeks or open drains, while pastures drain much better and are less likely to suffer damage. Eco-N has been very effective in improving pastures at the same time as reducing Nitrate leaching: *'It makes the grass very even, you don't have urine patches, it seems to spread the nitrogen out.'*

Compliance costs are a source of concern regarding the long-term sustainability of dairy farming. Farmer 4A believes that Environment Southland behave in a reactive manner, responding to public pressure or effects they can easily measure, rather than taking a sensible or strategic approach. As a result dairy farmers receive more attention and stricter enforcement compared to other kinds of farmers who are often worse in terms of environmentally harmful practices.

Farmer 4A believed that communication and involvement would greatly improve the relationship between local authorities and dairy farmers:

> *'Why don't they talk to farmers who are not offending and find out what they are doing right rather than sending out so-called experts with an academic qualification going on about what people are doing wrong, rather than what people are doing right with the likes of eco-N but they are not interested in it.'*

Social Sustainability:
Farmer 4A did not believe that there were any social sustainability issues with his farm. With all cow management undertaken by sharemilkers there are no real resource conflicts or problems with overwork on his side of the business.

Practice:

Resources:
It is important that adequate resources are assigned to DSL. This farmer has sufficient people, tractors and gear to ensure key tasks such as drainage, soil conditioning and cultivation are done. Farmer 4A gave an example of a farm that he purchased where the previous owner had not had the right machinery to ensure environmental impacts were contained:

> *'(The previous owner) had it for about a year and really hammered it with machinery and with animals (900 cows on 80 hectares) and the spring we took it over I didn't think it was ever going to grow grass again, but a year later it was coming right… If he'd had that farm for any length of time he would have stuffed it.'*

The right developments had to be in place; in this case drainage allows soils to reach productive potential while impacts on soil structure, mud and runoff are contained.

Timing and Attention to Detail:
Attention to detail and the right things being done at the right time appeared to be key to success at this case study site. Grazing management over winter was important with Farmer 4A being careful to back fence and avoid driving tractors on paddocks any more than necessary.

Tasks related to soil health were done effectively and on time; tasks that demand timing and attention to detail include:

- Re-doing drains on both milking and DSL areas.
- Looking after soil over winter, back fencing and being careful not to drive tractors on paddocks more than necessary.
- Carrying out tasks that relate to soil health effectively and on time; grubbing immediately after the forage crop is grazed, and waiting until the soil is dry before ploughing and sowing the next crop.

Features of Case 4A

Leased DSL:
Case 4A was notable in that it illustrated the risks of leasing DSL. Farmer 4A believed that leasing doesn't always work out and that people have to realize this when they go into lease agreements. In particular it is important not to make any capital investment that you would not walk away from at the end. *'Fences, houses, support buildings, water supply, tracks, fertility, pasture and he wanted us to pay…, it would make this farm but we wouldn't buy it at that price.'* As well as causing frustration for the lessee, an inability to recover invested capital has meant that the leased portion of farm 4A was never re-drained and the farm has not reached economic potential. In view of his experiences Farmer 4A stated that he would be reluctant to lease DSL in future.

Farmer 4A was sceptical of the environmental sustainability of leased DSL because he believed that many would lease land to use as DSL and not worry about environmental impacts or long term damage to the soil structure that may result from wintering cows on under-developed soils in this area:

> *'Some people would go in and just do their winter feed and go away and leave it, I think there's a cavalier attitude out there which is a bit hard (money) and I think our approach is better than that.'*

Success With Heavy Soils:
The soils on this farm need to be managed properly to ensure success. Essentially this is a matter of resources and attention to detail; adequate drainage, having the right machines, backfencing and small mob sizes at grazing, and appropriate soil management post grazing are all important to achieving a sustainable farm system.

Drainage and soil management is very important to success. Drainage is done at low cost, achieved by re-using tiles and having his own staff do the work with a hired digger. Tiles need to be deep enough, the outlet kept clear (above the level of the creek) and the tiles need to follow the lay of the land:

> *'A lot of people say (how far apart do you put your drains', but its not a case of that at all… you put your tile in in the lowest end of the paddock and have it flowing through… Tiles should be at least 1.2 meters in the ground, by the time the water gets down there it's been filtered by the soil and plants.'*

Cows on winter crops need to be managed properly. Ideally they should be divided into smaller mobs and they should be backfenced to minimize the time that the soil is exposed to the pressure of cow grazing. With reference to observed post grazing area; *'that ground is absolutely perfect, no damage whatsoever'*

After grazing the soil goes through a program of conditioning. Areas grazed by cows will be grubbed as soon as possible after the cows come off and will then be left until it is dry enough to plough and sow with either a second crop of kale or barley for whole crop before going into pasture:

> *'When it comes to early spring we go in with a big grubber when its quite wet to get the air into it and get the water to drain away… Then we plough it, but not until its dry, if you plough it when its wet it will smear the soil and you are burying all that stinky stuff under where it won't break down, it won't grow a proper crop of barley.'*

Doing a crop of barley helps improve the soil and takes much of the risk out of having a poor result re-grassing after crops as it will give that soil time to recover from any damage that might have occurred over winter. Barley is also an indicator of soil condition and thus of the appropriateness of management over winter:

> *'Any cereal crop will tell you how healthy your soil is, if its wet and not in good condition, it will just die out, if I'm not getting a good crop of barley, either the ground has not dried out or you've done something wrong in spring.'*

B.4.2 Case 4B

Case 4B is a 78 hectare detached DSL block that supports the winter grazing needs of 230 cows and 240 calves as well as providing silage to the dairy farm. Soils are of a heavy peaty type that can support high grass or crop production, but there can be difficulties if there are high stock numbers, active stock or poor drainage.

Soil condition on post-grazed forage crops were very good in most areas with very little wasted feed or soil damage, however some places were waterlogged or flooded with a lot of waste. The most likely explanation for this variation is the condition of the tile drains. In one place a blocked drain has resulted in persistent ponding. Practices such as disciplined back fencing and avoiding unnecessary trips onto the paddock with the tractor were evident. The system of portable troughs appears to be effective in supplying water reliably, however, there was an issue with frost freezing the lines.

The farm has undergone significant changes within the recent past. A large area of owned, adjacent DSL that had provided all necessary support services has been developed into a dairy farm and a smaller area of DSL leased nearby. As a result of these changes, the system now relies on the market for some support services. In the first year, there have been some problems with timeliness of implementation of DSL-related tasks and the reliability of graziers, however at the time of the interview it appeared that the farm was moving toward a good milking season.

This case highlighted the high potential productivity of some heavy soils in Southland as well as the importance of planning and timing, and developments such as drainage on heavy soils.

Perceptions of Sustainability

Economic Sustainability:
The DSL is used to control cow condition over winter, protect the milking platform and ensure a productive season: *'It's about days in milk, fully feeding the cows and high quality grass.'*

The owners of the farm feel that it is best if they can control winter feeding themselves because it is critical that cows are fed to capacity through winter:

> *'Feed them as much as they can physically fit in them so they are never hungry… stretch the stomach so that as soon as that calf hits the ground she can just go.'*

Farmer 4B believed that there was 'definitely' a commercial driver with leased DSL, but rates the success of a block by how well it is producing rather than how much money it makes: *'You can soon tell how well it is going by how good the crops are.'*

Environmental Sustainability:
Environmentally protective practices include minimal use of nitrogen, creeks fenced off, careful use of machinery to preserve soil condition, small mob sizes.

It seemed that environmental and economic drivers were in line as the consequences of mismanagement or under-resourcing would have severe economic consequences as well as undesirable environmental impacts.

Social Sustainability:
Integration of social and economic drivers were important on this farm;

> *'It's a very well organized farm, especially the bigger picture stuff, which makes it a good place to work.'*

> *'Fully feeding the stock and letting them get to potential is very satisfying, getting up early and working till late doesn't seem like all that big a deal when you know you can do your job well.'*

Farmer believes that the image of dairy farmers in the community is improving but that *'there are 10 per cent who are giving us a bad name.'*

Practice

Resources:
A fully resourced DSL leads to fully fed cows which the owners feel is critical, and a sustainable farm system. Farmer 4B believes that it is important to get control of winter feeding to get over 400MS/cow. In the previous season this farm achieved 475MS/cow and 1250MS/ha.

To ensure cows are fully fed, farmer 4B employs a nutritionist. This also helps prevent animal health issues; 'downer cows, lame cows.'

Using balage as the main source of supplement means that there is no need to invest in a silage wagon and less disturbance to the paddock.

Planning:
Planning and organization is important to success with the DSL unit. Preparations for winter and cow feeding are all well planned. A feed budget is done, with mobs assigned to 'blocks' of feed through the winter:

> *'We like to know exactly what's going on… we know exactly what date we've got crop to, how much supplement we've got, stock numbers over time, how much they are getting.'*

The DSL manager knows how much crop and balage will be fed to each mob on any given day.

As well as feeding the cows a measured amount, the cows are also fed according to appetite and behaviour; there should always be some feed left before feeding out and every three days someone will walk through the cows in the evening to ensure they are settled.

Feeding out of balage is organised well so that the tractor only goes onto the paddock twice a week.

Timing and Attention to Detail:
It is important that paddocks are cultivated as soon as possible after grazing to make sure there is time for two sprays (or ploughing) to be done before a forage crop is sown. If crop preparation tasks are not done crop yields will not be as good. Actual crop yield will be hard to predict and there may be severe losses as happened this year with yields of 11 tons/ha compared to an expected crop of over 20 tons/ha. This difference in yield is strong evidence for the assertion that timeliness of implementation is key to success with growing crops, and the ability to control how cows are fed and the cost of doing so.

Graziers
Farmer 4B sent his cows away to a grazier for the first time this winter, interestingly this was also the first time farmer 4B has been unhappy with cow condition:

> *'It is the first time we have been unhappy with the way they are putting weight on… you just can't get them to feed cows the way you want.'*

Features of Case 4B

Leased DSL:
The owners seemed to have had positive experiences of leasing DSL. Leasing DSL allowed the owners to convert their old DSL into a dairy farm.

Success with leasing was a matter of controlling capital inputs while still achieving economic and environmental goals:

'A lot of it is the same really, you just have to know the soil type and fertility, I suppose you have to make sure you know who's paying for what… everything's got to be signed, you've got to go through everything, it all has to be signed and agreed beforehand, you can't go back later and change it if something is not right.'

Difficulties with leased DSL arise when landowners are unwilling to invest in developments such as tile drains and stock water systems that are essential to bring environmental and financial drivers into line.

Success with heavy soils:
Good soil condition equates to high yields and low environmental impact. Although it is possible to winter cows sustainably on heavy, peaty soils, the right practices and developments must be in place. Traffic movements should be minimised and tile drains should be working effectively.

Activities related to care of the soil go on at the time cows are grazed and in spring. Appropriate practices include back fencing, moving cows every day, organizing balage so that trips onto the paddock are minimised. Small mob sizes allow better feeding, better care of lighter cows, less wastage and less impact on soils; *'With good crops we just give them a meter so they don't walk on it, there's not wastage.'* In spring it is important to aerate paddocks after grazing to facilitate microbial activity and allow the soil to drain.

Developments such as good drainage and stream protection should also be in place. This case illustrated the impact of poor drainage. In areas where drainage was good, the ground was firm underfoot and cows did not do a great amount of damage to the soil. This was in contrast to part of one paddock with poor drainage where severe impacts on soil and poor utilisation where an impediment to a sustainable farm system.

Crops:
Climatic conditions and rich, heavy soils mean that this DSL unit is capable of sustaining very high production. However for there to be success there must be attention to detail with all aspects of crop preparation. Crop preparation also needs to be done quickly to give the crop maximum amount of time to grow: *'It's all got to be in by October 1st.'*

Land coming out of pasture should be sprayed off twice to completely kill the old pasture. If this is not done, grass is likely to recover and compete with the crop, greatly reducing potential yield.

After two years in crop the land goes into whole crop silage then grass. Doing whole crop silage creates more options (turnips, rape, perennial or annual ryegrass) and results in a better and more reliable pasture establishment as there is more time to address issues with soil structure.

B.4.3 Case 4C

Farm 4C is a 256 hectare DSL unit that provides all support services to a 157 ha MP in addition to year round grazing for a number of dairy beef heifers and steers. The DSL meets the grazing needs of 500 cows over winter and calves, in-calf heifers and beef progeny through the season. Approximately 400 tons of feed is transferred to the MP as silage.

The large area of DSL relative to the MP, low rainfall and light soil types means that the DSL functions as a low-medium intensity grazing unit and that environmental impacts are controlled or dispersed. There are no streams on the property, but there is a shallow aquifer, which may be vulnerable to nitrate leaching. Winterfeed is based on swedes and kale with balage as a supplement. The DSL enterprises provide substantial income in their own right as well as saving the MP substantial input costs.

Case 4C was interesting in that leased DSL areas had facilitated business growth and that the role of DSL had changed over time.

Perceptions of Sustainability

Economic Sustainability:
The main purpose of the DSL is to control feeding:

> *'One of the biggest advantages of the runoff is that you are in control of your own destiny with regards to cows, in-calf heifers and calves… you are able to shift them, you are able to feed them what you want, manage them as you see fit.'*

The role of DSL has changed over the life cycle of the farm business. As a sharemilker, farmer 4C used leased DSL to grow his herd naturally over time from 400 to 940 cows, as well as ensuring control of winter grazing and feeding of replacements. He also saw control of support land as very valuable at this time because it allowed him to utilise staff and machinery all year rather than for ten months, as do many sharemilkers. Once Farmer 4C acquired his own dairy farm, the role of the DSL became that of managing external factors and creating a self sufficient farm system. Currently, farmer 4C has no plans to expand the system further as he does not want to go over 600 cows and incur what he sees as the unnecessary management pressure of running a large-scale dairy system.

Environmental Sustainability:
Farmer 4C believes that his DSL does not make a major environmental impact. The low rainfall (around 750mm) and relatively large areas of DSL mean that this DSL system is much lower intensity than the MP with those impacts that do occur concentrated in winter as well as being spread over a large area.

The greatest environmental impacts probably occur on the partially irrigated dairy farm, which is higher intensity and may be leaching nutrients into the shallow aquifer. If anything the DSL is a benefit in an environmental sense because the adjacent situation allows the farmer to take the pressure off the dairy farm at critical times.

This farmer also feels confident that the image of dairy farmers is improving as they learn to better contain environmental impacts and more scientific work is being done.

Social Sustainability:
Farmer 4C believes that the DSL helps manage the stresses and social vulnerabilities inherent in dairy farms. He is not interested in practices or additions to the system that create unnecessary stress: *'I've got no great ambition to go over 500-530 cows really… it's just where I'm up to in life.'* The DSL allows the strategic manager to step back with the herd manager in charge of the cows while farmer 4C undertakes tasks on the runoff: *'I primarily look after the runoffs, grazing management, beef stock and replacements.'*

Practice

Adequate Resources:
The light soil types also mean that the system is relatively easy to resource with no need to do soil conditioning or soil aeration on forage crop paddocks. Using balage on the DSL means there are fewer issues with mechanical breakdowns or other disruption over winter.

The biggest resource input is probably the time of the strategic decision maker. There are good staff on the dairy farm, which allows Farmer 4C to step back from day to day running of the dairy farm and assign time to planning and executing DSL operations; most DSL tasks are carried out personally by the farm owner. The farmer has enough time assigned to the DSL that he has time to plan well and attend to critical tasks such as cultivation and ridging swedes.

Planning:
There appears to be less need for clear plans as the strategic decision maker carries out most DSL related tasks and the staff are capable and motivated. The adjacent situation probably means they are familiar with DSL operations.

Timing and Attention to Detail:
Timing and attention to detail is absolutely essential to success with forage crops, especially swedes. All crops need to be sown early with kale in by the first week of November and swedes done by the 12^{th}. Swedes are ridged with a lighter sowing rate than other cultivation methods. Ridged swedes will grow bigger, have fewer problems with weeds and give better utilisation than non-ridged swedes. The light soil types mean that the forage crop paddocks do not require soil conditioning or deep ripping in spring. Farmer 4C will plough them when he is ready.

Timing and attention to detail is also important with cow management over winter. This farmer prefers block grazing of cows because it is easier to control how much cows are getting and there is less bullying than goes on with a break. It also appears that it may be easier to manage bales with block grazing. Cows are divided into mobs of 120-130: *'An ideal mob size, not only for the welfare of the animal, but also with controlling pugging.'* Finally Farmer 4C believes that it is important to do a transition feed onto crop when grazing on swedes. This is done to prevent cows from gorging and ingesting bulbs. He also believes that youngstock should not be fed swedes at all as their teeth are still developing.

Features of Case 4C

Leased DSL:
The DSL is on light land and the large area of DSL relative to MP means that the DSL system is under less pressure over winter than some. For this reason the issues that have existed with under-development on some other systems do not have the same impact in this case. All the same it has been important to be very clear about who pays for what and that essential inputs such as fertilizer are done.

Adjacent:

Farmer 4C believed that if DSL was not adjacent to the MP that it needed to be very close to enable him to oversee both the MP and DSL at the same time.

> *'Location is a big thing for me, you can get there in five minutes on the tractor, if you forget that set of pliers, if you don't fix that fence, it will come back to haunt you.'*

Soil Type:
Farmer 4C seems very aware of the various soil types on his farm and the way that this affects his management. On the adjacent DSL, there is a mixture of heavy and free-draining soils, while the detached block has very light soils. This means that summer production is unreliable, but easy to manage in winter: *'It is very good for wintering, utilizations great, we're not making a mess.'*

Scale:
Farmer 4C believes that going over around 500-600 cows will require a completely different approach with the management of the dairy farm:

> *'There's a much greater difference between going from 600 to 800 cows to going from 400 to 600 cows, though only if you are milking through the one shed…The skills required are very different… there's going to be more congestion at your cow shed, you're going to have to be better at managing paddocks, it all has to mesh together.'*

Even though scale is a critical determinant of dairy farm management, this does not apply to DSL and the basic approach to DSL management would remain the same no matter what the scale: *'There would just be more of it.*

Appendix C
Colour Plates


Plate 1: Mud 1


Plate 2: Mud 2


Plate 3: Italian


Plate 4: Self Fed Stack 1


Plate 5: Self Fed Stack 2


Plate 6: Ridged Swedes


Plate 7: Post Grazing


Plate 8: Grass Grub 1


Plate 9: Grass Grub 2


Plate 13: Leased Block


Plate 10: 12 Ton Crop


Plate 14: Lower DSL 1


Plate 11: Waiting to be Fed


Plate 15: Lower DSL 2


Plate 12: Stream Protection


Plate 16: Feed on hand


Feed pad


Fence line


Muddy Grass


Poor Crop

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