Growth and Innovation in the Canterbury Dairy Industry

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This thesis reports an investigation of factors that have influenced the growth and development of the Canterbury dairy industry over the period 1982-83 to 2009-10. The research initially utilised secondary sources of information to determine physical and financial growth parameters of the industry. In-depth qualitative interviews relating to the production sector were then undertaken with fifteen producers and six key informants. A further thirteen key informants were interviewed from the processing industry. A mail survey of farmers was also conducted to further identify key innovation and adoption influences. The research lens for these investigations was informed by industry development theory and innovation theory.

The development of the Canterbury dairy industry has resulted in a major land use change. In 2009-10 there were nearly 200,000 hectares in dairy farming in Canterbury compared with fewer than 20,000 hectares in 1982-83. During this period, milksolids (milkfat + protein) production grew from 2% to 17% of New Zealand's increasing production, which was a 25-fold increase. Farm size and cows per herd in Canterbury have grown to twice the NZ average, with Canterbury farms grazing 15% more cows per hectare. Milksolids production per hectare was 1.5-fold the North Island average in 2009-10, whereas in 1982-83 it was 81% of the North Island average. An analysis of profitability from secondary data showed that income and expenses per kilogram of milksolids were similar throughout the country, but because of higher levels of production per cow and per hectare in Canterbury, the operating surplus per hectare was greater. The same data suggest returns on capital were double the rest of the country from 1999-2000 to 2009-2010, averaging 9% versus 4%. The

analysis of a case study farm established in 1987-88 showed an average compound return on total capital in excess of 10%, and wealth creation of approximately 20% per annum (compounded in constant value dollars, 2010).

Interviews with industry informants determined that there were three waves of development. In Wave 1 (1980s) farmers tended to be driven more by entrepreneurial motives and were often moving from another dairy region that was not as favourable. The ability to purchase larger blocks of irrigated land at a lower cost than in other dairying areas was the main driver of the move to Canterbury. There were also human elements, as Canterbury was perceived to offer desirable social aspects and many were attracted to the challenge of developing a new industry. Considerable entrepreneurial profits were achieved. In Wave 2, (1990s) many conversions were completed by corporate entities. Due to low operating profits the corporate farmers had largely left the industry by the late 1990s. In doing so, they sold many of their farms to their sharemilkers, thus creating a new generation of farm owners. However, there were also traditional sheep/crop farms converting to obtain higher levels of profitability in Wave 2. Wave 3 (2000s) farmers tended to be established farmers from other sectors, who converted to dairy farming for economic reasons. The rate of growth was influenced by aggressive lending to dairy farmers by the primary and secondary financial institutions. Wave 3 farmers tended to develop large, more intensive farms. This wave also saw investment from non-farming investors, particularly in equity partnerships.

The research identified that factors involved in the development could be classified as drivers, enablers and facilitators – with some factors fitting into more than one classification. Drivers were factors that caused growth and included the lack of profits in other farming systems providing the opportunity for entrepreneurial individuals and corporations to purchase lower priced land to convert to dairy farming. Human reasons for becoming involved in the new industry were also a driver. The development of an underutilised water resource enabled the development, but also became a driver of growth as it encouraged the conversion of properties to the more profitable dairy industry. The majority of the drivers appeared in Wave 1; however increased farm profitability in Wave 3 was a driver of further development.

Enablers were factors that were necessary for growth and initially included government policies and economic conditions. The long history of dairy farming in New Zealand provided an infrastructure that enabled the rapid growth of dairying in Canterbury. The development of a successful processing cooperative was an important enabler as the processing of all milk produced meant that growth continued.

Facilitators are factors that did not drive or enable growth, but had a positive influence on growth. These mostly occurred in Waves 2 and 3 and included new infrastructure and farms that provided supplementary feed for the industry. Innovation and new technology were both enablers and facilitators as innovations to traditional technologies were needed to farm large irrigated farms with large herds of cows. The financial industry was an enabler and a facilitator of growth in Waves 2 and 3. Other facilitators included new business structures such as equity partnerships and family farms operating as corporations. The establishment of a demonstration farm in Wave 3 was facilitator through providing important messages about farming in the new area and offering a forum for discussing management issues. At the end of Wave 3, world trade liberalisation and increased demand for dairy products led to higher prices for dairy products, which was a facilitator of growth and influenced the driver of increased farm profitability.

This research has built upon existing theory by proposing an enhanced framework that integrates a series of developmental waves and influences within Van de Ven and Garud's instrumental, resource procurement and institutional subsystems. For those concerned with the development of industries, it is important to realise that the waves of development, factors and their alignment will be dependent upon the characteristics of the social system involved.

Key words: Canterbury dairy industry, industry development, agricultural industry development

Acknowledgements

"We don't see things as they are; we see them as we are". (Anais Nin)

I approach this section with some apprehension. As a person who considers himself merely the product of the influence of a great many people, there is a great fear of leaving someone out. For those who may not be mentioned, please be assured that I could not have accomplished this project without a lifetime of interactions with some wonderful people. I appreciate all those who have been a part of my life. This said there are a number of relationships that deserve special mention.

Firstly, I am deeply indebted to Professor Keith Woodford who has been a teacher, mentor and advisor for a number of years. This project would never have come to fruition without your encouragement and patience. Likewise, Dr Peter Nuthall has challenged my thinking and involved me in a number of philosophical discussions. Your comments in regard to my writing style have been invaluable in completing this work. I would also like to thank the other staff members in the Agricultural Management Group of Lincoln University for their friendship and support over the years. Russell Cameron and Guy Trafford in particular have become great friends.

A large number of people have contributed to the project through their willingness to be interviewed for the various research projects. Your input was greatly valued as you provided a depth and richness of information that has added much to the quality of this thesis.

On a personal level I wish to pay tribute to my family. I doubt that anyone could have provided a better environment for a child than was provided by my parents, sisters and extended family. I never wanted for anything that was important for my growth and development and was always encouraged and motivated by my parents and sisters. Wherever you may be, I hope that you know that you played a significant role in whatever I may have achieved. My immediate family also deserve a big thank you for tolerating a husband and father who may have neglected them at times in the pursuit of goals and achievements. I may have been maddening, but I don't think life with me has been boring.

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Terms and Abbreviations

EEC	European Economic Community
FMCG	fast moving consumer goods
GATT	General Agreement on Trade and Tariffs
GDP	gross domestic product
LIC	Livestock Improvement Corporation
LUDF	Lincoln University Dairy Farm
MF	milkfat
MP	milk protein
MS	milksolids (milkfat + milk protein)
MAF	Ministry of Agriculture
NI	North Island
NZ	New Zealand
NZCDC	New Zealand Cooperative Dairy Company
NZDA	New Zealand Dairy Association
NZDB	New Zealand Dairy Board
NZDG	New Zealand Dairy Group
OECD	Organization for Economic Co-operation and Development
PPMD	Primary Products Marketing Department
PSE	producer support estimate
SI	South Island
SIDC	South Island Dairy Cooperative
SIDDC	South Island Dairy Development Centre
SMP	skim milk powder
UK	United Kingdom
WMP	whole milk powder

Acknowledgement of References:

Throughout this thesis statistics have been obtained from publications prepared by dairy industry bodies. These reports include: the New Zealand Dairy Board Farm Production Reports from 1970-71 to 1983-84 and reports from Livestock Improvement (LIC)[1] from 1984-85 to the present. Prior to 1991-92 information was obtained from the analysis of the New Zealand Dairy Industry Cow Census. The year 1992 was a transition year from collecting data from the 'cow census' to the use of the LIC database. Since the 1991-92 Dairy Statistics publication was a transition year, some data is unavailable.

New Zealand Dairy Statistics (LIC 2010, p. 4) states that "Data is sourced from the LIC National Database, dairy companies, Animal Evaluation database, Animal Health Board Annual Report (year ending 30 June 2010), Quotable Value New Zealand Rural Property Sales Statistics, and Statistics New Zealand."

[1] LIC (formerly known as the Livestock Improvement Corporation) is a farmer cooperative that provides herd improvement services.

Chapter 1
Introduction

1.1 Preview

This thesis reports on studies designed to explore the factors influencing development of an agribusiness industry. Specifically, this study investigates the rapid growth of the dairy industry in the Canterbury Province of New Zealand (NZ). Although there is a volume of research involving industry development, there is very little pertaining to the development of agricultural industries in developed countries. Accordingly, the purpose of the research is first, to document the productive and business growth that has occurred. Secondly, factors that have contributed to the growth are examined. These factors are compared to the theory on industry development.

For the purpose of this thesis, an industry is defined as a "social system consisting of three loosely-coupled hierarchical systems involving the instrumental, resource procurement, and institutional subsystems" (Van de Ven and Garud 1989, pp. 206-211). The instrumental subsystem consists of the firms involved in an industry, including firms that develop a product, vendors, suppliers of applied research and development, manufacturers, marketing and distribution. The resource procurement subsystem involves the basic scientific and technological research, finance, venture capital, insurance, human resources and accreditation. The institutional subsystem provides the industry governance structures, legitimisation and industry rules and standards.

The thesis differs from most discussions on agricultural industry development, as previous studies generally refer to the importation of a completely different farming system to an area, or the development of an industry that has not previously existed elsewhere. In this case, although NZ has a long history of dairy production, the dairy industry in Canterbury was of minor importance prior to the mid-1980s. Therefore, the subsequent growth and development of the Canterbury dairy industry involves the development of an industry in a new location rather than the development of a new industry *per se*. However, it will be shown that the industry that has developed in

Canterbury has its own specific distinguishing features rather than just being a replicate of what exists elsewhere. Eliciting the factors responsible for this growth and development, and then linking the findings to industry development theory, is the aim of the research.

The study is essentially a case study, based on a range of qualitative and quantitative techniques. Authors of case study research are inevitably part of the research process and bring their own interpretive subjectivity to the research. This subjectivity is explicitly recognised here, recognising that the dangers of subjectivity can only be minimised by first recognising them. The author entered the Canterbury dairy industry as a sharemilker in 1987, progressing to farm ownership on a different property in 1990. The addition of irrigation enabled the farm to be converted to a dairy farm in 1993. Although currently employed as a lecturer at Lincoln University, farming interests remain the author's primary occupation. From the perspective of a 'participant observer', the author had already reflected informally on the reasons for the development of the industry prior to this thesis being undertaken. This thesis has provided the opportunity to investigate in a more formal context the factors of change, and the ways in which these factors have interacted to create the growth outcomes.

The philosophy of this thesis has been to 'give voice' to the views and perspectives of industry participants. As such, the study is essentially *etic* (telling the story as an outsider) in its perspective, but does have *emic* (telling the story as an insider) elements. In particular, the author's prior networks facilitated access to key industry informants.

There are eight further parts to this introductory chapter. First, the background to the thesis is described. This is followed by the research questions and a discussion of the philosophical model and methods used. The remaining sections provide an outline of the thesis and the final section provides a brief explanation of the NZ dairy industry.

1.2 Background

Prior to the 1980s, farming in Canterbury was dominated by dry land sheep and cropping industries. Although a fluid milk industry (referred to as town supply) existed around the cities, the export of processed milk products from the Canterbury dairy industry was minor in comparison to the dominant farming systems of those times.

The dairy farms producing for export (referred to as factory supply) prior to the 1980s were on high water holding capacity soils, often with limited or no irrigation. The installation of drainage was often a higher priority than the development of irrigation. Additionally, the abstraction and delivery techniques available for applying water were labour intensive.

From the 1940s, the development of community irrigation schemes utilising river water led to the intensification of farming on lower water holding capacity soils in mid Canterbury, North Otago and North Canterbury. In the late 1980s, technological improvements encouraged ground water extraction for irrigation from deep wells (50 metres plus), allowing additional areas to be irrigated and further development of intensive farming systems.

From the early 1980s, a new type of dairy farm production system developed in Canterbury on the more prevalent lighter soil types with irrigation. The dairy farmers who established in Canterbury were generally from the historical dairy areas in the North Island. North Island farming systems, such as all grass wintering and being self-contained for the production of feed for all classes of stock, required adaption to the very different Canterbury environment. Additionally, the infrastructure to support dairy farming was not as advanced in Canterbury as the North Island. Initial development of a dairy industry was slow, but the conversion of traditional farms to dairying rapidly increased from the 1990s (LIC 1985-86 to 2009-10, Engelbrecht 2010).

The New Zealand Institute of Economic Research (Schilling, Zuccollo, Nixon 2010, p. 23) estimated that the increase in dairy farming in Canterbury has resulted in the Gross Regional Product (GRP) increasing by $590 per person in Canterbury since 1998-99. Further data (ibid, p. 2) show that the value of dairy production in the districts included in the Canterbury region was $471 m in the Ashburton district,

$270 m in the Selwyn district and $185 m in the Timaru district in 2009 (base year 1998-99).

The development of the Canterbury industry coincided with the restructuring of the NZ economy from a regulated economy, with a high level of government support, to a free market economy with a low level of government involvement in the agricultural sector (Rayner 1990, Evans 2004, Rae et al. 2004).

1.3 Research aims and questions

The Canterbury dairy industry has experienced spectacular and sustained growth for almost three decades since the early 1980s. A key issue is whether there are lessons that can be learned from the from the industry development in Canterbury that have relevance in other contexts.

Accordingly, the aim of the research is first to quantify the growth of the Canterbury dairy industry, then to analyse the factors that have contributed to the development of the industry, and then to link this back to industry theory. Utilising primary and secondary data, predominately inductive reasoning is used to allow the drawing of insights which are compared to industry development theory. The Canterbury dairy industry is a case study and the overall dairy industry is the unit of analysis. However, embedded within this analysis are other units of analysis such as the production and processing sectors and the institutional environment. In particular, the following questions will be answered:

1) **What were the characteristics of the establishment and growth of dairy farming in Canterbury?**

2) **How has the development allowed business growth and wealth creation amongst participants?**

3) **What factor conditions drove or constrained growth?**

4) **How does the development of the Canterbury dairy industry follow theories of development in other industries?**

5) **What are the emerging insights from the Canterbury dairy industry for industry development theory?**

1.4 Philosophy of the investigations

The philosophical approach adopted for developing the research questions and design was influenced by aspects of Van de Ven's *Engaged Scholarship* (2007). Van de Ven argues (pp. 3-5) that "the central mission of scholars in professional schools is to conduct research that both advances a scientific discipline and enlightens practice in a professional domain". However, Van de Ven (ibid) identifies a gap between theory and practical adoption. He proposes that research bodies and industries look at problems in different ways. Managers develop an understanding of a problem and then look for solutions, whereas science tends to build generalizations and theories that often take the form of logical principles or rules involving causal relationships. These differences can lead to knowledge transfer problems. Van de Ven (ibid) suggests that the aim of problem formulation is to "situate, ground, diagnose and infer the research problems by determining who, what, when, why or how the problem exists".

The initial information on industry growth has been obtained from secondary data, with the results triangulated by primary data on the growth of a farm business from a specific case study farm. The material in the subsequent chapters which review industry growth theory, extension and the history of the NZ dairy industry further sensitised the author to issues that may have contributed to industry growth. This understanding was important to effectively discuss industry growth with key research informants.

The research elicited the factors that contributed to Canterbury dairy industry growth through several methods. Experts who had witnessed the growth were interviewed for their specialist knowledge which is presented in Chapters 7 and 8, with secondary data providing additional evidence. Data obtained from a farmer survey helped inform the role of extension in promoting growth and the adoption of innovations. This is presented in Chapter 9.

1.5 Research methods

Van de Ven (2007, pp. 298-299) defines epistemology as the study of the nature and scope of knowledge, or the theory of knowledge. He defines ontology as the study of the origin, nature and constitution of reality. In this thesis, the author has adopted the perspective of Woodford (1997, p. 15) that “an industry is a social system where decisions are influenced by the perceived economic conditions of management alternatives. In agriculture these alternatives are a function of the physical environment, animal biology, industry governance, consumer markets and the processes of production, processing and marketing. Epistemology defines the relationship between the researcher and the assumed reality.”

The methods used for this research involved predominately qualitative research philosophies, with data from both published and unpublished sources as well as case studies. The decision to use qualitative research was based on the need to explore the experience and ideas of people intimately involved in the industry’s development. Denzin and Lincoln (1994, pp. 1-6) define qualitative research as being “multi-method in focus, involving an interpretive, naturalistic approach to its subject matter”. Qualitative researchers study problems in their natural settings in an attempt to make sense or interpret phenomena. Denzin and Lincoln (ibid) further suggest that this can “involve the use of case studies, personal experience, life stories, interviews, and historical, interactional and visual texts”. Patton (2002, p. 4) writes of three types of qualitative data:

> “interviews where open-ended questions and probes yield in-depth responses about people’s experiences, perceptions, opinions, feelings and knowledge;
>
> field work descriptions of activities, behaviours, actions, conversations, interpersonal interactions, organizational or community processes, or any other aspect of observable human experience;
>
> written documents from a wide variety of sources.”

A grounded theory approach was used to collect information about specific historical events. This was used to develop theory which can explain the phenomena of growth in dairy farming in Canterbury. Grounded theory is defined by Strauss and Corbin (1994, p. 273) as:

> “a general methodology for developing theory that is grounded in data systematically gathered and analysed”

These authors also state that the major difference between grounded theory and other ways of thinking about qualitative research is its focus on theory development. In this case, the researcher will begin with an area of study and will allow the theory to emerge from the data. In other words, the researcher will not to try to prescribe in advance where the answers lie. Grounded theories, because they are drawn from data, are likely to offer insight, enhance understanding and provide a meaningful guide for action. Patton (2002, p. 11) said that qualitative inquiry is especially powerful as a source of grounded theory, because the theory emerges from a researcher's observations and interviews in the real world.

Inductive reasoning will be the main approach used to develop themes based on the data. Van de Ven (2007, p. 299) stated that "induction is an inference to a generalization from its instances. The claim in the conclusion goes beyond the claims enumerated or stated in the premises or instances." Using inductive reasoning the author has made judgements and drawn conclusions without having previously generated hypotheses.

The research strategy involves sourcing primary and secondary data, and conducting case studies and mail surveys. Chapters 2 and 3 provide the base data to affirm industry and farmer growth. The case studies in Chapters 7 and 8 and the mail survey in Chapter 9 contribute to eliciting the factors responsible for growth. Case studies have been chosen due to the potential for a significant number of factors for the development of the industry. To properly answer the research questions, it is necessary to obtain the opinions of those who have lived the development of the industry and to triangulate the data obtained from documents.

Case studies are a form of research commonly used in the social sciences and often arise due to the researcher wanting to understand a social phenomenon; in this case the development of the dairy industry in Canterbury. This involved sourcing and analysing data for the issue in the context of a 'real life' situation. Although the case studies in this thesis are qualitative in philosophy, the data are a mix of numeric and non-numeric information. Being longitudinal, case studies have the potential to provide depth and insights not available from other methods. A further advantage of case study research is the potential for 'richness' in the information obtained. This richness is possible due to the purposive selection of expert sources of information, as compared to the random selection techniques used in other research methods. Yin (2009, p. 11) stated “the case studies unique strength is its ability to deal with a full variety of evidence—documents, artefacts, interviews, and observations”.

Case study research is frequently criticised for lack of rigour, often because the researcher has allowed ambiguous evidence or biased views to influence the findings. Other concerns are that case studies provide little basis for scientific generalization, that they take too long to conduct and result in large, unreadable documents” (Yin 2009, pp. 14-15). However, as Yin (ibid) points out, although case studies cannot be generalised to populations, they are “generalisable to theoretical propositions”. The researcher’s goal (ibid) “should be to expand and generalise theories (analytical generalisation) and not to enumerate frequencies (statistical generalisation)”.

Adler (1989, p. 41) noted that “it is the outlier, rather than the average firm, that provides the interesting strategic lessons”. Case studies are a key means of identifying and investigating these outliers.

When conducting case study research, it is common to use ‘how’, ‘why’ or ‘what’ questions. However, it is believed that the literature is restrictive in its suggestions for the use of these question types. For instance, Westgren and Zering (1989, p. 416) state that case study research is superior to survey methods at answering the ‘whys’ and ‘hows’. Van de Ven (2007, pp143-145) proposes that there are variance and process models, with ‘what’ questions using a variance model or outcome-driven explanations for the input factors that statistically explain variations in some outcome criteria. ‘How’ questions entail a process model or event-driven explanation based on a story. These ‘how’ questions require “narratives explaining an observed sequence of events in terms of a plot or an event that happens in the real world and the circumstances or contingencies that occur when these mechanisms operate” (Van de Ven, 2007 pp. 143-145).

It is proposed that during this case study research, all three types of questions (why, how, what) will be asked, as it is desirable to obtain a broader range of information that is only available through informants telling their story, whether it be through why, how or what questions. This thesis starts with ‘what happened’ in Chapters 2 and 3 and follows with ‘why and how’ it happened in Chapters 7, 8 and 9.

In this thesis, qualitative information has been obtained through interviews, documents and the author’s participation in the industry. In addition, quantitative information has been obtained from industry personnel and archives, libraries and the personal records of those interviewed. Westgren and Zering (1998, p.419) suggest that in the case of agriculture this includes “data on production volumes, market prices, farm numbers and farm size in order to assess industry characteristics and performance”.

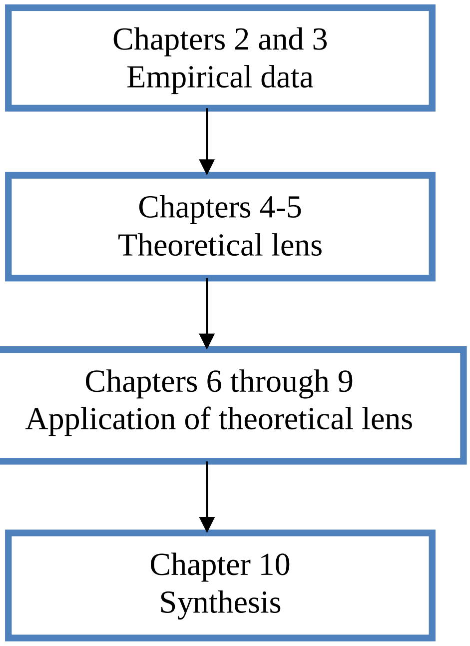
Eisenhardt (1989, pp. 532-550) proposes the approach to be taken when embarking on case study research starts with defining the research question (although this can be tentative in case study research) and selecting the cases to study. Eisenhardt (ibid) propounds that where the aim is to build rather than test theory, then hypotheses are not necessary and can even be counterproductive. Case study research should include multiple data collection methods and if possible these results should be triangulated. As theories develop, it is important to compare the “emergent concepts, theory, or hypotheses with the extant literature”. Eisenhardt (ibid) further suggests that a “strength of theory building from cases is its likelihood of generating novel theory”.

A checklist for case study research proposed by Westgren and Zering (1998, p. 421) has been reviewed to ensure that the case study research in this thesis is professionally acceptable. The list includes the “identification of the intent of the case study; the discussion of relevant theories and literature; the use of primary and secondary data; triangulation of information through the use of multiple sources of data; and being forthright about the limitations of the research”.

This thesis is conducted within the constructivist-interpretivist paradigm. Accordingly, in presenting the perspectives of those who lived and observed the industry development, the researcher acknowledges that these perspectives include the subjective interpretations of both the informants and the researcher. The industry is in essence a social system, and as with all social systems there are alternative perspectives on the realities of that system. In this thesis the aim is therefore to present the diversity of perspective that emerged from the interview process.

1.6 Thesis outline

Following this introductory chapter, there are nine further chapters in this thesis. The organisation of the thesis is unconventional, as it begins with an investigation of the growth which answers Research Questions One and Two. A review of literature proposed factors that may have contributed to this growth. The research then confirmed or expanded on the factors from the literature, with the final chapter discussing the previous chapters and presenting conclusions. Diagrammatically the thesis is organised as follow:



A brief overview of each chapter is presented below.

Chapter 2 is an introduction to the growth of the NZ dairy industry, in general, and the Canterbury industry, specifically. Statistics were obtained from published sources. The purpose of the chapter was to determine the extent of industry growth. The data show aspects of parallel growth in New Zealand and Canterbury, but also establishes where the growth in Canterbury diverged from the rest of the New Zealand industry. A second section presents data on the profitability of dairy farming in Canterbury and New Zealand. The information in Chapter 2 informs the subsequent research questions.

Chapter 3 presents a case study of an individual farming partnership that entered the industry in the early years of the industry's development. Physical growth and financial data from 23 years of farming were analysed to document business growth and wealth creation for this farm. Using primary data, the research involved a description of the steps in the business development process. An examination of annual balance sheets allowed the analysis of increases in net worth and the calculation of return on capital. Finally, since cooperatives dominated the processing and marketing sector of the New Zealand industry, an analysis was performed on the financial returns from investing in dairy cooperatives. The purpose of this chapter was to triangulate the information provided in Chapter 2 and to demonstrate the potential of growth and wealth creation as a driver of industry development. Whereas Chapter 2 was essentially a series of static snapshots at the level of the industry, this chapter captures the dynamics within a specific business. A limitation of this chapter may be that it is for one farm, in which the author has a financial interest.

Having established the dynamics of the Canterbury industry, Chapter 4 contains a review of the literature on industry development. The chapter begins with several definitions of an industry, which is followed by a discussion of industry development and competitive advantage. An analysis of new industries in New Zealand agriculture is included. Entrepreneurs may have played an important role in the development of the industry; hence the literature on entrepreneurs is reviewed. The result of Chapter 4 is a model which identifies potential factors that required consideration within the research.

As shown in the literature review in Chapter 4, the development of a new industry can be initiated by a new technology or innovation. A question raised by the review of new industry development is in regard to the process by which new technologies and innovations are transferred within an agricultural industry. Due to the special conditions that exist in agriculture and the high transactions costs involved, the diffusion and adoption process is considered of enough importance to deserve a separate chapter. Thus, Chapter 5 reviews the literature on the subject of diffusion and adoption and the role of extension in the development of New Zealand agriculture.

New Zealand has a long history of dairy farming, but it was primarily based in the North Island. In Chapter 6, the theoretical concepts introduced in Chapters 4 and 5 provide a lens for a review of this history, focusing particularly on national industry structures that subsequently facilitated the development to the dairy industry in Canterbury. This discussion not only further informs the first research questions, but also raises additional questions for consideration regarding the factors involved in the successful transfer of the industry to Canterbury. Chapters 5 and 6 also resulted in the amendment of the model proposed in Chapter 4 to include additional factors.

Chapter 7 details the results from interviews with 22 key informants. The informants were selected based on their involvement as farmers, consultants or commentators during the time period under review. Farmers were asked to describe their involvement in the industry - what they did and why. Consultants and commentators provided insights on technical matters and areas of expertise. This qualitative information is grounded in the reality of the participants who 'lived' the establishment of the industry. The oral accounts provided by the informants not only confirmed or rejected the previous suggestions outlined in Chapter 6 but also added additional factors. This led to a revised model for industry development. Quantitative data (when available) are included to support the informant stories.

Chapter 8 contains a case study of Alpine Dairy Products, the small processing cooperative that many informants in Chapter 7 discussed and considered instrumental in the development of the industry. Information was obtained from interviews with 13 key informants associated with the cooperative, and publications. Without the development of a successful processor, the industry would not have been able to grow. The analysis of Alpine Dairy Products is not only relevant for understanding the problems of rapid growth in a developing industry, but also for understanding the successful role that the company played in the growth of farmers' businesses and wealth.

Chapter 9 details the influence of the Lincoln University Dairy Farm (LUDF) extension programme through a survey of Canterbury dairy farmers. As detailed in previous chapters, new industry development generally required innovation and technology adoption. The diffusion and adoption process are key aspects for the incorporation of these advances. This chapter presents empirical data that details the rate of adoption of the technologies espoused by the demonstration farm and its effect on industry growth. As well, the chapter presents the demographics of farmers in a new industry and details where and how farmers obtain information.

The discussion and conclusions (Chapter 10) begins with a chart of the interactions amongst the previously discussed factors. This is followed by a comparison of the research findings with the research questions. Emergent insights and proposals for agricultural industry development as compared to industry development theory are presented. Limitations of the research and suggestions for future research complete the chapter.

1.7 Ethical considerations

The research presented in Chapters 7 and 9 is based on case studies. Participants were contacted by telephone and asked whether they would be willing to be interviewed. All interviews were tape recorded with the interviewee's permission and transcribed by the author. Tapes and transcripts are stored in a locked cabinet in the Agricultural Management Department of Lincoln University. An opinion was obtained from the Chairman of the Human Ethics Committee at Lincoln University that the research presented in these chapters qualifies for exemption under clause 6.2.3(2). Clause 6.2.3(2) states that "activities ordinarily exempted from review include research projects involving interviews with and/or observations of public figures or professional persons in the areas of their duties or competence (for example, a farm manager/owner or a forestry worker, as part of a field trip), provided that this is in accordance with the provisions of the Privacy Act." Confidentiality was assured to all participants and any details that may reveal their identity are omitted, unless the participant agreed to be identified. All interviews were conducted with respect for the participant's integrity and opinions.

Chapter 9 contains a description of a mail survey sent to dairy farmers in the catchment of the Lincoln University Dairy Farm. Human Ethics committee approval was sought prior to the research and is included in Appendix F1.

1.8 Terminology and New Zealand dairy production systems

The New Zealand dairy industry is based on the *in situ* harvest of pasture by cows, thus farming practices in the New Zealand dairy industry are different from those found in most other dairy industries in the developed world. With the exception of some parts of Australia, most milk production systems in the world involve a much higher level of dietary supplementation of herds, often with cows housed and milk produced on farms throughout the year.

In New Zealand, the aim for most farmers is to match the demand from lactating cows with the supply of pasture (ryegrasses and white clover). This has traditionally been a low cost production system that has allowed the development of an industry that exports 95% of its dairy production. A 'seasonal' system of parturition of the entire herd in late winter (July-September) and the cessation of milk production in late autumn (May) has evolved.

Because a high proportion of the milk produced is processed and then exported, milk volume is a problem rather than an asset (the water portion has to be transported, removed and disposed). The industry encourages the production of milksolids (milkfat + milk protein)[2] through its system of payment. In addition the farmer's objective of harvesting the maximum level of pasture encourages the grazing of high numbers of cow per hectare, which results in high levels of milksolids per hectare, but lower levels of milksolids per cow relative to biological potential.

[2] Milksolids will at times be abbreviated to 'ms' throughout this thesis, particularly to save space in tables and figures.

Chapter 2
Statistics for the New Zealand and Canterbury dairy industries

“The ultimate elements in production are labour and the gifts of nature, or land.” (Schumpeter 1961)

2.1 Introduction

The development of industries is the cornerstone of economic growth as well as being crucial in a world where population growth, changing economic conditions and changing tastes all impact on traditional industries. The Canterbury dairy industry has grown rapidly over the past three decades. The purpose of this chapter is to document this growth, and to compare and contrast with the growth of the entire New Zealand dairy industry. In addition, data on the asset growth and profitability of dairy farming in the region are presented.

The growth in both the New Zealand industry and Canterbury took place during a time of increasing milk prices. Inflation adjusted milksolids prices (constant value dollars 2010) show that although the price has fluctuated, the trend is for increased milk prices (Figure 2.1).

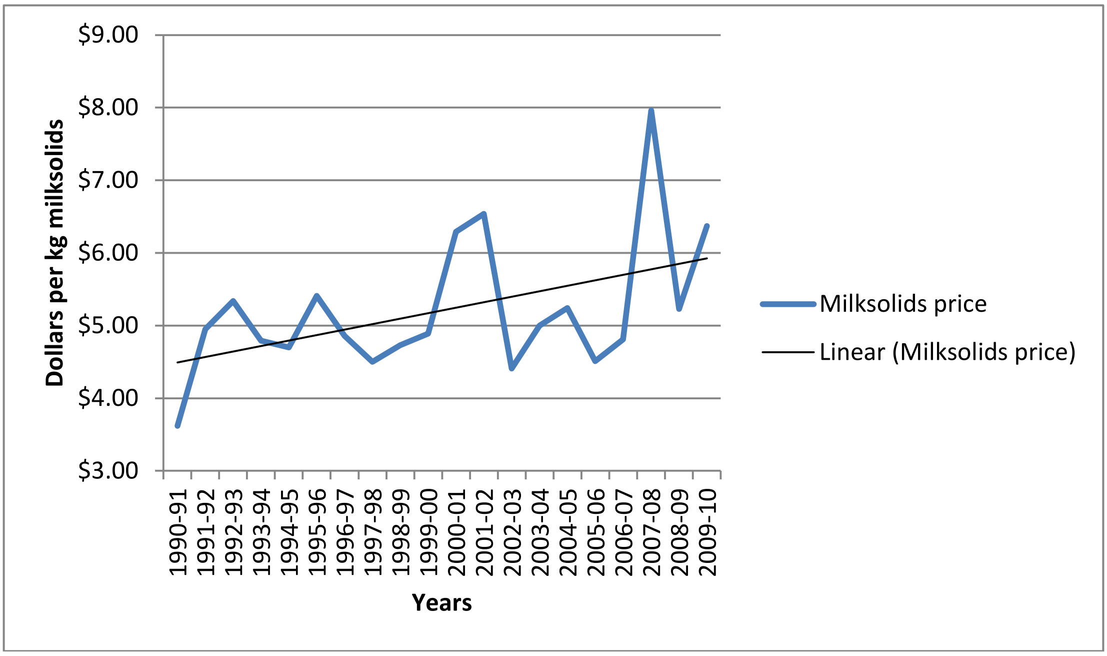


Figure 2.1 Milksolids prices (constant value dollars, 2010) for the NZ dairy industry 1990-91 to 2009-10

2.2 Methods and information sources for growth statistics

Sections 2.4 through 2.11 contain an analysis of the growth in the Canterbury dairy industry from the early 1980s through to the present. The changes in production, both in absolute terms and also relative to the situation in other parts of New Zealand, are analysed. Aspects of growth include the area involved in dairying, total production, number of farms, farm size and cow numbers. In addition, the measurements of production per hectare and production per cow are included as improved productivity may affect growth. The figures and tables produced utilise reports from the New Zealand Dairy Board's Farm Production Division for the period prior to 1984. From 1985, statistics have been sourced from the Livestock Improvement Report and New Zealand Dairy Statistics (LIC). Before 1982, the South Island was treated as one entity for statistical reporting. The statistics used to derive the figures are found in Appendix A.

2.3 Methods and information for profitability and investment section

Sections 2.12 through 2.19 utilise two data sets to compare profitability and capital investment in the Canterbury dairy industry with the New Zealand dairy industry.

These include Ministry of Agriculture and Forestry (MAF)[3] Farm Monitoring Reports (Ministry of Agriculture and Forestry - National 1990 to 1995, MAF Farm Monitoring Report South Central 1999, MAF Dairy Monitoring Reports 2000-2011). Further data was obtained from the Dairy New Zealand (DNZ)[4] Economic Surveys (2006-07 to 2009-10) and S. Nicol[5] (personal correspondence, July 11, 2011).

The information provided is a series of non-linked static 'snapshots' of the industry at specific points in time. Therefore, results are only valid for internal comparison between years and regions within the specific data set. Caution is needed if comparisons are made between data sets. All values are nominal. Data included are as reported by the organisation conducting the research, except for the MAF 1999-00 expenditure data which have been adjusted to remove interest from the operating expenses.

The MAF Farm Monitoring Reports provided details of physical, financial and market factors for dairy farms on a regional and national basis. Budget models were prepared by the MAF from on-farm interviews with selected farmers and meetings with agricultural consultants. Results from these models have been used to compile Figures 2.13 - 2.20. The Ministry did not construct a model for national dairy income and costs for the years 1995-96 to 1998-99; therefore there is a gap in the data set. Further data outlining growth in asset values, debt, equity and return on capital for dairy farms were sourced from MAF Dairy Monitoring reports (2000 to 2010). This analysis only covers the period from 1999-00 to 2010-11, as Canterbury investment statistics were not collected prior to these years.

2.4 Growth in dairy production area (hectares) in Canterbury

For most of the 1980s, dairy farming accounted for approximately 20,000 hectares in Canterbury. The area in production increased about 10 times from 1982-83 to 2010-11, with an overall annual compound growth rate of 11% (Figure 2.2). For the whole of New Zealand, the area in dairying has increased from 1,012,224 hectares to 1,563,495 hectares or about 1.5-fold.

[3] The Ministry of Agriculture and Forestry is the government department involved with issues surrounding agriculture, forestry, fisheries and bio-security in New Zealand. The Ministry merged with the Ministry of Fisheries in 2011.
[4] DairyNZ is the industry good body for the New Zealand dairy industry
[5] Sarah Nicol is an Economic Analyst with DairyNZ.

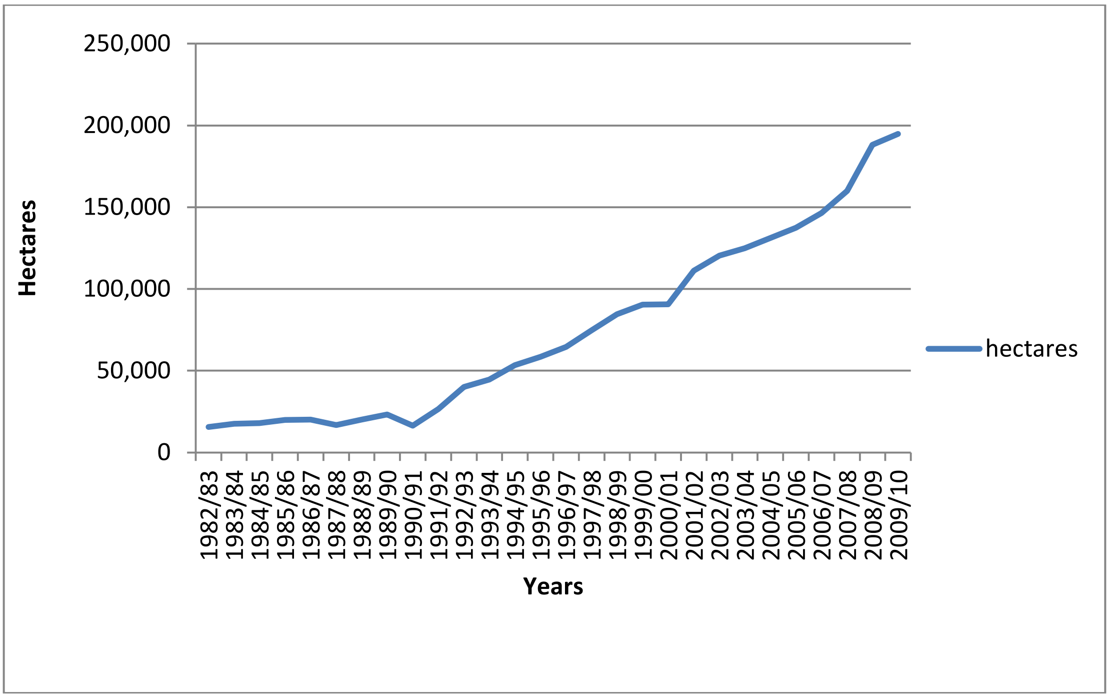


Figure 2.2 Growth in land involved in dairy production in Canterbury

2.5 Trends in New Zealand milk production

Prior to 1984-85, most Canterbury dairy farms produced fluid milk for town supply, with a smaller proportion producing milksolids (milkfat + milk protein) for export butter, cheese and powder production. Total production of milksolids in Canterbury in 1984-85 was 9.7 million kilograms or 2% of the New Zealand total. By 2009-10, Canterbury's production of milksolids had increased 25-fold to 248 million kg of milksolids, or 17% of New Zealand's total. Although growth in production also occurred in the North Island (an increase of 1.5-fold), the growth rate of the South Island was much greater at 13-fold. South Island production increased from 7% of total New Zealand production in 1984-85 to nearly 40% in 2009-10 (Figure 2.3).

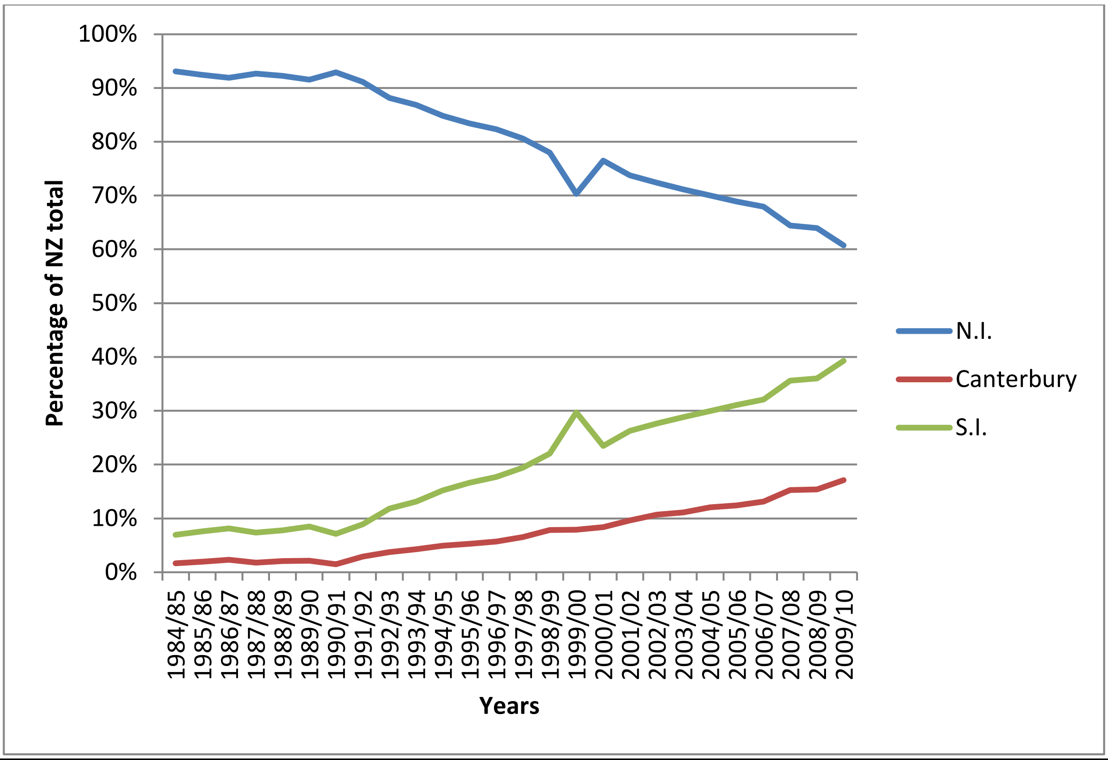


Figure 2.3 Percentage of total NZ milksolids produced in the North Island, South Island and Canterbury 1984-85 to 2009-10

Within the South Island, growth occurred in all regions but was most rapid in Canterbury, Otago and Southland (Table 2.1). There was also a change in the relative production by region, with Canterbury increasing from 20% of production to 44%.

Table 2.1 Production in the South Island manufacturing dairy industry 1984-85 compared to 2009-10.

	1984-85 kg ms	% of SI production	2009-10 kg ms	% of SI production
Nelson/Marlborough	8,678,772	31%	26,807,294	5%
West Coast	9,264,423	33%	44,167,917	8%
Canterbury	5,735,118	20%	247,843,540	44%
Otago	2,076,039	7%	73,791,163	13%
Southland	2,672,460	9%	172,285,585	30%

2.6 Numbers of farms

Between 1982-83 and 2009-10, dairy farm numbers in the North Island dropped by 33%, but more than doubled in the South Island (Table 2.2). The numbers of farms in Canterbury increased by 3.7-fold and, in Southland by 5.6-fold.

Table 2.2 Number of herds in the NZ dairy industry for selected years from 1982-83 to 2009-10[6].

	1982-83	1987-88	1992-93	1997-98	2002-03	2007-08	2009-10
North Island	13,368	12,630	12,930	12,659	10,865	9,050	8,998
South Island	1,087	1,142	1,528	2,014	2,275	2,386	2,620
Canterbury	226	229	409	534	624	729	846
Southland	144	156	246	471	632	710	809
NZ total	14,455	13,857	14,458	14,673	13,140	11,436	11,618

2.7 Farm size

There has been growth in farm size in all areas, although the growth has been much faster in the South Island, particularly in Canterbury (Figure 2.4). From 1982-83 to 2009-10, Canterbury farms grew in size at an overall compound rate of 4.5% per annum compared to 3.9% for the South Island. The North Island grew at a compound rate of 2.2% over this time. The drop in farm size in Canterbury in 2009-10 cannot be explained. The unit of measurement used for agricultural land in New Zealand is the hectare (ha)[7].

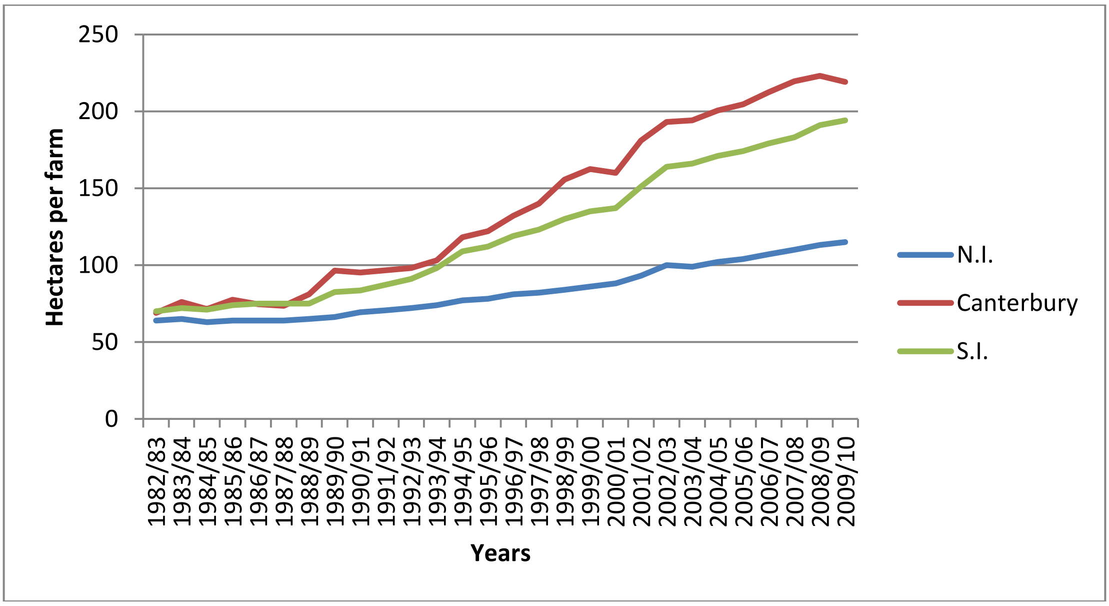


Figure 2.4 Trends in the size of farms in effective hectares from 1982-83 to 2009-10

[6] Data are for five year periods; however, the year 2009-10 has been added to provide the most current information.
[7] A hectare (ha) is 10,000 square metres and is equivalent to 2.47 acres.

2.8 Herd size and numbers

Cow numbers as a percentage of total New Zealand cows were static, at approximately 7% for the South Island and 2% for Canterbury from 1970 until 1990. However, since the early 1990s, the South Island industry has grown to contain over 31% of the national cow herd in 2009-2010 with Canterbury increasing to 13%.

Over 29 years (1980-81 to 2009-2010), the average North Island herd increased from 131 to 345 cows. In the South Island, herd sizes increased from 100 cows per herd to 565 cows per herd. Canterbury herds have grown from 89 cows to 730 over the same time period. By 2009-10, Canterbury herds were 2.1-fold the North Island average and 29% larger than the South Island average.

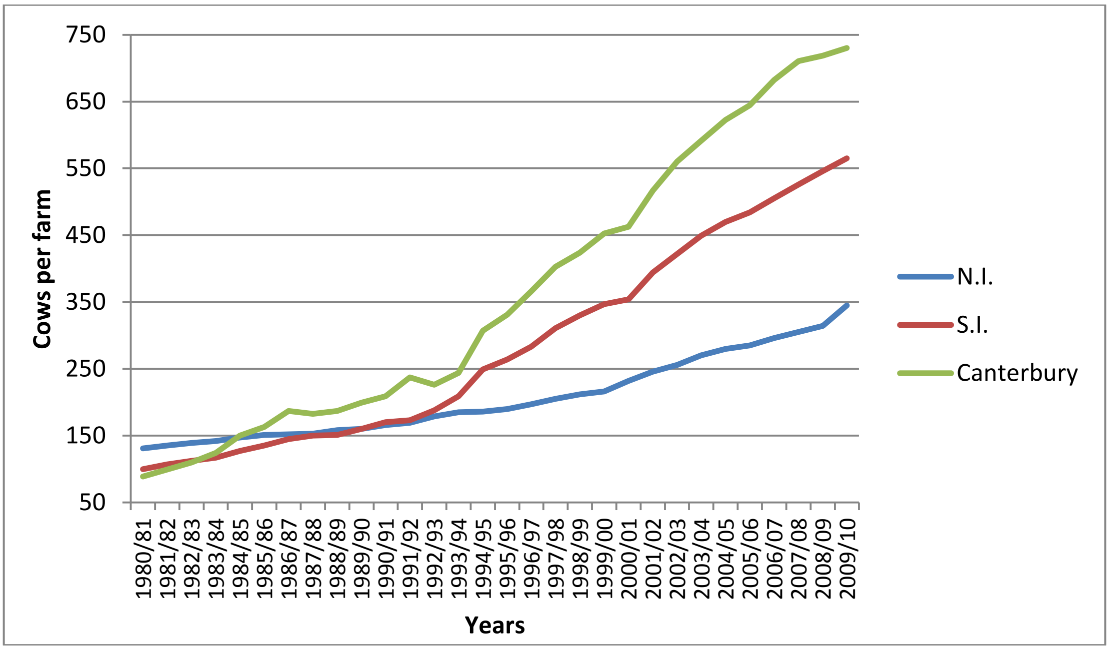


Figure 2.5 Growth in the number of cows per herd on NZ dairy farms, 1980-81 to 2009-10

2.9 Stocking rates

A major influence on the rapid growth in herd size in Canterbury has been a stocking rate (cows per hectare) that grew faster than in the rest of the country (Figure 2.6). In 1982-83 South Island farmers grazed approximately 1.7 cows per hectare compared to 2.2 cows per hectare in the North Island. By 2009-10, although stocking rates increased to 2.76 cows per hectare for the North Island, cows per hectare were 3.34 in

Canterbury. This is a doubling of stocking rates in Canterbury compared to an increase of 25% for the North Island.

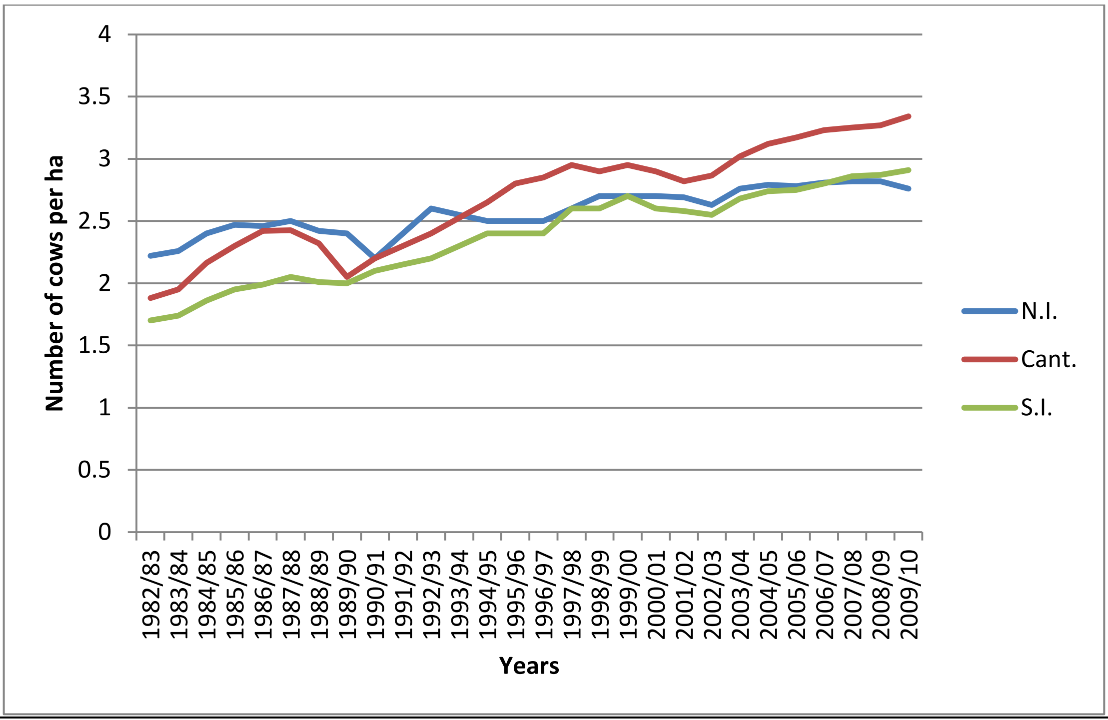


Figure 2.6 Changes in cows per hectare on NZ farms 1982-83 to 2009-10

2.10 Production per cow

Milksolids production per cow in 1982-83 was highest on the NI. But, by 2009-10 production in Canterbury was 378 kg milksolids per cow as compared to 327 kg milksolids per cow for the North Island or 16% higher (Figure 2.7).

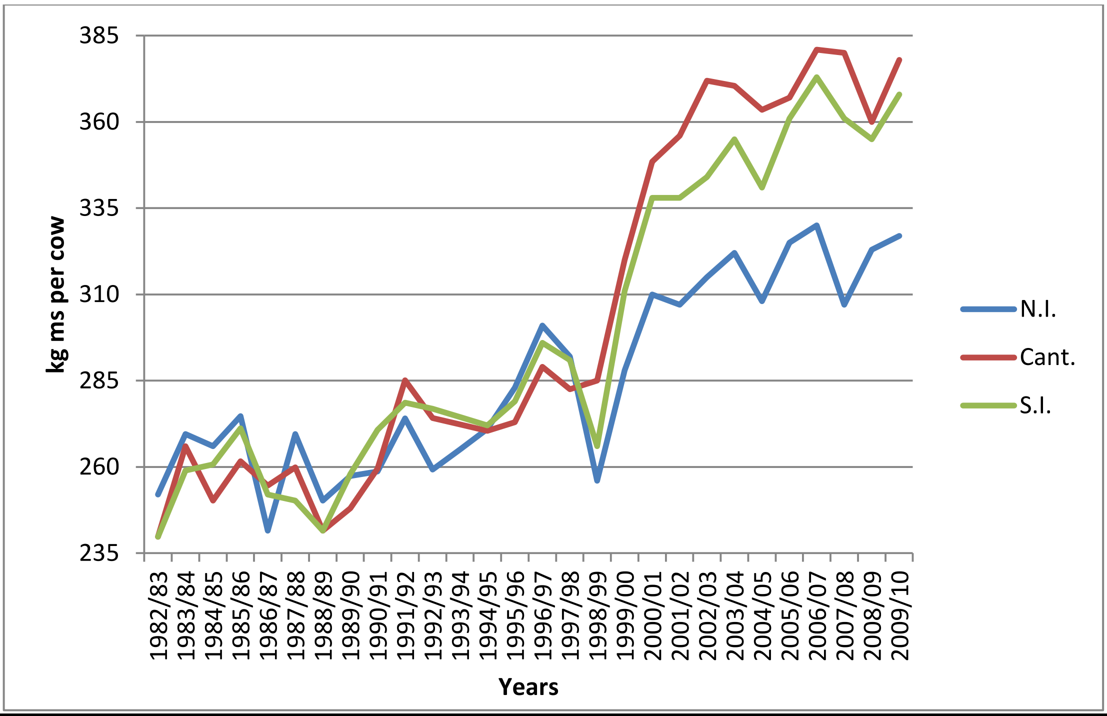


Figure 2.7 Changes in milksolids production per cow (1982-83 to 2009-10)

2.11 Production per hectare

The combination of higher milksolids production per cow and a higher stocking rate has produced an increase in production per hectare in all areas (Figure 2.8). In the 1982-83 season, milksolids production in the North Island averaged 561 kg milksolids per ha with Canterbury farms producing 453 kg milksolids per ha. Since the 1994-95 season, the degree of increase and absolute production per hectare has been greater in Canterbury. By the 2009-10 season, production in Canterbury had increased to 1,262 kg milksolids per ha (2.8-fold). In 2009-10, production in Canterbury was 1.5 times the NI average.

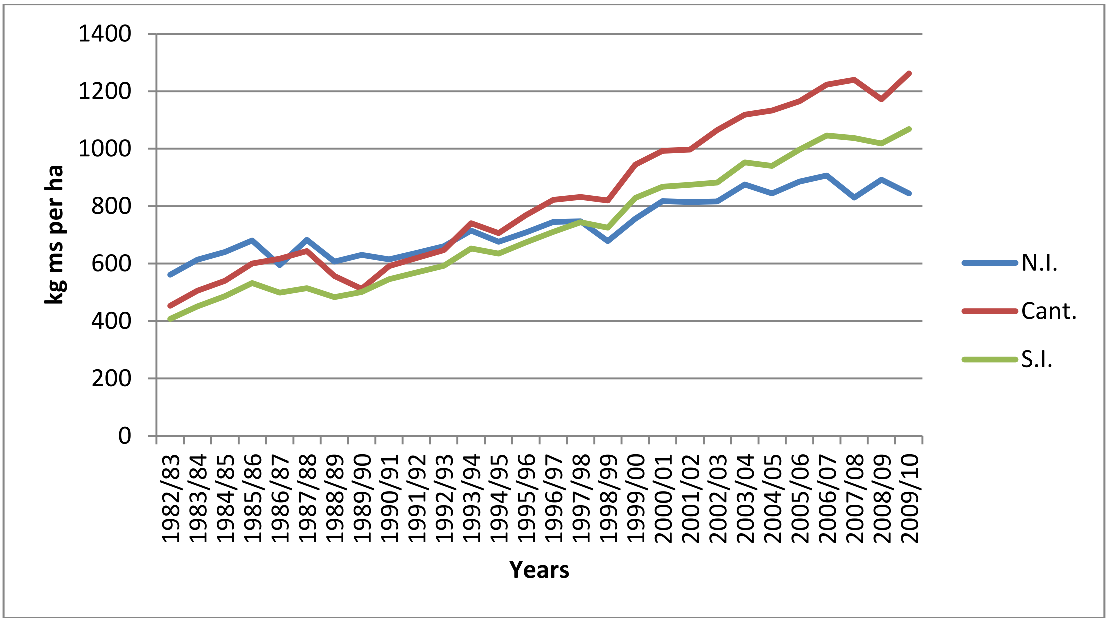


Figure 2.8 Changes in production per hectare in some NZ regions (1982-83 to 2009-10)

2.12 Gross farm revenue

In the MAF model, 'Gross Farm Revenue' consists of the sale of milksolids and cattle, grazing income and other farm income. Gross farm revenue per hectare was derived by dividing the gross farm revenue by the effective hectares listed. This analysis shows that since the 1999-2000 season gross farm revenue per hectare has exceeded the aggregate of New Zealand by an average of 28% annually.

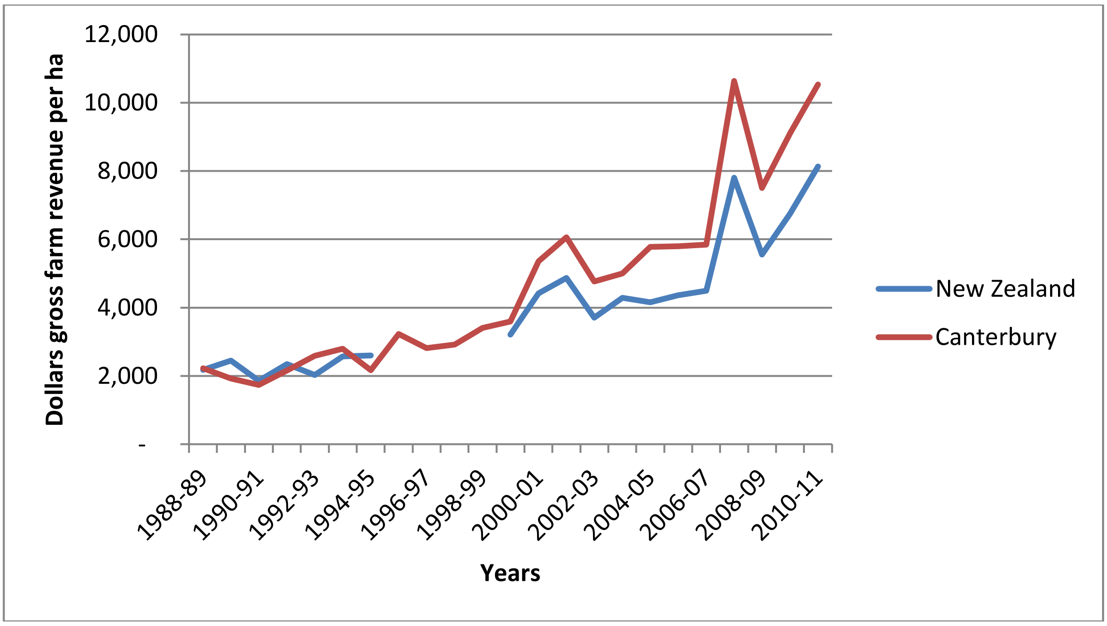


Figure 2.9 Comparison of MAF gross farm revenue per hectare 1988-89 to 2010-11

2.13 Cash farm expenditure

Cash farm expenditure includes the costs associated with production such as wages, animal health, feed, fertiliser, repairs, administration, etc. An analysis of cash farm expenditure on a per hectare and per kilogram of milksolids basis is shown in Figures 2.10 and 2.11. Prior to 1999-2000, expenditure per hectare was similar. From 1999-2000, the cash farm expenditure on average was 32% per hectare higher in Canterbury. However, due to the higher milksolids production, the average cost in Canterbury subsequent to 1999-2000 was only 2% higher than the overall New Zealand cost on a per kilogram of milksolids basis.

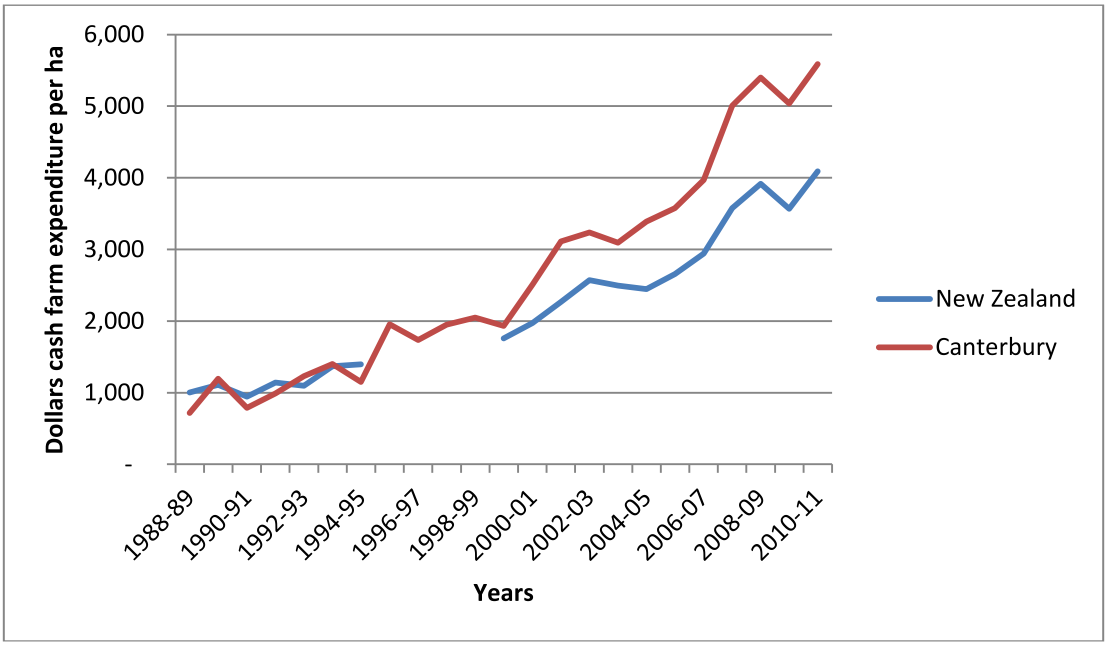


Figure 2.10 Comparison of MAF cash farm expenditure per hectare 1988-89 to 2010-11 for NZ and Canterbury

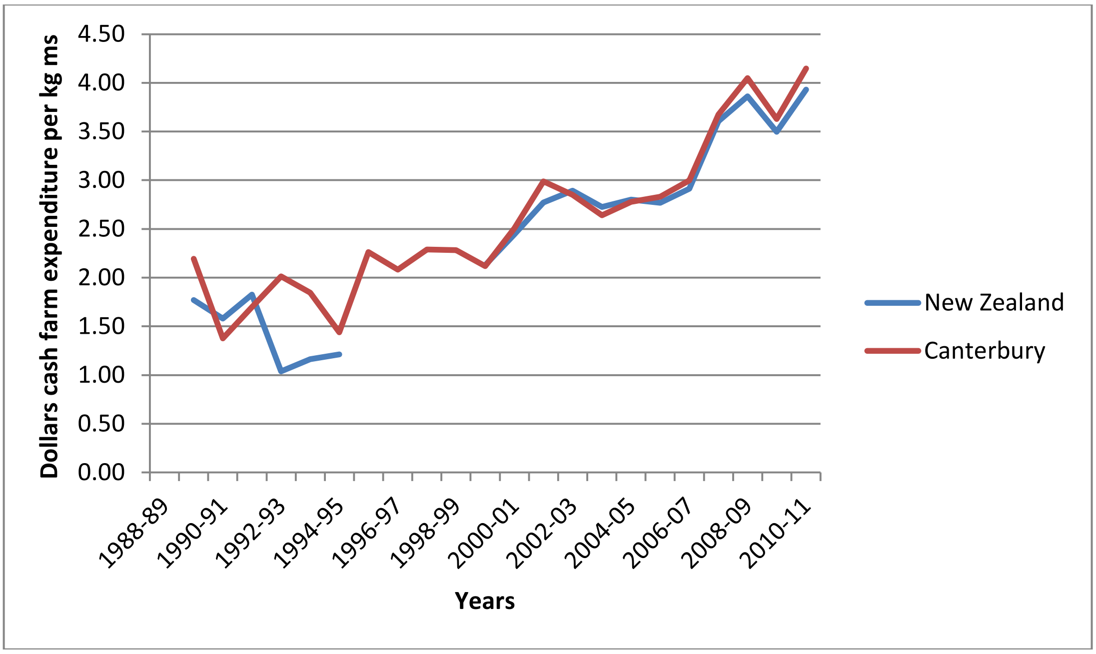


Figure 2.11 Comparison of MAF cash farm expenditure per kilogram milksolids 1988-89 to 2010-11 for NZ and Canterbury

2.14 Cash farm surplus

To obtain the 'cash farm surplus'[8], the cash farm expenditure was deducted from the gross farm revenue and divided by the number of hectares (Figure 2.12). Non-working expenses such as interest, stock adjustments, depreciation, interest, tax, principal payments, drawings and development are not included. For the seasons 1988-89 to 1994-95, Canterbury did not show a consistent advantage, but from 1999-2000 the cash farm surplus per hectare averaged 24% higher annually in Canterbury than in the rest of the New Zealand dairy industry.

[8] Cash farm surplus is the term used by MAF for income less farm working expenses. Other analysts may use similar calculations, but refer to the measurements as EBIT or net operating income.

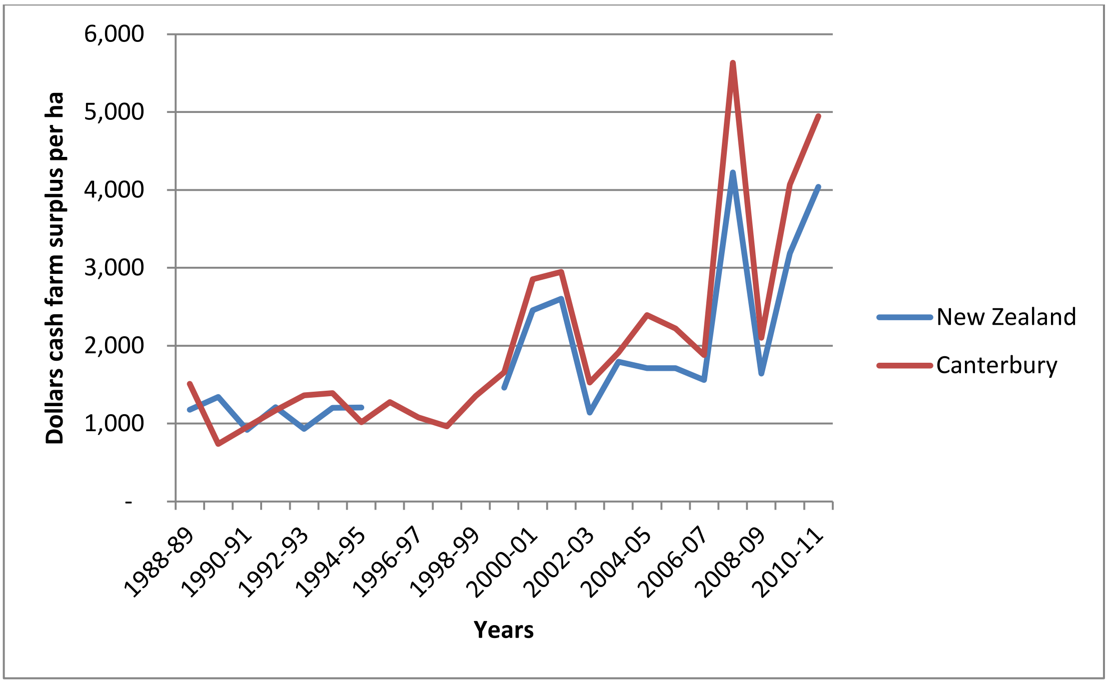


Figure 2.12 Comparison of MAF cash farm surplus per hectare 1988 -89 to 2010-11 for NZ and Canterbury

Although there were large differences at times in cash farm surplus per kilogram of milksolids for the areas up to 2003-04, there were similar levels of cash farm surplus for Canterbury and New Zealand from 2003-04 onwards (Figure 2.13). A number of climatic events have been identified as potential reasons for decreased cash farm surplus prior to 2003-04. Additionally, supplementary feeding in both areas became more prevalent after that date and could have contributed to more stable production and thus similar profit levels per kilogram of milksolids.

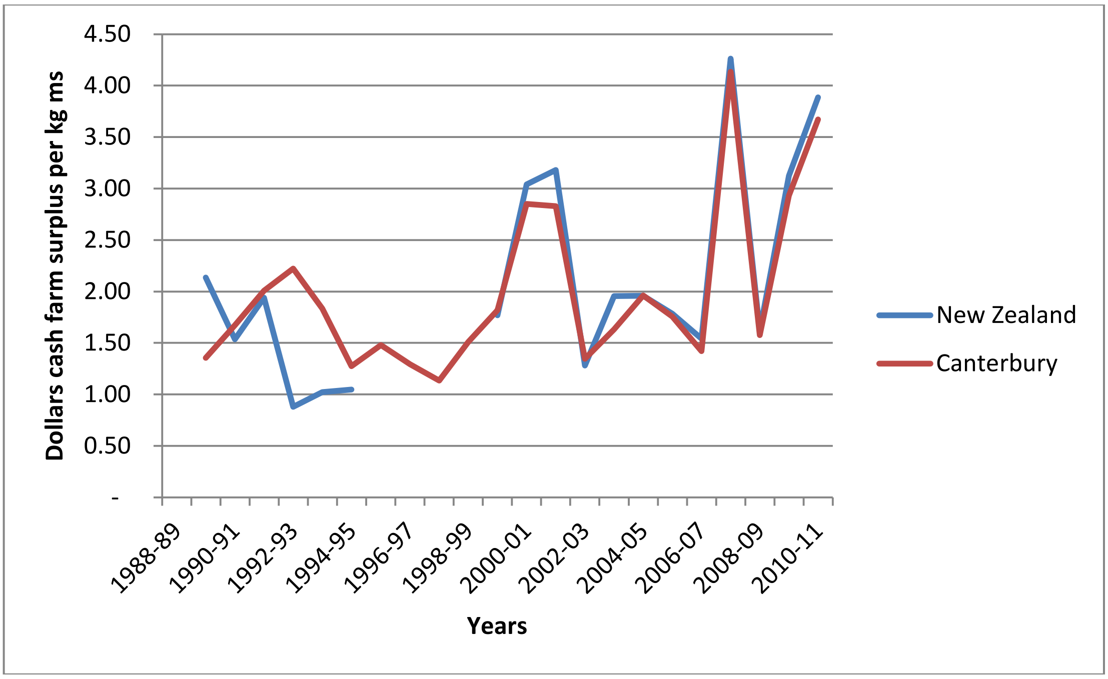


Figure 2.13 Comparison of MAF cash farm surplus per kilogram milksolids 1988-89 to 2010-11 for NZ and Canterbury

2.15 Operating Profit

An alternative calculation (operating profit per hectare) was obtained from the DairyNZ Economic Farm Survey and personal communication with DNZ personnel (2005-06 to 2009-10). Prior to 2005-06, the Economic Survey was prepared by the LIC for New Zealand as a whole; therefore regional comparisons are not possible. The 'operating profit' calculation includes all sources of revenue and an adjustment for changes in livestock inventories. The 'operating expenses' include the working expenses, as included in the MAF model, plus an adjustment for unpaid management, feed inventories, an adjustment for an 'owned run-off'[9] and depreciation. This data base allows the comparison of Canterbury with the key dairy areas of the Waikato and Taranaki as well as the North Island and the South Island. Under this method of analysis, the operating profit per hectare was reasonably similar for the areas in most years. However, in 2007-08 and 2009-10 when milksolids payouts were higher, Canterbury had an operating profit per hectare far greater than in the other regions.

[9] A 'run off' in New Zealand is land utilised by a dairy farm for grazing non-lactating animals, producing supplementary feed or wintering the herd.

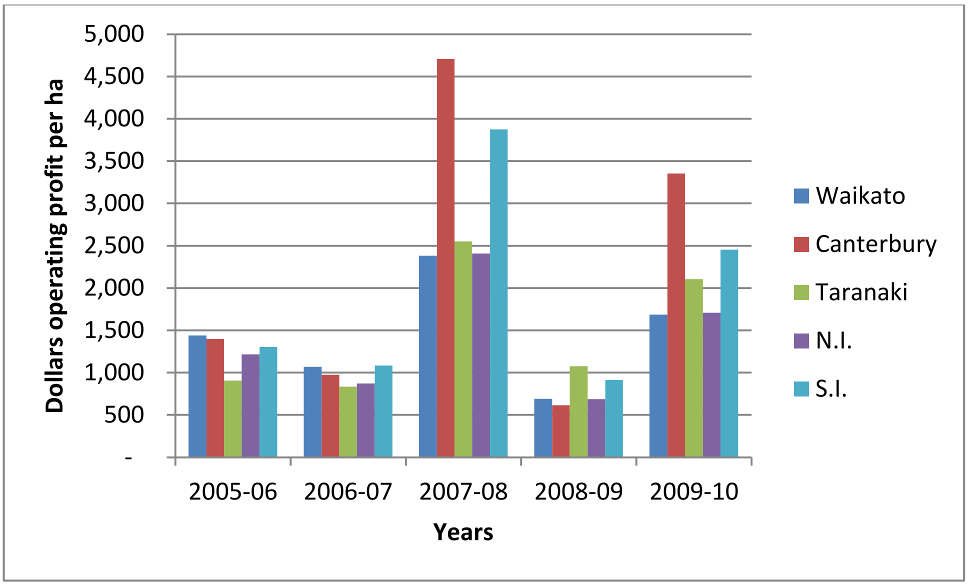


Figure 2.14 DNZ operating profit per hectare for some NZ regions 2005-06 to 2009-10

2.16 Capital investment

MAF data (capital investment) was utilised to determine investment per hectare. Assets are defined as farm, forest and building, plant and machinery and stock. The model does not mention shares held in agricultural cooperatives or companies. It must be noted that in this case, investment is the market value of the assets, not the amount that farmers actually invested in their farms. Investment was similar until 2009 when dollars invested per hectare increased by 10% for Canterbury, with the margin remaining nearly constant through 2011. The price of all farms on a per hectare basis has dropped since 2008-09.

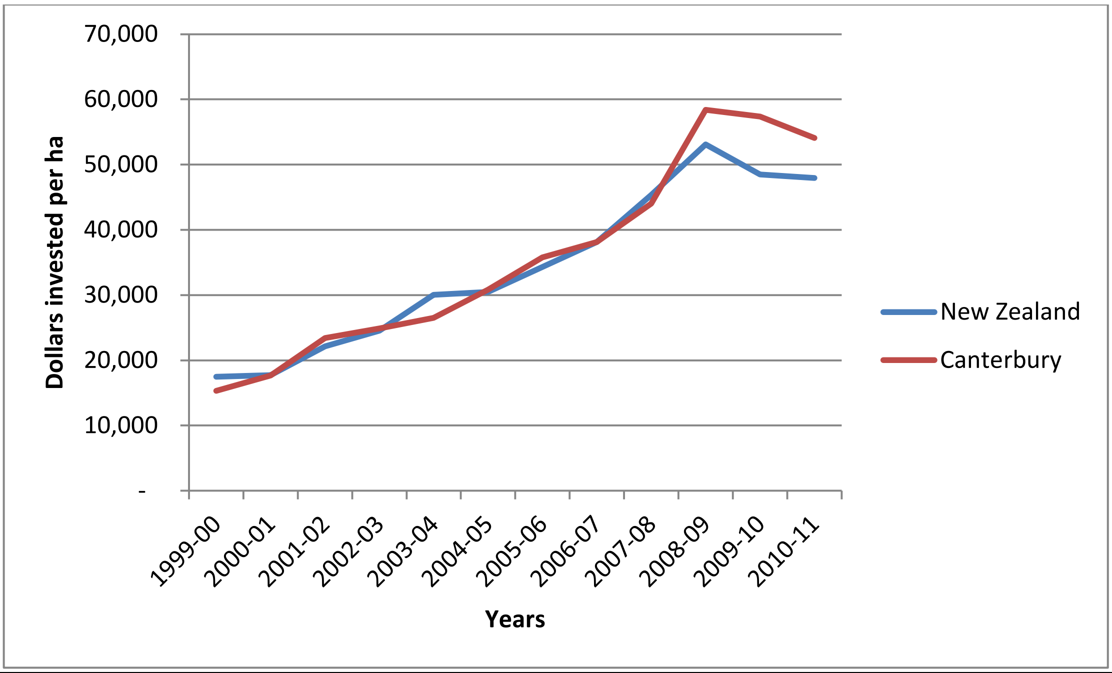


Figure 2.15 MAF model of total farm capital investment per hectare 1999-2000 to 2010-11 for NZ and Canterbury

However, due to the higher level of milksolids production per hectare, the capital invested per kilogram of milksolids has been 21% lower in Canterbury or an average of \$28 versus an average of \$36 per kg milksolids for the rest of New Zealand (Figure 2.16).

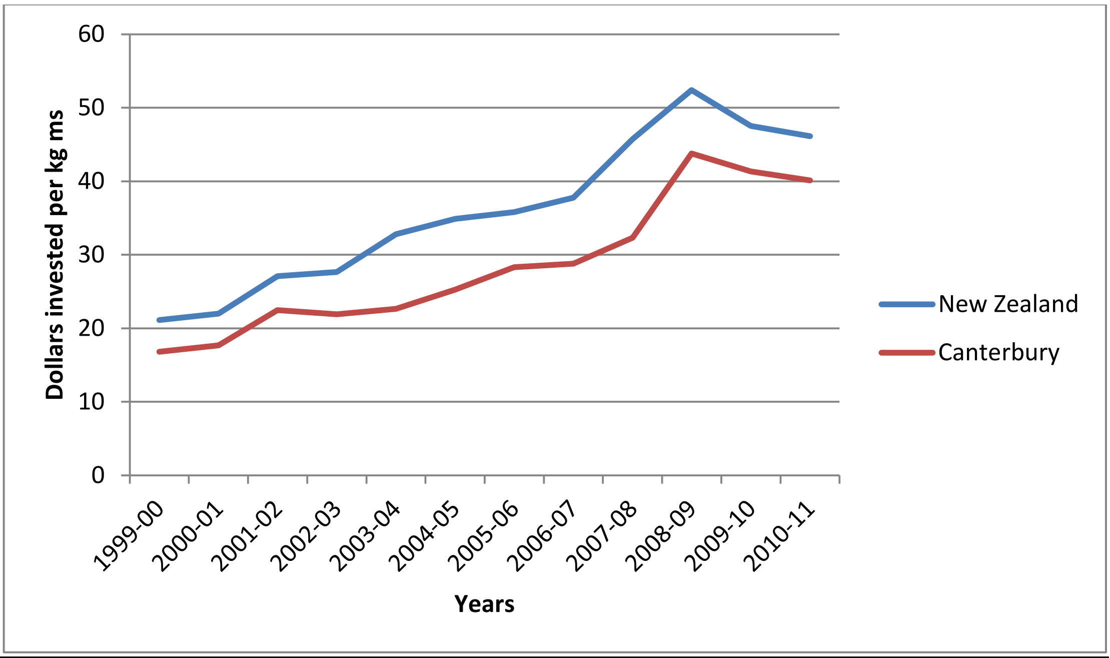


Figure 2.16 MAF model total farm capital per kilogram milksolids 1999-2000 to 2010-11 for NZ and Canterbury

2.17 Debt per farm

Debt per hectare has increased on all dairy farms, from \$5,000 per hectare in 1999-2000, to \$26,458 in Canterbury and \$19,707 for the rest of New Zealand, in 2011.

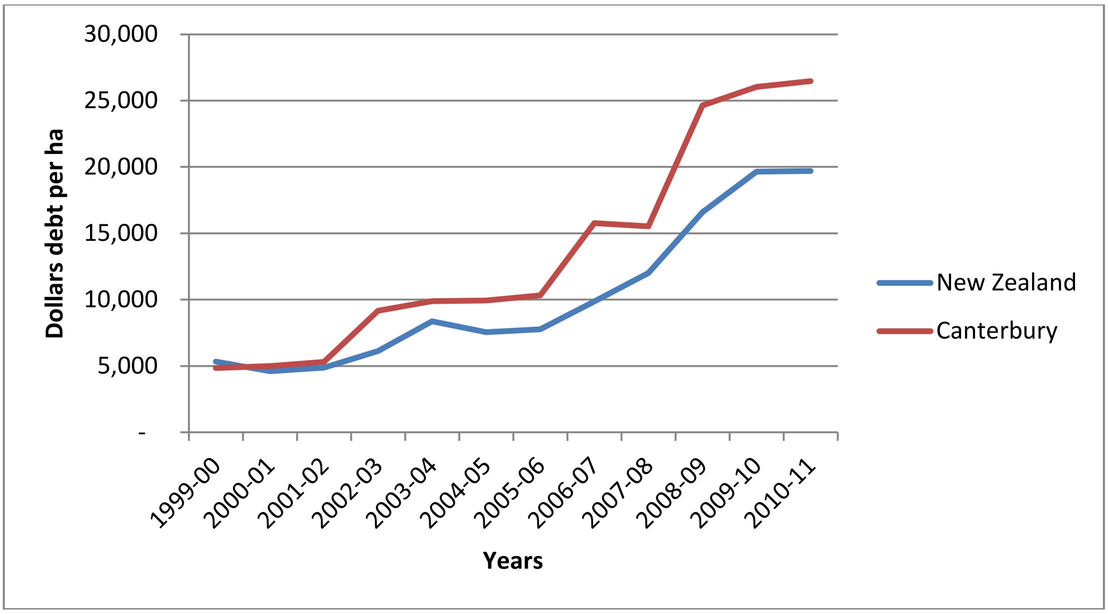


Figure 2.17 MAF model of debt per hectare 1999-2000 to 2010-11 for NZ and Canterbury

However, the higher production levels achieved in Canterbury have resulted in debt per kilogram of milksolids being nearly the same as the rest of the country (Figure 2.18).

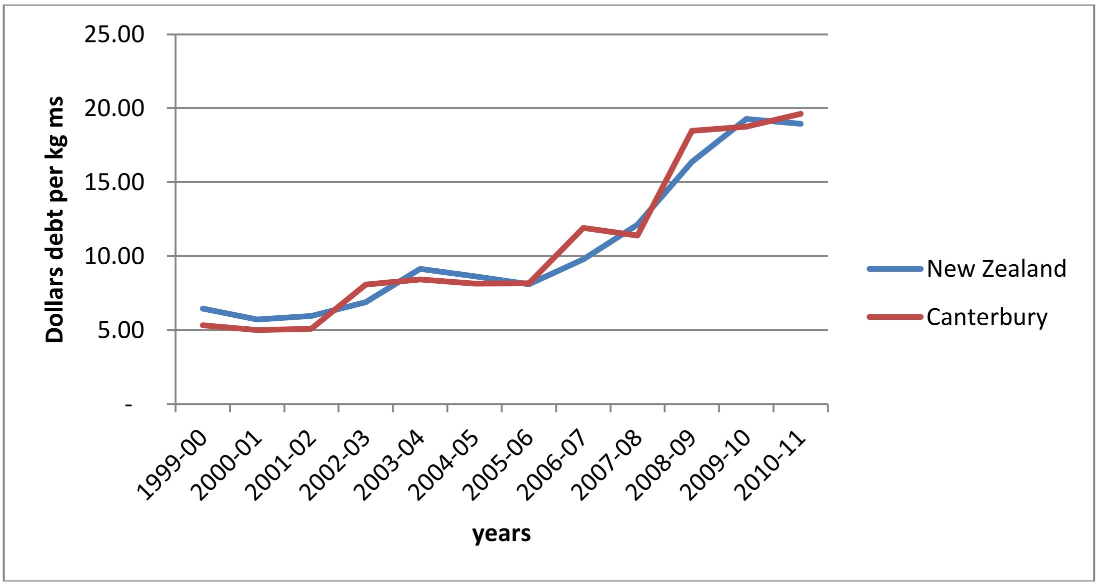


Figure 2.18 MAF model of debt per kilogram milksolids 1999-2000 to 2010-11

2.18 Farm equity

The MAF models show farm equity (investment less debt) of $12,117 per hectare for New Zealand and $10,471 per hectare for Canterbury in 1999-00. By 2008-09, equity peaked at $36,516 per hectare for New Zealand and $33,758 per hectare for Canterbury. Since 2008-09, dairy land values have declined and in 2010-11 the model predicted lower levels of equity per hectare for all dairy farms.

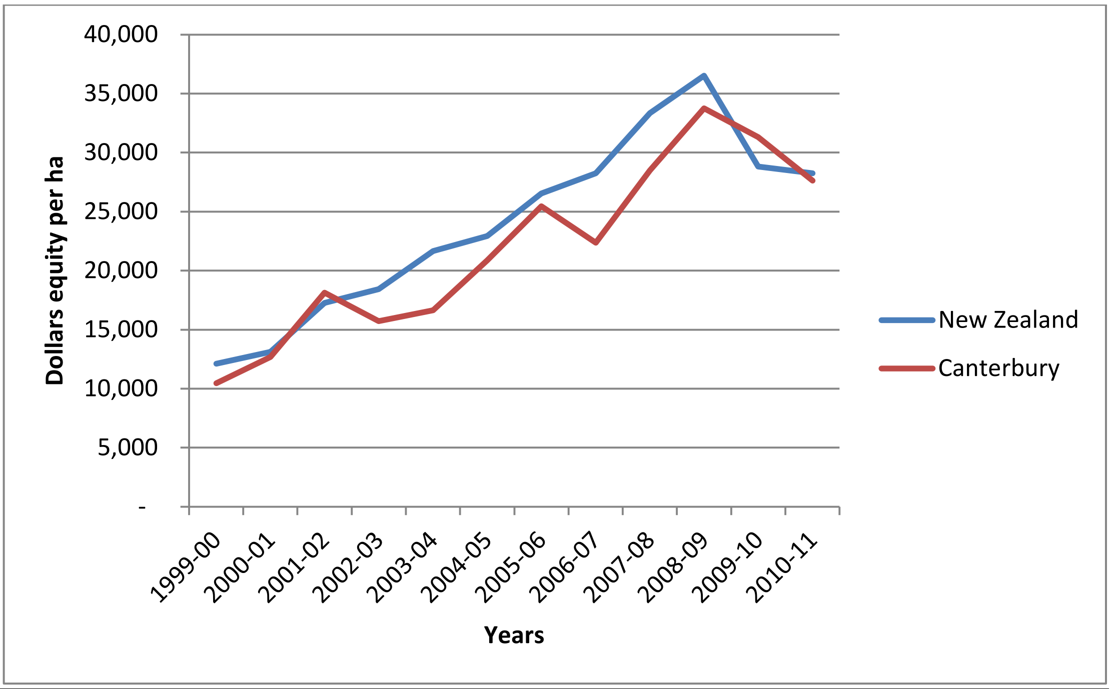


Figure 2.19 Comparison of MAF equity per hectare 1999-2000 to 2010-11 for NZ and Canterbury

2.19 Return on capital

Return on capital (ROC) was calculated based on the cash farm surplus as defined in the MAF model divided by the capital investment. Often an imputed ‘wages of management’, is included in ROC calculations. However, in this case because the objective of the analysis was to determine relativities, the inclusion of wages of management would not affect the result hence, it was omitted. The analysis shows a much higher ROC for Canterbury since 1999-00.

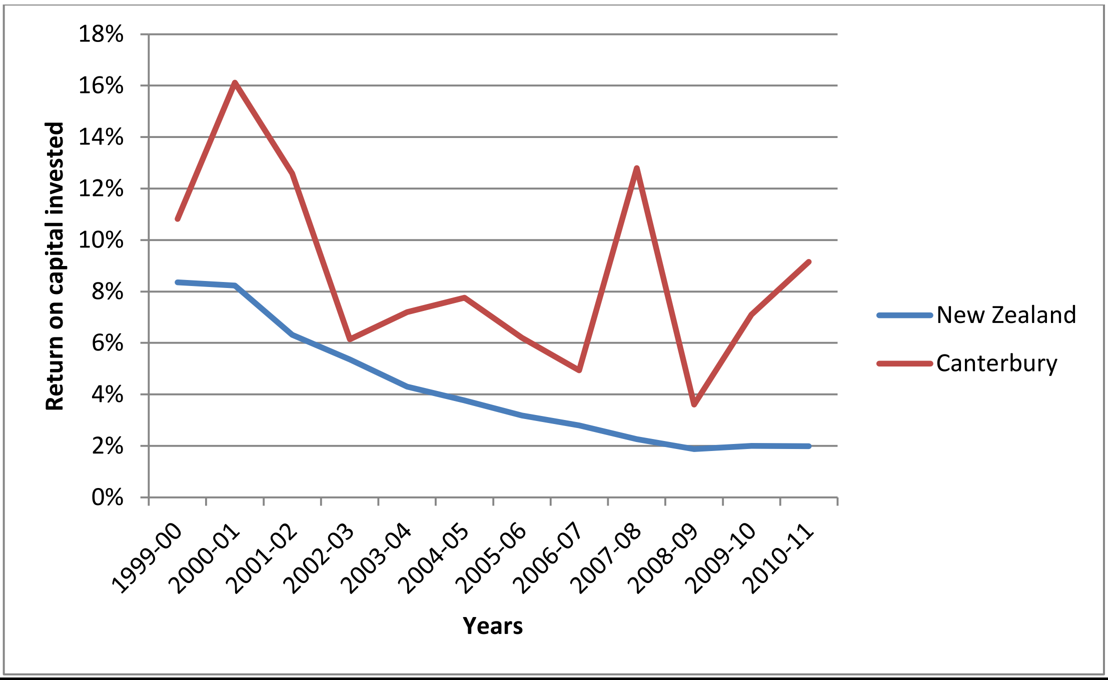


Figure 2.20 Comparison of MAF return on capital 1999-2000 to 2010-11 for NZ and Canterbury

2.20 Discussion

The statistics from to 2009-10 show a change in land use in New Zealand particularly in Canterbury and the South Island. The area involved in dairying in Canterbury has grown from fewer than 20,000 hectares to nearly 200,000 hectares or an overall annual compound growth rate of 11%. Milksolids production since 1984-85 has grown by 25 times in Canterbury. Obviously, growing from a low base produces impressive growth numbers. However, the fact that Canterbury production has increased from 2% of the New Zealand total to 17% in an industry that was growing on a national basis would indicate that there are special factors that encouraged growth of a Canterbury dairy industry. Although North Island production increased by 1.5-fold, South Island production grew from 7% to nearly 40% of New Zealand's annual production of milksolids.

Components of Canterbury growth have included farm numbers, farm size, production per hectare and production per cow. During 2009-10, these figures were greater than the levels achieved by the North Island and other areas of the South Island. Although the rapid growth in other South Island dairy areas would share ‘drivers’ similar to Canterbury, the notable extent to which production per hectare is higher in Canterbury would suggest some unique drivers in Canterbury.

According to the MAF models, income and expenses per kg milksolids and, hence, operating surplus per kilogram of milksolids, were similar for Canterbury and the rest of New Zealand. However, because of higher production per hectare, these operating surpluses per hectare were greater than elsewhere in New Zealand for all years. In contrast, DairyNZ data indicated that per hectare operating surpluses were greater in only some years, and similar (or less) in other years.

Debt levels in Canterbury were higher than elsewhere in New Zealand and this is consistent with development expenditure, which would require the injection of new capital.

Returns on capital (debt plus equity) were greater in Canterbury than the rest of the country (9% compared to 4%) based on similar capital per hectare but with lower capital per kilogram of milksolids. However, this capital is measured at market value rather than being a reflection of the initial investment plus development costs. Hence, the capital can only be viewed as being the capitalised value of the initial investment plus the profits. What these market values fail to identify is whether or not there is an embedded capitalisation of developer profits within the market capital valuation. Alternatively stated, the total capital may include capital gain from capitalised entrepreneurial profits.

Accordingly, although it can be stated that dairying in Canterbury has demonstrated strong and, in general, superior overall profitability compared to other regions, the question of wealth creation remains unanswered. This issue is now taken up in Chapter 3, through a longitudinal analysis of wealth creation on a specific farm.

Chapter 3
A case study of investment and growth in the Canterbury dairy industry

3.1 Introduction

Thus far, it has been established that there has been considerable growth in the Canterbury dairy industry in terms of size and productivity. It has also been shown that dairying returns per hectare in Canterbury have tended to be higher than other regions of New Zealand, and that annual returns on capital also tend to be high relative to other regions. However, what these analyses have not identified is the extent of capital growth in individual businesses and the presence of entrepreneurial development profits. Accordingly, the purpose of this chapter it to investigate the growth of a specific farming business established during the period. The author has an ownership position in this farm business, giving access to detailed records. Consequently, whereas Chapter 2 was a sequence of static positions, in this chapter all monetary inflow and outflows are able to be documented for the case study farm to create a linked longitudinal series which captures the costs and entrepreneurial profits associated with the development.

3.2 Organization of the chapter

In Section 3.3, the history of the farm and its growth will be introduced. Section 3.4 is an economic analysis of the growth of the farm business from the 1987-88 season to the 2009-10 season. Section 3.5 presents a complementary study of investment by the business in a series of associated processing/marketing cooperatives. The methods used are described in each section.

3.3 The case study farm

3.3.1 Method

Records have been kept of physical and financial performance since the farming enterprise began in 1987-88 through to 2009-10. Information available included diaries, balance sheets, stock reconciliations, development schedules and accountant prepared tax statements. Comparing the case study farm to the historical records found in Chapter 2, shows that when the partnership began sharemilking there were 229 factory supply farms in Canterbury. These farms milked 183 cows on 74 hectares. Thus the sharemilking position allowed the partnership to milk a much larger herd on a property that was nearly three times the district average.

3.3.2 The farming partnership

The case study farmers began their active farming operation in 1987-88. Both partners were from dairy farming families, but had been employed in agricultural support industries prior to entering the Canterbury dairy industry in their early 30s. The partners obtained a 450 cow, 50-50 sharemilking[10] job in Canterbury in mid-season due to the financial failure of the previous sharemilker. The economic restructuring of the New Zealand economy in the mid-1980s and poor world dairy commodity prices resulted in low cow values and the herd was purchased for $425 (nominal) per cow. The owner of the property provided finance for the cows for the first year at 12% interest (market rates were over 20% at the time), as an incentive for the partners to accept the job. The case study farming partners entered the business with about $100,000 (nominal) in equity based in cows, real estate and cash.

The farm was underdeveloped as the previous owner had converted to dairying in 1985, but did not have the funds to re-grass or raise fertility levels (Olsen P[11] levels were 9). When the partners arrived in October 1987, only half the herd had calved and thus production for the year was low, at 72,000 kg milksolids. The 1988-89 season was more productive with 88,400 kg milksolids being produced. The property was purchased by a corporate farming company in the spring of 1989.

Industry growth, fuelled by the entry of the ‘corporate farmers’ led to increased cow prices. The partners elected to sell the cows for June 1989 delivery and agreed to stay on the property for the 1989-90 season as contract milkers[12]. With the sale of the cows, net worth increased to $192,335 (nominal). The funds from the sale of the

[10] 50-50 sharemilking is a farm leasing arrangement which involves the lessee owning the cattle and machinery and providing management and labour for a dairy operation. The sharemilker receives 50% of milk proceeds, with the remaining 50% paid to the owner of the property

[11] Olsen P is the test used to determine phosphate levels in NZ soils. It involves introducing a bicarbonate of soda solution at 8.5 pH to soils to extract the element phosphorus.

[12] Contract milkers supply all labour, some machinery and pay for milking shed running costs. In return they receive a set dollar amount for each kilogram produced.

original herd were used to purchase heifers and cows with the intention of obtaining a smaller sharemilking job for the1990-91 season. However, in November of 1989, there was the opportunity to purchase, for $42,500, the 'improvements' (including water rights) for a 70 hectare (ha) leasehold property that was administered by the Canterbury Regional Council. Shortly after possession, a further 65 ha block of council land, referred to as 'reserve land' was offered with a three year lease at $25/ha per year. Both properties were poorly developed with Phosphorus (P) levels as low as 3 and unimproved grass species. Phosphorus and lime were applied, more land was irrigated and the farm re-grassed. An off-farm job was obtained by one of the partners and the development process initiated. During this time the partners traded stock and reared 300 calves per year to help fund development.

A 26-aside herringbone milking shed was built in October 1993 (it was impossible to get a shed built earlier due to competition for builders in a rapidly expanding industry) and the first milk was sold from 125 cows on the 15th of November. The nominal cost of conversion was approximately $150,000 ($217,371 in 2010 constant value dollars)[13] for a cowshed, water system and effluent system. The partners used their own funds to purchase cows and borrowed $150,000 from a bank for the conversion. A few weeks before the shed was completed, a neighbouring property of 80 ha was purchased for $85,000 in total. Production in the conversion season of 1993-94 was 25,500 kg milksolids. In the winter of 1994, additional cows were purchased so that 220 cows calved in August 1994. Production increased in the 1994/95 season to 70,000 kg milksolids (318 kg of milksolids/cow).

Over the next 15 years the enterprise expanded through purchasing adjacent land, developing irrigation and increasing stocking rates. New technologies were important to development. The first irrigation well was drilled to 73 metres in 1995-96 and was the first in an area where water was considered to be 'too deep' to access. Water was initially applied through 'long line laterals' (a sprinkler on the end of 100 metres of alkathene pipe), which was replaced by the innovation of K-lines[14] in 1997-98. Also in that year, 30 adjoining hectares were purchased and irrigated. In 2000-01 the

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[13] Calculated using the NZ Reserve Bank inflation calculator, www.rbnz.govt.nz

[14] K-lines are plastic pods with sprinklers inside that are attached at 15 metre intervals to an alkathene pipe that is generally 150 metres in length.

cowshed was expanded to a 36-aside herringbone with improved pulsation and a larger milk delivery line. This development allowed the herd, which had grown to 450 cows, to be milked faster. In 2001-02 the farm began to remove weed species from adjoining land leased from the Canterbury Regional Council. With the addition of irrigation, approximately 18 hectares was gained for the milking herd. Also, in 2001-02 an adjoining 20 hectares was purchased and irrigated.

In 2003-04, the herd was sold to a 50-50 sharemilker. With increased supplementary feed and irrigated land, the sharemilkers increased stocking rates to the point that the farm milked 700 cows and achieved production of approximately 284,500 kg of milksolids in 2006-07. Growth of the business further increased through the purchase of a 145 hectare farm, six kilometres from the home farm. In 2009, the 145 hectare property was converted to a dairy farm, which led production to increase to 482,080 kg milksolids from 1,150 cows in the 2009-10 season. The area of land on which the milking herd was grazed now totalled 336 ha with 80 ha of support land. A complete time line of the growth of the case study farm since the commencement of dairying on the original property in 1993 until the 2009-10 season is found in Appendix B1.

3.4 Business growth for the case study farm (1987-88 to 2009-10)

3.4.1 Methods

A series of balance sheets were compared (see Appendices B2 and B3) for the case study business from business initiation in late 1987 until 2010. From the 1987-88 season to the 1989-90 season, the partnership operated as 50/50 sharemilkers. A farm was purchased in 1990 and converted to dairy farming in 1993. Accountant-prepared financial statements are not available for these years, thus the analysis was prepared using annual balance sheets provided by the case study farmer’s records. Some items such as machinery, plant, vehicles and real estate valuations were based on the farmer’s estimate of the market. Other valuations such as livestock and shares (non-agricultural) were based on publicly available data.

Dairy farming commenced on the owned property in late 1993; with the results from that partial season included in the 1994 accountant-prepared financial statements. All information on assets and liabilities from 1994 until 2010 was sourced from accountant-prepared accounts, except for real estate values (see below). Asset classes analysed were as follows:

Cattle: the number of cattle on hand at the end of each financial year was ascertained from the cattle trading account or farmer records. All animals were valued using the National Average Market Value (NAMV) as published by the Inland Revenue Department (2010). Table 3.1 gives examples of the increases in values that occurred over the period.

Table 3.1 National Average Market Values ($) for dairy cattle for selected years in constant value dollars (2010).

	1988	1998	2008
Friesian r 1 yr heifers	367	346	1,074
Friesian r 2 yr heifers	616	680	1,922
Friesian mixed age cows	604	859	2,227
Jersey r 1 yr heifers	321	333	952
Jersey r 2 yr heifers	538	665	1,762
Jersey mixed age cows	447	844	2,154

Source: Inland Revenue Department (2010) and Reserve Bank of New Zealand CPI Inflation Calculator (2010).

Plant/equipment/vehicles: the values used were the depreciated value of the items from the accountant-prepared accounts from 1994 onwards and the farmer's records prior to that date. Depreciation systems used were a mixture of straight line and diminishing value, depending upon the type of asset.

Real estate: A data set was derived from the historical records of the New Zealand Valuation Department and its successor, Property IQ NZ Ltd (QV). The data are based on the average sales prices for Canterbury dairy farms on both a per hectare basis and a per kilogram of milksolids produced basis. A significant feature of the development of the Canterbury dairy industry has been the growth in land values. Valuation information indicated that the per hectare price of Canterbury dairy farms increased on an inflation adjusted basis (2010 constant value dollars) from $6,369/ha in 1987 to $31,262/ha in 2010. On a milksolids basis, the inflation adjusted increase (2010 constant value dollars) was from $ 17.79 to $36.95 per kg milksolids.

The determination of the real estate values caused the greatest problems for the preparation of the balance sheets. These problems involved low sales volume in certain periods and the timing of sales reported by the valuation departments. To maintain consistency, data from each six month report were used rather than the dataset that compiled sales on an annual basis. This decision was due to inconsistencies being found in the annual sales data.

Dairy Company shares: Values used for shares held in the cooperative dairy companies were reported in two ways. From the introduction of the 'growth funding growth' share by Alpine Dairy Products in1993 until the formation of Fonterra in 2001, the values listed are as reported by the accountant-prepared financial statements. With the advent of Fonterra, the industry adopted the Fair Value Share (FVS). Suppliers own one FVS per kilogram of milksolids supplied to Fonterra. This share was initially valued at $3 per kg milksolids in 2001 and later valued on an annual basis by independent valuers. In 2009, the value of the FVS was frozen at $4.52 as the company examined changes to its capital structure. The values are listed in Table 3.2 and have been used to determine the value of the total shareholding.

Table 3.2 Fonterra Fair Value Share values (2002-2010).

Year	Nominal Value ($)	Constant Value (2010 $)
2002	3.85	4.70
2003	4.38	5.27
2004	4.69	5.51
2005	5.44	6.22
2006	6.33	6.96
2007	6.79	7.32
2008	5.57	5.77
2009	4.52	4.60
2010	4.52	4.52

Source: van Polanen NZ Agri 2010.

Other agricultural shares: Values listed for investments in other agricultural cooperatives are based on the accountant-prepared financial statements. The investment of the case study farmers in other cooperatives has grown over the years, generally due to increased patronage.

Debt: Debt levels for the period from 1988 to 1993 are from the farmer-prepared balance sheets. Debt levels from 1994 to 2010 are from the accountant-prepared financial accounts.

Calculations:

1) The net worth was adjusted from nominal values by the rate of inflation reported by the Reserve Bank of New Zealand (2010), to give valuations in constant value 2010 dollars.

2) The debt to asset ratio was calculated as follows:

Total Liabilities/Total Assets

3) The percentage annual growth in net worth was calculated using the formula:

$$\frac{\text{Net worth year n} - \text{Net worth year (n-1)}}{\text{Net worth year (n-1)}}$$

Where n = 1, 2.........22.

4) The compounded annual growth in net worth (or growth factor) was determined using the formula:

$$R = \sqrt[n]{s/p} - 1$$

Where R = growth factor
n= number of years
s = final wealth
p = initial wealth

5) To obtain a return on the partners own capital, an internal rate of return (IRR) was calculated using the net worth (constant value 2010 dollars) at the beginning of investment, the net worth at the end of the investment, and

incorporating inflows and outflows from the business. All profits were reinvested in the business; hence, the financial impact is included in the final balance sheets and does not have to be separately included. Wages of management were not withdrawn, and, therefore represented injections of capital from the owners which were separately incorporated. Modest drawings were taken from the business but these were considered a business expense (or wages to the owners). No separate entry was therefore needed for these drawings as, like other working expenses, their impact was already accounted for in the balance sheet equity. Financial payments (borrowings, interest and capital repayments) also required no separate consideration as their impact was automatically recorded in the balance sheets.

3.4.2 Results

Table 3.3 summarizes the results of the 22 years of balance sheets under both a per ha valuation method and a per kg milksolids valuation method, with all dollars inflation adjusted to 2010 constant value dollars. The spread sheets for the datasets that were used in the calculations are found in Appendix B2 to B5.

Table 3.3 Results of Balance Sheet Analysis (1988-2010) in constant value dollars, 2010.

	Valuation of per ha basis	Valuation on a per kg ms basis
Debt/Asset range over all years	9% -72%	7%-72%
Debt/Asset average	30%	26%
Beginning NW (real)	$180,512	$180,512
Ending NW (real)	$8,150,456	$15,240,446
% compounded real growth in wealth (NW)	18.9%	22.3%
ROC	11%	15%

The debt/asset ratio varied significantly during the period analysed. The farming operation was highly leveraged (debt to asset ratio) at the beginning (72%) but at times was under 10% (Figure 3.1). The average debt/asset ratio on a per ha valuation basis was 30% and 26% under a per kg milksolids valuation. A number of factors affected the debt/asset ratio, including increasing the land area and cattle numbers, increased values for the real estate and livestock, paying down debt at times and acquiring debt during expansions. In Figure 3.1, there was no calculation of debt/asset on a per hectare basis prior to 1990-91 as the case study farmer did not own land during that period.

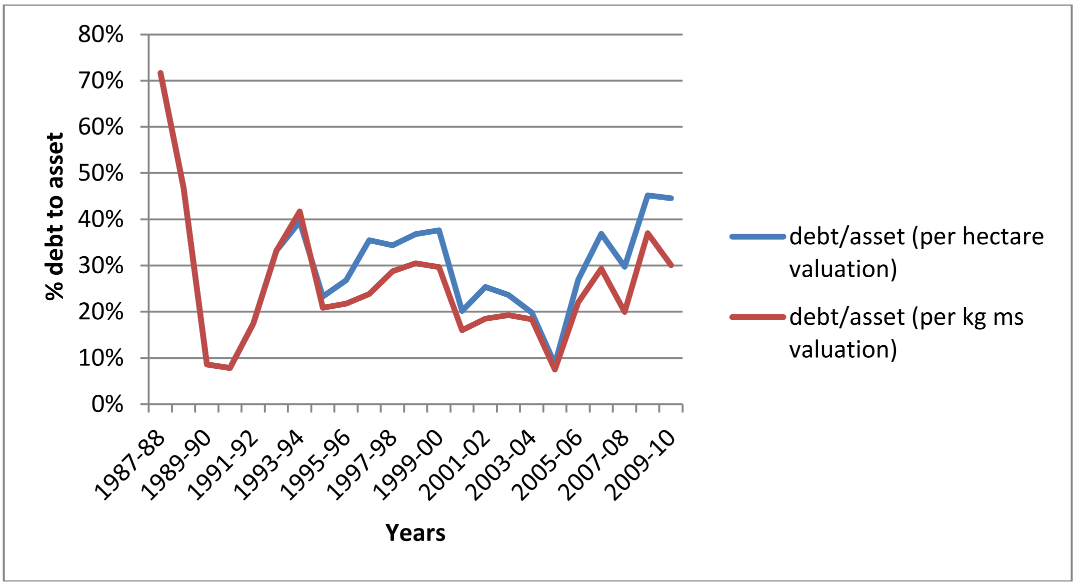
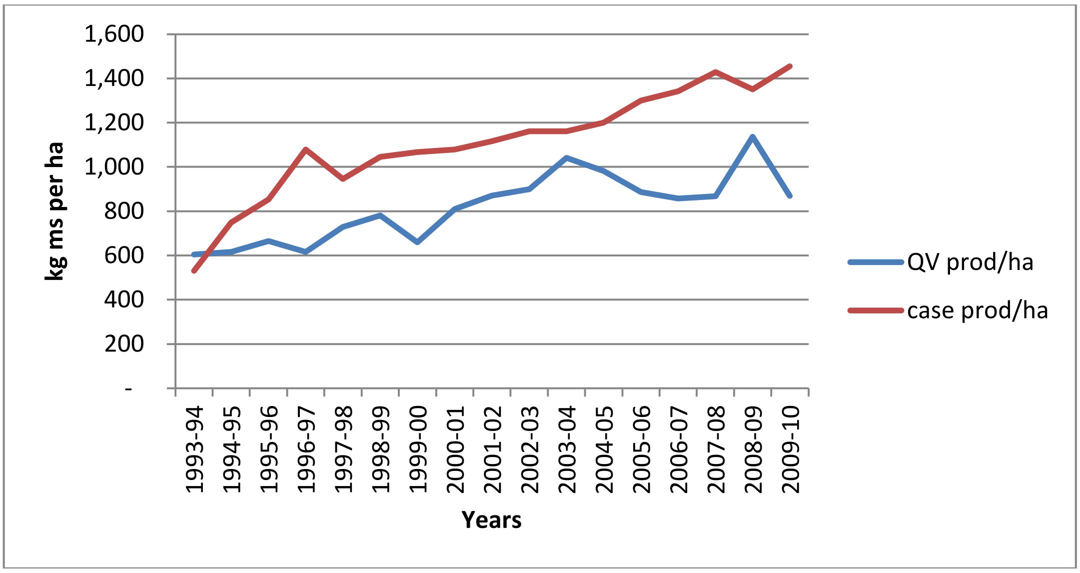


Figure 3.1 Debt to asset ratio for case study farm 1987-88 to 2009-10

Although different levels of net worth were obtained through using the two different methods for valuing real estate, the result on business growth was similar - as measured by net worth, the business has created wealth for the farming partners. The larger growth in net worth using the per kg milksolids basis as compared to the per ha basis ($15.2 m compared to $8.2 m) can be explained by the higher level of production per hectare obtained by this farm as compared to Canterbury averages. Figure 3.2 shows that since 1994 the case study farm has produced, on average, an extra 292 kg milksolids per hectare annually compared to the sale farms quoted by QV. In other words, valuing on a per kg milksolids basis attributes all of the economic returns to the physical factors of production, whereas per hectare values ascribe average values to the land unrelated to the managerial factors affecting the land, cows and buildings.



Source: derived from Valuation NZ (1994-1998) and Property IQ NZ Ltd (1999-2010)

Figure 3.2 Production per ha for case study farm as compared to QV sales data farms in Canterbury (1993-94 to 2009-10)

A consideration when comparing a farming enterprise to a corporate enterprise is that a farmer does not usually receive a salary similar to what would incur in a more typical business. Farmers tend to take ‘drawings’ to provide for living and tax needs, with excess funds reinvested in the farming business. Therefore, a Return on Capital has been calculated for the case study which includes a wages of management charge of $50,000 per year. Drawings have been treated as wages. This analysis showed that the average ROC under the per ha valuation method was 11% and 15% under the per kg milksolids method. These figures are approximately 8% and 7% lower than the compounded growth in wealth calculated and reflected the growth advantages for businesses where the owners reinvest.

Figure 3.3 presents the real growth in net worth for both options in a graphic form. In reality, the value of the farms would depend upon a number of factors including tenure, soil type, water rights and irrigation delivery systems, types of milking sheds and other improvements. Sales in Canterbury in 2010 reached $40,000 per hectare (Percy[15], pers. comm.). If this value is used for the 2010 real estate valuation, then the net worth in real dollars would be $11,147,590 and the compounded annual growth in wealth 20.6%.

[15] Ray Percy is a valuer and rural lending officer for the National Bank of New Zealand

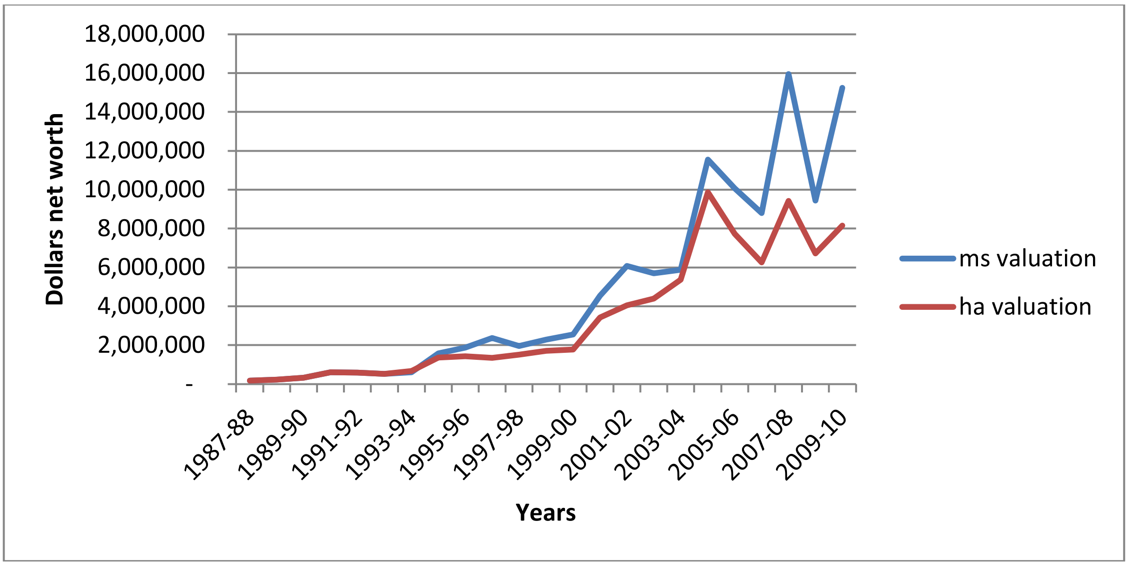


Figure 3.3 Increase in net worth (constant value dollars 2010) for case study farm (1987-88 to 2009-10)

From 1987-88 to 2009-10, there were years of growth in net worth and years of losses (Figure 3.4). The values ranged from -29% after the 'world economic crisis' of 2008-09 to 160% in 1994-95. A variety of factors were involved in the years of net worth growth. The 1990-91 increase reflects the price of cows doubling in the previous year. Dairy land values increased in 2000-01 and 2007-08; the result of higher milk prices. The major increases of 160% in 1994-95 and of 62% in 2009-10 were due to converting the farms from dry stock to dairying. The 2000-01 and 2003-04 increases were partially due to purchasing neighbouring un-irrigated land and adding irrigation. This then allowed herd expansion and additional production. In the case of the conversions and the addition of 'dry' land, the importance of the ability to add reliable and economical irrigation water should not be underestimated.

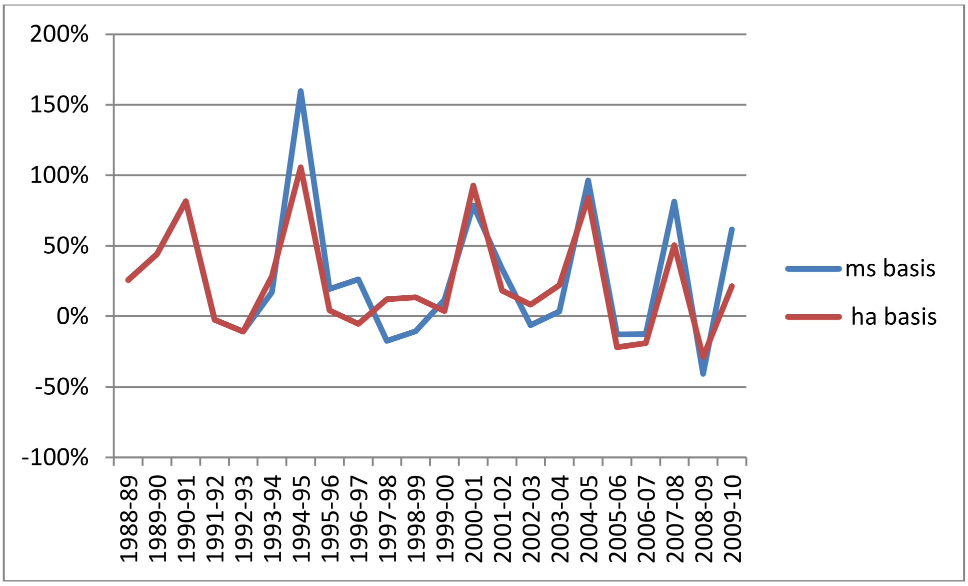


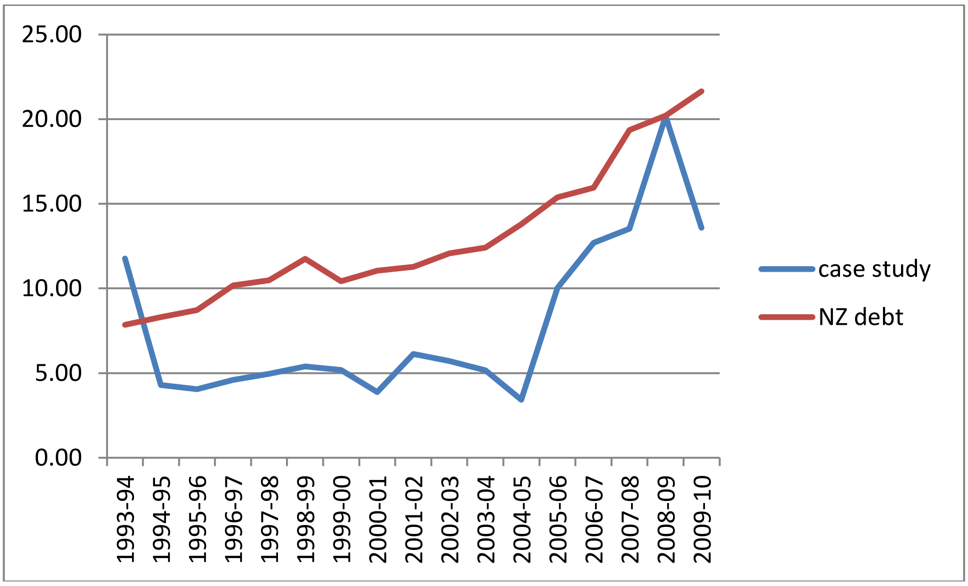
Figure 3.4 Annual percentage growth in net worth (1987-88 to 2009-10)

From Figure 3.4 there appears to be three periods which started with low rates of growth and ended with high rates of growth. The period 1987-88 to 1993-94 shows an IRR in excess of 20% for the period of business initiation as a sharemilker through to the conversion of the first farm. The period from 1994-95 to 1999-00 was one of consolidation, with an IRR between 5% and 10% depending upon the valuation method employed. In the period 2000-01 to 2009-10, the addition of land and the conversion of another farm to dairying have allowed the case study farmers to achieve an IRR between 10% (ha valuation method) to 14% (ms valuation method) for the period.

Table 3.4 IRR in constant dollar values (2010) for selected periods.

Time periods	ms valuation method	ha valuation method
1987-88 to 1993-94	22%	24%
1994-95 to 1999-00	10%	5%
2000-01 to 2009-10	14%	10%

A factor to consider in the development of the case study farm has been the use of debt to fund growth. Debt over the 22 years studied has increased in constant value dollars (2010) from approximately $264,292 to $6,500,000, a factor of 26 times. However, debt per kg of milksolids has increased from $5 to approximately $14, which is an increase of only three times (Figure 3.4). By the 2009-10 season the case study farm had debt significantly lower than the New Zealand industry average. The increase in debt per kg of milksolids, in 2008-09, was due to the increased debt incurred to convert the second farm before milk production began in the 2009-10 season. The decrease in debt in 2009-10 was due to the commencement of the second farm producing milk and thus the debt was spread over more kilograms of milksolids.



Source: derived from Dexcel (2000-01) and DairyNZ Economic Surveys (2009-10).

Figure 3.5 Debt in constant value dollars (2010) per kg milksolids for the case study farm and the average New Zealand farm

3.5 A case study of dairy cooperative investment

3.5.1 Introduction

A major difference between the New Zealand dairy industry and other agricultural sectors has been the high level of investment made by dairy farmers in their cooperatives. For dairy farmers who were established in the industry by the early 1990s, it appeared that a significant gain has been made from these investments.

The case study farmers established a dairy farm in 1993. A requirement of joining the nearest dairy cooperative was to purchase shares equal to production as the processor Alpine Dairy Products (see Chapter 8) instituted a ‘growth funding growth’ financing mechanism. Although the initial shares were in Alpine Dairy Products, subsequent dairy industry mergers led to shares being held in the South Island Dairy Cooperative (1998-99), New Zealand Dairy Group (1999-2001) and finally Fonterra (2001-2010).

3.5.2 Background

When Alpine Dairy Products established a ‘production linked investment’, the existing ‘‘revenue reserves” [*sic*] (Alpine Dairy Products 1993, p. 13) were bonus issued to existing shareholders in July 1993, as 20 cent capital notes in a ratio of one capital note per kilogram of milkfat produced. At the same time a portion of the capital reserves were allocated as shares in a ratio of one 50 cent share per kilogram of milkfat. A further bonus issue of 30 cents per kilogram of milkfat was made in July 1994, to establish the value of capital notes at 50 cents. In July of 1995 a bonus issue of two 50 cent capital notes per kilogram of milkfat was issued. This brought suppliers total holdings to one 50 cent share and three 50 cent capital notes per kilogram of milkfat. In July 1997, the shares were converted to a milksolids basis, which valued them at 29.5 cents, but a bonus issue was made to increase this to 35 cents per kg milksolids. Future shares were purchased by suppliers at 50 cents per kg milksolids. The three capital notes based on milkfat, converted to two capital notes based on milksolids worth 42.75 cents each, these were later to be bonus issued up to 50 cents[16].

Alpine shareholders gained financially from the mergers of the late 1990s. The merger with the Southland Cooperative Dairy Company saw Alpine shareholders trade two 50 cent capital notes for one share in the South Island Dairy Cooperative (SIDC). The 35 cent shares were converted to a $1 share in SIDC through a bonus issue. The 50 cent shares were treated in the same manner. A year later when SIDC merged with the New Zealand Dairy Group (NZDG), SIDC shares was traded on a dollar for dollar par basis for NZDG shares. When Fonterra was formed in 2001, the NZDG shares became the Fonterra Fair Value Share (FVS). At the formation of Fonterra, the FVS was valued at $3 per kg of milksolids. Shortly after the formation, a capacity adjustment vehicle known as Peak Rights was introduced. These were initially valued at 90 cents per kg of milksolids. In 2006 Peak Rights were incorporated into the FVS.

[16] The author acknowledges the assistance of former Alpine Dairy Products Chief Financial Officer, Paul Larking in the preparation of this paragraph.

3.5.3 Methods

To determine the return on the investment in shares an Internal Rate of Return (IRR) was calculated. The base period for accounting for inflation was Quarter 2, 2010 using the New Zealand Reserve Bank inflation calculator (Reserve Bank, 2010).

When looking at the capital gains for the case study business from investing in dairy cooperatives, it must be remembered that this farming business will be different to that of other dairy farmers. All farmers invested at different times, in different companies, with different terms of investment and grew (or didn't grow) their production at different rates. This analysis only includes the cooperative investment for the first farm (converted in 1993) as the investment for the second farm (converted in 2009) had not been completed during the time frame included in the analysis.

Table 3.5 presents the growth in production and investment in shares for the case study farm from the 1993-94 season to the 2009-10 season. It must be noted that in the early years, the shares and capital notes paid in any one year, do not line up with production for that year. This is because they were payable over three years.
To calculate the gain in capital value only, cash returns from interest paid on shares or notes (Alpine and SIDC) or dividends (Fonterra) have been ignored—the analysis is looking strictly at capital growth. Table 3.4 only lists the actual cash invested. Although production increased by 18,308 kg milksolids in 2007-08, no additional shares were purchased. In that year Fonterra gave shareholders the option of not purchasing shares, due to the effects of a major drought in the North Island. Since the valuers of the company indicated that share values would likely decrease in the following year, the case study farm opted to not purchase the additional shares in 2007-08.

Table 3.5 Milksolids production and investment in dairy industry cooperatives 1993-94 to 2009-10 (nominal and constant value dollars 2010)[17]

Season	Production in milksolids (kg)	Nominal investment ($'s)	Investment in constant value $'s (2010)*
1993-94	25,500	1,380	1,991
1994-95	70,000	5,806	8,013
1995-96	95,000	11,241	15,209
1996-97	120,000	18,381	24,595
1997-98	121,000	30,213	39,766
1998-99	140,000	1,500	1,981
1999-00	160,000	31,936	41,359
2000-01	177,792	23,423	29,384
2001-02	184,119	40,243	49,131
2002-03	197,496	49,246	59,247
2003-04	218,320	43,666	51,319
2004-05	238,700	114,274	130,584
2005-06	258,700	119,509	131,340
2006-07	267,142	56,133	60,480
2007-08	285,450	0	0
2008-09	270,070	13,279	13,500
2009-10	284,148	63,632	63,632
Total		623,862	721,531

*Constant values obtained using the Reserve Bank of New Zealand inflation calculator

3.5.4 Results

An IRR calculated on the investment in shares over the entire time period based on the 2009-10 FVS value of $4.52 yielded a nominal IRR of 10% or 8% in constant value dollars (2010). Further analysis compares the IRR from investments in the legacy companies versus investment in the Fair Value Share (FVS) since the formation of Fonterra. Up until the formation of Fonterra in July 2001, there had been $123,850 in nominal cash investments. The Fonterra FVS was initially valued at $3/share, increasing the value of the case study farm's shares to $510,493 (after removing that year's investment of $23,423). This produced a nominal IRR of 60% or constant value dollars IRR (2010) of 49%. Including the 2000-01 share purchase, the farm commenced membership of Fonterra with shares valued at $533,916 (nominal). Since the formation of Fonterra an additional $499,982 (nominal) has been invested. The nominal IRR yields have been 3% with an IRR of 1% in constant value dollars (2010) since the formation of Fonterra.

[17] This analysis only includes the first dairy farm as share values were frozen at the time of the share purchases for the second dairy farm.

3.6 Summary of Chapter 3

The case study farm has made significant financial progress since entering the New Zealand dairy industry in late 1987. Depending on the method of valuation used, the growth in net worth in constant value dollars has averaged between 18.9% and 22.3%. The key factors in the growth in wealth have been in growing the assets using moderate levels of debt, increased asset values through increased productivity, investing in cooperatives and an increase in the value of farming assets in New Zealand. The case study farmers suggested several business practices that allowed this to occur, including:

1) being prepared to sell assets at any time to take advantage of high prices,

2) increasing the value of stock—purchasing poorer quality stock, but improving the herd through breeding and selection,

3) belonging to a cooperative which focused not only on milksolids payments, but also on growing farmer wealth in the cooperative,

4) only investing in productive assets such as land, cattle, irrigation, fertiliser and re-grassing,

5) developing leasehold land and thus keeping initial capital investment low,

6) funding development, at times, out of cash flow to prevent increased debt levels,

7) a low level of investment in machinery,

8) participating in extension activities which contributed to the farm obtaining higher than average production levels (after the early years).

Investing in the cooperatives during the industry merger and acquisitions phase gave very high levels of capital gain as measured by the Internal Rate of Return. However, since the formation of Fonterra the FVS has provided a low rate of capital growth. There have been no gains in value since the share price was frozen by Fonterra in 2007-08.

3.7 Conclusions from Chapter 2 and 3

Chapter 2 presented physical growth, profitability and capital structure information based on the analysis of secondary data (LIC, MAF, DNZ). Canterbury has larger farms, with higher stocking rates, higher production per cow and a greater level of milksolids production per hectare. In addition, financial data show higher total returns and cash surplus per hectare. Although expenditure per hectare was higher, the greater level of milksolids production per hectare has meant that working expenditure per kilogram of milksolids in Canterbury has been nearly the same as the rest of the country.

The answer to Research Question One has now largely been answered through the information in the last two chapters. The growth in milk production was due to a growth in stocking rate and production per cow, which taken together have resulted in higher production per hectare. However, further research will be needed to explain the factors that allowed these differences.

The chapters also present data on profitability and financial growth. The MAF and DNZ information used two different methods of analysis to determine profitability. The MAF data shows a consistently higher cash farm surplus per hectare for Canterbury over the past decade. The DNZ data for five years (2005-06 to 2009-10) shows that Canterbury's operating profits per hectare have been volatile, but much higher than other districts in years of high milksolids payments.

The productivity and profitability results from the MAF and DNZ information were triangulated by the results from the case study farm in Chapter 3. Additionally, the examination of the financial records of the case study farm produced evidence of significant entrepreneurial profits gained through the establishment of a dairy farming business. It should be noted that the growth in net worth and the IRR calculations are in constant value dollars, thus nominal results were greater. These results answer Research Question Two, as the evidence suggests that there have been significant capital gains for participants.

The maximization of physical growth, profit and equity growth should be sufficient reason for an industry to develop; but physical and financial growth has also occurred in the rest of the country. However, growth accelerated faster in Canterbury from about 1993-94. The results from the analysis of profit showed similar results for New Zealand and Canterbury dairy farms in the late 1980s and 1990s, but higher levels of cash farm surpluses in Canterbury in the 2000s. More, importantly data available since 2000 show that Canterbury dairy farmers and the case study farmer have attained higher returns on capital than the rest of the industry. Equity levels per hectare were higher for the aggregate of the New Zealand dairy industry until 2007-08, at which time Canterbury equity per hectare became similar. The case study farm exhibited volatile levels of equity per hectare. However, this volatility often reflected periods of expansion in pursuit of capital gains (entrepreneurial profits).

This leads to the question of why early participants chose Canterbury, when the financial measurements showed no advantage for Canterbury over the rest of the country. Additionally, why have the production and financial results improved for Canterbury since 2000? The research in Chapters 7, 8 and 9 will examine the factors that promoted growth as expressed by the participants who initiated and grew the new industry.

At this point, a review of literature on industry development is necessary to gain an understanding of the theories behind industry development, innovation and entrepreneurship and to provide a framework for future analysis.

Chapter 4
Theories of industry development

4.1 Introduction

Chapter 2 contained a discussion on the growth, productivity increases and profitability of the Canterbury dairy industry since the 1980s. Chapter 3 presented details of a case study farm which identified the entrepreneurial profits attained through developing a dairy farming business during this time. The purpose of this chapter is to present a review of the literature on industry development that informs and guides the subsequent investigations reported in this thesis. Sections include the definition of an industry (4.2), industry development and competitive advantage (4.3), the forces behind industry emergence (4.4), the role of innovation and technology in the development of a new industry (4.5), constraints to industry development (4.6), the role of entrepreneurs (4.7), and a review of new agricultural industries in New Zealand (4.8). At times secondary literature sources are used instead of the original research. This is because the original research was completed in a different discipline, with the secondary authors discussing the research in terms of industry development.

4.2 Definition of an industry

An industry as defined by Porter (1980, p. 5) is a group of naturally selected firms which are producing products that are close substitutes in the marketplace. However, Van de Ven and Garud (1989, pp. 206-211) proposed that an industry should be viewed as a social system consisting of three loosely-coupled hierarchical systems: “instrumental, resource procurement, and institutional”.

Porter’s view is based on a belief that inter-firm competition is very important, usually manifesting itself as price based competition. Furthermore, because an industry consists of firms producing similar or substitute products, natural selection drives firms to become increasingly similar, overtime, within clusters of strategic groups by adopting some common key elements, such as technology, knowledge, organizational forms and/or practices.

However, Van de Ven and Garud (1989, 206-211) adopt a broader view based more on technological rather than price competition. Their definition depends on the industry components listed below.

> 1) The instrumental subsystem consists of firms producing products that are close substitutes for each other. This includes the individuals and firms that begin the applied research and development that leads to technological innovation. The subsystem also includes the vendors and suppliers of applied research and development, manufacturing, marketing and distribution.
>
> 2) The resource procurement subsystem develops the resources necessary to support activities. These include basic scientific or technological knowledge, financing, insurance, venture capital and a pool of competent human resources.
>
> 3) The institutional subsystem establishes governance structures and procedures for the overall industry and legitimises the industry in relation to industrial, social and political systems. Rival firms will sometimes cooperate to legitimise and gain access to resources necessary for their collective survival.

Other authors such as Woodford (1997, p. 20) have noted that industries are both cooperative and competitive:

> "individual firms compete with each other for customers and input suppliers, but also trade with each other. Moreover, it is only by cooperation that industry infrastructure and systems for governance can be developed"

Thus we see that in reality there is no one definition that fits all industries. In some cases they will develop, grow and prosper through competition. However, for most, a level of cooperation is necessary.

4.3 Industry development

Schumpeter (1961, p. 66) defined the development of industries as the result of "new combinations". These new combinations arise from the introduction of a new good, a new method of production, the opening of a new market, the development of a new supply of a raw material and/or the development/breaking up of a monopoly position.

Van de Ven and Garud (1989, pp. 200-201) quote Gould and Eldredge (1977) and Piore and Sabel (1984) who suggest that new industry development is the result of "punctuated equilibrium", which is where a major technological change punctuates extended periods of continuous equilibrium. Van de Ven and Garud (ibid) also quote (Astley 1985) as suggesting that development is an evolutionary process whereby the development of technology takes place through learning that is "context dependent and largely self-contained in the industry of its origin" (ibid, p. 199).

However, Van de Ven and Garud (pp. 202-204) theorise that an industry and its development is, in reality, an emerging social system. This industry development relies on the development of research, financing and people to make the combinations happen. They further suggest that there are a number of phases in the development of a new industry which include the initiation of the business, the actual start of the business and the point where the business takes off as a commercial venture. Often this will follow an "S" shaped (sigmoid) growth curve of slow establishment, rapid growth, a levelling off period and, even, decline. Klepper and Graddy, (1990, pp. 27-28) state that chance events and outside factors may influence the number of potential entrants, the growth rate of firms and the ease of imitation, which will influence the ultimate number and size distribution of firms in an industry

Clustering is a concept often espoused as being important to the development of a new industry. Clustering refers to new industries being located in close proximity. Baptista (1996, p. 6) identified the important factors behind clustering to be:

> "labour market pooling, or the creation of a pool of skilled workers";
>
> "an increase in the number of intermediate input suppliers which should reduce costs";
>
> "spillover, which is where information about new technologies, goods or processes flows more easily locally than over a distance."

As expected, new industries face a number of problems. Taking an idea and converting it to a marketable product has many potential dangers. Common problems for emerging industries include 'learning how to do it' or technological uncertainty; defining strategies for production, marketing, servicing and dealing with uncertainty; the high costs of the initial products; problems inducing buyers to purchase a new product or service, and dealing with the problems of meeting demand for the new product while, at the same time, dealing with product problems (Porter 1998, p. 216). Aldrich and Fiol (1994, pp. 645-670) discuss a further constraint that faces emerging industries as the lack of cognitive and socio-political environments. These authors (ibid, p. 648) define cognitive legitimation as "the spread of knowledge about a new venture" and socio-political legitimation as "the process by which key stake-holders, the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws". To gain legitimacy (ibid, pp. 652-663), the authors propose that leaders or proponents of a new industry need to utilise "encompassing symbolic language and behaviours, communicate internally consistent stories regarding their activity, encourage convergence around a dominant product or service design, take collective action to protect the industry, promote their activities through third party actors (trade associations), be willing to negotiate and compromise with other industries, establish linkages with the education sector and organise collective marketing and lobbying efforts."

Van de Ven et al. (1989, pp. 221-298) also commented on potential problems involved in the business initiation process from a number of case studies. They found that new businesses tend to have a "gestation period" of up to four years. Often there were a number of products envisaged, with a plan to get the first product to market with the development of additional products dependent upon the success of the first. Additionally, financial, personnel and technological resources are often needed to be sourced from outside the new business. Common problems for new firms as reported by Van de Ven et al. (ibid, pp. 294-295) were:

1) the development sequence deviated from initial plans as unforeseen problems and events resulted in "trial and error" adaptation;

2) the business plans prepared were mostly used to source external capital, but usually underestimated capital requirements and the time involved in getting products to market;

3) failures occurred in a few critical components, which often resulted in falling behind schedule and budget overruns;

4) failures with the first product affected further product developments and jeopardised the survival of the business creation effort;

5) "trial-and-error" problems were observed because participants could not decide which issues were important, leading to errors not being corrected;

6) cycles of problems were only broken with external interventions, which resulted in frequent revisions in the business idea and start up strategy;

7) multiple levels of top management involvement were needed to provide "checks and balances" between contradictory forces in the corporate hierarchies;

8) the process of business start up and take off involved many transactions with other firms and customers, and these transactions were found to be highly fragile and could produce unintended consequences.

Porter (1998, p. 221) mentions that a crucial choice for competing in an emerging industry is the appropriate timing of entry. Early entry involves high risk but may involve low entry barriers and can offer a large return. However, a risk of early entry is that technological change may make early investments obsolete and allow firms entering later to have an advantage by having the newest products and processes. Porter (ibid) theorised that early entry was appropriate when the following general circumstances exist.

1) Image and reputation of the firm are important to the buyer; the firm can develop an enhanced reputation by being a pioneer;

2) Early entry leads to enhanced learning so that the firm has gained experience that will be vital when dealing with newer technologies;

3) Customer loyalty will be high so that benefits will accrue to the firm that sells to the customer before competitors;

4) Absolute cost advantages can be gained by an early commitment to suppliers of raw materials and distribution channels.

Some of the entrepreneurial gains achieved by the case study farmers in Chapter 3 were due to their early entry. They were able to buy the assets for production at a lower price, as well as secure large volumes of water for the future development of irrigation.

4.4 Forces behind industry emergence and competitive advantage

Porter's examination of the competitive advantage of nations (1990, p. 72) is useful for looking at the forces behind industry emergence. Porter's 'diamond' (Figure 4.1) was developed to determine the ability of a nation to reach international success in selected industries; however, it also provides a model to explain why an industry emerges and succeeds both locally and internationally. The four elements of the diamond are: factor conditions, demand conditions, related and supporting industries and firm strategy, structure and rivalry. These elements are then affected by government and chance.

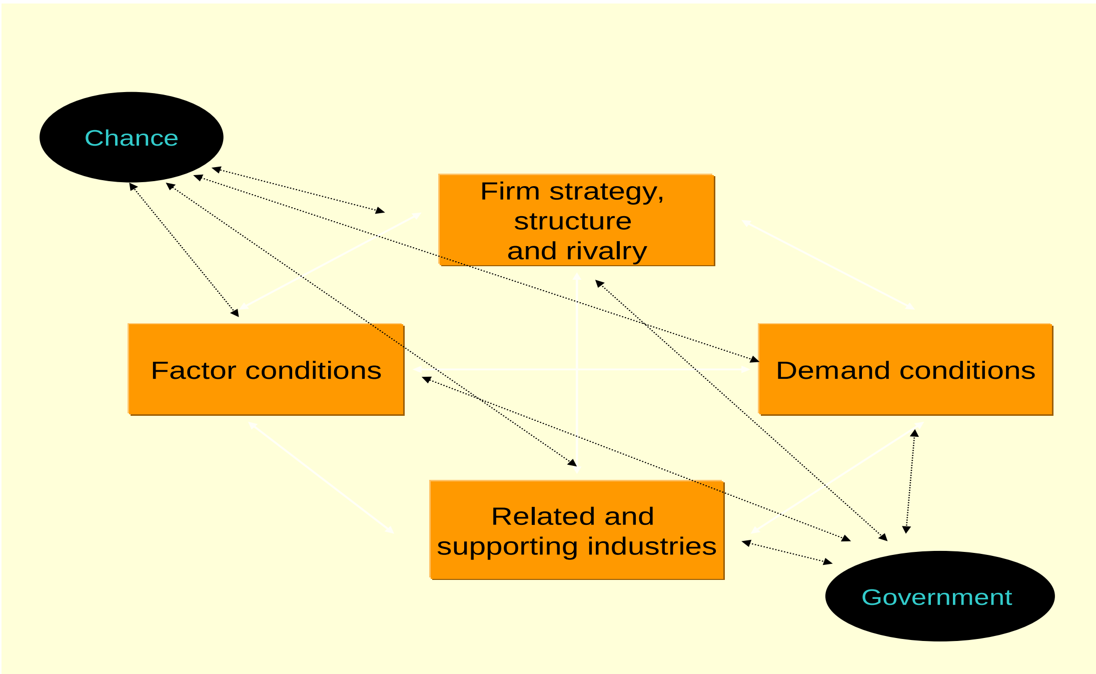


Figure 4.1 Determinants of national advantage (Porter 1990)

The factor conditions in a country can contribute to an industry's success (Porter 1990, pp. 73-75). These conditions can comprise human resources, physical resources, knowledge resources, capital resources and infrastructure. Factors like location, climate, and mineral wealth are considered basic factors, whereas factors that require large and long term investments such as communication infrastructure and a highly skilled labour force are considered advanced factors. Other factor categories can be generalised or specialised. Lamotte (2007, p. 45) provides the example of a generalised factor being a country with a high level of university graduates, whereas a specialised factor would exist if the country had a large number of graduates with a specific knowledge in a field such as engineering.

Porter (1990, pp. 86-99) theorises that demand conditions in the home market are important as a firm tends to concentrate on this market first and thus allocate and develop suitable resources to satisfy the local consumers. However, Porter (ibid) also believes that the home market needs to meet the following conditions to be a positive influence on the creation of an advantage: 1) the demand is larger than that of overseas markets, 2) the demand is sophisticated and 3) the home demand anticipates overseas buyers' needs or can influence them. Porter (ibid, pp. 100-107), states that related and supporting industries are necessary to facilitate access to inputs and increase coordination between firms and their suppliers. The presence of competitive supplier industries creates advantages to downstream industries through access to the most cost-effective inputs and through innovation and upgrading due to the working relationships between suppliers and industry. Porter (ibid, P. 101) uses the example of the Italian jewellery industry which (at least in the 90s) was sustained by the fact that two-thirds of the companies producing jewellery making machinery were located in Italy.

A fourth determinant of national competitive advantage relates to the firm's strategy, structure and rivalry or, in other words, the context in which firms are created, organised and managed (Porter 1990, pp. 107-124). It is theorised that competition between home based firms is important for innovation and competitiveness. However, these goals, strategies and ways of organizing firms vary between nations. Some of the most important aspects are the society's attitude toward authority, the attitude of management and workers towards each other, as well as whether a society is individualistic or group orientated, and the society's professional standards. The willingness of a firm to compete on an international level is potentially a result of the saturation of the home market demand and the development of international demand. However, managerial attitudes to international trade play an important role.

The importance of the home market (domestic rivalry) is not universally accepted. Rugman and Verbeke (1993, pp. 71-84) argue that small economies rely on a large host nation, or numerous host nations. They quote the work of Cartwright (1991), who stated that:

> "The lack of domestic competition in the home base of a New Zealand industry need not negatively influence the international competitiveness of this industry, if it had to cope with strong international rivalry in the first place. Such international forces may be as relevant for international competiveness and strategy formation as domestic diamond characteristics."

An example of a New Zealand company using a foreign nation as a host market is the dairy cooperative Fonterra, which treats New Zealand and Australia as one market, with the division offices for the New Zealand/Australian market and the largest section of the product development department located in Melbourne. Although geographically separated, the culture and eating habits of the countries are similar and a larger population gives Fonterra the ability to trial and develop products and systems to be used in both countries (Fonterra 2005).

Chance events in Porter's Diamond (Porter, 1990, pp. 124-126) can create imbalances or opportunities for the diamond, or for a single component of the diamond. Chance events can include acts of invention, major technical changes such as biotechnology, volatility in input costs such as oil price shocks, shifts in world financial markets or exchange rates, surges in world or regional demand, political decisions by foreign governments or wars.

The effect of government, according to Porter (1990, pp. 126-128), is to encourage an industry to progress, but not to provide so much help that an effort to improve is avoided. Governments can influence factor conditions through subsidies, policies towards capital markets and education. Demand conditions can be influenced through the setting of standards and through government purchases. Government can also control an industry through regulation of the advertising media or regulation of supporting services. Furthermore, government policy can influence firms' strategies and structures through tax laws, capital market regulation and anti-trust laws.

Lamotte (2007, pp. 63-66) identified further reasons for industry emergence as the development of new innovations and technologies and "open environmental space".

Innovation and technology will be covered in Section 4.6. Open environmental space refers to there being a physical or market space for a new industry to enter.

4.5 Possible constraints to industry emergence

Just like existing industries, the growth and success of new industries is affected by a number of factors. Porter (1998, p. 4) describes the forces driving industry competition as the buying power of buyers as well as the bargaining power of suppliers. The industry can also be affected by potential new entrants to the industry, or substitute products. The final force is the rivalry among existing firms. Diagrammatically these forces appear as in Figure 4.2

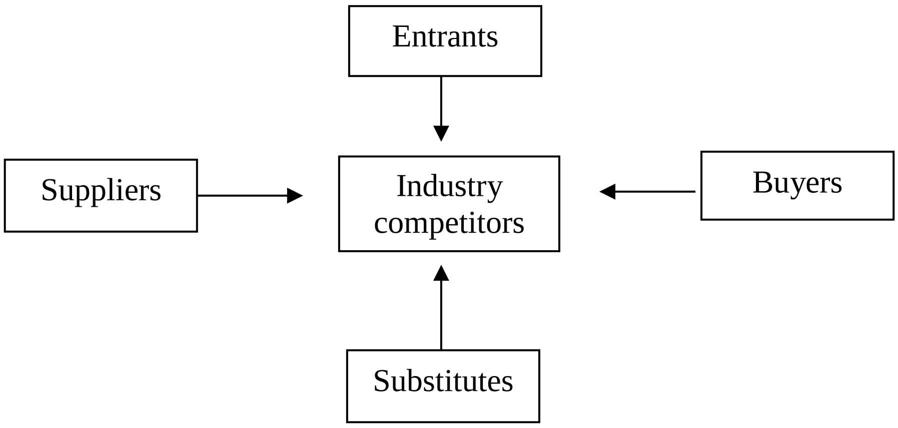


Figure 4.2 Porter's Five Forces of Industry Competition (1998)

Porter (1998, pp. 7-28) believes that for a new entrant there are a variety of initial barriers, from the difficulty of obtaining economies of scale in production and purchasing, to the development of distribution channels. Government regulations on the use of resources, pollution control and safety requirements may also cause difficulties. Finally, they must also overcome the "brand loyalty" associated with the current products. After becoming established new industries must deal with the rivalry that develops with existing competitors.

Porter (1998, pp. 7-28) also comments that it is possible that an entrant is not only competing against industry rivals, but also competing against another industry producing a substitute product. Problems will arise when a substitute industry has a development that allows them to reduce their price or improve performance. Industries may act collectively to protect themselves from substitute products. A New

Zealand example of collective action is when Beef + Lamb NZ[18] cooperates with red meat producers in other countries to generically promote the consumption of red meat versus white meat.

Further, Porter (1998, pp. 7-28) feels that the bargaining power of suppliers and buyers can have significant effects on entrants. Supplier groups are powerful if supply is dominated by a few companies and there are limited substitutes available. Suppliers can also gain power if the new industry is not an important customer of the supplier group or the supplier's product is an important input for the buyer's business. Finally, supplier groups can increase their bargaining power if there is a threat of forward integration or if they can make the cost of switching products difficult for the buyers. In contrast, a buyer group is powerful when the buyers are concentrated or purchase a large volume of the seller's sales, the products purchased from the supplier tend to be commodities, if the buyer faces few switching costs, if the buyers pose a credible threat of backward integration, or the industry's product is unimportant to the quality of the buyer's products or services.

Additionally, the literature suggests a number of other potential problems for an emerging industry. From a production point of view these problems can include an industry growing faster than its supplier's ability to supply raw materials, which can lead to a rapid escalation in input prices and opportunistic behaviours. The absence of the infrastructure for processing, supply channels or personnel can lead to production problems, which can be compounded by the absence of product standards and erratic product quality. From a customer's point of view, there can be a perception that the next generation of product will be better, along with confusion due to variations of the same product. If the product is subject to some form of regulation, then any slowness in the regulatory process can have adverse effects on the rate at which products reach the market. Finally, in the event of these problems arising the financial community will tend to re-evaluate their association with the industry (Porter 1998, pp. 221-224, Greer, Greer and Zwart, 2000 pp. 3-7 and 15-18).

[18] Beef + Lamb NZ is the industry good body in NZ that promotes consumption of beef and sheep meats as well as fulfils extension functions with NZ farmers

4.6 Innovation and technology development

Afuah (2003, p. 13) defines innovation as “the use of a new technology and perhaps also market knowledge, to offer a new product or service that customers want”. These innovations can originate from several sources. According to Rogers (2003, p. 12), an innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption. Afuah (2003, p. 31) commented that Schumpeter originally theorised that innovation came from small entrepreneurial firms, but changed his view to one where innovation came from larger firms with some form of monopoly power. Schumpeter’s latter reasoning was that larger firms have the size to invest in the commercialisation of a new product, they are more diversified and hence more willing to take risk, they have better access to capital and through having a monopoly position they do not have competitors and so they are more willing to invest. Hagedoorn (1989, p. 64) added that Schumpeter also believed that innovation was greater in monopolistic industries because the firm can prevent imitation and thus capture more profit, with these profits being used to finance more development.

De Carolis (2010) listed a number of characteristics which influence technological innovation. These include the potential for innovation in an industry, the “technological dynamism” of the industry, the industry’s reliance on technical standards, the extent of collaboration among firms and government regulation.

The role of private firms is important in the development of innovations. However, it is often public organizations which play a major role by conducting public good research (Van de Ven 1993a, p. 214). Van de Ven (ibid) reviewed the research of a number of authors (Mowery 1985, Thirtle and Ruttan 1986, Freeman 1986 and Dosi 1982) and theorised that “the commercial success of a technological innovation reflects the institutional innovation embodying the social, economic and political infrastructure that any community needs to sustain its members”. Van de Ven and Garud (1989, p. 196) stated that, “Seldom can an innovation be developed by a single firm alone in the vacuum of a community or industrial environment”. They add, “The management of innovation must not only be concerned with micro developments of a particular technical device or product, but also with the creation of an industry infrastructure needed to commercialise the innovation”.

Rogers (2003, pp. 137-157) describes the innovation development process as a situation where a problem or need is recognised, which stimulates research and development activities for solutions. Commercialization then occurs through production, manufacturing, packaging, marketing and distribution of the product. Often there is an analysis of the results to determine if the original problem/need that began the process has been solved by the innovation. New problems/needs may arise, leading to a new cycle. This process can be diagrammatically described (Figure 4.3) by Dewey's problem solving cycle (Roling 1988, p. 58).

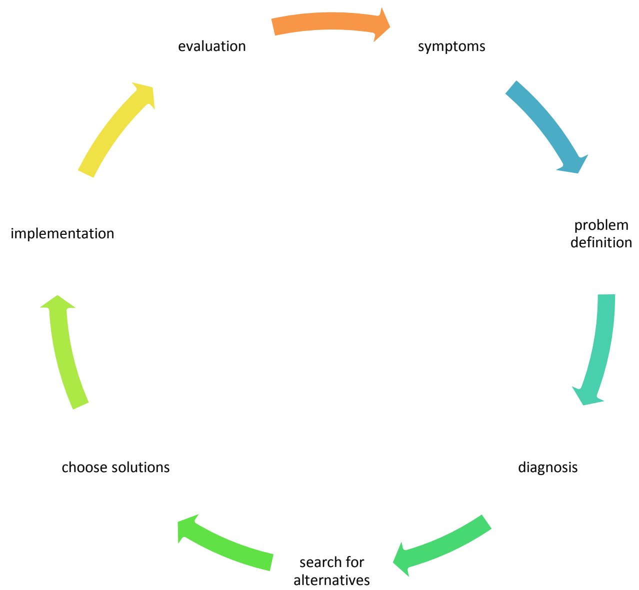


Figure 4.3 Dewey's problem solving cycle (Roling 1988)

A society's attitude to innovation is considered important. Adler (1989, pp. 35-36) writes that more advanced industrial societies have a bias towards innovations as compared to pre-capitalist society. Additionally, he comments that the values that encourage education indirectly encourage the emergence of innovators and raise the receptivity to innovation.

Innovation often involves a wide range of society. Afuah (2003, pp. 37-39), has proposed that there are a number of "people types" necessary for innovation. These include: "idea generators" who find ideas that lead to new products or services, "gatekeepers" who take the idea and adapt it for the firm and outside world, "champions" who take an idea and do all that is necessary to guarantee its success, “sponsors” who are coaches/mentors who provide the behind the scene support, and “project managers” who have a vision for the potential of an innovation and communicate this vision to the rest of the organization. Salomo and Gemunden (2010, pp. 263-267) formed a similar classification system which includes: “power promoters, expert promoters, process promoter, relationship promoter and technological gatekeepers”. However, a range of personality types alone does not lead to innovation and Van de Ven (1993a, p. 216) suggests that a pool of competence needs to develop among the “people types”. This is accomplished through: “1) the establishment of educational training programmes and accredited degrees at colleges and universities; 2) the recruitment and training of people in specific skills related to the innovation and the diffusion of these skilled people between institutes and firms in the industry, and 3) the sharing of knowledge among industry participants at conferences, technical committees, and informal communication networks.”

A difficulty in the management of ideas is that by nature humans are inclined to focus on protecting existing practices rather than on moving in new directions. Van de Ven (1986, p. 594) feels this is because “people have a basic psychological limitation of not being able to handle complexity, of unconsciously adapting to gradually changing conditions, of conforming to group and organizational norms, and of focusing on repetitive activities.” A lack of innovation can be the result of a number of factors including a shortage of appropriately trained staff, an economic climate that discourages innovation, and firms and organizations that do not have the linkages that encourage the effective dissemination of results (Marsh 2006, pp. 6-8). Van de Ven (ibid, pp. 592-595) adds that the more specialised, insulated and stable an individual’s job, the less likely the individual will be to recognise the need for change or to pay attention to innovative ideas.

Van de Ven (1986, pp. 346-359) has developed propositions on the successful emergence of innovation. The propositions suggested that the shorter time it takes to establish an innovation the greater the level of success, with “novel” innovations having a greater chance of failure, often due to the significant changes required to the social system’s functions. If the original design of an innovation becomes dominant then firms can constrain future developments. Entrepreneurial firms that “run in packs" will be more successful than those that operate alone to develop their innovations. The greater the number of cooperative and competitive ties between firms, the more stable and flexible the overall system; however, aborted efforts at establishing cooperative relationships can turn out to become competitive relationships.

Another consideration when considering innovation is the risk associated with the adoption of an innovation. Scheuing (1989, p. 309) identified the following types of risk.

> "financial---the potential loss of money,
>
> functional---the product will malfunction or fail to perform,
>
> physical---the product may inflict physical harm on the user,
>
> psychological---potential psychological discomfort from a poor choice,
>
> social---loss of face or respect in the eyes of relevant others"

A number of authors have discussed the adoption of innovation by the agricultural sector. Nuthall (2010, p. 9) has suggested that a new technology must be easy to trial, lack complexity, be easily compared to benchmarks and easily observed. Flett et al. (2003, p. 2), quoted a number of studies that showed that economic models adequately explain farmer behaviour to technology adoption when the innovation is easy to adopt, the adoption has clear economic advantages, the innovation has low complexity and there are no other intervening considerations. Guerin and Guerin (1994), when reviewing adoption by Australian farmers, agreed with the above authors but added the further factors of financial cost, the farmer's beliefs and opinions to the new technology, the relevance of the technology and the farmer's attitudes towards risk and change. Flett (ibid) also found that the ease of use of a new technology was a separate factor from profit/production and supported the theory that there was more to adopting technologies than just economics.

4.7 The role of the entrepreneur and motivation

Landstrom (2005, p. 3) states "entrepreneurship is one of the oldest of activities. To discover or identify new business possibilities and to exploit these possibilities in new ventures for economic gain has always been important in human life." Although the word had its origin in France in the 12th century, (ibid, p. 8) many discussions of entrepreneurs started with Schumpeter (1961, p. 61). He defined the carrying out of new combinations as "enterprise" and the individuals who carry them out as "entrepreneurs". In a footnote Schumpeter adds that the entrepreneur is merely the "bearer of the mechanism of change".

When discussing entrepreneurs, Schumpeter (1961, pp. 92-93) dismisses Grossen's law which assumes that entrepreneurs are driven by an insatiable craving for hedonistic satisfaction and proposes.

> "In entrepreneurs there is an indifference to hedonistic enjoyment, because, 1) there is a dream and the will to found a private kingdom, 2) there is a will to conquer, the impulse to fight, to prove oneself superior to others, to succeed for the sake of success - the financial result is a secondary consideration and for 3) the joy of creating, of getting things done or simply of exercising one's energy and ingenuity. The entrepreneurial function is not in principle connected with the possession of wealth, as analysis and experience teach, even though the accidental fact of the possession of wealth constitutes a practical advantage."

Schumpeter (1961, pp. 228-230) also theorises that entrepreneurs appear in clusters because the appearance of one or more entrepreneurs encourages the appearance of others. This is because:

> "the carrying out of new combinations is difficult and only accessible to people with certain qualities, more people become entrepreneurs with the successful appearance of an entrepreneur, the original entrepreneur removes obstacles for further entrepreneurs and as the process of development becomes familiar, the weaker the obstacles become and the less leadership is needed."

He added that:

> "this swarm like appearance of new combinations explains boom periods where there is increased capital investment, a decline in unemployment, a rise in wages, a rise in interest rates, an increase in freight, and increased strains on bank balances."

However, he also states (p. 233) that just as entrepreneurs arrive "*en masse*", so do their products - "this appearance of new products causes a fall in prices, which terminates the boom, may lead to a crisis, must lead to a depression and starts a new cycle".

Van de Ven (1985, p. 594) countered Schumpeter's exuberance for the qualities of entrepreneurs when he said,

> "Much of the folklore and applied literature on the management of innovation has ignored the research by cognitive psychologists and social-psychologists about the limited capacity of human beings to handle complexity and maintain attention. As a consequence, one often gets the impression that inventors or innovators have super-human creative heuristics of abilities to walk on water."

Van de Ven (1993a, pp. 212-213) adds that historical studies show that most innovations are collective achievements from the efforts of many participants working over an extended period of time.

Langlois (2002, p. 1) quoted predictions by Galbraith in the 1950s of the demise of entrepreneurs, as innovation would become the "matter of routine in the large bureaucratic corporation". Stewart, et al. (1998, pp. 189-214), however, found in the 1980s that entrepreneurs were usually individuals with goals of profit and growth for their ventures and were notable for their use of strategic planning. Stewart's psychological research compared entrepreneurs to small business owners and corporate managers. They found that those identified as entrepreneurs were higher in achievement motivation, risk-taking propensity and preference for innovation. Although small business owners showed a propensity to take risk, they tended to operate a business as an extension of the individual's personality to further personal goals and to produce family income.

Several authors have addressed the issue of entrepreneurship and motivation among the agricultural sector. De Lauwere (2005, pp. 229-238), found that agricultural entrepreneurs exhibited the traits of self-criticism, leadership, creativity, perseverance, and initiative. From a practical point of view, DeWolde[19] (pers. comm., October 2006) commented that agricultural entrepreneurs have the following characteristics:

> "Long term perspective with helicopter views and hands on knowledge; inquisitive minds and a lifetime commitment to self-improvement; analytical skills; 7 successful ideas out of 10 attempts isn't bad - not all ideas have to be winners; the courage to be different."

Giera (1999, pp. ii) in a case study of New Zealand farmers, defined entrepreneurial farmers as "farmers who had reached the point of achieving most farm-based goals and had decided to pursue new challenges and goals for their farm business". These challenges generally involved innovative production, processing or marketing of their products. Comparing the entrepreneurial farmers to conventional farmers, the management styles were quite similar. However, the entrepreneurial farmers tended to have higher levels of confidence, were prepared to accept higher levels of risk and sourced extensive levels of information from different sources.

If in fact entrepreneurs are not interested in "hedonistic pleasures", and are more inclined to pursue new combinations for the "thrill of the chase" as theorised by Schumpeter; then a look at motivation is appropriate. Nuthall (2010, pp. 36-37) looked at motivation of farmers and concluded that:

> "most people would consider motivation to involve not only an ability to think of, and initiate a project, but also to control the direction of its conduct and final completion including the persistence to finish off what is started, if this is indeed rational. Further motivation probably relates to a need, want or interest that a person has that propels them in a certain direction. All of these drives are internal with success leading to the person feeling better about themselves."

It has been suggested by several authors that motivation revolves around a need to feel achievement or mastery of an endeavour, a person having a competitive nature, the desire for power or for affiliation with an organization (Nuthall 2010, p. 38, Kanfer and Ackerman 2000, p. 470). The latter authors comment that in some cases

[19] Abe DeWolde is a New Zealand dairy farmer from the Southland Province. He won the Lincoln University Foundation Innovation Award in 2006 for incorporating a wintering barn and associated system changes into his dairy farming system.

the motivation can become an anxiety to complete a project. In a study of New Zealand dairy farmers, Valentine, Hurley and Glass (1993) stated that the commonly assumed farmer motivations of productivity and profitability did not describe farmer decision making as well as the achievement of long term goals. However, this is countered by a study by Solano et al. (2001 p. 154) of Costa Rican dairy farmers which found that economic goals were the most important goal for a majority of farmers.

4.8 Development of new industries in agriculture

The literature on new industry development in agriculture tends to be dominated by development in lesser developed countries and these tend to involve raising the standard of living of the lower income members of the population. Sonka (1995) also discusses new industries in agriculture, but his focus is on the development of strategic alliances in agribusiness or what is commonly referred to as vertically integrated supply chains. Instead, this section has concentrated on the development of new farming systems and related agricultural industries in New Zealand and Australia due to the importance of agricultural exports to the economies of these countries and their geographical isolation from the major markets for their products.

4.8.1 Definition

From a theoretical standpoint, Woodford (1997, p. 21) cites Wollin's theory (1995) that change occurs in rural industries due to an interplay between the industry's

> "durable deep structure, its wider environment and the purposeful action of actors in both the industry system and the wider environment"

Wollin (ibid) suggests that the change process stems from an "irregularity that acts to deconfigure [sic] some of the deep structure that variations then emerge, that a sorting process favours some forms of the new deep structure and eventually a new durable form emerges".

From a sociological standpoint, Mayell and Fairweather (2000, p. 5) quote the work of Granovetter and McGuire (1998) who argue that new industries develop not only out of technical and economic factors, but may also be "socially constructed by the mobilization of resources and the existence of social networks". These could include friendships, shared experiences, social connections, interactions between firms and public authorities and the engagement of research centres. They also suggest that the role of clubs, associations and, even, journalists can be important in the development of new industries.

Considering agriculture specifically, Hyde (1998, pp. 2-3) suggests that new agricultural industries develop to create employment opportunities, to develop more sustainable farming systems, to improve standards of living and to fulfil an innate personal yearning to do something different or better. Wood, Chudleigh and Bond (1994, pp. 5-6) adopted Vinning's (pers. comm.) proposals for what constituted a new cropping industry in Australia. These crops could be new to the country or region, new to the time of year, involved a new variety or technology, had not been grown commercially in the past, was a new product for customers or the new use for an existing product. Collins (2011) commented that success from a biological prospective was necessary but that economic and social factors were also necessary for success.

These definitions are important for analysing the Canterbury dairy industry; because it could be argued that dairying is not a new industry, since dairy farming has always existed in Canterbury. However, aspects of Hyde's definitions of developing more sustainable systems, improving living standards and fulfilling an innate need to do something different may apply. Vinning's definitions of an activity being new to a region and involving new technologies may also add weight to the argument that the Canterbury dairy industry is a new industry.

4.8.2 Research on new agricultural industries

A number of authors have observed the success factors important to new agricultural industries. Most research stresses the importance of the identification and development of markets (Wynn-Williams 1985, Wood, Chudleigh and Bond 1994, pp. 79-86, Hyde, 1998, pp. 4-8, Greer, Greer and Zwart 2000, pp. 15-17). Clearly there is no benefit in developing the production techniques if there is no market for the product. Successful new industries identified markets, established marketing programmes and stressed product quality often through the development of product descriptions and quality assurance organisations. Poor quality was a major constraint to industry development. A new industry must have close contact with customers and share critical information. For some industries the establishment of a brand or an emphasis on product characteristics such as ‘fresh’ or ‘clean and green’ has been helpful. The failure to dispose of all product at an economic price was mentioned by Greer, Greer and Zwart (2000, p. 16) as a likely impediment to success.

Production factors are equally important. Due to factors such as climate and agronomic performance it is important to conduct research in the country adopting the new industry; however, techniques can be adopted from overseas (Wynn-Williams 1985, Wood, Chudleigh and Bond 1994, pp. 79-86). There can be a need to localise genetic material and mechanization techniques. Although, Wood, Chudleigh and Bond (ibid) suggested that the establishment of processing was important, it was not as important in predicting success as the production factors of climate and environment. It was theorised that this is because processing technology can often be imported from overseas. Greer, Greer and Zwart (2000, p. 15) noted that it is important to develop a skilled labour force.

Production research and development (R & D) was considered important by Wood, Chudleigh and Bond (1994, pp. 79-86)—particularly plant improvement, cultural practices and the control of pests and disease. Mechanisation R & D was important in some industries. The lag period for the adoption of R & D averaged six years for plant improvement and four years for mechanization and agronomic R & D. They added that the chances of success are greater if the crop can be easily incorporated into an existing farming system and the industry has the potential to expand in a short time frame.

Hyde (1998, p. 4) stressed the importance of an industry champion, with government playing a key role in setting the right economic environment to support research and to deal with market access issues. However, Wood, Chudleigh and Bond (1994, pp. 33) only found a weak correlation between an “industry champion” and high growth rates and gross product values. They suggested the role of government in contributing to success was minimal, although there was some effect from the setting of quality standards and marketing incentives, as well as tax incentives.

Mayell and Fairweather (2000, pp. xi-xii) believe new industries with a formal industry council with extensive functions and professional, full-time, paid employees are more successful than grower associations with limited functions and unpaid volunteers. Furthermore, successful industries tended to have extensive involvement with outside groups, export markets, extensive research and development activities, multiple quality controls and considerable liquid funds in the industry organization.

Hyde (1998, pp. 4-8) wrote of the need for financial management and he observed that new ventures required more equity capital and lower interest costs. Additionally they required significant levels of operating funds in the early years, as they tended not to be profitable at start up. Government incentives and tax concessions are important, but in the long run an industry must have some competitive advantage and prospects for long term profitability.

Finally, Hyde (1998, pp. 4-8) commented on the "style of operation" of successful industries. They had a strong profit and quality focus, a strategic long term approach, value adding and vertical integration, compatibility of the new venture with other farming operations, imaginative marketing and trading arrangements, quick adoption of new technology and, in some cases, the use of joint ventures.

4.8.3 The development of the deer, kiwifruit and wine industries in New Zealand

There have been only a few new agricultural industries that have achieved success in New Zealand in the past fifty years. Examples are the farmed deer (*Cervus elaphus*) and kiwifruit (*Actinidia deliciosa*) industries. In addition the wine grape (*Vitis vinifera*) industry, which had long existed in a small way in the North Island, successfully established in the South Island in the 1990s. Other animal industries such as ostriches and rabbits have failed and a number of new horticultural industries have only achieved modest success (calla lilies and persimmons). A search of published literature has failed to provide credible case study examinations of these poorer performing industries.

Deer were introduced into conservation areas in New Zealand for sporting purposes early in the settlement of the country and, over a number of years, the population grew to become considered an animal pest. The export of venison sourced from the wild developed in the 1960s and 1970s, giving way to a domestically farmed system from the late 1970s. McDermott et al. (2008, pp. v-vi) reviewed the factors that had led to the success of the industry. Initially, the venison was able to be marketed as a ‘game’ animal from New Zealand, for which there were traditional venison markets in Europe. The development of an industry to farm deer required the support of government to legalise farming, as deer’s status as a pest initially prevented farming of the species. Once established, deer farmers developed a comparative production advantage through the development of productive and efficient farming systems often borrowing expertise from other farmed animal sectors. Further, the industry utilised the existing economies of scale in the processing and exporting sector and cooperated in the development of a marketing strategy and collective promotional funding. At the time of the report, the authors considered challenges to the industry to be the reliance on one large market (Germany) and difficulty in establishing brands. This has led to price volatility at times.

The kiwifruit (Chinese gooseberry) has been grown in China for many years. The first seed was imported to New Zealand in 1904 and the Hayward variety was developed in New Zealand in 1925. The first domestic fruit was marketed in the early 1940s with exports beginning to the United Kingdom in 1952 (Kilgour et al., 2008, p. 3). Most of the early history of kiwifruit revolved around the development of production and processing that enhanced orchard productivity. A later development involved the creation of a brand (Zespri) and international marketing strategies. The export of kiwifruit to the world (except for Australia) is managed by Zespri, a producer marketing board[20]. In 2008, Kilgour et al. (pp v-vi) identified success factors in the industry around industry champions and management. They felt that growers and processors had shown a high level of innovation, developed a successful industry structure and obtained economies of scale. Market power has been obtained through branding, differentiation, value chain developments, market research, responsiveness to the market and information dissemination throughout the chain. Challenges to the industry involved the maintenance of government support for the

[20] In NZ the government historically created ‘producer marketing boards’, which have compulsorily acquired the entire product from an industry and marketed the product overseas. Most of these statutory bodies were eliminated in the 1990s, with the exception of Kiwifruit.

marketing board, developing future leadership, continually updating marketing strategies (including varieties) and ensuring effective business and scientific research and development activities. A current challenge to the industry is the introduction of strain 5 of the PSA (Pseudomonas syringae pv. actinidiae) bacteria in 2010. PSA causes kiwifruit vines to die and its introduction was a bio-security breach, which is a potential problem for all New Zealand agricultural industries.

Wine grapes (V*itis vinifera*) have been grown in New Zealand since European settlement. Stewart (2010, pp. 31-35) describes attempts to establish an industry, initially by New Zealand's first "Official British Resident", James Busby, in the 1830s and later by Governor Gray in the 1870s. An industry did develop; however, the production of wine was only a minor industry as land use became dominated by animal agriculture. In fact, production dropped from 1.58 million litres of wine per year in the 1890s to 300,000 litres by 1910 due to the temperance movement (Stewart 2010, pp. 170-171). Although growth in hectares of grape vines increased slowly over the following decades, the potential entry of Britain into EEC in the 1970s led agriculturalists to begin looking for alternatives to pastoral production in the 1960s. Grapes suited the lighter soil types on the warmer and drier east coast of the country. Individuals and corporations began to experiment with wine production and the industry experienced considerable expansion. By 2000, there were 10,197 hectares planted in grapes and 80,100 tonnes crushed to produce 60.2 m litres of wine. The contribution to the New Zealand economy from wine exports was $168 m in 2000. In 2011, there were 33,600 hectares planted in grapes, 328,000 tonnes crushed and 235 m litres of wine produced with an export value in excess of $1 b (New Zealand Wine Statistics 2011, p. 28). The major contributing factor to industry growth was the development of world class Sauvignon Blanc wines from the Marlborough region. In 2011, Sauvignon Blanc accounted for 69% of New Zealand wine production and 80% of New Zealand wine exports (ibid, P. 5). However, growth of this magnitude has caused oversupply problems and grape prices have dropped from a peak of $2,022 per tonne in 2006 to $1,172 in 2011 (ibid). As well as the profitability of the industry in the first decade of the current century, the "romance" of owning a vineyard/winery cannot be discounted as a reason for growth (Stevens 2011, pers. comm.)[21]. The industry has a strong governance structure through the organization, New Zealand Winegrowers.

4.9 Summary of Chapter 4

It has been shown that most literature refers to an industry as a social system producing products that are close substitutes for each other in the market. New industries develop (often in clusters) due to “new combinations” and emerge due to the generic desire of societies to improve the standard of living and the specific drive and enthusiasm of convinced stalwarts. The success of a new industry is dependent upon combining a market demand with the factor conditions (resources, knowledge, capital and infrastructure) that give the industry a competitive advantage in producing a product. The development of a new industry is dependent upon innovation, which is the use of technology and market knowledge to meet market demand. Entrepreneurs are often given credit for bringing innovations to market, but in reality some authors have suggested that the development of innovations is reliant on the actions of many individuals and firms. It is noted that many of the references on industry development date from the 1980s and 1990s. The inability to find more current references on the subject indicates that there have been few advances in new information since that decade.

In New Zealand agriculture the successful emergence and growth of a new industry is rare; however, deer, kiwifruit and wine grapes have been successful examples in the recent past. The literature on the development of new agricultural industries stresses the need to locate, develop and establish supply chains for marketing. The new industry also needs to solve production and processing problems through research. The development of a well-run, professional industry structure was also seen to be important.

The development of an agricultural industry has characteristics which make it different from the ‘generic’ industries discussed previously. Often farmers in new industries are geographically dispersed and operate in isolation, rather than in clusters

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as suggested by general theory. In addition, the farmer's work place is often his home.

The successful new agricultural industries in New Zealand have shown the common characteristics of rapid growth and the development of industry governance structures. The deer industry has been able to build on farming and processing technologies from other pastoral industries. The kiwifruit industry has had the advantage of 'single desk seller' legislation which allowed the development of a marketing structure and brand that have enhanced revenues. The wine grape industry has experienced significant growth predominantly through the creation of a new appellation (Marlborough sauvignon blanc), which commanded a significant premium until market saturation was reached. A smaller premium does still exist for Marlborough sauvignon blanc as compared to other white wines produced in New Zealand.

From the growth figures in Chapter 2, it was established that the Canterbury dairy industry has also achieved rapid growth. In a manner similar to the deer industry, borrowing from other pastoral industries, Canterbury dairy farming has benefitted from the technologies available from an established industry. Like the kiwifruit industry, strong marketing structures appear to have been in place. However, unlike the wine industry the dairy industry produces a number of products, the majority of which are of a commodity nature and basic to human nutrition. This fact presents different demand conditions than exist for wine and gives the dairy industry the ability to produce different products to suit changing markets.

The above review of literature and discussions in Chapters 2 and 3 have suggested factors that may have been components in the development of the Canterbury dairy industry. These proposed factors are outlined in Figure 4.4., which becomes the 'theoretical lens' through which the Canterbury dairy industry will be analysed. These factors take into account the importance of the industry being a social system which is influenced by Porter's factors of infrastructure, chance events and government. The figure also acknowledges the importance of entrepreneurs and the role of innovation. The increased productivity and profitability achieved in Canterbury certainly was a contributing factor to the growth of the new industry.

It is likely that the development was influenced by innovation and new technologies.

Figure 4.4 Proposed factors in the development of the Canterbury dairy industry

If innovation and new technologies were a necessary component in the growth of the Canterbury dairy industry, then a method for passing new knowledge, skills and techniques to farmers was required. This area is considered of such importance that further examination is required. The diffusion of innovation in agriculture has historically operated in the realm of government agencies and is commonly called extension. Since the economic reforms of the mid 1980s, this role has increasingly been assumed by industry and private organizations. A discussion of diffusion through extension follows in the next chapter.

Chapter 5

Diffusion and adoption of technology

> **"Agriculture is a human activity—so why do we keep ignoring humans?" (Botha, pers. comm., April 2011)[22]**

5.1 Introduction

Given the large number of small firms within the production sector of many agricultural industries, there are particular issues associated with the introduction and transfer of new technologies and new knowledge. Accordingly, this chapter reviews the theory of innovation diffusion, followed by a discussion of agricultural extension and its relevance to agricultural industry development.

5.2 Definition of diffusion

Rogers (2003, pp. 36-38) describes diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. A social change is defined as the process by which alteration occurs in the structure and function of a social system. Rogers (2003, pp. 28-29) categorises these new ideas or practices as being either optional (up to an individual), collective (decision of a social system), authoritarian (made by people with power) or contingent (individual adoption after a system makes a decision).

Communication is often through a change agent who operates through opinion leaders in a group. The process usually involves an individual or group that has experience with an adoption and another that does not. The communication channel simply connects the two entities either interpersonally or via mass media. Most effective communication occurs when two individuals are similar (homophilous); however one of the most distinctive problems in communication is that participants are usually quite different (heterophilous) (Rogers, 2003 p. 9).

A social system is defined by Rogers (2003, p. 19) as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The structure of

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[22] Neels Botha is the Team Leader, Social Research with AgResearch in New Zealand

a social system can facilitate or impede the diffusion of innovations. The change agent is the individual who influences a client's innovation decisions in a direction deemed desirable by a change agency—the change agent uses opinion leaders who are often well trained professionals. In some cases they seek to secure the adoption of a new idea, in others they try to prevent adoption of certain innovations. Opinion leaders are the members of a social system capable of influencing the attitudes of others and tend to be the centre of interpersonal communication networks.

Several commentators have discussed the rate of adoption. Scheuing (1989, p. 307) suggests the importance of the innovation's relative advantage over competing products, its compatibility with the lifestyle of the prospective innovator, its complexity and ease of use, the ability to trial the innovation on a limited scale and the ease with which its benefits could be observed. Di Benedetto (2010, p. 113) added that a good experience by users will influence later users through 'word-of- mouth'.

To accomplish the diffusion of innovations which increase agricultural productivity or the development of new industries, social systems must provide information. In agriculture the systems that provide information are commonly referred to as 'extension'.

5.3 Extension theory in agriculture

Extension is about the transfer of technology. Roling (1988, p. 39) cites Zuurbier (1984) in defining extension as providing information to assist the individual to clarify and achieve their own goals, or to achieve change through empowering the poor. He defined extension as an activity with elements that involve:

> "1) an intervention;
> 2) communication as its instrument to induce change;
> 3) effective only through voluntary change;
> 4) a number of different target processes and outcomes which distinguish it from other communication interventions;
> 5) deployed by an institution."

Because of the perception of public good for many elements of agricultural knowledge and the high transaction costs involved, agricultural extension services have been one of the most common forms of public-sector support of knowledge and innovation diffusion (Birkhaeuser, Evenson and Feder 1991, p. 608).

The most common method in agriculture has been the ‘linear or technology push model’, whereby scientists define which aspects of farming should be studied and provide solutions which are passed on to farmers through a process of extension by specialist educators (Morris, Loveridge and Fairweather 1995, p. 4). Fairweather et al., (2011, p. 163) state that “since the linear model is like a pipeline from R & D to uptake, the assumption is that enhancement of R & D inputs will lead to an increase of innovation outputs”. However, Fairweather et al. (ibid) quote empirical evidence from Kline and Rosenberg (1986) that many innovations do not originate with scientists but from other participants. Fairweather et al. (ibid) refers to this phenomenon as ‘market pull’ or ‘user innovation’. This view is supported by Flowers (2011, p. 5) who states that “it is the users of a product (rather than its suppliers) who have the insights and ideas that lead to innovative products and services”.

The linear model of extension was traditionally used by many government agencies. However, the economic restructuring of a number of world economies in the mid-1980s reduced the level of support for public extension in a number of countries (Scrimgeour 1993, p. 35). Feller (1987, p. 315) when speaking of the U.S. Cooperative Extension Service, pointed out that change had occurred both technologically and economically in US agriculture which resulted in questioning the role of public sector spending on agricultural extension. These changes included (Feller, ibid):

> “Increased complexity of agricultural production with; production being concentrated in a small number of farms; availability to farmers of multiple information sources; increased educational levels of farmers; and the bypassing of county agents[23] by producers who seek direct contact with extension specialists or researchers.”

Coutts (1994, p. 10) referred to Bennet (1992) who questioned the traditional role of extension agents as advocates of the adoption of innovations (in a one-on-one

[23] ‘County Agent’ is the title given to a university employed, agricultural extension officer in the United States. These change agents are usually domiciled in the county in which they work. Counties are a sub-level of government in each US state, similar to a District Council in NZ.

situation) and suggested that they become facilitators of education. This new paradigm, as described by Coutts (1994, pp. 3-4), involves at one end of the spectrum, “persuasive extension” and at the other end “facilitative extension”. Persuasive implies that there is a predetermined “correct course of action” that needs to be taken by extension’s target. The role of facilitative extension is to influence voluntary behaviour so that the innovation is adopted. Facilitative extension is designed so that given the right conditions, information, mutual interaction and opportunity; people develop solutions for a problem. Roling commented (1988, pp. 20-21) that as the “bottlenecks to agricultural production” are removed by improved marketing, banking, infrastructure, land tenure and input delivery; the growth of productivity becomes more technology driven. This is directly dependent on new extension methods that rely on “the synergistic functioning of research, extension and education”.

Coutts (1994, p. 28) speaks of the need to maintain “commercial advantage” in a user pay environment for extension services and the potential to restrict the free flow of information. He comments that a problem with the privatization of extension services is that privatization forces staff to search for “knowledge products” which can be sold to farmers. Hoag (2005, p. 7) adds that a clear advantage of publicly funded extension is “a reputation for delivering high quality, research-based, unbiased information”.

5.4 The historical context of extension in New Zealand

Morris, Loveridge and Fairweather (1995, p. 6) state that the New Zealand Department of Agriculture was formed in 1892. Nightingale (1992, p. 37) quotes the department’s mission as being “to collect and distribute information on subjects connected with agriculture among the settlers by means of lectures and pamphlets, and generally to study and promote the welfare of the farming community”. Among its duties was the employment of instructors in farming techniques. By the 1920s, the extension service had grown large enough to allow face-to-face consultation with farmers as well as the provision of pamphlets and reports and this dominated the activities of the department (ibid, p. 62). However, an attempt to operate experimental farms in the North Island was abandoned in 1922 due to the expense of operating the farms and dissatisfaction with the extension results (ibid, p. 69). Scrimgeour, Gibson and O’Neil (1991, pp. 2-3) note that in 1973 there were 600 extension workers in New Zealand, 68% provided by government. The New Zealand Dairy Board provided a consultancy service through a levy on dairy farmer incomes and sheep/beef farmers had a variety of sources of information including the Ministry of Agriculture advisers. Dairy Board personnel spent about 20% of their time on 'face-to-face' consultancy, with the balance of their time spent with discussion groups.

During the restructuring of the New Zealand economy in 1984-87, the role of the government in agriculture was reduced (Scrimgeour 1993, p. 35). As a result, the Ministry of Agriculture was split into a number of new entities with the extension role changed to a 'user pay' system. This resulted in a reduction in the number of advisors and clients, as some farmers could not/would not pay for the service. The division was renamed Agriculture NZ and eventually sold to a corporation.

A survey of 100 Waikato farmers by Scrimgeour, Gibson and O'Neil after the restructuring (1991, pp. 10-16) found that although 40% thought there should be a free extension service, 46% felt that it was inappropriate. Two thirds used non-MAF personnel, with most saying that MAF's role should be in responding to adverse events, research, regulation and protection.

The results of the restructuring were a change in the delivery of extension in New Zealand. Walker (1993, pp. 126-129) stated that there became four distinct, though inter-related, practices of extension which he summarised as follows:

> "facilitation - the achievement of government objectives through the identification and promotion of opportunities to intermediaries who then service farmers,
>
> extension - assisted learning through farmer groups such as the NZ Dairy Board, NZ Wool Board, NZ Meat Board,
>
> technology transfer - communicating new practices to farmers usually through mass media by Crown Research Institutes, Universities and local government.
>
> consultancy---advice to fee-paying clients by private organizations."

This model was expanded by Botha and Coutts (2006, p. 10) to include: group facilitation, training, technology development, information access and individual consultant and mentor.

The change from a publicly funded extension service led Paine (1997, p. 37), to comment that “although the linear model was the pre-eminent theoretical framework for extensionists in the early 1970s, it was found wanting when confronted with the management of extension services in privatised economies”.

For the past 20 years, the majority of New Zealand’s agricultural and horticultural industries have made use of the Commodity Levies Act 1990 (Greer, Zwart 2010). Through the collection of levies, industries can develop structures for promoting research and development. These producer accessed funds are often used to attract additional public funding. Currently, dairy farmers pay a levy of 3.6 cents per kilogram of milksolids processed from a farm and meat producers pay 55 cents per head of sheep and $4.20 per head of cattle supplied to processors.

5.5 Research about the adoption of innovation in the agricultural sector

If it is accepted that innovation is necessary for an agricultural system to grow and develop and that this innovation is transferred through extension, then it is appropriate to review research on the adoption of innovation in agriculture.

Botha and Coutts (2006, p. 11) suggest that “the adoption process is a series of different stages of mind that an individual goes through up to a point where they make a decision”. A potential adoptee moves from ignorance to awareness/interest. From this point they can test and/or perform comparisons, with the result being either adoption or rejection.

Oreszczyn, Lane and Carr (2010, p. 12), have stated that farmers constantly cope with significant amounts of new knowledge. Their learning about new technologies occurs in a complex social learning system (or web), where they rely on their own experience while interacting with other farmers and a network of “influencers” which includes a wide variety of individuals and groups. For example, they found over 50 potential influencers on crop farmers considering genetically modified crops in England (ibid, p. 7).

Massey et al. (2004, p. 2) found that adoption is likely to be faster with young, better educated farmers who are willing to break with tradition. Adoption will also be quicker on larger, profitable farms which are in a position to access economic resources and with successful adoptions in the past. To be successful the extension delivery system needs to include credible individuals who can communicate the advantages of an adoption. Farmers will pay for information, but they need to see a return. Massey (ibid) suggested that management intensive innovations are more readily accepted than capital intensive innovations. Gray, Parker and Kemp (2003, pp. 116-119) found that learning about innovations was most likely stimulated by either extreme conditions or the introduction of a new practice.

Morris, Loveridge and Fairweather (1995, pp. 123-127) state that to reach farmers, an extension system must appeal to the farmer's orientation (production, profit and/or monitoring) and demonstrate what is considered to be best practice, preferably with farmer involvement in demonstration farms or field days. However, Holmes (2006, p. 47) suggests that commercial farmers are better than researchers and extension personnel at operating dairy systems. He adds that dairy extension officers should consult the most successful dairy farmers in their district, study their methods and pass on information about these methods to as many other dairy farmers as possible.

A look at the characteristics of innovations is also helpful in explaining the different rates of adoption and is discussed by several authors (Nuthall 2010, p. 91, Flett 2003, p. 2). Issues such as the compatibility of the innovation with existing systems are important for adoption along with the past experiences and the needs of the potential adopter. A complex innovation is less likely to be adopted, particularly if the potential adopter cannot trial the product on a small scale himself. Equally important is the degree to which the results from an innovation are visible to others. These factors will sometimes cause non-adoption even though economic analysis suggests that it should be profitable.

Several examples illustrate this point. Nitrification inhibitors have been proven to have positive environmental and economic benefits to dairy farmers (Moir, Cameron, Di 2007). Despite a large investment in research and testing, farmer uptake has been slow due to the product being complex to use and the difficulty of measuring the results (Smith[24] pers. comm., January 2011). Likewise, Alvarez and Nuthall (2006, pp. 48-60) commented that the adoption of computers as a key component in farm management had not been as significant as they expected. They suggested that adoption is dependent upon farmer attributes such as objectives, personality, education, skills, current information management processes and learning style. Additionally, they stress that software designers need to work with farmers in design, training and support (user innovation). Perhaps, in both examples, farmers could not readily see the potential to increase profitability and thus adoption was restricted.

5.6 Effectiveness of agricultural extension

Birkhaeuser et al. (1991) reviewed 48 studies on the impact of agricultural extension in crop farming in the U.S. They concluded that in the majority of cases there were significant and positive extension effects, although they noted that in a number of the case studies results were variable amongst different crops. Hoag (2005, pp. 3-5) promotes the attributes of publically funded extension on a number of fronts. First, he states that the public sector is more likely than the private sector to address issues like natural resources, information availability and risk. Secondly, he cites research by Alston et al. (2000) on the returns from research and extension which showed a rate of return for investment in research of 87% and 30% for extension. Finally, in the context of the United States, he notes that there is a multiplier of two for funds invested by the federal government in extension through productivity gains and the business activities of the local extension office.

5.7 Summary

In Chapter 4 the definition of an industry in general was considered as well as the importance of innovation and the role of entrepreneurs. The development of three new agricultural industries in particular, was also briefly reviewed. It was suggested

[24] Daniel Smith completed a Master of Applied Science at Lincoln University in 2011. His dissertation involved interviewing 100 dairy farmers in the South Island of New Zealand about their reasons for the adoption or non-adoption of the nitrification inhibitor, EcoN.

that for the Canterbury dairy industry to develop and grow there needed to be a significant level of extension to increase farmers' knowledge, skills and techniques. Since innovation has previously been highlighted as being important to industry development, a review of diffusion/extension was considered important when discussing industry development in agriculture.

The review of diffusion theory provided the definition that diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 2003, p. 5). This has been discussed in the context of the history of agricultural extension in New Zealand. Originally driven and funded by government and featuring 'one-on-one' advising, the system now relies on extension personnel becoming educators, with 'one-on-one' methods being handled by the private sector. Research was also cited in regard to the adoptive capacity of New Zealand farmers. American research on the effectiveness of extension proposes a high return on investment.

Extension appears to be one of the factors that may have contributed to Canterbury's dairy industry development and further develops the possible answers for Research Question Three. Important aspects of diffusion/extension theory adopted in the dairy industry are the use of change agents (consulting officers) working through opinion leaders (respected farmers). The role of the change agents has been to introduce new innovations and to communicate 'best practice'. Historically, the change agency has been the New Zealand Dairy Board and, to some extent, the New Zealand government. The extension model currently operated by the farmer levy funded DairyNZ works in several ways. Discussion groups are a form of co-learning whereby farmers learn from each other through the facilitation of DNZ consulting officers. In addition, DairyNZ scientists and business managers conduct research which is transferred through consulting officers, demonstration farms, publications and/or websites.

Questions that have arisen from this chapter are whether extension activities have become less prescriptive and more facilitative. Has the resurgence of demonstration farms in dairying areas increased technology transfer? And, how important have private consultants been to the development of the Canterbury industry? All of these areas need further research.

However, having the appropriate factors like extension services in place does not necessarily guarantee the development of a new industry. The emergence of the Canterbury dairy industry is also about a change in land use within an existing industry (agriculture). For an industry that existed in other locations, the existing knowledge and infrastructure could be a factor influencing the development. To proceed further it is appropriate to gain an insight into the history of New Zealand agriculture and the development of the New Zealand dairy industry. Insights gained through this review should provide more factors and illuminate possible drivers of growth.

Chapter 6 History of agriculture and dairy farming in New Zealand

“The history of economic development shows that few countries have achieved sustained economic growth without first, or simultaneously, developing their agricultural sector. In most developing countries agriculture is the most important economic activity providing income, employment and foreign exchange” (Birkhaeuser, Evenson and Feder, 1991, p. 607).

6.1 Introduction

The purpose of this chapter is to review the nature, development and present situation for New Zealand agriculture, in general, and the dairy industry, in particular. A review of the past may provide additional factors influencing industry development and suggests drivers for the growth of the Canterbury dairy industry. The review is undertaken using the theoretical lens developed in Chapters 4 and 5.

6.2 A brief history of New Zealand agriculture

International trade has been a vital element in the development of New Zealand since the arrival of the first European settlers. Since the 1870s, the agricultural sector has been a major contributor to the export income of New Zealand. Wool was the first significant export and, after the introduction of refrigerated shipping in the early 1880s, meat and dairy products were exported (Sheppard 1993, p. 1).

Technological innovations have been a part of the growth and prosperity of farming. These changes have included the replacement of native vegetation by exotic grasses in the 40 year period leading up to the start of the First World War (WW1). The use of superphosphate, lime and trace elements allowed for the intensification of land use on flat land or low hill country between WW1 and the depression of the 1930s. After the Second World War (WW2), the application of superphosphate to hill country pastures was possible due to the advent of aerial topdressing[25] (Sheppard 1993, p. 1).

[25] Aerial topdressing is the use of airplanes to apply of fertiliser to land that is not topographically suited to wheeled vehicles.

In 1960, New Zealand was debt free and enjoyed a standard of living ranked in the top three of OECD nations (Rayner, 1990, pp. 13-14). This position steadily declined as government economic policies protected farm incomes from declining export prices through subsidies; labour markets were regulated; and the government invested heavily in projects to reduce national dependence on expensive energy imports. Rae, Nixon and Lattimore (2004, p. 4) state that the producer support estimate (PSE)[26], as measured for New Zealand agriculture peaked at 35% in 1983, and was almost identical to that of the European Union.

By 1984, a number of economic problems had become acute for New Zealand. The fiscal deficit had reached 9% of GDP, servicing the public debt accounted for 15% of public expenditure, a current account external deficit problem persisted, the exchange rate (fixed) was over-valued and 'loose' monetary policy had led to excessive monetary growth. National debt servicing costs rose to 50% of GDP. Heavy selling of the New Zealand dollar, threatened to exhaust the country's foreign reserves (Rayner, 1990, pp. 13-24).

A Labour government was elected in 1984 and immediately embarked upon a programme to deregulate the New Zealand economy. The new government faced a foreign exchange crisis as the country's private and public debt had reached 95 per cent of GDP. This resulted in a downgrade of the country's sovereign debt (Evans 2004, p. 4). Initially, the new government devalued the New Zealand dollar by 20% and, in 1985, the dollar was floated. The Reserve Bank of New Zealand was given the mandate to restrict inflation to within a 0 to 2% range (Rae, Nixon, Lattimore 2004, p.5). Agricultural support was discontinued and export assistance programmes ceased. Other policies adopted over time were: the removal of wage and price freeze mechanisms, financial market deregulation, the rate of import protection was lowered, government trading entities were corporatised (including agricultural extension) and direct taxation rates lowered (however, a type of value added tax was instituted)[27].

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[26] The PSE measures the percentage of the value of (assisted) output that is provided by various governments' agricultural assistance programmes.

[27] New Zealand also abolished death duties (estate tax) in 1992.

The effects on the agricultural sector were an appreciating exchange rate, interest rates in excess of 20%, a cost price squeeze, reduced land prices and thus reduced levels of equity. According to Rae, Nixon and Lattimore (2004, p. 5), the PSE for New Zealand agriculture reduced to 9% in 1987 and to 2% by 1994. Subsidies to agriculture reduced from $1.2 billion in 1983 to $116 million by 1993 (Paine 1997, p. 1). From 1986 to 2001 the number of farmers decreased from 71,000 to 52,000 and the number of farm workers from 144,000 to 129,000 (Rae et al., 2004, p. 14).

From 1986-87 to 2002-03 (following the reforms of 1984-85) the contribution of agribusiness[28] to GDP rose from 14.2 per cent to an estimated 16.5 per cent and, combined with forestry contributed around 20 per cent of GDP (Ministry of Agriculture and Forestry, p. 5). The MAF (ibid) estimated that the total output gain in agricultural productivity was 2.1% per annum for the period 1985 to 2002, as compared to 1.1% for the period from 1972 to 1984. More current statistics from Federated Farmers stated that “inside the farm gate” agriculture contributes 5% of GDP and, if processing is taken into account, the contribution is 15% (Federated Farmers 2011).

There have been changes in the relative importance of the major agricultural industries. Table 6.1 and Figure 6.1 provide a summary of data found in Appendix C1. Between 1991 and 2009, returns from the dairy industry have grown by 4-fold and the meat industry 2-fold, but the wool industry has decreased by 40%. These statistics point to an increasing dairy industry, but a decreasing sheep industry due to the loss of revenue from wool. From 1985-86 to 2008-08, tonnes of wool produced decreased by 43% and tonnes of lamb exported by 26% (Appendix C2). The lack of profitability in wool has led to a reduction in the importance of wool from 40% of a sheep/cattle farmer’s gross income to 14% (Appendix Table C3).

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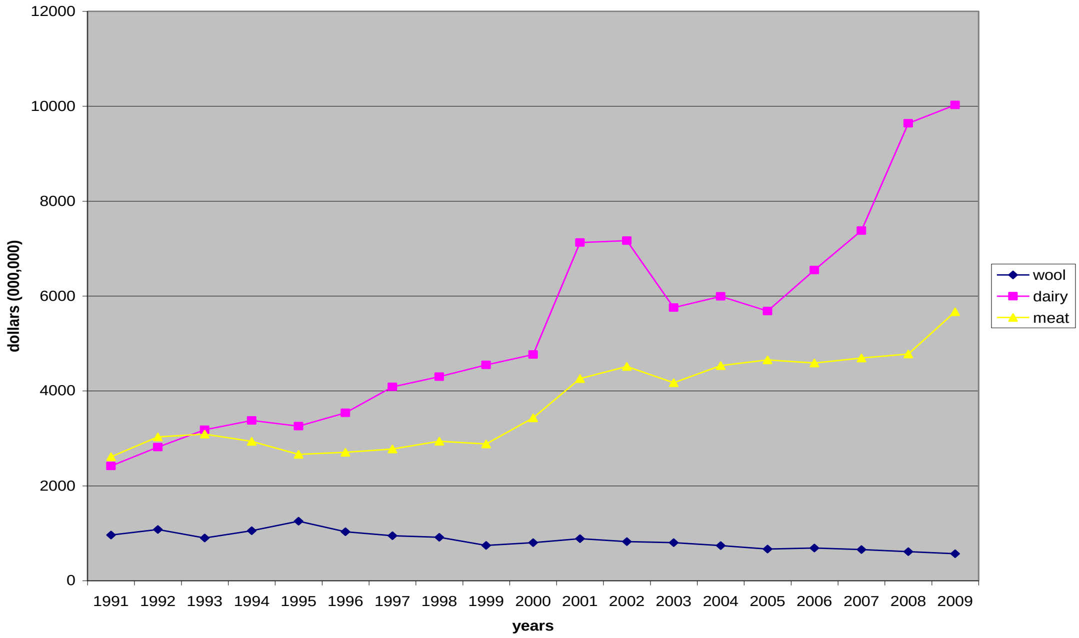
[28] In agriculture, agribusiness is a generic term for the various businesses involved in food production, including farming and contract farming, seed supply, agrichemicals, farm machinery, wholesale and distribution, processing, marketing and retail sales.

Table 6.1 Dollar value (nominal) of NZ exports by sector (1991 to 2009)

	Wool (000,000)	Meat (000,000)	Dairy (000,000)	Other animal (000,000)	Livestock (000,000)	Total pastoral (000,000)
1991	963	2,612	2,420	682	179	6,855
1994	1,253	2,663	3,257	853	141	8,157
1998	915	2,941	4,302	711	140	9,008
2001	886	4,260	7,128	886	154	13,313
2004	740	4,532	5,992	697	182	12,143
2009	569	5,668	10,026	741	163	17,166

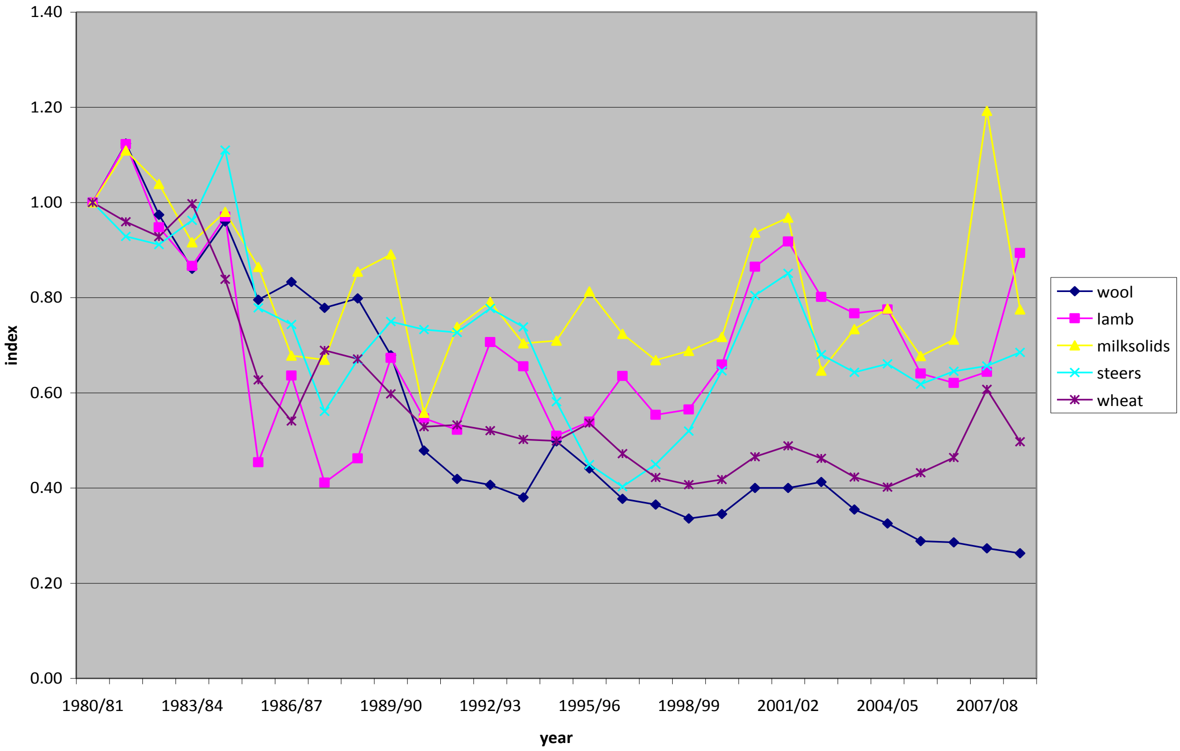
Source : Compilation from Meat and Wool New Zealand Economic Service (Gonzalez-Macuer 2010)



Source: Compilation from Meat and Wool New Zealand Economic Service (Gonzalez-Macuer 2010)

Figure 6.1 Income (nominal) from the dairy, meat and wool industries (1991-2009)

When returns for agricultural commodities are converted to indices with a base year of 1980, it can be seen that all prices have dropped. However, lamb prices per kg and milksolids prices per kg have followed the same trend and dropped to a lesser extent relative to beef, wheat and wool. Beef prices have been volatile and, at times, the index price has been closer to lamb and dairy prices. Wheat trended downwards until the mid-2000s when prices rose, only to drop during the world economic crisis in 2008-09. Inflation adjusted wool prices have decreased to approximately 25% of the returns achieved in 1980.



Source: Compiled from statistics available from Meat and Wool New Zealand Economic Service, Dairy Statistics and NZX Agri (2010).

Figure 6.2 Inflation adjusted agricultural commodity indices (base year 1980)

6.3 The development of a dairy industry in New Zealand

"Dairy farming in New Zealand has emerged from a mix of changing cultural, economic and technological forces operating on the land and its people" (Paine 1997, p. 79).

The history of the dairy industry in New Zealand reflects the growth and development of New Zealand for some periods. Reviews by Ward (1975), Conforte, et al. (2008), Duncan (1933), LIC (1985-86 to 2007-08), Nightingale (1992), Nayga & Mtonga (1994) and the annual reports of the New Zealand Dairy Board (1975-00) and the New Zealand Dairy Board Dairy Products Division (1970-85) make this point clear. Furthermore, these authors and other reports, provide a synopsis of industry growth and development, as presented below.

The Reverend Samuel Marsden is generally given credit for introducing dairy cattle to New Zealand in 1814 at his mission in the Bay of Islands, Northland. Over the next few decades cattle numbers grew and by the 1840s there were numerous small herds of Shorthorn (Durham) cows spread throughout the country. The first Jerseys were imported in 1862 and Friesians in 1864. The Shorthorn remained the dominant breed until the 1920s, when post war demand for butter made the higher butterfat Jersey more popular (Ward 1975).

Ward (1975, p. 3) cites Clark (1949) in saying that by 1857 there were 18 dairies on the Akaroa Peninsula and cheese and butter were being exported to Australia. Without refrigerated transport, the cheese was heavily insulated in hogsheads[29] or boxes and the butter was packed in crocks or tubs in brine alone or heavily salted. Exports to Australia were 1,889 kilograms of butter and 2,347 kilograms of cheese in 1859 (Ward 1975, p. 4). Over the next twenty years exports were sporadic, depending upon population increases, climatic conditions and the world economy.

Initial manufacturing was concentrated 'on-farm'. In 1871, the first cooperative was established near Dunedin as the Otago Peninsula Cheese Factory (Ward 1975, p. 5). By 1881 the government had become involved in the dairy industry offering a 500 pound bonus for the first factory to export either 25 empirical tons of butter or 50 empirical tons of cheese[30]. The prize was won by the Edendale factory near Invercargill, which exported 50 tons of cheese in the 1882-83 season. Edendale at that time was a proprietary company, but became a cooperative in 1903. Ward (1975, p. 5) states that early government policy was to, "Stimulate factory production at the expense of farm or home manufacture, where quality was less easy to control". In 1888, the Department of Agriculture appointed an 'inspector' to visit factories and offer advice on management (Nightingale 1992, p. 30).

The government policy was to promote cooperative factories, although proprietary ownership was not to be discouraged. However, the Department of Agriculture actively encouraged cooperatives (Nightingale 1992, p. 45) as a "way of overcoming mistrust between producers and processors" and to help solve the industry's "organisational and quality problems" (ibid, p. 48). This second stage of industry development (factories vs. farm manufacture) was assisted by the development of refrigerated shipping in the early 1880s. Companies soon learned that export markets demanded higher quality product than the domestic market and quality control issues

[29] A hogshead is a large cask of a liquid or food, usually of a specific volume.
[30] an empirical ton is roughly equivalent to a metric tonne

became important over the next decade. Factories in the Waikato formed an organization called the Waikato Dairy Factories Association in 1885 and, in 1890; the New Zealand Middle Island Dairy Association was formed in Dunedin. These organizations were designed to "watch and promote common interests of the dairy industry" (Ward 1975, p. 7). The Middle Island Association was expanded to form the South Island Dairy Association (SIDA) in 1891 and a number of North Island associations formed the National Dairy Association (NDA) in 1894. These associations became the dairy industry representative bodies until their role was taken over by the Dairy Control Board in 1924.

The Dairy Industry Act of 1892 regulated the manufacture of butter and cheese for export and provided for the purity of the milk used in its manufacture. The second Dairy Industry Act of 1894 gave the Department of Agriculture the power to inspect dairy farm and factory premises, to grade the product and to ensure the quality of the product and its packaging (Ward 1975).

The influence of proprietary companies in the establishment of the industry was important. There were 124 dairy factories in 1894, with just under 40% cooperatively owned (Ward 1975, p. 8). The raising of capital to build a factory was a major obstacle; however, this was much more easily accomplished nearer to settlements by proprietary investors. In more outlying areas, cooperatives were more common, but often needed 'dry shareholders' from the local business community to commence business.

Two prominent proprietors involved in the establishment of butter and cheese factories were Chew Chong in Taranaki and Henry Reynolds in the Waikato. Chong was a merchant and established a factory which stressed quality control. Reynolds also owned a factory and is credited with the establishment of the sharemilking system. Although both prospered in their early years, they eventually sold to cooperatives due to competitive pressures making it difficult to maintain supply. Ward (1975, p. 13) wrote,

> "While admitting the force of the cooperative movement and recognising the soundness of the principle underlying it, one should not forget that the industry owes much to the enterprise of the factory proprietors. While so-

> called cooperation had started the factory system and brought it to a standstill through bad management it was the syndicator who stepped in, bought up the discredited factories and built new ones, offered the public a fair price for their milk and put the industry on a sound financial basis."

Eventually, the financial position of the cooperatives was strengthened by competition for their product from overseas importing houses. Ward (1975, pp. 7-8) commented on farmer's preference for cooperatives:

> "The dairy farmer preferred the in-built reassurance of a factory where he and his fellow farmers elected and controlled the directorate through their shareholding. The dairy farmer was cautious of outside help from authorities or commercial interests. He was suspicious, frequently unnecessarily and ungenerously so, of approaches from, or commitments to those interests. He was slow to make business friends other than those with whom he had worked and of whose integrity he could be sure. He developed a suspicion of city and urban interests as not being allied to his own, and believed they were seeking more than a fair share of his hard-won livelihood. Consequently he sought through his cooperatives and district association to secure as much of the selling price of his produce as was possible. He needed this for his own meagre living and for his farm's future development."

By the turn of the century, cow numbers were 350,000 and Great Britain was taking 85% (8,500 tons) of the butter and 75% (370 tons) of the cheese produced in New Zealand (Ward 1975, p. 18). This period saw a change in marketing from selling the product in New Zealand to be exported, to sending the product to Britain to be sold by importing houses (referred to as Tooley Street) on commission. The government became more involved, sponsoring annual conferences and setting up further systems for quality control. By 1910, cow numbers had reached 600,000 (Ward, p. 25).

Innovation and technology development have long been a part of dairying. For suppliers to butter factories, the home separation of cream became a widely adopted technology, with 70% of suppliers owning separators in 1918 (Ward pp. 28-29). Although the innovation allowed the growth of a pig industry fed on the skim milk and reduced transport costs, it also contributed to quality problems. The adoption of milking machines (35-40% of the cows milked by 1913-14) increased quality problems due to poor maintenance of the machines on farm. Although herd testing schemes had been available to pedigree breeders from the turn of the century the service was not available to commercial herds until 1922-23. The production of casein and lactose began in the 'teens' and in 1918-19 the first dried milk was produced. The adoption of these technologies allowed for larger, higher producing herds with the development of new products giving marketers a broader product range to sell.

During the First World War (1914-18), the government of Great Britain "commandeered" the total supply of New Zealand dairy products - this lasted until 1920 for cheese and 1921 for butter (Ward, 1975, pp. 33-42). The prices offered were usually lower than the market. Ward estimated that in 1915 alone the compulsory purchase cost NZ £250,000[31] in lost revenues. However the system did provide security to New Zealand, as the price was 'free on board' (F.O.B) which protected New Zealand from the uncertainties of shipping during the war.

Finance became an issue in the 1920s as the Associated Banks released a circular which stated,

> "Any new dairy factory being formed or any existing company requiring further accommodation in connection with its land, building and equipment must at the outset put up 24% in cash before a bank will make an advance. It was also required that capital should be subscribed equal to two thirds of the advance required, or of any subsequent advance; and that 1pence/ lb butterfat should be withheld from the suppliers annually; that full permissible depreciation be written off and the amount be applied in permanent reduction of the overdraft limit; and that all advances be secured by joint and several guarantees of suppliers and by security over all the assets of the company" (Ward 1975, p. 46).

Due to market instability in September of 1922, the industry requested that the government form a "Control Board" to organise a compulsory pool for the export marketing of dairy produce. This was met by opposition from the proprietary companies, Tooley Street and even some of the cooperatives; however it had the support of the large New Zealand Dairy Association (NZDA). The Dairy Produce Export Control Act was passed by parliament in August of 1923. Initially sales in Great Britain were through the Co-operative Wholesale Society (CWS) and some Tooley Street firms. This effort at 'absolute control' involved selling products at a

[31] Using the NZ Reserve Bank Calculator, this is equivalent to $33.3 million dollars in 2010 constant value dollars. Sourced from: www.rbnz.govt.nz/statistics/0135595.html

fixed price and if the merchants were unable to sell the quantity shipped to them within a specified timeframe, the product would be transferred to another merchant. The policy caused sales to fall as merchants moved to other suppliers and a stockpile of New Zealand product developed in Great Britain. Eventually in March 1927, the Board instructed the London Agency of the Control Board to clear all stocks by the end of June. Ward (1975, p. 68) reported that "sales could not be made quickly enough" and in the first week 100,000 boxes of butter and 50,000 crates of cheese were sold to merchants and shops who had run their stocks to low levels. This marketing disaster led to the industry reverting to the 'free market' to establish prices until the early 1930s. The Control Board remained in existence until 1935, but only to conduct administrative functions. During this period most products were sold to Tooley Street merchants, although NZDA sold about 30% of the industry's butter and 12,000 tons of cheese through their own outlets (Ward, p. 74).

A drop in prices of 50% occurred in the 1930s due to increased agricultural protectionism, increased production from New Zealand and the effects of the worldwide depression. However, other agricultural sector prices fell to a greater extent so there was an upturn in milk suppliers, increasing from 55,000 in 1924 to 70,000 in 1933 with cow numbers increasing by 500,000 to approximately 1,800,000 (Ward 1975, p. 82). Adding cows to an existing farming system was a much needed source of income for many struggling farmers.

Duncan (1933, p. 1) recorded that in 1933 there were 534 registered factories, of which 499 were cooperatives and 35 proprietary. These factories exported 117,783 empirical tons of butter and 94,635 empirical tons of cheese. Duncan (ibid) stated that the growth of the New Zealand dairy industry was due to "natural and climatic advantages, the application of mechanical refrigeration to ocean steamers, the application of science to the manufacture of dairy produce and the progressive spirit of the New Zealand dairy farming community".

In 1935, the Labour Party was elected to govern New Zealand. The party had campaigned on a policy of guaranteed prices for cheese and butter. With the government guaranteeing price, the government was also obliged to market the product - this was the launch of the first major state trading department. Some staff members from the Dairy Control Board were transferred to the “Primary Products Marketing Department” (PPMD), with the Dairy Control Board becoming the New Zealand Dairy Board. The PPMD only handled cheese and butter, with the companies (primarily NZDA, which was now called NZCDC) handling powder, casein and other products. The New Zealand Dairy Board adopted an administrative role organizing the annual Dominion Dairy Conference, controlling the supply areas for the factories, sponsoring research, herd testing and herd improvement.

Although similar to the failed “absolute control” programme of the 1920s; under the guaranteed price scheme there was no attempt to fix prices by the government. Tooley Street merchants were used as agents, but received their allocations from the PPMD. Under the guaranteed price scheme a milk price to farmers was set each year by the government in consultation with the industry. This resulted in annual negotiations to fix the price based on farm costs and relativities between rural and urban conditions.

Ward (1975, p. 100) noted that economist John Maynard Keynes criticised the guaranteed price scheme, stating that:

> “The plan is unsound on the grounds that a domestic price for producers of goods selling on an international market should not be isolated—or insulated—from the effects of the market place, and from the relative incomes of groups of others exporters or traders. Under guaranteed prices this would tend to occur and would lead to subsidisation of one selected group of farmers irrespective of the desirable competitive forces of the prices in the market place.”

After the Second World War was declared in September, 1939, conditions of marketing changed. The United Kingdom government became the sole purchaser of imported foodstuffs and the PPMD in New Zealand became the authority responsible for the purchase and shipment of dairy products. Prices to farmers were basically frozen throughout the war. After the war a ‘bulk purchase’ agreement for dairy products was signed by New Zealand and the United Kingdom. With guaranteed prices and bulk purchase, a system of cost adjustment and economic stabilisation developed. Under this scenario, the industry had an account with the Reserve Bank (Dairy Industry Stabilisation Account), which was either in credit or debit depending upon the prices received and the amount paid to farmers. The effects of wars, bulk purchases and guaranteed prices although positive from a stability point of view - in fact led to only modest growth in production over the decades involved. The Labour government promised that ‘efficient’ dairy farmers would achieve a reasonable standard of living, however research by the Department of Science and Industrial Research[32] in 1936 found that many dairy farmers lived in poverty (Nightingale, 1992, p. 232).

During the 1940s the Herd Improvement Department of the Dairy Board established a progeny testing service for young sires and the Ruakura Research Centre developed artificial insemination. Vaccine was imported to control ‘contagious abortion’ (Brucellosis). A Consulting Officer Service was initiated and the Society of Animal Production was formed. The dairy industry was instrumental in establishing Veterinary Clubs throughout the country (Ward 1975, pp115-118).

In 1948, control of exports moved from the PPMD to the Dairy Products Marketing Commission. A seven year agreement (1948-49 to 1954-55) was signed with the United Kingdom for the sale and purchase of butter and cheese (Ward, p. 142).

Prices for products during the 1940s and 1950s were often subject to debate. In the early years New Zealand was pleased to have guaranteed markets and safe shipping of product. Prices between New Zealand and the United Kingdom were generally negotiated annually, but were affected by world prices. The prices paid to farmers were negotiated with the New Zealand government, with most arguments around the ‘labour return’ portion of the price. By the mid-1950s, agricultural protectionism dominated the world’s dairy industry. This led to over production and caused surpluses over and above domestic usage in a number of countries. These policies put pressure on the United Kingdom market for New Zealand products as other country’s surpluses were often ‘dumped’ into the United Kingdom. The United Kingdom reacted by establishing quotas for the import of product.

[32] The Department of Science and Industrial Research was established by the NZ government in 1926 for research purposes. It became the Crown Research Institute company IRL in 1992 and concentrates on research for the manufacturing and industrial sectors.

Interventions and protectionism led to volatility in prices. Ward (1975, p. 174) commented that in 1958 the dairy reserve account was predicted to be in deficit due to low butter prices. The New Zealand government financed the proposed deficit of £7 m[33] on the condition that the industry made the "utmost effort" to repay the deficit (the government considered this to be an accommodation loan, not a subsidy). In fact, butter prices increased to such a level that the reserve account showed a £14 m[34] surplus for the 1959-60 year. The increases in price led consumers to shift to margarine with a reduction in butter consumption. An industry adage developed "more money is lost in buying the market back than is gained on the way up" (Ward 1975, p. 182).

In 1959, it was suggested the Dairy Board and the Marketing Commission be combined and, by 1961, they had become the New Zealand Dairy Production and Marketing Board. Membership of the board entailed 11 producer members and two government representatives. The Prices Authority (who set the guaranteed price to farmers) was retained, with seven members (three from the Board/Commission, three from the government and a Chairman appointed by the government). In June 1966, all government divisions and farmer groups were merged and the name was changed to the New Zealand Dairy Board" (NZDB).

In response to the establishment of British quotas on New Zealand butter in the mid-1950s, the industry had been actively pursuing alternative markets. By 1961-62; 22.5% of New Zealand dairy products were sold to over 70 countries as compared to just 3% in 1954 (Ward, 1975, p. 193).

Despite Keynes concerns about the stabilisation scheme, it had in fact stabilised prices to farmers. An analysis of the dairy reserve account in mid-1965 showed that over the 30 years of operation the total cost to the tax payer had been £267,850[35] which had been written off in the first year of its operation (Ward 1975, p. 200).

[33] $296.7 million in 2010 constant value dollars
[34] $558.9 million in 2010 constant value dollars
[35] $27.7 million in 2010 constant value dollars

However, this did not mean that it operated flawlessly. For instance, low prices in 1966-67 saw the reserve account reach -£5.6 m[36].

Finance for industry infrastructure remained an issue. Improvements to processing facilities had to come increasingly from the industry's Dairy Industry Loans Council rather than through retentions. Because the council was limited by the stringent economic conditions administered by the Reserve Bank, the Dairy Board in the mid-1960s raised $6 m from debentures (New Zealand adopted decimal currency in 1967). These debentures were placed with the public, the Meat Board and Dairy Board internal funds (Ward 1975, p. 203).

The 1970s again saw the NZDB actively trying to maximise sales in areas other than the United Kingdom, but this time it was due to the United Kingdom's impending membership in the European Economic Community (EEC). Leading up to entry, Britain had negotiated tariff quotas for New Zealand sheep and dairy products into the United Kingdom, but these were fixed and their future security was uncertain. In 1968-69, Board officers visited 94 countries in pursuit of new markets (Ward 1975, p. 207). However, the market diversification generally entailed lower and more volatile returns than were available in the United Kingdom (Evans 2004, p. 3). Initial attempts to establish further processing/distribution facilities in Asian markets were abandoned as it was felt that the Boards activities interfered with local interests and were difficult to control from Wellington. A policy of remaining a distributor of dairy products at "first hand only" was established (Ward, 1975, p. 208). However, the industry was successful in diversifying the export destinations of dairy products as shown in Table 6.2.

[36] $88.3 million dollars in 2010 constant value dollars

Table 6.2 Percentage of NZ dairy exports to the United Kingdom and other markets

Years	United Kingdom %	Other %
1967-68	63	37
1968-69	59	41
1969-70	53	47
1970-71	47	53
1971-72	43	57
1972-73	40	60
1973-74	24	76
1974-75	37	63
1975-76	32	68
1976-77	27	73

Source: derived from NZ Dairy Board accounts 1977

During the 1970s and 1980s, New Zealand experienced high levels of inflation which had a significant effect on the dairy industry (Table 6.3). Although income levels were generally increasing, so were costs for inputs and for purchasing farms.

Table 6.3 Change in income, farm values and costs for NZ dairy farms (nominal $'s)

	Average net income ($)	Ave. price for farms sold ($)	Dairy cost price index (%) increase
1974-75	9,000		
1975-76	9,720		
1976-77	11,400	127, 952	
1977-78	10,200	125,876	11.4
1978-79	13,000	153,009	12.4
1979-80	13,742	175,000	19.2
1980-81	15,400	253,488	20.4
1981-82	19,200	255,252	20.8
1982-83		357,140	10.4
1983-84		327,475	1.9
1984-85		373,243	11.3
1985-86		378,519	12.1

Source: derived from NZ Dairy Board accounts (1974-75 to 1985-86).

A major influence on the industry in the 1980s and 1990s was the effects of northern hemisphere government's agricultural policies. Whereas, in the 1950s and early 1960s, the United States was the most active country in subsidizing exports, by the late 1960s and early 1970s they were succeeded by the European Community. The accounts of the New Zealand Dairy Board (NZDB 1984, p. 8) note that:

> "However of all the factors that influence dairy export price levels, the export subsidies set by the European Community continue to have the most

> immediate impact on dairy export price levels. It is most significant therefore that during 1983-84, faced with an already chronic but worsening surplus production problem, and a resulting budgetary cost crisis, the community agreed to the introduction of quota controls on production, reinforced by severe penalties for over-quota production."

In 1986, the government price stabilization scheme was removed. After lengthy negotiations with the government, the industry came to an arrangement which provided the industry with a government guarantee for income stabilization borrowing. However, this came with the requirement that the industry move from Reserve Bank financing to the private sector (NZDB, 1986, p. 3).

During the period in which the New Zealand Dairy Board (NZDB) was the monopoly exporter, the main goal for the industry was to sell all of the milk that New Zealand produced. The single desk exporter status of the Dairy Board gave the industry marketing economies of scale and a certain degree of market power. The NZBD 1989 accounts (p. 4) comment on the earnings objective of the NZDB as follows:

> "Unlike a typical company, the key objective of the Dairy Board is to pay the most it can afford for its main raw material, milk. This maximization of payout means that the concept of profit in the normal commercial sense is largely irrelevant. Aside from the milk price payout, the main financial focus of the board is the maintenance of reserves to sustain its operations and to provide a buffer against any sharp changes in its trading environment."

Table 6.4 gives details of the New Zealand dairy industry in the 1970s and early 1980s. This period reflects the period when the United Kingdom entered the European Union and before the New Zealand economy was restructured. Although the number of suppliers dropped, herd sizes increased by 32% and per cow production increased by 26%. Butter production increased by 38% and cheese dropped by 17%. However, the major growth was in the production of powders and casein.

Table 6.4 Dairy statistics from 1973-1986

Year	No. of suppliers	Herd size	Cows in milk	Mf/cow	Butter tonnes (000)	Cheese tonnes (000)	SMP* tonnes (000)	WMP* tonnes (000)	Casein tonnes (000)
1973	19900	106	2.2m	122 kg	149.8	94.9	161.6		
1974	18500	109	2.1m	118 kg	138.0	68.8	215.5		
1975	17700	112	2.1m	128 kg	140.0	70.0	113.7	23.3	15.1
1976	17400	115	2.1m	137 kg	171.3	80.8	96.7	34.9	48.6
1977	16800	117	2.1m	140 kg	172.9	79.1	158.4	65.8	73.5
1978	16000	120	2.1m	131 kg	165.6	73.7	167.2	60.7	63.5
1979	15800	123	2.0m	142 kg	151.7	58.6	130.1	64.5	72.7
1980	15500	126	2.0m	151 kg	175.7	66.8	146.5	77.0	62.7
1981	15020	129	2.1m	147 kg	157.5	76.2	164.6	73.4	47.5
1982	14845	133	2.1m	144 kg	168.0	96.9	155.7	116.8	58.5
1983	14800	137	2.13m	143 kg	206.2	78.5	201.1	94.1	53.1
1984	14900	140	2.2m	154 kg	146.1	83.6	94.1	106.0	68.1
1985	14700	143	2..26	151 kg	244.4	87.4	172.3	133.8	73.7
1986	14650	150	2.35m	153 kg	284.3				

Source: derived from NZDB annual accounts (1973-1986). The commodities listed are the tonnes reported as exported annually. However, there are discrepancies as some reports are for calendar years and others for the year ending in May.
* (SMP) Skim milk powder, (WMP) Whole Milk Powder

The late 1980s and early 1990s were a period of rationalisation at the processing level (Table 6.5) During this time period, the NZDB (1989, p. 8) had moved from the policy of being a seller at “first hand only” and was growing larger, listing 78 subsidiary companies (at least 50% owned), 28 associate companies (25-50% owned) and a large investment in a publicly listed company. Investment in subsidiaries increased from $19 million, in 1980, to $414 million in 1988. In 1988, 80 per cent of the subsidiaries sales were generated from milk produced in New Zealand (Conforte, et al. 2008, p50.).

Table 6.5 Number of dairy cooperative companies in NZ.

	May 1970	May 1980	May 1991
North Island	59	29	9
South Island	36	13	8
Total	95	42	17

Source: Nayga & Mtonga (1994)

The mid and late 1990s were turbulent times for the New Zealand dairy industry. The decade started with improved milk prices and financial stability after the restructuring of the New Zealand economy of the mid-1980s. During the 1990s there was a movement towards larger farms, a larger national herd, more cows per farm and increased production in the South Island. The figures in Chapter 2 detail this growth.

These significant increases put pressure on many aspects of the industry, particularly processing and marketing.

Evans (2004, p. 8) stated that “from the 1970s demand grew to rationalise the structure of the dairy industry as companies sought further economies of scale and better coordination of production and marketing”. He added that a difficulty with the ‘single desk export’ system was that farmers were being given mixed market signals due to the bundled price that they received for milk. The price did not distinguish between the production cost of raw milk and the return on milk processing capital, leading to over production.

Although the NZDB was in pursuit of adding value to the basic commodities being produced, the financial performance of the manufacturing cooperatives was directly related to the manufacturing cost models (make allowances) developed by the NZDB. Through mergers, companies reduced their product-mix risk by establishing large diversified processing plants. These large plants were often able to be more efficient than the cost model and gave the large companies a competitive advantage against smaller cooperatives (Conforte et al., 2008, pp. 51-53).

Other issues that lead to a changed environment were international trade liberalisation through the Uruguay Round of GATT, a push to develop fast moving consumer goods (FMCG) and global pressure on businesses that were considered to be ‘state owned trading enterprises’. In late 1998, the National-led government suggested that the state sanctioned producer export boards had outlived their usefulness and that industries should consider deregulation. The NZDB annual accounts for 1998 (p. 3) contain the following statement from the Chairman of the NZDB:

> “The announcement by government that it intends to work towards the eventual removal of the Dairy Board’s statutory powers, which have been so crucial to the industry’s success, is particularly unwelcome. As it has always been the National party’s policy that the future of the legislation is a matter for producers, farmers are particularly affronted that government has neither sought their view, nor indicated how farmers will benefit from removal of the legislation. There is overwhelming agreement on the fundamentals. The industry will remain farmer-owned and vertically integrated, selling through a single marketer owned by the shareholders, the cooperative dairy companies.”

Despite the Chairman's statement, there were indeed a number of problems that had developed between the NZDB and the cooperatives. These problems were detailed by Evans (2004, p. 10), as follows:

> "1) the pooling of product returns into a single price for milk (so companies did not receive the market price for products they produced);
>
> 2) the cost of reimbursement (so companies did not share in the commercial success and failure of products);
>
> 3) large penalties on downgraded product (creating incentives for companies to sell product outside the Board if possible);
>
> 4) the Board's marketing priorities differing from those of dairy companies."

Additionally, as the NZDB moved away from 'make allowances' to the 'commercial pricing model' for payment to farmers, there became very strong business drivers for companies to produce a wide range of products (see Chapter 8). This in turn led to amalgamations and the eventual dominance of the industry by two large companies. By 1998-99, the Kiwi Cooperative Dairy Company (Kiwi) and the New Zealand Dairy Group (NZDG) controlled 95% of New Zealand's milk production. Under this scenario the NZDB became largely redundant.

Despite the industry's initial objection to restructuring, by 1999 a proposal was developed to merge the two largest companies with the NZDB. The first proposal was rejected by the New Zealand Commerce Commission in 2000 due to the perception of a reduction in competition. The industry proceeded to negotiate with the government and successfully by-passed the Commerce Commission. This allowed the formation of the Fonterra Cooperative in 2001. However, to get this agreement, the industry accepted the following conditions, as outlined by Evans (2004 pp. 17-18):

> "1) open entry to any prospective supplier and open exit from the cooperative by shareholding farmers;
>
> 2) supply of up to 400 m litres of raw milk on demand to independent processors on competitive terms;
>
> 3) divestment of 50% of the domestic market;

> 4) appointment of a milk commissioner to arbitrate grievances between Fonterra and suppliers."

Two smaller cooperatives (Westland and Tatua) opted not to join Fonterra. Since 2002, there have been a number of proprietary dairy processing companies established (Open Country Cheese 2004, NZ Dairies 2006, Synlait 2007).

By 2007, Fonterra sold products to customers in 140 countries; collected 13 billion litres of milk and manufactured 1.8 million tonnes of product. It had 20,000 staff in 40 countries (Conforte et al. 2008, p. 60). Since the economic restructuring of the New Zealand economy (1984-85) milksolids production in the New Zealand industry has grown 2.2 times. In contrast, Chapman (2011, p. 36) reports that Australian milk production decreased by 2.2 billion kilograms of milksolids from 2001-02 to 2008-09.

Schilling, Zuccollo and Nixon, (2010, pp. C-D) reported in 2009 the dairy sector contributed 26% of New Zealand's total goods exports ($10.4 billion), was 2.8% of GDP ($5 billion) and employed 35,000 workers (excluding up to 10,000 self-employed contractors). These authors (ibid, p. 19) also reported that New Zealand's GDP increased by $690 million from growth in the dairy sector compared to the projected GDP growth in New Zealand if the industry had not grown during this time period.

A significant change in New Zealand's overseas markets has been the emergence of China has a major purchaser. Historically, China has purchased limited quantities of New Zealand dairy products; however, by 2011 purchases amounted to $2.2 billion (Statistics NZ, 2011).

Conforte et al. (2008, pp. 49) interviewed key industry participants on their opinions of the critical success factors of the dairy industry on a national basis. Participants felt that on-farm production has increased due to improved farming technology, other technological improvements, the use of nitrogen, labour saving technologies, the use of the results from science investment in the 1960s and 1970s and the exploitation of the lack of success of other land based industries. The same group stated that the industry's success in international marketing could be attributed to legislative support, effective connections to market demand and reduced global subsidies. The group suggested that other positive developments were farm consolidation which had led to economies of scale, the development of 'family corporates' which served as an improved mechanism for raising capital and the development of innovative share milking agreements and equity partnerships.

The same participants suggested that industry success off-farm had been due to economies of scale and political support for the development of international markets. Within New Zealand, the evolution of an industry structure to facilitate growth while maintaining farmer engagement was important. Also important were continuing technological advances and New Zealand's disease free status, which reduced trade barriers and compliance costs (Conforte et al., 2008 pp. 63-64).

As detailed in Chapter 2, the average size of New Zealand dairy farms grew from the mid-1980s to 2009-10. Not only did production increase, but dairy farms also increased in value on a per hectare basis. Figure 6.3, details this growth. It is speculated that the growth in real estate values relate to higher milk prices, increased production and farmers pursuing capital gains. The decreases in real estate values in 2008-09 are attributed to world economic conditions and their effect on milk prices.

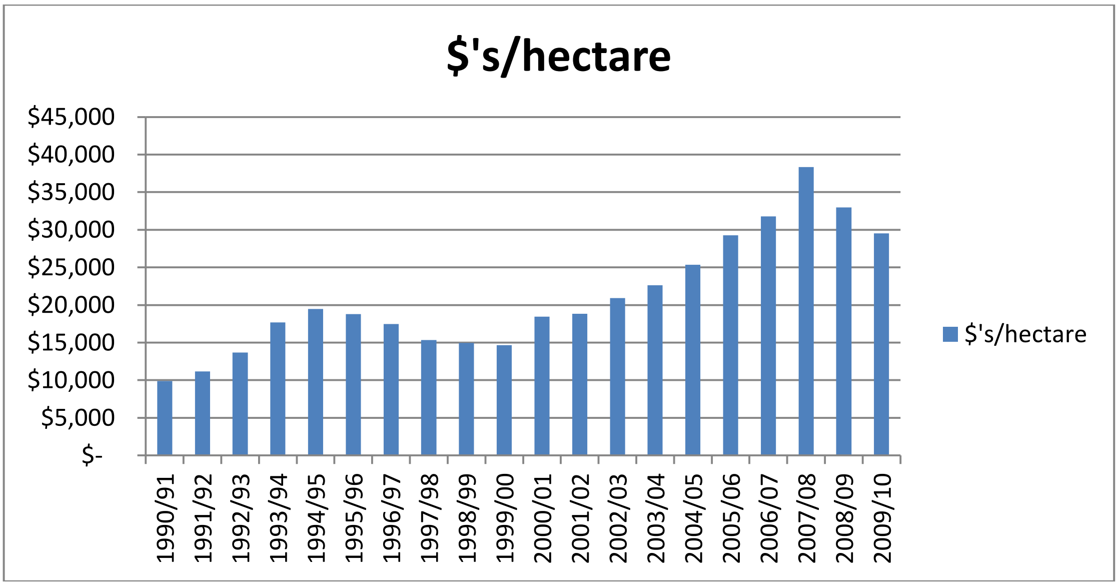


Figure 6.3 Value of dairy land in NZ (constant value dollars 2010) on a per hectare basis (NZ Dairy Statistics 2011)

Painter (2007), in providing a commentary on the state of the industry, stated, “New Zealand dairy farmers, operating in a free and competitive market with no government subsidies, have become the world cost leaders in the production of milk and have diversified along the value chain into the processing and marketing of dairy products. Through Fonterra, their dairy processing and marketing cooperative, they have captured 40% of the world dairy export market with branded New Zealand dairy products. As a result, New Zealand dairy farmers have good incomes and have accumulated significant net worth, compared with the average net worth of all families in New Zealand. Their success can be attributed to good farm management and a willingness to take risks.”

6.4 Discussion

Table 6.6 has been prepared to identify factors and drivers that have been important in the development of the dairy industry in New Zealand.

From the material reviewed in Chapters 5 and 6 it is clear that as one of the first industries to emerge in the development of New Zealand, the dairy industry has a long history of growth, innovation and extension. It has struggled with pricing mechanisms, industry ownership, funding, and government policies both domestically and internationally - not to mention the vagaries of climate and animal production systems. Since the economic restructuring of the mid 1980s the dairy industry has seen continued growth – in part through land use change and associated investment. This growth has resulted in the creation of wealth in real terms (see Chapters 2, Section 2.18, Chapter 3, Section 3.4.2 and Figure 6.3.)

Physical resources such as climate and suitable soil types have given the industry a competitive advantage. Additionally, chance events like world wars, inflation, global economies and markets have affected industry growth and development over the years.

However, commentators have suggested that the success of the industry was also due to the development of international marketing expertise which would not have been possible without political support and the development of processing/marketing structures that maintained farmer engagement. A key driver in the early years was government intervention through promoting the industry, setting quality standards and providing price stability. Demand was driven initially from the United Kingdom, particularly during the war years, where New Zealand was seen as the United Kingdom's farm.

From the end of the Second World War, the industry has been affected by international protectionism as well as changing New Zealand government policies (subsidies and deregulation). International protectionism had the effect of forcing New Zealand farmers and their cooperatives to constantly become more efficient and focus on low cost farming and processing systems through innovation and the adoption of new technologies. The controlled economy present in New Zealand from the end of the war until the economic restructuring lead to inefficient business models in other farming sectors. When these systems were challenged by deregulation, land use change to dairy farming occurred. These growth dynamics have continued into the new century.

Larger more productive farms with improved business structures for raising capital have been important. Additionally, the development of the sharemilking system has allowed the industry to develop a system for succession and the entry of new farmers.

Table 6.6 Growth and development of the New Zealand dairy industry

Time period	Events	Factors contributing to growth	Drivers of growth
Settlement to 1880s	First cows & farm manufacture First exports of cheese and butter First cooperatives	NZ climate	Need for food & income Proprietors Farmers wanting control
1880-1899	Industry organization formed Factory manufacture 372,000 cows & 5,500 suppliers in 1900	Government set standards Refrigeration, on-farm cream separation, new grasses	Government encouraged production Increased level of cooperatives Demand from United Kingdom
1900-1919	United Kingdom commandeer of NZ products Exit of proprietors World depression 783,000 cows & 35,604 suppliers in 1919	Milking machines Herd testing New processed products Superphosphate	Wartime demand from United Kingdom Absolute control by dairy board and then reversion to market prices Need for income in depression
1920-1939	United Kingdom bulk purchases—WW2 1,719,000 cows & 63,900 suppliers in 1939	Stability of prices and shipping	Wartime demand from United Kingdom Stable prices due to govt. guarantees
1940-1959	Agriculture protectionism 1.9m cows & 39,900 suppliers in 1959	Rotational grazing, artificial breeding, veterinary clubs & brucellosis vaccination	International protection decreased demand, but guaranteed prices allowed modest growth
1960-1979	Consolidation of NZDB High inflation New markets developed International subsidies 2.3m cows and 24,628 farms in 1969	Large herringbone & rotary cow sheds Investment in research to improved technology Inflation	Inflation caused need for growth Dumping by US and Europeans Consolidation of NZDB board
1980-1999	Industry rationalization International trade liberalization 3.3m cows and 14,362 farms	Increased farm size, less farms Growth of SI industry NZ economic restructure	Increased values for dairy farms Lack of profitability in other farming systems
2000-2010	Formation of Fonterra Increased productivity growth 4.3m cows and 11,618 farms in 2009	Improved supply chains Availability of finance Increased productivity Government support for trade reforms Continued SI growth	Growth in demand from Asia Increased production & profit Lack of profit in other farm systems Business structures Disease free status & product quality Re-entry of proprietary companies

The material reviewed in Chapters 2, 3 and 4 led to the development of Figure 4.4, which indicated that a developing industry was influenced by existing and new infrastructures, government and economic conditions, innovation and adoption and entrepreneurs. Chance occurrences can also be important if they lead to new opportunities or cause problems for a new industry.

The review of New Zealand agriculture and dairy farming in New Zealand has led to an expanded version of Figure 4.4, as shown in Figure 6.4. This figure now includes the additional conditions of extension, lack of profitability in other areas of land use, economic conditions and incentives, and the history of the industry. To determine the validity of these propositions, the results from interviews with informants involved in the development of the Canterbury industry are discussed in Chapter 7.

Figure 6.4 Proposed factors for the development and growth of the Canterbury dairy industry

Chapter 7

Factor conditions in the development of the Canterbury dairy industry (1982-2010)

"A nation which depends on agricultural sales abroad to pay for most of its imports must encourage any technical and social developments which emphasise greater production per ha and hence greater total production" (Morton, 1978)

7.1 Introduction

Figure 6.4 in Chapter 6 was created from the review of literature and data in previous chapters. It presents a number of possible conditions for growth in the Canterbury dairy industry. The purpose of this chapter is to examine these factor conditions from the point of view of participants in the industry.

The research discussed in this chapter came from interviewing a number of industry participants who were involved during the period examined. The interviews were designed so that the informants suggested factors that they felt were important. All informants have been assigned a number for reference purposes; for example informant number 1 will be referred to as (In1). The findings are compared to Figure 6.4 and will further inform Research Questions One to Four.

7.2 Methods

A group of 22 key informants were identified through purposive selection. Thirteen informants had been practising dairy farmers during the entire period. Two informants had been dairy farmers in the latter half of the period. Four consultants were interviewed either because of their involvement during the development or because they had provided expertise on a particular topic. One source was an observer of the dairy industry from another farming system, with the final informant a manager of a corporate farming entity. These informants were selected based on the author's knowledge of industry participants along with input from several key industry sources.

Interviews followed grounded, case study methods. All the semi-structured interviews were conducted towards the end of 2010.

The interviews began with the presentation of the graph (Figure 2.1) that depicted the growth in hectares involved in dairy farming in Canterbury. The interviewees were then asked to ‘tell their story’ of involvement with the industry. As the personal histories unfolded, the researcher listened for reasons for industry growth. The responses were compared to the proposed factor conditions listed in Figure 6.4; if a condition proposed by the literature review was not mentioned by the respondents then a question was asked to try to elicit a response. For instance, if the respondent did not suggest that there was an involvement by government, then the question was asked: “How has government effected the growth of the dairy industry in Canterbury”. A number of new reasons for growth were proposed by the respondents. Notes were taken during all interviews and the interviews recorded after receiving permission from the participants. The notes were typed and reviewed through listening to the recordings[37].

Section 7.3 details the history of the industry in Canterbury with data obtained from primary and secondary sources. Section 7.4 reports on the opinions of the informants about the factor conditions as listed in Figure 6.4. Section 7.5 details additional conditions identified by the informants and Section 7.6 is a discussion of the social implications of the development as outlined by the informants. Finally, Section 7.7 presents a summary of the chapter.

The statistics used to prepare Figures 7.1 through 7.5 are found in Appendix D.

7.3 Results

This section provides a brief history of Canterbury dairy farming and compares the answers of the informants to the conditions proposed in previous chapters, as listed in Figure 6.4.

[37] All recordings are stored in a locked cabinet in the Agricultural Management Department of Lincoln University.

7.3.1 Background of the Canterbury dairy industry

There has been a manufacturing dairy industry in Canterbury since the late 1880s (see Chapter 6, Section 6.3). However, until the early 1980s the dry climate and light soils were considered more suitable for sheep and cropping, with the exception of parts of Banks Peninsula and the pockets of heavier soil types near Christchurch and Temuka.

In the late 1940s in Canterbury, there were 11 cheese factories producing 2,500 tonnes annually and five butter factories producing 3,500 tonnes annually (McPherson 1952, pp. 225-229). Most of the milk for these plants was produced by small herds of cows milked on sheep and cropping farms. At this time, many of the farmers were servicemen who had been settled on farms upon their return from World War Two. These farmers were on tightly managed budgets with the New Zealand Government's State Advances Division (later to be called the Rural Bank). However, they were allowed to keep the proceeds from cream sales without prior approval of State Advances. Therefore, it was common to find between 4-10 cows on otherwise traditional sheep and cropping farms (ibid). These funds supplemented the farmer's allowable drawings from their State Advances managed account of 8 pounds per week (In6) or $416 per week in constant value dollars (2010).

Commencing in 1946, the possibility of commercial dairy farming was investigated by the Department of Agriculture's Winchmore Irrigation Research Farm near Ashburton. The research was initiated on 150 acres (60 hectares) at the request of the Ashburton Rehabilitation Committee (McPherson 1952, pp. 225-229). The committee's view was that if the venture was successful, dairying would provide another means of settling returned serviceman on flood irrigated farms. The significance of this research was that it established larger scale commercial dairy farming as a viable farming system in mid Canterbury. McPherson (ibid) reported that the farm was developed to milk 80 cows for separated cream production with the skim milk fed to pigs. The results from a five year trial showed that the farm was successful in milking 80 cows as planned and production reached 18,500 pounds of butterfat (approximately 14,715 kg milksolids or 245 kg milksolids/ha.). These results contradicted common perceptions that Canterbury winters were too severe for dairy stock and established that there were no serious stock diseases. Additionally, it found that winter feed could be grown and young stock reared successfully. The conclusions were that “although light land with the aid of irrigation has possibilities, while the returns from sheep products remain so high dairying is unlikely to be undertaken on this class of country” (ibid, p. 229).

As the returned servicemen became more settled on their farms, budgetary restrictions were lifted and the cows began to disappear. As the supply of cream to the factory diminished, the Midland Dairy Company of Ashburton began to look for new supply; one of the first converters to ‘fulltime’ dairying (In6) did so in the late 1950s and recalled the following:

“One day the Chairman and Chief Executive from the Midland dairy company in Ashburton came by and asked if we would be interested in milking cows. I laughed—yes, we would be interested in milking cows but we couldn’t buy a cow’s tail. We’ve got no money and would be lucky to hang on to this place. That’s why we came they said, we’ll buy the cows—you milk them, we’ll take the cream and you can have the skim milk and we’ll keep half the cream cheque until the cows are paid for. He asked whether we could build a cow shed, I said yes, because we had worked for builders before immigrating to New Zealand. Of course, we had no money but there were ways round that. They noticed that there were 12 big pine trees and suggested that we cut some down - two would build a cow shed, six would buy the concrete. It was all done with a cement mixer and that’s what happened. We built a four cow walk through shed. They bought us 14 cows and kept half the milk share. There were three barbed wires for a yard with no concrete. The company organised an irrigation turn out for 70 pounds, but we didn’t have the money. We took on a job to build 10 miles of fence for an old boss—who paid for some of it in advance so that the Ministry of Works would start. He also provided a two stand milking plant to put in the shed. By 1969 we had built a 12-a-side herringbone and were milking 70 cows. Since then we have helped a number of young farmers build sheds.”

The history of one of the first converters tells much about the future of the industry. The new dairy farmers often started with limited means, included many immigrants (from overseas and the North Island) who worked hard and often had significant help from other farmers. Additionally, the cooperatives were innovative in attracting and financing future supply. However, McPherson was correct in that even though it was proven that dairying could succeed in the province, the profitability of traditional industries provided a more attractive farming system to most and, in fact, the industry did not grow dramatically for over 30 years.

Historically, there have been two dairy industries in Canterbury, town supply (liquid milk) producers around the cities and a factory supply (manufacturing) industry in the rural areas. The town supply producers, although part of the industry, had a separate body to allocate town milk quota and set prices. Milk surplus to the quota was sold at factory supply prices. Annual surveys of the cost of production were carried out and prices for the new season set. This industry was very profitable (In17) and although based on pasture involved more supplement than traditional factory supply grass based systems. Informant 17 felt that the town supply producers held back the development of a factory supply industry in Canterbury as they had successfully convinced the rest of the industry that dairying must operate on heavy soils due to limited irrigation, and with intensive systems. Besides the 'dairy immigrants', the move of several key town supply farmers to lighter land and seasonal supply was instrumental in the eventual growth of the present industry (In17). The town milk industry was deregulated in 1988. Fluid milk is now sourced from what was previously known as factory supply farms for most of the year. Over the winter months, a small number of farmers are contracted to provide liquid milk for domestic consumption.

In the late 1970s, the factory supply cooperative at Temuka borrowed heavily to build a Parmesan cheese plant, but on completion it was only 40% full (In9). A board member was dispatched to the Rural Bank (RB) in Wellington to negotiate 3% loans for cow purchases to increase production in Canterbury[38]. The Temuka and Tai Tapu cooperatives merged to form Alpine Dairy Products in 1987. The company had product quality issues and low levels of equity, estimated by several sources at 6% (In21, In3 and In4). By the early 1990s the Alpine company was growing at a rate of 40% per year. A number of informants identified the development of Alpine as crucial to the growth of the Canterbury industry (In20, In13, In21, In3 and In6). The company developed many innovative programmes to deal with growth (processing and financial), product quality and environmental contamination. Growth could only continue through farmers contributing additional capital (In11). Several sources commented that the need to buy shares and changing company policies caused cash flow problems for farmers (In4, In5 and In1). However, the development of Alpine

[38] The head of the Rural Bank said that Canterbury would never be a dairy area because it had the highest level of diploma and degree holders in the country and they had too good a lifestyle to become dairy farmers (I6).

created a more robust industry that attained credibility with the wider industry (In20). The survival and success of Alpine is reported in the next chapter.

During the 1990s there were a number of mergers within the New Zealand dairy industry. Alpine merged with the Southland Cooperative Dairy Company in 1998 and the North Island based New Zealand Dairy Group (NZDG) in 1999. Nearly all sources identified the mergers as being a positive factor in the growth of the Canterbury industry. The merger with NZDG gave Canterbury producers the higher milk prices received by North Island producers (In20). A number of sources indicated that the mergers increased the value of farms in Canterbury (In3, In19, In13 and In4).

The merger of the New Zealand Dairy Board, NZDG and Kiwi formed Fonterra in 2001. Informant 3 felt that this had given dairy farmers an advantage over other agricultural industries through the ability to work at scale. Putting Fonterra together took at least five years, with several approaches to government to gain approval (In14, In21). Although Fonterra's performance received criticism from some sources (In2, In7), most informants felt that performance had improved and that a large marketer of dairy products was important for farmer's incomes (In7, In13, In4, In12, In3 and In21). The sources who criticised Fonterra commented that it was an improvement on the NZDB which was 'top heavy' and cost the industry millions in bureaucracy. Informant 18 mentioned that Fonterra, as a cooperative, has an advantage in securing suppliers as farmers feel vulnerable if they do not have control of processing.

In summary, the past and present industry structure has been important for the growth of the Canterbury dairy industry. Informant 12 stressed the importance of being able to sell every litre of milk produced, a concept that is not universal in other dairy industries. In the case of the Canterbury industry, the creation of production backed shares allowed the industry to grow. Mergers led to better prices thus increasing the values of farms and making them more financeable (In17). A number of respondents suggested that the single seller concept of the NZDB and the market dominance of Fonterra have been important (In12, In4, In14). Informant 12 felt that the growth of the industry would not have been as fast if all of the processors had been proprietary companies. Informant 19 commented an advantage of the dairy industry is the free sharing of information. He added that all members have been treated equally with no special arrangements for large suppliers as happened in the meat industry. Finally, leadership has been important (In6). The industry has a strong link between farmers and directors, with significant pressure put on directors to perform (In18).

7.3.2 Entrepreneurs

Several early converters gave a variety of reasons for choosing to farm in Canterbury. Some (In21, In4, In10) said that they first thought of Canterbury after reading articles about farmer/entrepreneurs like Don MacDonald[39] in the *Dairy Exporter*.[40] Another (In13) visited an early converter while a student at Lincoln University. Informant 10 said that for him it was the challenge of farming in a new area. A number admitted that they did not analyse the opportunity as deeply as they would now, often doing simple budgets (In13, In10) and even entering into purchase agreements written on the backs of envelopes (In3). Two converters (In13, In8) purchased in areas where there were no dairy farms as they felt there were larger capital gains available and fewer prospective purchasers. In the end they were all after the same thing - cheap land and water (In14) or, as In8 said, he moved to a new area to get “size, scale and the opportunity for growth”.

Informant 11, who was originally from the town supply industry; suggested that the ‘light land’ dairy farmers in the late 1970s and early 1980s were only “experimenters”, but that by the 1990s it was accepted that you could successfully milk cows on this land type in Canterbury.

Early growth and development was a “rocky road with not particularly good cash flows” said In3. Looking back at the early converters, In1 suggested that they took significant risk, “Not only did they have to build their own business, but they also had to grow their processing cooperative and often worked without traditional

[39] Don MacDonald was an early farmer who moved from the North Island to Canterbury. He purchased 148 hectares (80 hectares irrigated) for $185,000 in 1976 (NZ Dairy Exporter, November 1978 pp. 12-13).

[40] The NZ Dairy Exporter is a leading periodical for the dairy industry. Founded in 1925, the Exporter was formerly owned by the NZ Dairy Board. It was sold to NZX Agri a subsidiary of the New Zealand Stock Exchange in 2009.

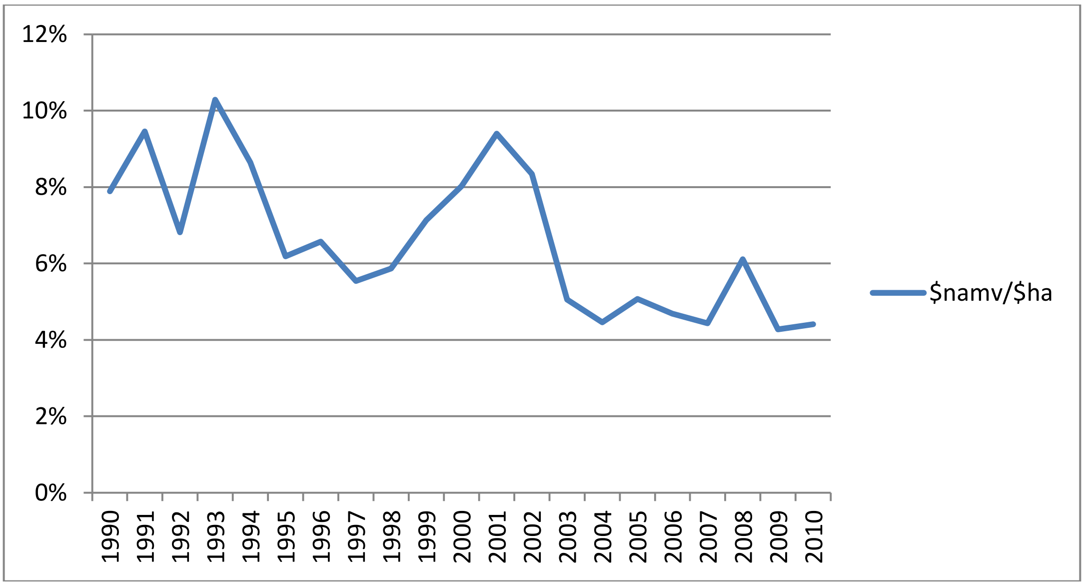
infrastructural support". An example of the risks undertaken came from In8 who drilled a well in a new area not knowing whether he would find water. Farmers were "willing to take short term losses if they felt that they could cover them later", said In10.

Informants 4 and 5 felt that the early converters who stayed in the industry have achieved the highest gains - although some converted and sold to make a quick profit (In4). However, they added that a significant number struggled to cope with leaving family in the North Island, dealing with labour, the financial restructuring of the New Zealand economy and the effects of drought and poor irrigation systems. A number of these farmers eventually sold and left the industry. Informant 2 said that contrary to popular belief, the dairy industry has never been "a licence to print money", but has constantly demanded new investment in either the processing companies or on farm. Informant 4 commented that dairying is an ideal business to set up and let someone else run, either through managers or sharemilkers. Many of the early converters have moved into other pursuits such as industry governance, consulting or other businesses (In4).

As well as farmers who converted land to dairying, there was also an influx of sharemilkers. Many of the early sharemilkers who moved to the province in the 1990s were very concerned with wealth creation (In20).

Another entrepreneurial trait exhibited by the early converters was continuous adjustments to their systems. Many initially tried to adopt North Island systems of being self-contained with minimal supplementation. However they learned that there was more profit to be made in using the farm as a milking platform and grazing stock off the farm when appropriate. Some tried utilising the by-products of other farming systems and most were constantly looking at labour saving technologies (In4, In3).

Informant 13 said that many of the first conversions used less than ideal pasture renovation systems (triple disked, 90 kilograms of superphosphate and ryegrass drilled into existing brown top). Early conversions were short on fertiliser due to the shortage of development funds (In3, In6, In12 and In14). In 1993, In2 converted 128 ha for $437,743---$125,486 for shares, $204,280 for the shed, $29,182 for laneways and the balance for stock water and power (2010 dollars[41]). He added that his 50-50 sharemilker spent the same amount to purchase his cows. If he were to convert today, he estimated that the conversion would cost $2.5 million (eight times more expensive), but the sharemilker would only spend $600,000 (two times more expensive). The difference in conversion costs is partially due to the standard of conversion that is expected (rotary cowsheds, pivot irrigation). Figure 7.1 confirms that the relative cost of a herd has decreased compared to land when comparing the national average market value (NAMV) of a Friesian cow as a percentage of land prices.



Source: derived from LIC and IRD statistics 2010

Figure 7.1 National Average Market Value (NAMV) of a Friesian cow as a percentage of land values in Canterbury from 1988 to 2010 (real 2010)

Although the later converters of the 1990s strived to keep the costs of their conversions low, they demolished existing structures, shelter and fencing and the farms were developed to suit irrigation and cowsheds (In13, In14 and In4). Most sources felt that this was a vastly improved method for converting a farm to dairying compared to the methods of the 1980s converters.

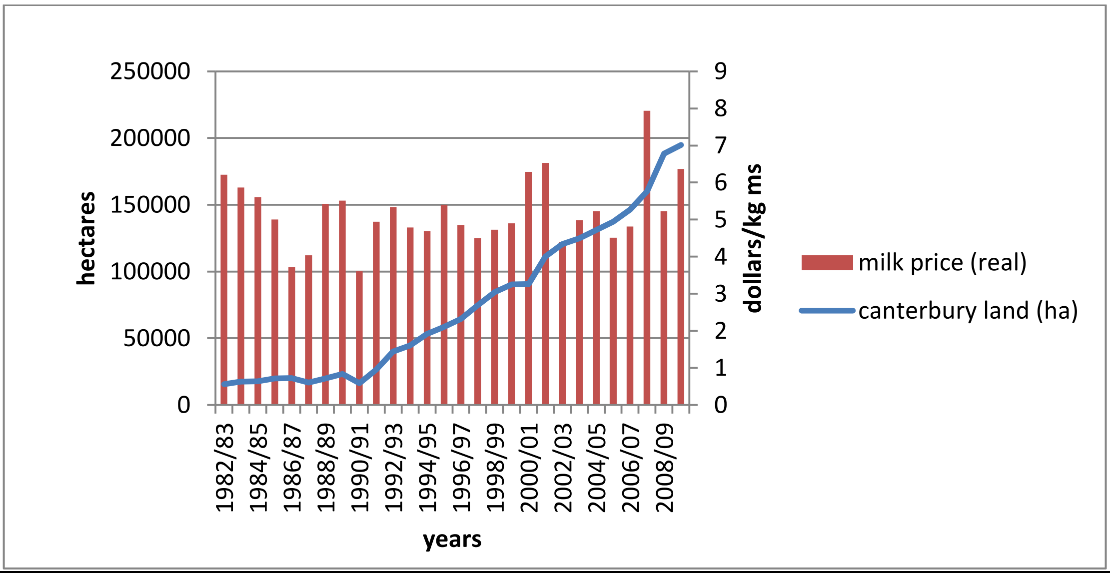
With the later converters (late 1990s and 2000s), there were fewer true entrepreneurs involved as the converters were generally existing farmers changing farming systems

[41]Calculated using NZ Reserve bank inflation calculator

or established farmers expanding their operations. With the relaxed financial standards of the banking industry, they were able to source finance more easily and hire conversion specialists to oversee the process (In13).

Most of the early informants have expanded their businesses over the years and a considerable number admitted that they were currently looking to purchase additional farms (In14, In3, In8, In1 and In6). One informant (In15) suggested that the re-development of farms to incorporate pivot irrigation has boosted early converters enthusiasm to farm.

Although the increasing milk prices might be seen as a major incentive to the growth in dairying, Figure 7.2 shows that there is not a clear positive relationship between milk price and the growth in hectares involved in dairy farming in Canterbury. Thus it would appear that the entrepreneurs grew their businesses to capture the entrepreneurial profits as detailed in Chapter 3, or for the reasons suggested by Schumpeter (1961, pp. 92-93) in Chapter 4.



Source: derived from LIC and Quotable Value NZ data.

Figure 7.2 Relationship of milksolids payout (constant value dollars 2010) and hectares in dairy farming in Canterbury

7.3.3 Extension

When considering how they learned about new technology or innovations, the informants generally identified the positive input of consultants (private and industry consulting officers) and the effect of the Lincoln University Demonstration Farm (LUDF) after it was established in 2001. Informant 7 (with substantial holdings in both the arable and dairy industries) felt that an advantage of the New Zealand dairy industry is the high level of "home grown technology" available in New Zealand, whereas other farming systems such as the arable sector rely on research from Europe.

The LUDF was established as a demonstration farm and has been particularly successful in demonstrating grazing management techniques (to the point of changing the industry in the opinion of In15). According to In16 it was important that the concept of the LUDF was encouraged by successful farmers. He added that the farm has also been important in performing research on the environmental effects of dairying. A number of respondents stated that the farm had been exceptional in providing Canterbury grazing management information, stressing the importance of farm monitoring and in examining profit (In1, In15, In20, In17, and In10). Informant 15 felt that the profits achieved by the farm were undersold, as he claimed it is probably the only farm in New Zealand producing over 1,600 kg milksolids/ha with little supplementary feeding. Consultants have been important in spreading the messages from the LUDF (In14). However, In20 mentioned that the LUDF focus on grazing residuals and monitoring were pioneered at the Ruakura Agricultural Research Centre[42] many years earlier.

A number of sources (In4, In17 and In6) indicated that private consultants have been important to the growth of the industry. In the opinion of In17, traditional extension providers were slow to come to the South Island and that growth would have been slower without private consultants. There were no specifically private dairy consultants in mid Canterbury until 1989 (In20). Informant In6 felt that specialised dairy consultants have been more important than the general consultants who were

[42] The Ruakura Agriculture Research Centre in Hamilton, NZ has been a leading agricultural and life sciences research centre for over 50 years.

available when growth was initiated; the existing consultants did not understand dairying and in his opinion did not support the development of the industry.

For many early converters the only consultants available were the Consulting Officers provided without charge by the Livestock Improvement Corporation (LIC). However since their main area of activity was in organizing discussion groups, they seldom had time for individual consultations. A number of sources indicated the value of discussion groups (In13, In8, In4 and In6). Informant 8 commented that there was more help and guidance from other farmers in the early days than is prevalent now. Another early converter (In13) commented that the discussion groups were the highlight of his month and the source of a great deal of information—mostly learned from each other. Informant 15 felt that the dairy industry has a strong succession ethic, dairy farmers believe in training the next generation and giving them a chance.

One early discussion group hired a plane each year and travelled to the North Island to look at farms (In6). When dairying started to grow, with the help of Ruakura scientists they established monitoring programmes for the group on several new conversions. Informant 16 commented that discussion groups and demonstration farms were appropriate learning tools for farmers as farmers are very good at assessing a technology and fitting it into their system. He felt that often they were not too worried about the economics, if the technology met other goals.

A number of professionals working in the industry were given credit for seeing the potential of Canterbury for dairying and promoting its development. These included Ruakura scientist, D. Clayton, Northland consulting officer, H. Kirton, and Lincoln University dairy lecturers, M. Hollard and T. Hughes.

In the early development of the industry many problems arose. Informant 17 (himself a scientist) felt that most problems were solved by farmers, consultants and their tradesmen, as the existing providers of research did not become interested in the

Canterbury dairy industry until “late in the piece”.[43] Informant 16 commented that one of the major research providers was not interested in being a partner in the LUDF because they could not see the emergence of a quick technology that they could sell.

7.3.4 International markets

The Uruguay round of the World Trade Organization (WTO) negotiations was important to New Zealand as it placed limitations on the export subsidies provided by the European Union. Informant 7 felt that the Uruguay round was particularly good for dairy, but bad for arable farming. However, it was the best thing to happen to New Zealand agriculture from an overall trade standpoint. Two sources (In7 and In12) commented that New Zealand governments have done well in trade negotiations having worked to remove distortions and have been able to place representatives in key positions within the World Trade Organization[44].

7.3.5 Government

The New Zealand government was not considered to have had a large effect on the growth of the industry by most sources. However, government sponsored projects such as irrigation infrastructure was eventually important to the dairy industry (In12). Additionally, the government formed the New Zealand Dairy Board, which at least one informant (In12) thought was important for the development of the industry.

A number mentioned that the economic restructuring of the mid-1980s was good for agriculture, as it changed the psyche of farmers away from farming for subsidies to farming for profit (In3, In11, In14 and In13). Informant 11 gave credit to two Ministers of Finance (Douglas and Richardson) for opening up the economy, introducing more fiscal responsibility and reforming the labour market. One source felt that the lack of a capital gains tax in New Zealand has been important for the growth of the industry (In4).

A number considered the government generally sympathetic to farmers (In12, In11 and In7). An example of government support was mentioned by In13 in regard to the

[43] However, evidence of some limited involvement at an earlier stage is provided by Rowarth et al. (2006).

[44] The World Trade Organization (WTO) is an organization that intends to supervise and liberalise world trade.

government allowing the dairy industry to by-pass the Commerce Commission to form Fonterra. Informant 11 commented that government policies needed to be good for agriculture, but not necessarily good for individual farmers.

At the local level there were concerns that government driven compliance issues surrounding effluent and animal welfare were a problem for dairy farmers (In4, In9, In7 and In14). Policies like river conservation orders have added complications to the operation of some surface water based schemes (In13). Due to their responsibility for managing the environment, Environment Canterbury (Ecan) can have a positive or negative effect on farmers' business growth. Many sources felt that Ecan had not stopped growth, but had certainly slowed it down in the past five years through moratoriums on issuing water rights and increased compliance costs (In9, In10, In12, In2 and In17). Informant 8 mentioned that Ecan did not affect him any more than it should, however, at times it has attempted to impose goals through "bullying" the farming community rather than through consultation. An informant (In15) who deals with a number of councils felt that Ecan has not necessarily been negative and, in fact, he considered Ecan the best regional council with which he deals.

7.3.6 Lack of profit in other sectors

Canterbury was traditionally dominated by sheep and crop farming (often grain and clover for seed). As wool and wheat prices began to decline in the early 1980s (see Figure 6.2), the government further increased subsidies for sheep farmers. This allowed sheep farmers to continue to farm profitability on dry land, which, along with poor irrigation technology, limited the adoption of irrigation (In9). However, a series of droughts and better technology (delivery systems and deep wells) encouraged the development of irrigation, which changed the pattern of land use (In8). Informant 11 commented that by 1990 "farmers could see that the government wasn't going to help them out and some could see that the future of sheep and cropping farming did not look that good".

This was confirmed by other informants, with most citing lack of profitability in other industries as a major reason for dairy industry growth. Informants 19 and 2 moved from the meat industry due to price volatility. Informant 7 has converted a large portion of his cropping operation to dairying and commented that New Zealand crop farmers are “amongst the highest paid in the world and always complaining whereas dairy farmers have traditionally been amongst the lowest paid, but happy”. He also felt that dairy farming is more environmentally sustainable than cropping because of lower chemical use and that pasture is better for soil carbon and organic matter levels.

According to Informant 9, dairy farmers only use 10% of the chemicals used by cropping farms. Informants 7 and 9 felt that crop farmers could convert to dairying easily as it is a simpler system to operate than cropping. However, other sources (In3, In8) stated that for some crop farmers the change was difficult due to the need to manage the additional labour required in dairying.

Several other advantages of dairying were mentioned. These included: increased profitability in dairying due to the formation of Fonterra (In13), the feeling that a downturn in the dairy industry was never as long or as severe as in other farming systems (In3) and that “once the milk is in the vat, the marketing is over as compared to cropping where there are a lot of middlemen” (In7).

Informant 15 observed that New Zealand meat farmers have allowed the processors to dictate the farming system so that they can keep their plants full. In other words, farmers have adopted expensive systems to finish lambs to heavier weights for ‘out of season slaughter’. Dairy farmers produce at the optimum time for economic production with the processing plants operating often at less than full capacity.

7.3.7 Innovation and technology

The development of new irrigation technologies was rated as significant by all informants. For the industry to move to Canterbury, it first needed to be accepted that cows would not destroy the border dykes[45] already in place (In17). In addition the irrigation, which started with the Rangitata Diversion Race (RDR) and borderdykes, had to move from ‘sheets and frames’[46] in the 1960s, to gates and clocks in the 1970s and laser levelling in the 1990s (In9). Informant 11 spoke of “green droughts” where

[45] Borderdyke irrigation is a flood type system, where water is channeled down a ‘border’ between earthen ‘dykes’. The system relies on gravity flow and the contouring of land to provide ‘fall’.
[46] Early borderdyke systems involved the placement of movable frames with canvas sheets attached within the water delivery race to direct water. This time consuming process was replaced by permanent concrete dams and metal gates in the 1970s using modified alarm clocks to deploy the gates in sequence.

the pastures were green but not growing due to long rotations (up to 17 days) under the initial borderdyke systems.

Equally important was the development in New Zealand of deep well drilling capabilities (In22). This allowed new areas that were not serviced by surface water to be developed (In20). Along with deep wells was the development of the Brigg's rotorainer, a simple and reliable machine that could handle Canterbury conditions and for which parts could be purchased locally (In1, In17 and In20). Informant 20 commented that the development of wells and rotorainers were more important than the move from borderdykes to pivots, as it allowed more land to be converted to dairying through the development of the underground water resource.

Centre pivot irrigation has been a major innovation, using less water and growing more grass (In7). A change that has accompanied pivots on many farms on the RDR scheme in mid Canterbury has been 'on-farm' storage. Originally, farms were only allocated 5/8 of the theoretical requirement of the farm because most farms had some pastures for grazing and seed production and other areas in crop (In9). By carefully organizing their farming rotations, the water could be allocated to the species needing water and, thus, more farmers could take advantage of the limited resource. Although this worked well for sheep/cropping, the allocated water was insufficient for borderdyked dairy pastures. The adoption of storage and pivots has increased the water available for pastoral farming. Informant 9 commented that pivots were not new with the first being installed in 1986, but they were unreliable and the early models were often found parked "along a hedge" after a few years. Farmers have invested heavily over the years upgrading their systems to better technology (In9). Other innovations have been more reliable power supplies, improved underground piping and submersible pumps (In17).

Several informants felt that the development of larger, more reliable rotary cowsheds was important for industry growth (In20, In17 and In4). However, one older farmer felt that the 36 aside herringbone was important as it was cheaper to construct, but still big enough to milk herds up to 500 cows (In6). Shed technologies have also advanced with in-shed meal feeding, automatic drafting, automatic teat spraying and cup removers (In4, In20 and In13). However, several sources spoke of failures with some of these devices (In12, In10). Improvements to the machinery used on farms were mentioned by In4 and included four-wheel motorbikes and geared electric fence reels. The importance of re-grassing paddocks was stressed by In14 and In4. New grass along with urea has allowed for increased production and is necessary if farmers are to adopt the low grazing residuals espoused by the Lincoln University Dairy Farm (In14). Other improvements include pasture monitoring with plate metres, software for the analysis of feed supply/demand and other software for financial and production monitoring (In12).

The practice of baling and wrapping silage (baleage), allowed for ease of storage and transport. With baleage becoming a traded commodity, it was increasingly used to fill feed deficits at the beginning and end of the season (In20, In12). Being able to better manage the ‘shoulders of the season’, allowed more days in milk and higher stocking rates (In12). An old technology that has been rapidly adopted in the past 10 years is grain feeding in the milking shed (In20). This technique is particularly prevalent among late converters, many of whom still own grain producing land.

Although a number of the innovations identified by informants were important, their availability was not restricted to Canterbury so they did not provide Canterbury farmers with a competitive advantage compared to other New Zealand dairying areas. However, they did provide an advantage relative to other land uses in the region.

Innovation was also necessary in developing farming systems to handle the new industry. Learning to manage large herds and the people operating large farms has been important (In14, In13). One multiple farm operation found a human capability shortage, so the company developed simple, low cost systems which maximise pasture utilisation (In15). In their opinion the use of significant levels of supplements makes the management of pasture more difficult. Farm layouts and design have been an innovation that has made larger herds feasible (In7). Informant 17 mentioned that initially milking sheds were located close to roads, but later converters (particularly the corporates) located sheds in the middle of farms which was more convenient for cows and staff. New products have been found for the surfaces of walking tracks and methods of fencing have changed to suit centre pivot irrigators (In17). Some farms have moved to once-a-day milking (OAD) to provide a more sustainable system (In13).

Increased nutrient monitoring to reduce fertiliser usage and manage effluent application has been important (In14). When converting a new farm, In14 designs disposal systems to apply effluent to as much of the farm as possible. A perceived problem with dairying is the leaching of nitrogen from cow urine into ground water; however, In12 and In*7* felt that nitrification inhibitors can be used to manage the problem.

Informant In16 stated that innovations have worked well in Canterbury due to the calibre of people involved in the industry and their ambitions and motivations - strategic investors and corporates have been important. He added that the industry's farmers set goals and have good governance structures.

7.3.8 Economic conditions and incentives

Prior to the economic restructuring of the mid-1980s the New Zealand economy was very controlled with import restrictions, tariffs, a managed currency and increased subsidies to sheep farmers. Informant 11 referred to the period as "the worst of government planning, as sheep/crop farmers had no reason to change and became locked in to their system". He also suggested that the producer boards operating at the time were a hindrance.

With the restructuring, land prices fell by 66% in the late 1980s (In9). This drop attracted farmers in good financial position to expand and the first large scale dairy farmers appeared. With improvements in dairy prices, and company mergers during the 1990s, dairy land values increased, which allowed borrowing against the capital gain and further expansion (In3).

Increased land prices in the North Island in the early 1990s led North Islanders to move south in search of cheaper land and bigger farms. This helped existing sheep and crop farmers to sell. Informant 11 felt that Canterbury has been a story of cash inflows from the North Island and overseas. Informant 16 suggested that capital gains of 9% and operating returns of 4% per annum for the past 15 years had been drivers of growth. Although not mentioned by informants, the lack of a capital gains tax in New Zealand may have provided an incentive to farmers to purchase and develop land.

With the formation of Fonterra, some farmers expanded production due to a desire to purchase Fonterra Fair Value Shares (In22). Since one share was needed for each kg of milksolids production, expanding farms needed to buy additional shares. At that time shares could only be held in proportion to patronage. Some farmers who were planning to expand, increased production early to buy ‘lower priced’ shares while others saw the shares as an investment and increased production to acquire more shares (In22). The shares were initially offered at $3 and for some farmers became an investment option as the value increased to $6.70 over a number of years, before being ‘frozen’ at $4.52 by Fonterra in 2009.

7.3.9 Chance events

None of the sources identified any chance events[47] that increased industry growth. However, events that slowed growth were identified. A number of informants (In4, In11, In17 and In20) suggested that the discovery of high levels of the metabolite of the pesticide DDT in dairy products in the late 1980s constrained growth for a number of years (see Chapter 8). The development and application of mitigation techniques coincided with the sudden growth of the industry in 1993 as shown in Figure 1.1.

Informant 11 felt that several events had significant effects on New Zealand and, thus, the development of the dairy industry. The first was the rapid rise in oil prices which began in the 1970s. This caused inflation and economic problems for an oil importing nation. The second shock was the restructuring of the New Zealand economy in the mid-1980s and removal of government subsidies to agriculture. These events changed the New Zealand economy and ‘set the scene’ for a change in land use. For some early converters the timing of the restructuring increased the difficulty of getting their conversions fully operational. As an example, In10 was left in a

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[47] Chance events can include acts of invention, major technical changes such as biotechnology, volatility in input costs such as oil price shocks, shifts in world financial markets or exchange rates, surges in world or regional demand, political decisions by foreign governments or wars (Porter 1990, pp. 124-126).

vulnerable position at the time of the restructuring because the Ministry of Works took four years to complete his irrigation development.

7.3.10 Existing infrastructure

There was a difference of opinion among informants on the infrastructure available to support the developing industry. A number of early converters (In21, In3 and In12) spoke of being frustrated when trying to source basic dairy farming necessities like calf rearing supplies. One even took a list of needs to a supplier so they knew what to order for dairy farmers in the future (In3). However, a number of other sources felt that the supply of inputs was adequate (In4, In5 and In10). Later converters did not report having problems with finding inputs (In19, In7).

Several sources mentioned a lack of competition, particularly among companies installing milking machinery (In12, In17). Two converters felt that the veterinarians took some time to adapt their skills to dairy cows (In3, In10) and In3 surprised the fertiliser spreading companies with the amount of fertiliser he would apply at any one time. Informant 1 mentioned that one input supplier in a new dairying area always shut during the lunch hour; however, this had to change with the influx of dairy farmers who often rushed to town for supplies over this period.

Perhaps the support industry having the most influence on the development of the industry was banking (positive and negative). A number of informants stated that banks and other financial institutions had been cyclical in their approach to both the industry and irrigation development (In9, In4 and In5). Initially, the difficulty in obtaining finance could be attributed to a lack of industry history in the province, an outbreak of salmonella in one of the processing plants in 1986 and the economic restructuring placing some ‘pioneers’ in a poor financial position due to declining land values (In17). He also commented that if one of the high profile early converters had been placed in bankruptcy in the late 1980s, the growth of the industry would have stopped for a number of years. An early converter was refused finance by the Rural Bank to expand from 90 cows in 1981 because they milked Jerseys (considered unable to withstand cold temperatures) in an area without a dairying background and he was “too young” and his father “too old”, even though they had very little debt (In12). Eventually, they were able to obtain funds from an insurance company.

Shortly before the economic restructuring in the mid-1980s there was a government imposed interest rate freeze which made borrowing money difficult. Consequently, both In4 and In11 required vendor finance when they bought their farms.

The conservatism of the Rural Bank was shown in the case of In13 who had an application refused that year, even though he had $150,000 in cash and 300 cows to buy a farm priced at $350,000. He appealed the decision and eventually received a 6½% fixed rate loan (three years); this loan and fixed interest rate was very important to his success (In13). Although having trouble securing their first loan, a number of sources (In13, In5 and In3) were within two years; able to easily obtain finance to buy additional properties.

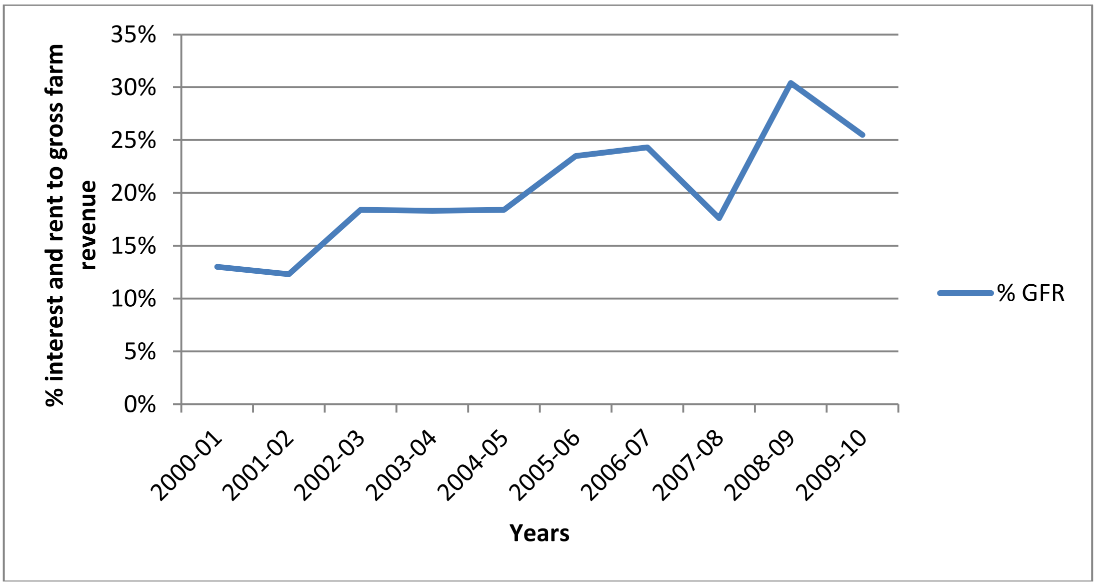
Problems in sourcing finance for the first converters resulted in conversions being completed slowly and often to a poor standard. Informant 12 mentioned that it took 10 years to reach their initial targets because he had to develop using cash flow surpluses rather than borrowings.

By the 1990s, finance became less of a problem with nearly all respondents reporting little problem in securing funds. Informant 22 felt that the banks could see a declining sheep and cropping sector and an opportunity for business growth in the dairy industry. This coincided with the advent of corporate farms that raised capital in the equity markets (In15).

Informant 8 felt that timing was important for the purchase, conversion and/or expansion in the mid-1990s. The profits derived at the end of the 1990s, along with increases in farm values due to industry mergers, gave farmers increased equity which some leveraged in the new century (In15).

By the end of the 1990s and up to 2008, all respondents stated that finance had been easy. Informant 19 noted that in 2001 he was able to purchase his farm with 100% bank finance, with only cattle and a leveraged support block for additional security. This period coincided with increased milk prices and dairy expansion became an expanding source of business for banks (In16). In addition, other institutions (finance companies) entered into agricultural lending, often in second mortgage positions at higher than base market interest rates (In20). This was partially fuelled by rapidly increasing land values (see Figure 6.3). In the words of In7, “dairying became a very bankable industry”.

The increased number of banks and increased competition for farm lending was a contributing factor to liberal lending policies. A banker told In14 that they were forced to make loans outside their credit criteria; otherwise they would lose the customer to another bank. Additionally, the secondary source of funds from finance companies allowed farmers to borrow larger amounts than were historically available. According to In8, many farmers got into trouble by “borrowing for their wants versus their needs”. Informant 14 added that “a number of young farmers over the preceding three years have been wrecked by excessive borrowing”. He stated that the banks had broken their own rules in lending more than 50% of asset values, with the finance companies compounding the problem. Figure 7.3 details the increase in debt servicing levels for New Zealand dairy farmers since 2000-01.



Source: DairyNZ 2010

Figure 7.3 Debt service as a percentage of gross farm revenue for NZ dairy farmers from 2000-01 to 2009-10

7.3.11 New infrastructure developed

As the industry developed, a number of businesses such as electricians, plumbers, engineers, fertiliser spreading and trucking companies, have grown their businesses in association with the dairy farmers (In8, In13 and In17). Cooperatives have been important for the provision of nearly all input supplies, particularly fertiliser where two large, very competitive cooperatives dominate the market (In15, In14).

7.4 Additional factors impacting on industry growth

As the interviews developed, a number of new conditions were proposed by the interviewees. These additional factors are presented in this section.

7.4.1 New resource developed - Irrigation

The informants were unanimous that the growth in dairying would not have occurred without the development of a new resource, in this case irrigation[48]. Recent statistics on irrigation are provided by Rajanayaka, et al. (2010). The greatest use of total water consumption at 75% is for irrigation. Canterbury has 33% of the weekly national water consumption allocation. Canterbury accounts for 63% of the consented irrigated area (680,128 ha), an increase of 70% since 1999. Irrigation uses 88% of the weekly consumption in Canterbury. Of the consented seasonal allocation for irrigation in Canterbury, 58% is from surface water (997 consents) and 42% from ground water (4425 consents); there are 590,202 hectares consented for pasture, 31,358 hectares for arable and 53,089 hectares for horticulture. However, it is estimated by Rajanayaka et al. (ibid) that the actual annual use for irrigation as a percentage of consented volume in Canterbury is 57%.

Cameron (2009, p. 6) describes the need for irrigation in Canterbury. "The Southern Alps have a major effect on the wind ferocity and moisture content of the prevailing westerly winds. As the winds flow up and over the mountains they lose their moisture

[48] At the 1978 NZ Irrigation Association Conference, historian H. A. Morton of the University of Otago presented a historical perspective on the effects of irrigation:
"Throughout history, irrigation economics, if on a large scale, have forced the creation or strengthened the powers of central government and often became a bureaucratic maze. In some cases it involved the development of new systems to solve problems of title and boundaries and thus new mathematical systems. However most of the problems have surrounded the adjustment to growth both in production and in population which arise from a stable production and income base". Looking towards increased irrigation in Canterbury he suggested that " there would be subtle changes in society which one can confidently forecast will arise directly because of irrigation's effects on the individual farmer's psychology and only indirectly because of its effect on the area's production. To put it briefly, security of mind breeds different men than does risk. Different men create societies which differ".

and become very strong and exceedingly dry. Humidity of 20% is common and rapidly removes further moisture from the soil". Prior to the development of irrigation, farming was conservative with low stocking rates, low value drought tolerant crops and contingency plans for droughts. Farmers carried large amounts of conserved feeds, were prepared to sell stock at 'fire-sale' prices and buy grazing or feed often at very high prices (ibid, p. 79).

The first major irrigation project was the Rangitata Diversion Race (RDR) scheme started by the government during the economic depression of the late 1930s, becoming operational in 1944. In 2010, it provided water to 64,000 hectares in mid Canterbury. Although a number of schemes were proposed over the years, only a few became a reality. Research conducted in the 1960s by Lincoln University, showed that there was no increase in profitability from irrigation if farmers used this new resource in traditional sheep farming systems (Stewart, 1963). Initially, irrigation was used for drought proofing, rather than to increase production (Nuthall, pers. comm. 2011).[49] Engelbrecht (2011, p. 17) has commented that the benefits of irrigation in the early years were likely to be greater for the farm servicing and wider business sector than for individual farms. This is due to the need to change production systems and the additional debt acquired. "With the significant increases in debt required to fund the more modern irrigation technology, the payback period can be many years and is frequently inter-generational" (ibid).

More recent community schemes included the Amuri (first water supplied in 1980, with considerable government subsidies) and the Opuha Dam in South Canterbury (commissioned in 1998, with major funding from farmers) [50]. Extensive development

[49] Peter Nuthall is an Associate Professor in the Agriculture Management Group of Lincoln University. He worked on the research reported by Stewart (1963).

[50] Cameron (2009, p. 32) described a proposed government scheme in 1956 to irrigate from the Rakaia River at a cost of 27.5 pounds per acre. Although 75% of farmers voted for the proposal, this was only 60% of the land area. Cameron (ibid) proposed the following reasons that the scheme vote was lost:

1) farmers lacked the confidence or desire to adopt the vastly new technology;
2) concern about the perceived economics of irrigation, coupled with the apparent high cost of the scheme;
3) large land owners were probably financially well off and enjoying an easy lifestyle and thus did not have the economic need that smaller farmers may have felt;
4) fears about an increase in weed, foot rot, worms and poorer wool quality;
5) opposition from Corriedale sheep breeders who felt that irrigation would result in a change in sheep breeds.

of underground water sources commenced in the 1990s as a consequence of improved deep well and submersible pump technology.

Although one informant felt that early irrigators received little incentive from government (In9), there were examples of government funding through the RDR and Amuri Schemes. Informant 2 was part of a government scheme in the late 1970s that had support from the Ministry of Works, the Ministry of Agriculture and the Rural Bank. Headworks for the schemes were half funded by a government grant and half by a loan to be repaid by water charges. On-farm work was half paid by the government and half financed by a suspensory loan[51] to the farmer. Informant 2 quoted his father saying, “look if the government is dishing out money you’ve got to be in and you’ve got to be in pronto. You mark my words someone is going to find out about how good this is and there will be a bloody outcry in the papers and that will be the end of it.”

The Rakaia Conservation Order[52] was important to the development of irrigation according to In18. He added that the order was the conservationist’s first achievement and led to the Ministry of Works withdrawing from large scale public irrigation schemes and limitations placed on future abstractions. Before the conservation order there was no need for storage, as rivers were reliable on a ‘run of river’ basis. A catalyst for change in water demand came with the droughts of the late 1980s and people looking for water to remain financially viable. “People with 200 ha were going nowhere farming dry land systems” said In18; “farmer research by Cameron and others proved you could pump deep water” he added. Informant 18 added that “with the restrictions on the rivers, farmers started looking to groundwater for irrigation - the important part was that the development of wells was under their control not government, so the development could be done in a short period of time. Permits were easy to get and banks would finance development, which lead to a short gestation period. Without the conservation order, people would have waited for river water - so the conservation order sped up the process of irrigation development.” All development since 1990 has been private. Informant 11 spoke of the 1980s being a

[51] Suspensory loans were loans where the principal was forgiven over time by the government.
[52] In NZ a water conservation order is a legal ruling to protect aspects of water bodies. It may be to protect the quantity of water itself or for any issues relating to the water body as a whole (natural, cultural or recreational values).

nightmare for his farm due to new restrictions on river takes, however, this problem was solved in the 1990s by the creation of a community dam in his area (privately funded) that provided reliable water and growth for his business.

Informant 8 stated that the addition of irrigation to a farming system causes land use change; what is farmed is a matter of economics; therefore the growth in dairy is not really about dairying but about irrigation. In the case of Canterbury, water along with land being available led to a new economic model for dairying (In8). Informant 1 commented that due to the economic advantages of irrigated dairying, once irrigation was developed on a farm, a conversion to dairying frequently became the farm's best option. Although dairying has been the major land use change resulting from irrigation, Rowe (1982, pp. 111-115) spoke at an early irrigation conference of an expanded horticultural sector with irrigation and informant 16 suggested that in the future horticulture will supplant dairying due to the production of more food per unit of water consumed.

The increased interest in irrigated dairy farming in Canterbury in the late 1980s and 1990s was also influenced by a series of droughts in the North Island (In20). He added that "visitors to Canterbury were mesmerised by water being applied by borderdykes and they wanted it". But there were also effects on farming practices from irrigation; In5 moved to Canterbury from the West Coast of the South Island and he commented that in a dry climate with water, a farmer could maximise the response of an input - "on the Coast you could put urea on and it might get washed away or it could be ineffective due to a dry spell". Through being able to control at least one aspect of the climatic environment, dairy farmers were more likely to achieve consistent production and thus could budget more accurately and "push the envelope" in terms of acquiring debt (In11).

However, as the groundwater resource became over allocated, further abstractions were denied by the regional council Environment Canterbury (Ecan)[53]. In addition, in 2011 Ecan decreed that wells were to have seasonal allocation limits (In18). The advent of seasonal limits on groundwater has encouraged farmers to use surface water

[53] Regional councils were formed in 1989 and replaced more than 700 *ad hoc* bodies. Their primary responsibility is in environmental management.

where possible, often with the development of storage ponds. Several respondents felt that for dairy growth to continue more reliable water will be necessary which is only possible through storage (In7, In1, In18 and In15).

Although irrigation gained some momentum in the 1970s, adoption was slow until the 1990s when technology and economic changes were important (In9, In11 and In18). These initial irrigation systems often resulted in inconsistent pasture growth (In20); partly due to the schemes coming under stress from long return times and adverse climatic conditions. The development of the Briggs rotorainer made irrigation a 'once a day' job and the rotorainers were not as affected by wind as were gun irrigators.. Because of the reduced labour requirement, they were very important for the development of dairy farming (In18). Informant 5 agreed that a number of irrigation problems have been alleviated by changing to spray from borderdyke systems, with further improvements through the development of pond storage and pivots. In the Amuri scheme 65% of the 20,000 ha are now irrigated by spray irrigation rather than by the original border dykes (In10). Informant 15 estimated that the recent change to river water storage and pivots from deep wells has reduced power costs from $1200/ha to $350/ha on his properties. From an economic point of view an increase in production of 200 kg milksolids/ha pays for a pivot (In2).

An informant with New Zealand and Tasmanian interests (In14) mentioned that without irrigation in Tasmania, his company had struggled to reach 1000 kg milksolids/ha compared with much higher levels of production on irrigated New Zealand properties. North Islanders who moved to the South Island produced more milksolids per cow and per hectare with the same cows due to better feeding and having irrigation to combat droughts (In2). He added that "even a 17 day round on borderdykes was better than a drought in Taranaki".

Informant 22 suggested that there was not only a production incentive for the development of irrigation, but also since the allocation of water rights by Ecan was on a 'first come, first served' basis, farmers applied for water and expanded their operation to capture the capital gains associated with irrigated land.

7.4.2 Human reasons

For early farmers, who milked just a few cows, the reasons for dairying were quite different. Informant 12 recalls his father saying that “everyone milked a few cows to survive during the depression and WW2”. In his family’s case, his father ran the mixed cropping and sheep operation, while an unmarried sister milked 20 cows—the start of their dairy operation.

Early converters in the 1980s did not necessarily have money or business growth as their prime objective for moving to Canterbury. A number (In3, In21, In4 and In5) moved to Canterbury to get closer to schools, sporting opportunities, airports and universities. Informant 20 noted that many of the early converters were moving from difficult areas like the West Coast of the South Island or Northland. Rarely did early farmers move to Canterbury from an established dairying area like the Waikato (In20). Informant 14 felt that farmers were attracted to Canterbury due to irrigation and sunshine which allowed consistent production - “people leave Southland and the West Coast to get away from rain”. According to In9, for many later converters, changing to dairying has changed their lifestyles, adding that without the profit provided by dairying they would not have a lifestyle.

Several informants identified the Canterbury dairy development as a story about people and their hopes and aspirations (In14, In4). Early converters had to learn to deal with staff and droughts - which caused many to leave the Province (In4). In addition, most were moving away from family and support networks (In4). In a number of cases the tenure of early converters was short for these reasons. Others such as In10 listed the challenge of developing a new area as a major motivation. Informant 4 said that an attraction was being able to buy a large section of flat land and set the farm up the way he wanted, rather than buying the problems associated with a farm established many years before in different economic times and with older technologies.

The ability to develop larger farms has allowed many early converters to move into other areas of interest (In11); however, a number of early converters are still expanding (In6, In12, In8, In1 and In14). Expansion for In12 has always had the incentive of pursuing additional profits, but lifestyle objectives like re-modelling a house has led to more cows being milked at times.

Informant 6 stated that dairying has always provided an opportunity for everyone; truck drivers or factory worker's sons, could progress in the dairy industry. The cornerstone of the industry is farmers working together through industry bodies like Dairy New Zealand, Livestock Improvement or other cooperatives to grow the industry - the industry is outwardly looking for the good of all (In12). Informant 17 added that the growth in Canterbury dairying was due to astute people recognizing a business opportunity and pursuing it.

7.4.3 Ability to purchase land at a lower cost

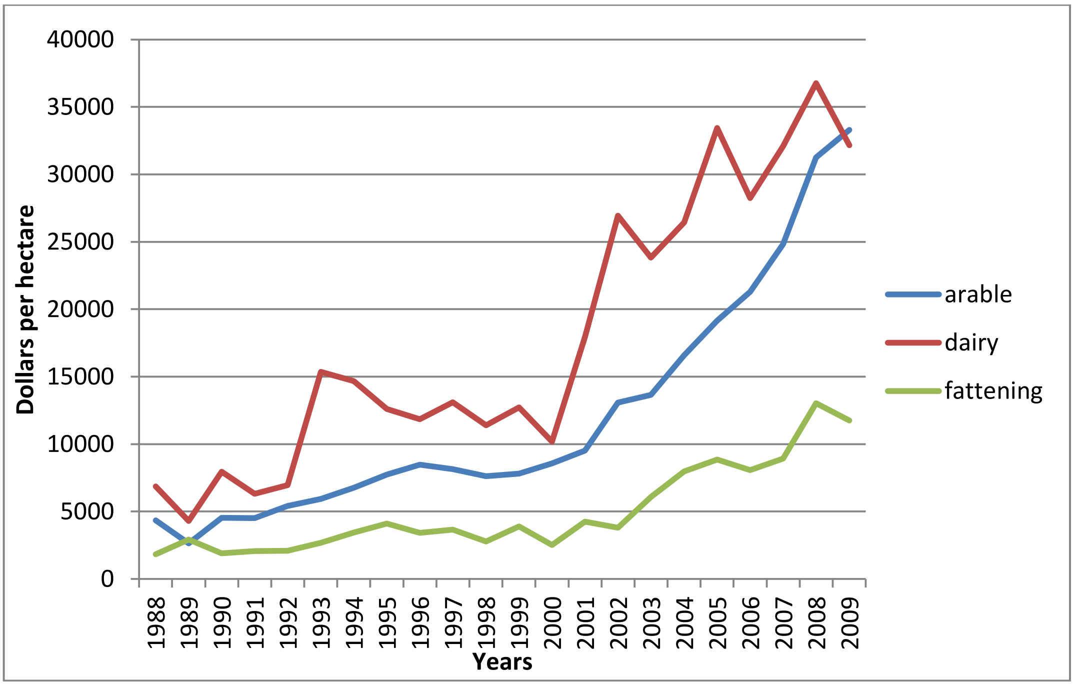
A number of informants listed the ability to buy lower priced land (In1, In14, In10, In4 and In13) as a primary motivation, with the perception expressed by some that changing land use has always been the best way to make money in New Zealand (In4, In14). Although property values declined during the New Zealand economic restructuring and briefly dropped at other points during the period under investigation (In1), they have generally trended upwards (see Figure 6.3). Informants 20 and 14 mentioned that corporates could see the profits available in buying farms and converting. However, with the haste to buy as much 'cheap' land as possible and convert quickly, a number of conversions were done very cheaply, sometimes without adequate water allocations (In1, In14).

Other farmers such as In13 purchased in Canterbury due to an inability to buy more land in his previous location. This was also the case with many of the sharemilkers who arrived from the North Island in the 1990s (In19).

Several converters had sought farms in Canterbury locations considered poor for farming, as a less desirable area meant they did not have to compete with other farmers for land (In13, In8) - their land was less attractive and thus lower priced.

Figure 7.4 compares the value of a hectare of dairy, arable or sheep fattening land over the period from 1988 to 2009 in constant value dollars (2010). The graph shows that there have been large increases in land values for all types of farming systems.

The chart confirms the informant's reports of the availability of lower priced land and that land has been a good investment. The data would suggest that there was a larger increase in value from converting from a 'fattening' property to dairy, with a much smaller increase when converting from 'arable' to dairy. It is proposed that the cropping farms which were generally on heavier soil types were providing higher levels of returns than the fattening properties which tended to be on lighter soil types (stony and sandy, with lower levels of organic matter). These differences were reflected in the land price.



Source: derived from Valuation NZ and Quotable Value NZ

Figure 7.4 Values per hectare (constant value dollars 2010) of Canterbury dairy, arable and fattening land from 1988 to 2009

7.4.4 Ability to develop large scale farms

Although the key factors of water and lower priced land were identified by all informants, the ability to develop large farms was also seen as important. Informant 4 was able to buy twice the hectares of land in Canterbury as he could in Taranaki, which allowed him to employ more labour and, eventually, sharemilkers. Large farms allowed the adoption of technologies and the ability to "work on the business rather than in the business" (In11). A large farming business allowed In13 to hire an office manager and develop better HR programmes, which greatly improved the operation of the business.

The downside of large farms was the managing of people (In1). Although all of the informants felt they had developed the skills to employ and retain labour, a number of dairy farmers have exited the Canterbury dairy industry because they did not like managing labour (In4, In5). Informant 1 stated that a certain number of those who failed in managing staff had entered the industry solely focussed on business growth.

Informant 4 mentioned that the ability to develop large farms was helped by the dry climate allowing higher stocking rates and thus larger herds with less susceptibility to pasture damage in most seasons.

7.4.5 Growth of an irrigated support industry

The lack of profitability in other farming sectors has seen traditional farmers providing services for dairy farms. Informant 6 mentioned that for each hectare used for milking cows, a hectare of support land was required. These farms graze the calves, yearlings, winter the cows, provide baleage and grow the grain. The ability to source off farm grazing and supplementary feeds has allowed the maximization of stocking rates on the dairy farm (In3, In11 and In9). Informant 10 stated that the development of this industry was very important for dairy growth. Informant 9 noted that farmers converting to dairy support have found the move to be profitable. Early converter In10 said that winter grazing was initially a problem. The attitude of existing sheep/crop farmers was that you were not a good farmer if you had cows on your property over the winter.

Informant 15 stated that many farmers were now looking to purchase support blocks rather than expanding their milk producing capacity. This is due to the high cost of converting farms and a desire to gain control of a vital part of the farming system.

7.4.6 Influence of corporate farmers

In the late 1980s, a chance meeting between a town supply dairy farmer who was moving to the factory supply industry and an investor resulted in the formation of a publicly listed company (In17). This event was quickly followed by dairy investments by another group. Over the 1990s these companies had a major effect on the dairy industry in Canterbury and Southland. Eventually the first company converted and owned 74 farms with 42,000 cows in New Zealand and 13 farms and 14,000 cows in Tasmania. The other owned 32 farms in New Zealand.

Initial conversions were completed on what had become unprofitable sheep farms in Southland and Canterbury. Canterbury farms usually had borderdyke irrigation (In14). The corporates changed the method of completing a conversion, by setting up the irrigation first and then locating the sheds, tracks and other buildings to suit the irrigation (In4, In17, In14 and In10). Previous conversions had been more piecemeal due to lack of finance, equity and experience (In4, In10). As land prices increased in Southland and mid Canterbury, the corporates moved to lower priced land in the Amuri Basin (In10, In2). Existing sheep farmers tended to sell rather than convert, as they wanted to remain sheep farmers and tended to move elsewhere (In10). By the mid-1990s the first corporate began to convert spray irrigated cropping farms, particularly in coastal areas. They found that production was higher with spray irrigation than with borderdykes (In4).

Although the corporate farmers made a significant contribution to the growth of the industry, by 2002 the price of unconverted land had risen to the point that there was no longer a profit to be made in buying farms and converting to dairying. The shareholders in the first group wanted a 10% return on investment which could not be received from farming operations (In14). Additionally, these investors were not happy that agricultural shares frequently were valued 25% lower than the market value of the assets, which was considered a reflection of the risks of farming (In14, In15). Informant 15 suggested the largest single investor needed funds and pushed for a liquidation of properties for cash flow purposes. The farms were sold and the shareholders received a profit on their investment (In14). The first group was required to offer the farms to their sharemilkers first (as part of the sharemilking agreement). This resulted in many sharemilkers purchasing their first farm (In19). The other corporate sold to a variety of buyers due to the need for cash for other unrelated farming operations (In1). Informant 19 commented that corporates presented an opportunity for new sharemilkers to enter the industry and grow. When looking for a sharemilking job, he targeted the first corporate as a potential employer due to their reputation as a ‘fair’ employer. The accountability demanded by the corporate was important for monitoring his business. As well, the personal mentoring provided by the managing director (and his wife) and field staff were important to his success.

Nearly all sources felt that corporate farmers were important. They stimulated a growth in milk production through the purchase and conversion of ‘no frills, but sound’ dairy farms. They gave many ‘immigrant’ sharemilkers from other parts of New Zealand an opportunity to develop a business and buy their own farms. They also were significant contributors to the growth and development of the cooperatives servicing the industry (In21, In4). Informant 15 suggested that strengths of a corporate can be in compliance and in the ability to ‘stick to a plan’. Farmers learned a lot from the corporates about managing staff, finances and purchases (In14).

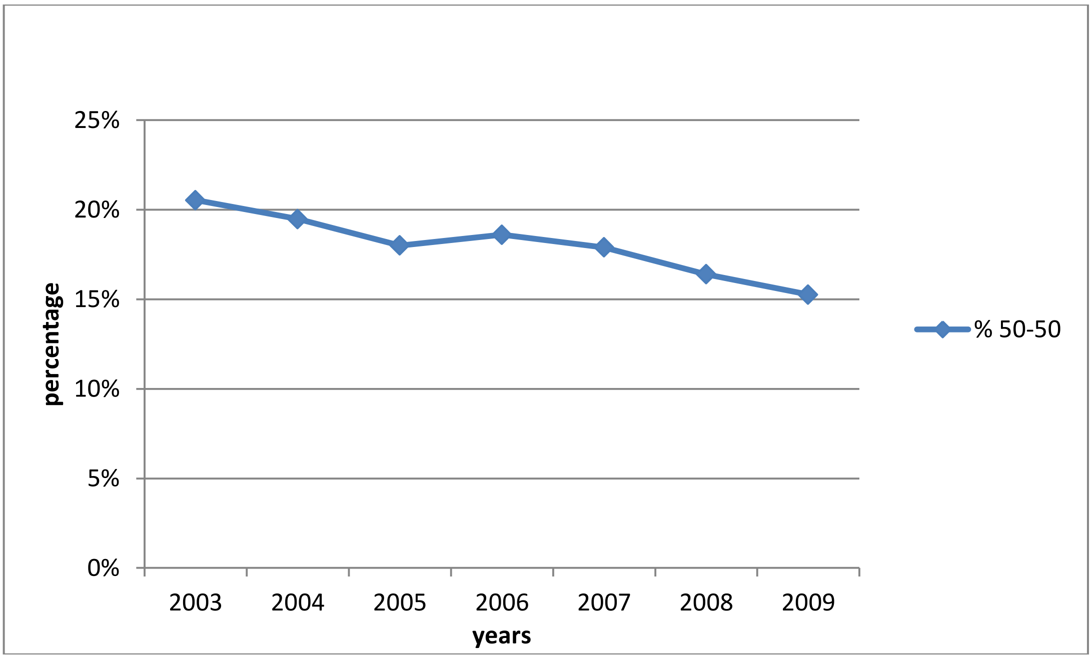
It would appear that corporates were attracted by the potential to achieve entrepreneurial profits from purchasing and developing a dairy farming business. They appeared to have been very successful in developing a model for farm development which they replicated on multiple properties. However, they were less successful in obtaining the desired levels of profit from the developed farms.

7.4.7 Business structures new to the industry

Although one of the early converters did have investor partners (In3), the majority of early conversions were family owned operations. During the 1990s, farmers began to utilise investors (known as equity partners) to provide additional equity to meet the credit requirements of the financial institutions. Informant 13 noted that a significant number of the conversions since 2000 have tended to take the business structure of equity partnerships. The additional financial strength has allowed them to buy or convert a larger farm and develop the farm quickly to a higher standard.

In most cases, the farmer operating the business is called an equity manager and receives a salary and dividends as well as gains in the value of the property. According to In4, equity partnerships have made a significant change to the nature of the industry. Historically, a 50-50 sharemilker would move from a large sharemilking job (500+ cows) to buy a small farm (150-200 cows). As equity increased, the farm would be sold and the farmer would move to a larger farm. This process might be repeated several times in a farming career (Clarke 2008, pp. 1-2). The advent of equity partnerships has allowed the sharemilker to partially own a large property more quickly, albeit with investors to whom they must report.

The advent of equity partnerships appeared to be associated with a decline in the number of 50-50 sharemilking jobs, as equity partnerships have replaced landowners with sharemilkers (In4, In5). Figure 7.5 details the decline in the percentage of 50-50 sharemilkers operating in the Canterbury dairy industry since 2003.



Source: derived from LIC 2010

Figure 7.5 Percentage of farms with 50-50 sharemilkers in Canterbury

Although equity partnerships have opened up opportunities for some sharemilkers to achieve a form of farm ownership, they needed to obtain a high percentage of the ownership to ensure they were treated as equal partners (In7). Two informants (In4, In5) stated that many equity managers enter into partnerships where they own less than15% of the business, and thus lacked control of the operation. The best equity partners are other farmers because they understand the ups and downs of farming (In14). Several of the informants were involved in equity partnerships and have found them a successful way to grow their business (In1, In7, In8 and In19).

7.5 Social effects of the new industry

Informant 4 commented that dairy farming in Canterbury was more a business than a lifestyle compared to other dairying areas and this has had social impacts, which posed problems for early converters.

A number of early converters mentioned the changes to social systems in communities with dairy conversions. Informant 17 commented, that historically, the social hierarchy from top to bottom for farmers in Canterbury was high country sheep and cattle, intensive mixed cropping, intensive cropping and intensive sheep farming with the bottom of the 'social ladder' being dairy, pig and poultry farmers. A number of sources (In3, In5, In10, In1 and In4) relayed stories of initial antagonism to dairying and the effect of the influx of dairy farmers on the social structure of the area. Neighbours commented that dairy farmers "weren't real farmers" (In11). Informant 7 suggested that humans disliked change, whether it is cows in Canterbury or changing the dry landscape of Central Otago through irrigation.

In recent times, high milksolids payouts have also changed the public's attitude. Informant 6 felt that the payout of nearly $7/kg milksolids in 2008 led to the public considering dairy farmers to be multi-millionaires.

Informant 9 mentioned that because dairy farming used fewer chemicals relative to sheep and cropping farms and there were no processing activities in mid Canterbury, the industry had caused some unemployment. However, he added "Those who have witnessed the development of Ashburton Borough, and the district as a whole over the past 30 or 40 years would probably not wish the district to return to its earlier days of drought crisis, employment losses and erratic stop-start business fortunes".

On a positive note, most informants mentioned increased school rolls and increased population in country districts.

Informant 18 commented that "The social structure of Canterbury has changed due to dairy---it used to be that the Land Rover that passed you on the highway was driven by a guy in a tweed jacket, now days it will be a guy in a pair of blue overalls".

7.6 Summary and discussion of Chapter 7

It was apparent that there have been three distinct periods of development, which have been named 'the three Waves'. These roughly encompass the 1980s, the 1990s and the 2000s. The differing characteristics of the waves were:

Wave 1 (1980s) farmers tended to be driven more by entrepreneurial motives and were often moving from another dairy region that did not appear as favourable to the farmers for a variety of reasons. Most saw the ability to farm at scale through purchasing lower cost, irrigated land as the main driver of their move to Canterbury. For many there was a human element. These immigrants often came for the extra feed security available through irrigation - not necessarily for business growth.

Wave 2 (1990's) farmers tended to be more interested in growing their wealth, often sharemilkers from other dairying areas in New Zealand, who were striving to buy a farm. This was aided by the conversion of many sheep/crop farms to dairying by corporate farmers after the economic restructuring of New Zealand in the mid-1980s. The corporate farmers had largely left the industry by the early 2000s. In doing so, they sold many of their farms to their sharemilkers, thus creating a new generation of farm owners. However, there were also traditional sheep/crop farms starting to convert for economic reasons.

Wave 3 (2000s) farmers tended to be established farmers from other sectors, who converted to dairy farming for economic reasons. There was also an effect on the rate of growth from aggressive lending to dairy farmers by the primary and secondary financial institutions. Wave 3 farmers tended to develop large intensive farms. As there were other processing opportunities at this time (NZ Dairies and Synlait), a number of the third Wave converters did not join the dominant processing cooperative. This Wave also saw a larger degree of investment from non-farming investors, particularly in equity partnerships.

When comparing this research to Chapters 2 and 3, a number of insights have been gained. Most of the farming informants established their farming businesses in Canterbury in the 1980s (Wave 1), but the rapid increases did not occur until the early

1990s. In the early years the industry's farming systems were only a reflection of established dairying areas, with similar productivity levels but with lower milk prices and thus lower profitability.

However, by the 1990s cows per hectare and farm sizes began to rapidly increase (Wave 2). This coincided with conversions by corporate entities, new methods of financing growth in processing, more liberal bank financing for farms and the development of mitigation technologies for dealing with pesticide contamination of land. The capital gains available from converting to dairy from other land uses were significant (see Chapter 3 and Figure 7.6) and would have contributed to additional conversions. These steps allowed the industry to develop the critical mass necessary to become an important segment of the national industry.

By the 2000s (Wave 3) the land in dairying had increased by five times (100,000 hectares) and productivity had increased in comparison to traditional dairy areas. But from 2000, Canterbury increased cows per hectare and milksolids production per hectare much faster than the rest of the country. Profitability in Canterbury, and for the case study farm, was often considerably higher than the rest of the industry in the 2000s.

The Wave 1 farmers exhibited many of the characteristics of Schumpeter's definition of an entrepreneur in that they often purchased and converted land in Canterbury for the challenge as much as for financial returns. They took on significant risk and had to build the infrastructure and industry, as well as constantly adjust their systems for the new environment. Some showed evidence of building their 'own kingdom'.

The importance of extension was confirmed with early converters suggesting there was a lack of extension at the industry's onset. A number of informants stated that early problems were usually solved by the farmers, consultants and their tradesmen, as existing research providers were not interested in the fledgling industry. Several informants suggested that the growth in the 1990s was greatly assisted by specialist dairy consultants establishing in the area. Chapters 2 and 3 outlined an advantage to Canterbury in terms of productivity and profitability in the 2000s. It was suggested by some informants that these gains were due to the establishment of the Lincoln

University Dairy Farm. A postal survey of Canterbury farmers described in Chapter 9 examines this proposition.

Although most informants did not credit government policies with contributing to growth, a number appreciated the role of government in trade negotiations. In contrast to the informant opinions, Chapter 6 outlined a significant involvement by government. However, a great deal of the government support came in earlier decades (quality assurance, guaranteed prices, and support for industry establishment), whereas most of the informants would have spent much of their farming career in an environment when government was exiting involvement in agriculture.

Table 6.1 and Figures 6.1 and 6.2 in Chapter 6 demonstrate changes in relative profitability of the prevalent New Zealand agriculture systems. Although most informants had always been dairy farmers, several had converted from other sectors due to economics. Some considered grassland farming more environmentally sustainable than crop farming and most had a strong positive attachment to their involvement with a large processing/marketing cooperative.

Innovation and the adoption of new technology played a significant role in the development of the Canterbury industry. Rotary cowsheds, supplementary feeding and new machinery types were adopted throughout the country. However, in Canterbury, changes in irrigation were the most important technology changes. Canterbury has led the way from shallow wells or ‘run of river’ water to deep wells and the storage of river water. Initial irrigation was ‘hand shift’, which progressed to rotorainers and k-lines to centre pivots. A number of informants also mentioned that since the new industry participants tended to start with large herds, Canterbury farmers had to design farms to handle these large herds as well as the increased staffing.

Most informants did not feel that economic conditions or incentives favoured the development, although they recognised that the restructuring of the New Zealand economy provided opportunities. Likewise, few recognised the effect of chance events on growth. As detailed in Chapter 6, the development of Asian economies has led to increased demand and higher prices for dairy products; however, this was not mentioned by informants. Perhaps, time had dimmed the memories of the effects of war, weather, pestilence, oil price shocks and protectionism.

It is proposed that the growth in Canterbury dairying was significantly affected by actions of the local processing cooperative. Alpine Dairy Products faced a number of problems based around the annual growth in milk to process. Informants discussed problems with processing capabilities; environmental contamination; the financing of growth; product quality and governance (see Chapter 8). A history of cooperative involvement and farmer investment in their cooperatives has given New Zealand dairy farmers strong supply chains. Additionally, informants suggested that the creation of Fonterra provided the industry with the ability to have an increased level of influence in international markets. The dairy industry provides an interesting contrast to the meat industry where a mixture of cooperatives and private companies compete for raw material domestically as well as for overseas markets. Although there are frequent discussions about meat industry rationalisation and the creation of a Fonterra structure, the meat industry has not been able to consolidate activities to the same degree as the dairy industry.

Most discussion around the existing infrastructure revolved around the availability of finance. Informants suggested that the banks had not initially supported the industry; however, those converting in Wave 1 did so during the economic restructuring and depreciating land values. The banks were also criticised for lending too freely in some periods. Considering the growth in debt levels, there was no doubt that the banks involvement has been important. Although some informants suggested that there was a lack of support industries initially, the void was quickly filled. Informants listed the development of dairy support farms to provide grazing and supplementary feed as important. In Wave 1 this industry did not exist and was considered a problem for early converters. The growth of this sector was aided by the development of irrigation and was often the result of a reduction in the profitability of traditional systems.

Besides the development of a support industry, a number of other factors not included in Figure 6.4 were identified by the informants. The development of water resources for irrigation was considered the major contributing factor to development. Although irrigation had been available since the 1940s, it was initially seen as drought insurance rather than as a means to increase productivity. The ability to apply water from surface and groundwater to 'light land' opened up a large land area to dairying. This was only possible through improved technology and innovations in irrigation systems.

Also of importance were human reasons, such as a desire to build a larger business, improve educational/sporting opportunities or to take on a new challenge. A number of informants suggested that the industry offered people from all walks of life an opportunity to better themselves. The lower priced land with irrigation in Canterbury appealed to farmers, such as the case study farmers in Chapter 3. The data in Figure 7.4 suggests that there have been significant entrepreneurial profits available from converting fattening farms to dairying.

From a business prospective, the entry of corporations to dairy farming was seen as positive by informants. Without the financial constraints which affected most Wave 1 farmers, corporates developed systems that produced standardised, 'easy to operate farms'. The farms were operated by 50-50 sharemilkers and resulted in an influx of new, generally younger, farmers to the area. However, the inability to obtain a sufficient return for shareholders from operations led the major corporates to exit the industry early in Wave 3. As the price of land increased, many farmers (particularly in Wave 3) involved investing shareholders or equity partners in their business. This has resulted in a farm business structure in Canterbury that at times reflected a model more commonly associated with corporates. A number of informants stressed that a growing industry brings in new people and creates a positive attitude.

Finally, a number of informants commented on the social impacts of the development of the dairy industry. Obviously, the new industry created a situation where the composition of communities changed and, as mentioned by I6, humans tend to resist and, often, resent change. For some members of the community, there was an effect on their jobs or businesses. Others saw the change and additional economic activity as an opportunity and adapted to the new industry. It should be noted that the growth took place in the context of a restructured New Zealand economy which provided incentives for growth and development through reduced tax rates, coupled with the lack of a capital gains tax and the removal of death duties (1992).

A diagram (Figure 7.6) places the factors proposed in Chapters 4, 5, 6 and 7 in the form of a timeline of the proposed development of the Canterbury dairy industry.

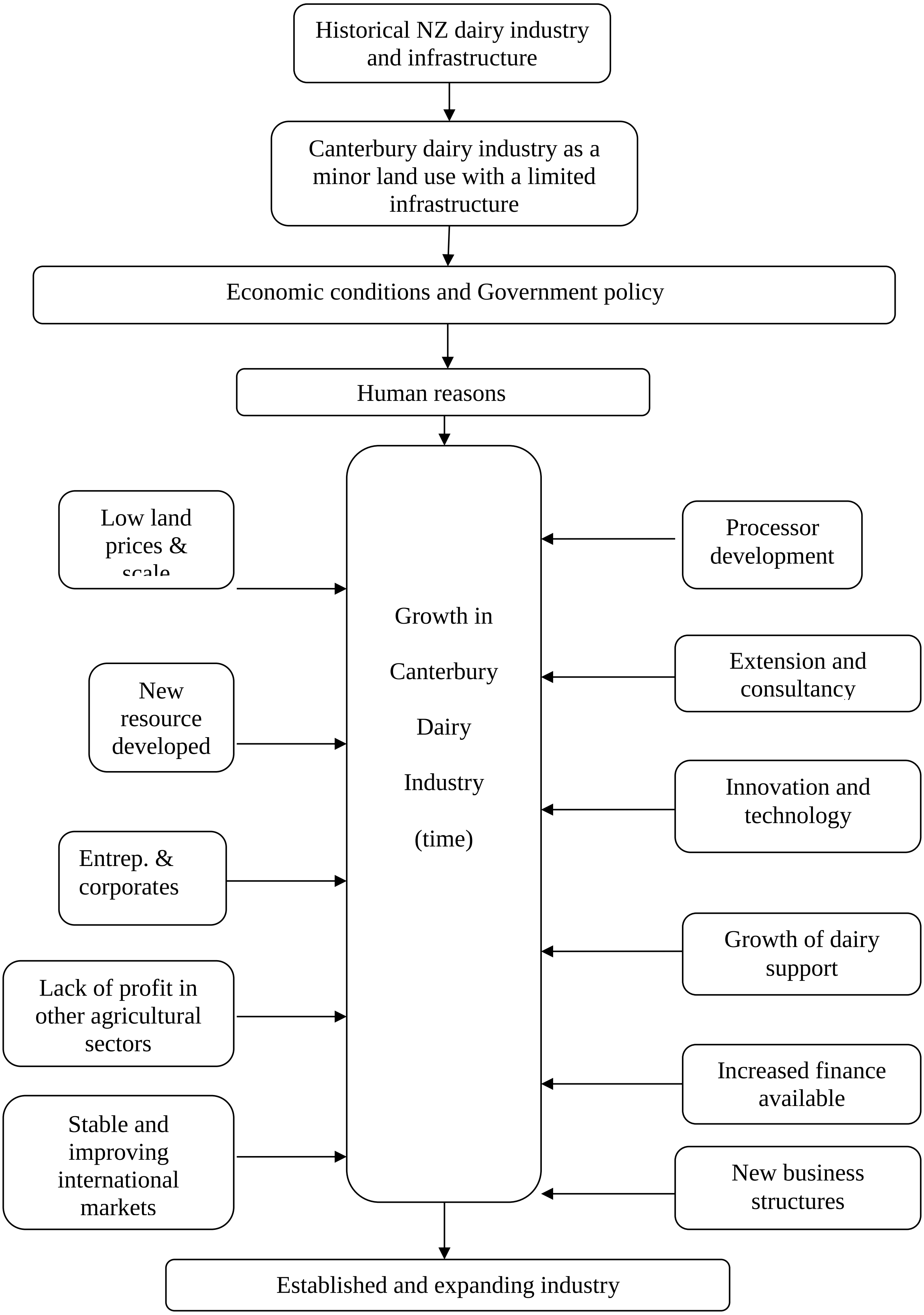


Figure 7.6 Timeline of development for the Canterbury dairy industry (1984-2010)

Chapter 8

The role of the local dairy company in the development of the Canterbury dairy industry

> **“Cooperatives are a commercial solution to an economic problem of market power. Individually farmers are weak sellers, so a cooperative is an appropriate business model to give them strength” (Roadley 2003, pers. comm.)**.[54]

8.1 Introduction

Chapter 7 contained the perspectives of industry participants, consultants and commentators as to the reasons that led to the growth in dairy farming in Canterbury. All industry participants identified the importance of the local dairy processing cooperative to this growth. As discussed in Chapter 6, before the formation of Fonterra and the Dairy Industry Restructuring Act (DIRA) of 2001, the cooperatives operating in New Zealand were independent, although required to sell their product through the New Zealand Dairy Board (NZDB). The cooperatives had defined geographical areas and there were no competing processors.

The purpose of this chapter is to explore how this small dairy cooperative managed a number of issues including: high levels of growth, on-farm quality control, dealing with pesticide residues and funding growth in processing capacity to handle the ever increasing milk supply. Additionally, the discussion will cover innovations in cooperative governance, the creation of shareholder wealth and this company’s role in creating a unified dairy industry in New Zealand. The chapter does not include a discussion on the development of a processor after the DIRA and creation of Fonterra, as these developments solved the processing problems for new entrants. Thus the potential lack of processing capability was no longer a problem for industry development.

[54] John Roadley was an early converter in the Canterbury dairy industry. He was chairman of Alpine Dairy Products and the inaugural chairman of Fonterra.

The discussion will further inform Research Questions One, Two and Three, by describing a major factor that became a facilitator of growth. Additionally, it will contribute to Research Questions four and five through suggesting the importance of the processor in the development of an agricultural industry.

8.2 Methods and key information sources

Information used to produce this chapter was obtained through interviews with past directors (8), management (1), employees (2) and consultants (2) of four cooperatives in the South Island. These cooperatives included the Temuka and Tai Tapu Cooperative Dairy Companies, which merged to form Alpine Dairy Products in 1987. The Southland Dairy Cooperative merged with Alpine Dairy Products in 1998 to form the South Island Dairy Company.

These interviews took place during the months of December 2006 and January 2007. All interviews were recorded with participants' permission and a draft of the chapter was provided to two interviewees for comment as to accuracy. If quoted in this chapter, those interviewed, are identified by a code using an 'S' plus a number. A wide range of printed material (secondary sources) provided financial data and commentary. These included company annual reports, merger documents, supplier newsletters, research documents and media publications.

8.3 History of legacy dairy cooperatives

When the Canterbury dairy industry expansion began in the early 1980s, two cooperatives existed to process milk that was not from the 'town supply' industry. The majority of the resulting products were sold overseas by the New Zealand Dairy Board (NZDB)[55]. These cooperatives were the Tai Tapu Central Cooperative Dairy Company Ltd (near Christchurch) and the Temuka Cooperative Dairy Company Ltd (near Timaru), which merged to form Alpine Dairy Products in 1987.

The Tai Tapu Cooperative Dairy Company was founded in 1888 near the township of Tai Tapu with 528 shares. The shares cost £2[56] and farmers collectively guaranteed

[55] most companies did provide a small quantity of products to the domestic market
[56] £2 in 1888 is equivalent to $355 in Quarter 2, 2010 (Reserve Bank CPI Calculator)

the milk of 500 cows (Dunstan 1963). In the ensuing years, a number of cooperatives emerged within a 50 km radius of Christchurch; however, by 1943 all the cooperatives had merged into the Tai Tapu Central Cooperative Dairy Company (ibid). In 1949, a new plant was commissioned in Christchurch to produce 4,000 empirical tons of butter per year and to include a drying operation to produce buttermilk powder. By the time of the merger with the Temuka Cooperative in 1987, Tai Tapu was handling 59 million litres of milk annually (ibid).

The Clandeboye Cooperative Dairy Company Ltd was formed in 1910 in South Canterbury, as a collection facility to send cream by rail to a butter plant in Ashburton (50 kilometres). The cooperative began processing its own milk in 1914. Several other small cooperatives were formed in the area at Orari in 1919, at Milford in 1929 and at Temuka (Cloverlea Cooperative) in 1934 (Blyth, Price 1999, p. 10). These factories all produced cheese. A collective cool store for cheese was built in 1957 at the Port of Timaru. In the 1970s, these cooperatives merged to form the Temuka Cooperative Dairy Company and were joined by the butter - producing Midland Dairy Cooperative of Ashburton in the early 1980s. In 1980, the company built a brine plant for producing parmesan cheese and in 1987 gouda cheese production commenced. By 1986-87, the factory was annually handling 169 million litres of milk (ibid, p. 51).

By 1987, both companies had problems. The Tai Tapu cooperative had suffered an outbreak of Salmonella in its powder plant in 1986. This affected the company’s balance sheet, with “Capital and Reserves” [*sic*] dropping from $5.5 million to $4.6 million. The annual accounts for 1987 show an increase in accounts receivable from $2.4 m to $9.5 m, in creditors from $2.4 m to $9 m and in the bank overdraft from less than $100,000 to $1.3 m. The Temuka cooperative had been weakened financially through attempts at diversification. These investments included a finance company designed to raise funds to finance the company’s growth and to lend to new farmers, a transport company, a plantation forest, a cool store and a maritime services company. The business model to repay the debt incurred for the new processing plant relied on further conversions of sheep/cropping farms to dairying. When the conversions did not occur due to the economic restructuring of the New Zealand economy, the company was not able to operate the plants at full capacity and struggled to meet debt obligations. Alpine Dairy Products was formed in 1987 from the merger of these two companies. As well as company problems, many of the Alpine farmers (Wave 1) were in a weakened financial condition due to low levels of equity and reduced product prices In addition, a severe drought affected the area in 1987-88.

At the time of the merger to form Alpine, there were approximately 160 members in each cooperative. Several sources (S1, S2 and S8) speculated that at merger, the equity of the new company was 6%. When the accounts for each company were consolidated, equity appeared to be closer to 20% (Alpine 1987). However, the commentators could be correct, as the accounts for the Temuka cooperative appeared to overvalue the cool stores (which were sold for $636,000 less than book value in 1989). Additionally, the value of plant (buildings, plant and equipment) was increased from $7.6 m to $21.6 m, but the term debt only increased by $8.7 m. In the first year, ex-Tai Tapu suppliers received 30 cents per kilogram of milkfat less than Temuka members (Wilson, Russell 1986).

The merger document projected that costs would be reduced by $649,000 annually, primarily in the distribution/marketing, laboratory/administration and financial areas. It was also predicted that manufacturing costs would decrease and there would be future buying advantages for inputs (Wilson, Russell, 1986). The 1987-88 accounts stated that “over thirty percent of the group’s turnover came from marketing, distribution and value added processing”. Prior to the economic restructuring of the New Zealand economy, dairy products such as fluid milk (town milk) and butter were highly regulated in terms of licenses to produce and market in New Zealand. After partial deregulation in 1988, the smaller companies found that competition with the much larger New Zealand Dairy Group and Kiwi Cooperative Dairies was difficult in the domestic market. By 1991-92, Alpine had withdrawn from domestic marketing and distribution activities.

Over the next 10 years, until the merger with the New Zealand Dairy Group, the Board of Directors and Management were faced with a wide variety of problems and opportunities. As second Board Chairman, John Roadley, stated, “we found a new hole in the road each year”. As the company developed, the directors and management instituted a number of programmes and systems that became industry standards. But equally important were the activities that created wealth for their shareholders - a concept new to the industry.

8.4 Dairy industry structure in the 1980s

As discussed in Chapter 6, the New Zealand Dairy Board developed from a number of New Zealand government interventions to provide price stability to farmers. The NZDB had the statutory powers to compulsorily acquire all dairy products as well as the ability to issue domestic and export licenses. It provided leadership to the industry and was governed by nominees from the industry and government. It controlled the Livestock Improvement Company (herd improvement), the extension services and the magazine *The Dairy Exporter*. The Dairy Board was one of several ‘Producer Boards’; these were entities created by Acts of Parliament. The ownership of the Dairy Board was passed to the dairy industry by the government in 1996 (New Zealand Dairy Group, 1996).

The main advantages to the farmer owned cooperatives of the NZDB, were that the NZDB was required to buy all products produced by the cooperatives and pay for it on the 20th of the month following manufacture - with no relationship between the timing of manufacture and the timing of sales. The price paid by the NZDB to the cooperatives was the theoretical cost for an efficient factory to produce the particular product and was referred to as the ‘make cost’. This price became the base price paid to farmers. If a cooperative could produce their products at a lower price, or had other sources of income, they could provide a higher return to suppliers.

8.5 Problems for the company

As an undercapitalised company, Alpine Dairy Products struggled financially from the time of formation in 1987. The high debt levels, small supply base, large collection area and limited product range, made it difficult for the company to pay out more than the base payout that they received from the NZDB [57]. The company was

[57] The North Island companies were often able to pay over 30 cents/kg of milksolids more than Alpine. The large companies had the advantage of being able to ‘chase higher paying markets’ through their diverse product range. Other income/cost savings for some of the North Island companies were derived from owning input supply companies (Anchormart and Town & Country) as well as cheaper sources of energy (coal and natural gas)

also noted for processing and product quality problems. In addition, the rapid increase in supply strained the company's governance, management and balance sheet.

Those interviewed for this study identified the following problems in the early years of Alpine Dairy Products:

1) governance and management,
2) milk quantity and quality,
3) finance,
4) mergers and industry restructuring.

These areas will be discussed in the succeeding sections.

8.6 Governance

When the Alpine Dairy Company was formed, voting rights were based on one vote for every 15,000 kg of milkfat produced, up to a maximum of 10 votes. Directors were elected by wards based on geographical areas. Directors had to reside within their wards and initially the directors from the Temuka Cooperative outnumbered the directors from the Tai Tapu cooperative by seven to five. In 1993, the ward system was abolished in a move to elect the 'best directors available', regardless of where they lived.

By the late 1980s, several corporations could see the potential for dairy farming in Canterbury, as discussed in Chapter 7. These companies were at first distrusted and feared by the traditional 'family farmers', particularly when they reached 20% of the company's milk supply in 1994. To allay the farmer's fears and to keep the corporate farmers from taking control of the company, a new system of voting was adopted that year. Voting for directors was based on production (with a maximum of 10% from any entity), but all other votes were based on 'one farm, one vote'. Over the years, one of the corporates gained the respect of farmers through their business practices, the advice they offered to the company and their involvement on the Board (S1, S2 and S5). The introduction of capital notes (which is discussed in Section 8.8) was an attempt to 'lock' the corporates into the company. Source 5 commented that the corporates changed the mind-set of farmers in that "it was now OK to have more than one farm".

In 1987, Alpine Dairy Products appointed one of the first outside directors of a New Zealand dairy cooperative. Sources (S2, S5) stated that the outside directors added financial wisdom and were a stabilizing influence for the farmer directors. They were important to the farmer directors' understanding of complicated financial matters and created a "better business culture on the board" (S5). Introducing outside directors was not without its tensions. An outside director (S6) recalled a meeting to discuss the final payout for the season. When he suggested that the directors were attempting to payout more money than they actually had available, he was told "it's all well and good for you to come down here from Christchurch in your shiny ass suit and try to tell farmers how much money they will receive".

Very few of the directors had experience in other businesses or tertiary qualifications. Programmes were initiated to send directors to training courses and an annual evaluation process of directors was initiated. A climate was created on the Board where directors were encouraged to ask questions until they understood an issue. The Board communicated well and learned about milk processing through touring the factory regularly (S2). Early meetings tended to concentrate on "micro" issues involving individual suppliers, processing issues and milk quality. Most sources commented that governance improved when the Board stopped reviewing "nuts and bolts" at each meeting and started thinking strategically. During the early years, the Board also tended to leave industry matters to the CEO. As the momentum for change in the structure of the dairy industry gained strength, the Board members became 'governors' and management concentrated on processing.

Sources identified that the Alpine Board of Directors was able to generate trust with the farmer/owners of the cooperative by being "upfront and honest" about problems encountered (S1). Source 2 commented that Canterbury farmers were particularly good to deal with as they were mostly "immigrants" to the South Island who wanted to grow their business and understood debt. This trust would serve them well as the company grew and pursued merger opportunities. However, one informant (S5) commented that the early Boards lacked the commercial ruthlessness to compete with other farmer cooperatives when deregulation of 'town milk' presented the opportunity to become more involved in the domestic market.

There were a number of key employees over the years from the formation of Alpine until the eventual merger with NZDG. One early executive started with the Temuka cooperative in 1982. Initially hired to run the finance division, he became the Company Secretary/Financial Controller. His contributions to changes in voting and capital structure were significant. The second CEO inherited numerous problems including rapid growth and a company unable to fund processing expansion. Every year the plant had to be pulled apart, expanded and staff had to learn how to run the new plant for the next years 'wall of milk'. This contributed to quality problems in the product. To compound matters, the problem with pesticide residues in the product surfaced (discussed in Section 8.7). The last CEO arrived in 1996 with a long career in the industry and a new $90 m+ powder plant under construction. He understood the importance of obtaining high yields of product from the raw material, controlling costs and producing high quality products (known as yields, costs, grades). Sources (1, 2, 4, 7 and 8) stated that he established a culture of excellence amongst employees, combined with financial management skills and an empathy with farmers in regard to wealth creation. He commented that a traditional dairy cooperative CEO ran a "profit and loss" business, but in the climate of the late 1990s, growth in the value of the cooperative was equally important.

The use of outside consultants was also important to the company. One consultant, who became associated with the company in 1996, defined his role as one of education, training and mentoring of Directors. He immediately identified two challenges for Alpine: "1) to get a payout above the dairy board base payout, and to 2) take industry issues away from management - leave the factory to the manager and the strategy to the Board". Other consultants included a large international firm who provided financial projections and analysis which became important to the strategy and structure of future mergers.

8.7 Quantity and quality

A major challenge for Alpine Dairy Products commencing in 1989-90 was processing the ever increasing volumes of milk from a rapidly expanding supplier base (Table 8.1). Milk volume and milksolids increased more than 4-fold over a nine year period. Milksolids production increases ranged from 7% to 39% annually. Production increases came from both increasing farm numbers and from increasing production per farm (more than doubling during this time). These levels of growth meant the processing systems were constantly under stress to develop new capacity.

Table 8.1 Growth in production and farm numbers of Alpine Dairy Products (1987-88 to 1997-98)

	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98
Litres (000,000)	181	172	189	220	235	254	348	411	486	598	754
Litres increase %		-5%	10%	16%	7%	8%	37%	18%	18%	23%	26%
Kg ms	14.5	13.6	15.2	17.7	19	20.7	28.7	33.7	40.3	49.8	62.4
Kg ms increase %		-6%	12%	16%	7%	9%	39%	17%	20%	24%	25%
Farm no.'s	276	276	284	282	276	281	306	348	366	387	466
Farm no's increase %		0%	3%	-1%	-2%	2%	9%	14%	5%	6%	20%

Source: derived from annual accounts of Alpine Dairy Products (1987-1998)

An additional problem of rapid growth was that it led to product quality issues. Sources commented that processing staff were always under pressure to commission new plant and then immediately began planning the next year's expansion. The management of the time considered that 'on-farm' milk quality issues were the main contributing factor to poor product quality. In 1991, one of the first Total Quality Management (TQM) systems in the New Zealand industry was established by Alpine. The emphasis of the TQM programme was on education and self-management.

With the TQM programme in place, the company lowered the levels at which poor quality milk would attract financial penalties (grades). Raw milk is tested for a number of quality measures ranging from several types of bacteria to sediment, antibiotics, excess water, somatic cells and other contaminants. All these problems can be countered by good management. The TQM was supported by a monthly column on milk quality in the company newsletter from the programme manager.

Appendix Table E1 details the percentages of milk grading either finest, first grade, second grade or reject grade. The percentage of milk grading finest dropped from 97% in the 1987-88 season to 95% for several years, however, improvement was noted after the implementation of the TQM programme in 1991-92. Because these percentages were reasonably small, S1 and S2 commented that they had felt management blamed the quality issue on farmers when it was, in fact, a processing plant problem. Another way of looking at milking quality is to analyse grades according to the test run on the milk. Appendix Table E2 details the types of grades incurred and how the grades relate to suppliers. In some measures such as coliform bacteria, sediment and inhibitory substances, marked improvements were seen. Over the years the types of grades changed to mostly bacterial problems, which were not as problematic for the processor. The reduction in inhibitory substance grades (generally antibiotics) was very important to the company's profitability due to the problems these substances cause in processing and marketing.

The issue of DDE in products first became known when cheese sent to Japan in 1986 was rejected for having levels in excess of the CODEX[58] recommendation of 1.25 parts per million (ppm). DDE is a metabolite of the pesticide DDT which was used widely in Canterbury in the 1950s and 1960s to control the grass grub insect (*Costelytra zealandica*). The product has a very long half-life and concentrates in the food chain. The problem in Canterbury involved farms with high levels of DDE in their soil[59].

An informant (S1) spoke of first learning about the problem when he approached the company in 1986 about producing organic milk. The manager at the time laughed and said "not with the levels of DDE in your milk!" The first meetings with farmers who had high levels of DDE in their soil occurred in1987. The discovery that their properties were high in DDE was a highly emotional experience and for many there were questions as to whether they would be able to continue dairy farming.

During the 1988-89 season, research was conducted by the Ministry of Agriculture and Fisheries Technology Division (MAF) to determine how the milk supply patterns influenced company DDE levels (MAF Technology, 1990a). This was accompanied

[58] The Codex Alimentarius Commission was created in 1963 by the FAO and WHO to develop food standards and guidelines.

[59] As part of normal grazing practices, the DDE was ingested by the cows and concentrated in their body fat. During the spring it is common for cows to be in a state of negative energy balance which results in the mobilisation of body fat for the production of milk. This mobilisation of fat resulted in DDE being released into the milk and concentrated in the resulting products. The use of DDT was banned in New Zealand in the 1970s due to concerns over issues with human health.

by a study on the factors affecting DDE levels in milk (MAF 1990b), followed by studies on the seasonal variation in milk DDE levels (MAF 1991a) and the effect of autumn management on milk DDE levels (MAF 1991b). The research was jointly funded by the government through MAF and the company. In an agricultural sector accustomed to the total funding of research by government, the partial funding of this research by the dairy company was another step on the road to deregulation of the agriculture sector. Additionally, the on-farm research was conducted on the chairman’s farm. The results of the trials were a series of recommendations to suppliers on how to maintain low DDE levels in their milk and on how to lower the DDE levels in the milk if they had high levels in their soil. Source 1 commented that the advantage of a cooperative in this type of situation is that the cooperative would work with farmers to correct the problem, whereas a corporate would possibly cease collection. Another source (S4) said that in the formation of the DDE programme, they realised that “education had to come before the stick”.

Initial policies adopted in 1991 were a moratorium on accepting new supply from farms with soil levels in excess of 0.6 ppm (reducing to 0.2 ppm in the following year), the encouragement of later calving on farms with high DDE levels (early season milk had the highest levels), a penalty system to ensure that farmers either made the effort to reduce DDE levels or suffered financially and an extension programme to work with known problem farms.

From a Canterbury industry growth standpoint, the DDE discovery was a significant factor in slowing growth until research uncovered methods for dealing with the issue. DDE milk levels have declined over time, with MAF (1991) reporting a reduction of 7% from 1988 to 1989 and a further 12% from 1989 to 1990. Fonterra personnel[60] have reported that from 1987-88 to 1997-98, there was a 38% reduction in DDE levels and from 1997-98 to 2005-06 there was a further 44% improvement.

Another first for Alpine was when the levels of thermoduric bacteria in milk (to become known as Japanese thermoduric) suddenly rose in the autumn of the 1995-96 season. Thermoduric bacteria survive the pasteurization process and can result in

[60] Pers. comm. from David Williams, Regulatory Programme Manager of Fonterra, 2006

quality problems in brine salt cheese, often months after manufacture. High levels of thermoduric bacteria are usually the result of perished rubber ware or poor cleaning procedures of the milking plant. However, field staff could not find the usual problems in the farm's milking plant/silo sanitation. Again, company funded research (see Appendix E4) found the problem and, based on experience from the DDE problem a mitigation programme was quickly adopted. The problem was found on farms that had adopted the new technology of baled silage stored under large plastic tarpaulins. Usually stacks were made of 50-100 bales. It was found that once these stacks were open, bacteria of the thermoduric type developed rapidly and would colonise on the cow's udder when the baleage was fed. A change to individually wrapped bales solved the problem.

The quality problems in the finished product were the last to be solved. Sources (S1, S2, S3 and S11) stated that the underlying problem was the rapid growth in milk supply. Until a large powder plant was built in 1997, manufacturing capacity was never ahead of new milk production. Source 5 commented that due to lack of time, staff would be forced to clean the plant at a level that was less than optimal so that all milk could be processed during peak production on farms (mid-October to mid-November). Processing staff often worked 11-12 hours days at this time of the season.

A former Manager (S3) mentioned that when he arrived in 1996, the NZDB stated that because Alpine's product quality was low, they were not selling Alpine products to a number of their customers. The NZDB was unwilling to carry the quality risk of Alpine products internationally. With the DDE issue under control, a new powder plant, a better financial position and improved raw milk quality, product quality became the manager's number one goal. Within a year, 21 cents per kg milksolids was added to the NZDB base price. This involved better systems, improved quality, higher yields and controlling costs.

8.8 Financial factors

From the formation of Alpine Dairy Products in 1987-88 until 1993-94, the company had low levels of equity relative to assets and high debt servicing requirements (Table 8.2).

Table 8.2 Comparison of key financial indicators for Alpine Dairy Products (1987-88 to 1997-98)

	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98
Assets($ m)	59	61	56	49	49	51	71	91	113	226	268
Debt ($ m)	43	45	41	34	34	33	40	54	70	135	142
Equity ($ m)	16	16.4	15	15	15	17	31	37	44	92	126
Equity/asset %	27	27	27	31	31	34	43	41	39	41	47
Interest: cents/kg ms	45.2	34	26.6	24.3	11.8	8.5	4.4	3.8	6	8.9	11.4
Debt in $ per per kg ms	3.00	3.32	2.72	1.94	1.72	1.49	1.40	1.59	1.74	2.71	2.27

Source: derived from 1987-88 to 1997-98 Annual Accounts of Alpine Dairy Products

In the early years (1987-88 to 1992-93), the company assets ranged from $50 to $60 million. Liabilities were between $33 and $45 million, leaving shareholder equity around $15 million. The decrease in assets and liabilities from 1988-89 to 1991-92 was primarily due to the sale of non-core, underperforming assets, with the proceeds used to repay debt. The equity/asset ratio ranged from 27% to 34%.

Over the life of the company (1987-88 to 1997-98) there was over a 4-fold increase in assets and a more than a 3-fold increase in debt. Equity to assets levels consistently increased, but never exceeded 50%. Debt per kg milksolids was halved between 1987-88 and 1992-93, but increased to $2.27 by 1997-98 when the large powder plant was built. Interest costs per kg of milksolids decreased dramatically from 45 cents in 1987-88 to as low as 3.8 cents per kg of milksolids by 1994-95, before increasing to 11.4 cents in 1997-98. The company reduced debt through asset sales in the early years. However, growth in production, lower interest rates and a new capital structure contributed to lower debt servicing.

Although Table 8.2 details improved financial ratios, a number of financial innovations were needed to achieve these results. By 1992, the continued growth and the resulting financial strain led the Board to place a moratorium on new supply. This policy led to a split at the Board level between those wanting to grow the milk supply and those who felt that growth was weakening the company’s finances and, hence, payout. In the end, the Board members wishing to pursue growth were successful and the moratorium was removed after one season (S1, S5 and S7).

Under a growth strategy and, with a high demand for conversions in 1993, a new method was required to finance growth. As a 'traditional cooperative', Alpine members had a minimal number of shares that showed very little change in value from when the farmer entered the cooperative until they left. The Board adopted a programme designed by the Secretary/Financial Controller (with help from the Plunkett Society)[61], known as "Growth funding Growth". The company determined the cost to add infrastructure and required farmers producing 'new milk' to pay half the cost of the infrastructure required to process their production. The balance was financed through financial institutions. The concept was sold to farmers as the only way that the company (and farmer's production) could continue to grow.

Under the proposal, each supplier needed to have one share per kg of milkfat produced. Shares were initially set at 30 cents per kg of milkfat, becoming 50 cents per kg of milkfat by 1994-95. Before the introduction of the growth funding growth programme, the company capitalised its reserves and bonus issued them to existing suppliers. This meant that existing shareholders were fully shared based on their 1992-93 production.

A more important debt instrument for adding financial strength than shares were capital notes. These were used to not only add greater equity to the balance sheet, but also were seen by the Board as a means to "lock" in suppliers (particularly the corporates) who otherwise might be encouraged to sell their shares and create a drain on capital. The capital notes were priced at 50 cents per kg of milkfat and each shareholder was required to have three capital notes per kg of milkfat. They were payable over three years in arrears to ease the strain on-farmer's cash flow. The capital notes paid interest, usually around 5% and did not have to be redeemed by the company for up to 40 years (S5). Although some farmers predicted that the requirement to invest in the company would be detrimental to their farm growth, the programme soon became accepted and the costs of shares/notes were factored into the costs of either increasing milk supply or converting non-dairy farms to dairying (S1, S2, S9).

[61] The Plunkett Society was founded in the United Kingdom in 1919 and has a mission statement of "Improving rural livelihoods through co-operative and social enterprises.

In July 1997, the shares were converted from a per kg of milkfat basis to a milksolids basis (milkfat + protein), making them worth 29.5 cents per kilogram of milksolids. A bonus issue was then made to value the shares at 35 cents per kg milksolids. Suppliers still needed to own one share per kg of milksolids produced. Capital notes based on milkfat were converted to two capital notes of 42.75 cents for each kg of milksolids produced.

With additional capital, the company was able to expand their asset base. As the expansions continued, the company was re-valued regularly. A ‘mothballed’ cheese plant was found in Taranaki in 1994-95, purchased cheaply and bolted onto the existing plant. This transaction increased total assets by $10 million, with very little additional debt. In 1995-96 a plant was constructed to further process whey. This had previously been pumped onto neighbouring farms, but was now to become a source of income. In 1996, the decision was made to address the under capacity problem and build a large powder plant. This investment was $90 million and resulted in further growth in assets and shareholder equity. In one year the company increased total assets from $113 m to $226 m, liabilities from $70 m to $135 m and equity from $44 m to $92 m.

A further boost to shareholder equity came with the acquisition of shares in the NZDB by the dairy companies. The industry became aware in the early 1990s that the ownership of the NZDB was unclear. Industry leaders at the time were able to negotiate with the government for the ownership of the NZDB to pass to the industry in 1996 (NZDG Annual Accounts 1996). A total of $39 m in NZDB shares was allocated to Alpine during the 1996-97 year.

Further capital ($3 m) was realised by Alpine during the 1997-98 season when the NZDB purchased the “reversionary rights” to the Fernleaf Brand from Alpine. Fernleaf had been developed by the Tai Tapu Cooperative and was considered an iconic brand for marketing New Zealand butter in the lucrative UK butter market, thus the NZDB wished to own the brand for the use of the industry.

8.9 Mergers and industry restructuring

Through involvement with the Chairman's committee of the NZDB, the Alpine Chairman became convinced that Alpine needed to merge with other companies to get the maximum return for shareholders when the NZDB replaced 'make allowances' with the Commercial Pricing Model (CPM) milk payment plan (see Appendix F1). He proposed that if Alpine did not take an aggressive stance in determining its own future it would be "swallowed up"; probably not under the best terms and conditions.

In 1996-1997, a group of other 'smaller company' leaders proposed the industry combine to form one large cooperative with the associated economies of scale. Four companies funded a study on industry structure which predicted that a one company model would save the industry $250 million per year.

Drawing upon these factors, the chairman developed a vision for a "one company" future for the industry and convinced his own members of the need for mergers. From this point until the eventual merger with the New Zealand Dairy Group (NZDG), Alpine actively pursued mergers with other companies. Although studies financed by Alpine showed the benefits of mergers, there was only limited interest by the other South Island companies (S1). An initial merger proposed to the Westland Dairy Company was rejected (Cox 2003, p. 18). However, by the late 1990s the Kiwi Cooperative from Taranaki was making strategic takeovers in the South Island. By the time they had acquired Otago Cheese and Canterbury Dairy Farmers, there was no longer the possibility of a monopolistic South Island cooperative, with the only potential merger partner the Southland Dairy Cooperative[62].

The Southland Province, as noted in Chapter 6, was an early participant in the New Zealand dairy industry. Between 1881 and 1932, there were 80 dairy factories in operation in Southland ("Edendale", 1998) which rationalised to one company by the 1980s. Products produced by the company included cheddar cheese, anhydrous

[62] The Southland Dairy Cooperative Limited was founded in 1977, the result of the merger of the Aparima, Edendale, Seaward Downs, Otautau and Thornbury cheese factories. They were joined by the Tisbury suppliers in 1978 and the Mataura suppliers in 1981 ("Edendale", 1998).

milkfat, butter, lactose and whey products. The Southland factory had a reputation for quality cheese and was the preferred supplier for several NZDB contracts.

The rapid growth in dairy farms in Southland began in the 1989-90 season with growth in supply of 30%. The Southland Dairy Cooperative grew even faster than Alpine Dairy Products with milksolids increasing nearly 5-fold from 1991-92 to 1996-97. Table 8.3 outlines the growth in suppliers and production for that portion of the decade until the merger with Alpine.

Table 8.3 Growth for Southland Dairy Cooperative Ltd. (1991-92 to 1996-97)

	Suppliers	% change	Milksolids (m kgs)	% change	Cow numbers
1991-92	194	7.8	8.6	21.1	28,000
1992-93	226	16.5	12.2	41.9	40,000
1993-94	286	26.5	19.4	59.0	66,000
1994-95	358	25.2	25.7	32.5	85,000
1995-96	414	15.6	35.7	39.0	112,000
1996-97	438	5.8	42.2	20.1	130,000

Source: derived from the annual accounts Southland Dairy Cooperative 1994 and 1997

As with Alpine, the rapid growth of the 1990s caused problems for Southland, although Southland was in a stronger financial position initially and did not institute a "growth funding growth" programme until 1994-95. New plants were being added each year and milk was, at times, diverted to other factories. The decision was made in 1992 to build a $52 m powder plant that was commissioned during the 1994-95 season. Cost overruns increased the cost to $70 m. By 1995 the new factory was full and the decision was made to build a casein plant for $175 million. New production and conversions were required to pay $3 per kg of milksolids to help finance the factory.

The 1995-96 season was very difficult for the Southland Cooperative as peak production was 2.2 m litres per day with processing capacity at 1.9 m litres per day ("Edendale", 1998). This resulted in moving milk to other factories and the dumping of milk (300,000 litres) due to plant breakdowns. Additionally, although the new casein plant was ready to commission in October of 1995, the company had failed to obtain resource consents. Not only did this contribute to the processing problem, but it also resulted in $1.5 m in additional costs to receive the permits. The total cost of the oversight was $5 m and resulted in strict conditions being placed on the company as part of the resource permit hearings (pers. comm., Christie 2007)[63].

The share standard was changed in April 1997 following revisions to the method of accounting for NZDB shares. The ‘new milk’ share standard was reduced from $3 per kg milksolids to $2 per kg milksolids, payable over three years. With growth expected to be in excess of 10% in the 1998/99 season, $11.5 m was spent on another evaporator for the powder plant and a 223 ha farm was purchased for the disposal of wastewater. All of these factors caused debt to grow significantly. The large increase in equity in 1996-97 was mostly due to the allocation of shares in the NZDB and increased shareholdings by suppliers. The company had a negative surplus in 1996-97.

Table 8.4 Historical financial details of the Southland Dairy Cooperative Limited (1987-88 to 1996-97)

	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97
Sales $m	15.4	22.4	34.2	30.1	37.0	55.2	81.5	109.5	176.4	191.1
Surplus $m	1.5	1.5	2.5	2.7	3.1	3.3	4.9	2.9	2.4	-2.4
Assets $m	11.7	14.5	18.3	17.4	21.6	30.3	70.6	83.4	112.3	199.1
Liabilities $m	4.2	6.4	9.0	6.0	7.1	12.3	46.7	51.8	75.2	116.6
Equity $m	7.5	8.1	9.3	11.4	14.5	18	23.9	31.6	37.1	82.5
Equity/asset %	64.1	55.9	50.8	65.5	67.1	59.4	33.9	37.9	33.0	41.4
Debt/kg ms cents	0	0	0	0	0	4	118	161	95	169

Source: derived from annual accounts of Southland Dairy Company Limited (1987 through 1997).

The merger of Alpine Dairy Products and the Southland Dairy Cooperative to form the South Island Dairy Cooperative (SIDC) was crucial to the success of the Alpine Chairman’s ‘vision’. It was to be very difficult as Southland felt that they were in a much better position from a product and financial standpoint. The process was helped by a corporate farmer who owned farms in the collection area of both companies. Some of the corporates’ associates formed a separate milk supply company to break away from Southland and sell milk to Alpine. This tactic along with the corporate-

[63] Pers. Communication, Richard Christie (February, 2006). He was formerly the Planning Manager, Southland Dairy Cooperative Ltd.

affiliated directors on the Southland Board eventually convinced the other Southland Directors of the need for a merger.

In order to investigate the potential benefits to shareholders of forming a new cooperative, a steering committee of directors, management, consultants and lawyers was formed in mid-1997. The steering committee set up a four stage process, the details of the process and proposed benefits are provided in the Appendix E3.

The final proposal called for Alpine suppliers to receive 18 cents per kg of milksolids as a 'one off' payment to equalise the value of the shareholdings (a surprise to Southland members). The method used to determine the necessary adjustments was, as follows:

1) the future earnings of Alpine and Southland were forecast on a standalone basis,
2) the assumptions underlying these forecasts were benchmarked to ensure accuracy,
3) adjustments were made to items such as depreciation rates and the ownership of on-farm refrigeration and vat washing units.

The analysis predicted that Alpine's forecast payout would be approximately eight cents per annum greater than Southlands for the 4.5 year period selected for analysis (the 4.5 year period was selected due to its use in previous industry mergers). The reasons listed for this difference were that Alpine would have lower capital expenditure, economies of scale with their powder plant and further income from the whey processing operation. The projected payout for SIDC was the weighted average of the forecast for the two companies plus the merger gains.

A net present value analysis was prepared as listed below (South Island Dairy Cooperative 1998):

(Cents per kg milksolids)	Alpine	Southland
Standalone payout	142	115
SIDC payout	143	143
Payout gain	1	28
Capital Distribution (pre-tax)	27	0
Interest cost of distribution	(2)	(2)
Payout gain	26	26

Therefore, the Alpine Dairy Products suppliers needed to receive an additional 27 cents per kg milksolids for the 1997-98 season. As the capital distribution was tax free, the payment was reduced by the tax rate of 33%; thus, the cash payment was 18 cents (27 cents x .67).

In terms of shareholdings, Alpine Dairy Products suppliers traded two 50 cent capital notes for 1 share in SIDC. The ordinary shares of 35 cents were converted to ordinary shares of $1 in SIDC, following a non-taxable bonus issue of 65 cents per share. The ordinary shares of 55 cents were converted to ordinary shares in SIDC following a non-taxable bonus issue of 45 cents per share.

Southland Dairy Cooperative suppliers were allocated two ordinary shares of $1 in SIDC for every $2 share in the Southland Dairy Cooperative. Additionally, shareholders received 6 cents for every kg milksolids supplied in the 97-98 season to cover a change in the ownership of on-farm refrigeration units.

To put these changes in context, the following describes the wealth creation for a hypothetical Alpine shareholder, producing 100,000 kg milksolids at the time of the merger. The shareholder probably would have owned 70,000 ordinary 35 cent shares and 30,000 in 55 cent shares, plus 200,000 capital notes valued at 50 cents. The difference in ordinary shares would be due to the farmer increasing production from the time of the introduction of the original 35 cent shares (most farms had increased production over this time frame). The effect on the value of shares from the merger would be:

	Before	After
70000 Ordinary shares @ 35 cents	24,500	70,000
30000 Ordinary shares @ 55 cents	16,500	30,000
Ordinary shares @ $1		100,000
Capital notes	100,000	0
	$141,000	**$200,000**

In the one year of operation, SIDC had turnover of $566 m with operating expenses of $154 m, leaving $412 m to be paid to farmers. Total assets were $530 m, with liabilities of $298 m, leaving shareholder funds of $231 m or $249,568 per farm. There were 926 farms supplying 1,452 billion litres of milk. Milk grading was 98%

finest and 1.5% first. The payout to suppliers was $3.415 per kg milksolids. The annual accounts for Alpine and Southland for the 1997-98 season are compared to the results for the merged company's 1998-99 season in Table 8.5.

Table 8.5 Comparison of performance of Alpine Dairy Products, Southland Dairy Cooperative and South Island Dairy Cooperative

	Alpine 1997-98	Southland 1997-98	SIDC 1998-99
Milk processed (million litres)	753.9	561.8	1,452
Milksolids processed (million kg)	62.4	47	119.7
Group revenue (million $)	286.8	207	565.7
Total payout ($/kg milksolids)	3.22	3.20	3.42
Total assets (million $)	268.3	205.1	529.5
Net borrowings (million $)	142.1	112.8	298.4
Equity to total assets (%)	44	45.2	43.6

Source: derived from annual reports of Alpine Dairy Products 1998, Southland Dairy Cooperative 1998, South Island Dairy Cooperative 1999.

From the creation of SIDC, the objective was to make the new company a target for the two large North Island companies, the New Zealand Dairy Group (NZDG) and the Kiwi Cooperative Dairy Company (Kiwi) and thus promote the formation of one 'mega company' for New Zealand. Cox (2003, p. 16) stated that within two weeks of SIDC formation, talks began with Kiwi and NZDG. Consultants were employed to analyse the company's options and a company profile was printed to promote the company, entitled "*South Island Dairy - A Company with Drive and Momentum*" ("South Island Dairy", 1999).

Both companies offered the SIDC members the ability to trade their SIDC shares for equivalent shares in the North Island companies. But, SIDC joined the NZDG on June 1, 1999. Sources (S1, S2) mentioned that Kiwi had made a more lucrative offer (additional cash payment of 10 cents per kg milksolids), but the Board of SIDC felt that the goal of a 'mega company' was more likely if one of the new players was larger, than if there were two equal companies. One informant (S8) mentioned that he felt that Kiwi could not afford its offer.

At the time of the merger with NZDG, it was projected that the cost of the merger to NZDG suppliers would be 1 cent per kg of milksolids in payout (NZDG 1999, p. 7). To partially compensate, a distribution was made to NZDG shareholders of $80 million and shares in New Zealand Dairy Foods (NZDF), a NZDG subsidiary that traded in the New Zealand domestic market. Fifty percent of the shares in NZDF were given to the shareholders, with NZDG retaining the other 50 percent. It was estimated that the annual dividend from NZDF of 5 cents per kg milksolids would help cover the loss in payout to NZDG members from the merger. These moves reduced the NZDG debt to equity ratio by around 2% (Davis 1999, p. 7). NZDG shareholders voted 78% in favour of the merger, with SIDC shareholders voting 97% in favour. An industry commentator stated that "the merger was the first genuinely competitive dairy merger for many years - as most had been effectively takeovers" ("Unity calls", 1999, p. 72).

The annual accounts for NZDG and SIDC for the 1998-99 year were compared to the results from the merged company for the year 1999-00 and showed that the combined company exceeded the results of the predecessor companies (Table 8.6).

Table 8.6 Comparison of SIDC and NZDG in 1998-99 with the merged NZDG in 1999-00

	NZDG 1998-99	SIDC 1998-99	NZDG (merged) 1999-00
Milksolids processed (m kg)	386	120	570
Group revenue (million $)	2,451	566	3,427
Company payout (¢/kg milksolids)	38	16.5	40
Total payout ($/kg milksolids)	3.63	3.42	3.75
Total assets (million $)	1,650	566	2,591
Net borrowings (million $)	347	298	526
Equity to total assets (%)	53.1	43.6	56.7

Source: derived from annual accounts of NZDG and SIDC

For the SIDC farmers, the payout of $3.75 per kg of milksolids was an increase of nearly 10% over the previous year's $3.415. Another advantage of the merger was that NZDG historically had a higher payout than Alpine Dairy Products (Table 8.7).

Table 8.7 Alpine Dairy Products/SIDC and NZDG payout per kg of milksolids (1987-88 to 1998-99)

	87-88 $	88-89 $	89-90 $	90-91 $	91-92 $	92-93 $	93-94 $	94-95 $	95-96 $	96-97 $	97-98 $	98-99 $
Alpine	2.18	2.88	3.28	2.15	3.05	3.36	3.10	3.25	3.60	3.38	3.22	3.42
NZDG	2.34	3.26	3.62	2.50	3.39	3.67	3.39	3.50	4.10	3.69	3.51	3.63
Diff.	.17	.38	.34	.36	.34	.31	.29	.25	.50	.31	.29	.215

Source: derived from annual accounts of NZDG and SIDC. Note: until the 93-94 season, the payout was in kilograms of milkfat, these payouts have been converted to milksolids using a conversion factor of .565

The difference ranged between 17 cents and 50 cents, with an average of 29 cents. For the hypothetical Alpine farmer producing 100,000 kg milksolids, the merger could mean $29,000 extra income per year based on this average difference.
In addition to the increase in revenue, the mergers had an effect on farm values. Dairy farms in New Zealand are often valued on per kg of milksolids. North Island dairy farms had for many years been valued at a higher level than South Island dairy farms (Valuation NZ, 1987-99). This was based on the cost of production factors such as less purchased feed and a reliance on rainfall rather than irrigation. However, up until the time of the merger, there was also a further discount due to the lower payout of Alpine/SIDC. Upon receiving a North Island payout the value of South Island farms increased by $5 per kg of milksolids (pers. comm., Davison 2010)[64], thus the hypothetical 100,000 kg milksolids unit would increase in value by $500,000 ($5 times 100,000 kg milksolids).

8.10 Summary and discussion

Alpine Dairy Products was formed in 1987 by the merger of two small cooperatives in Canterbury and North Otago. The companies were not in a strong financial position due to the economic restructuring of New Zealand agriculture, drought, processing problems, underperforming assets and oversupply in world dairy markets. Alpine Dairy Products merged with the Southland Dairy Cooperative to form the South Island Dairy Cooperative in 1998. The South Island Dairy Cooperative merged with the New Zealand Dairy Group in 1999. The New Zealand Dairy Group became part of Fonterra in 2001.

Alpine Dairy Products, acting as a cooperative owned by farmers was vitally important to the development of the Canterbury dairy industry. For a new industry to develop rapidly, processing capacity has to increase with production. As small traditional cooperatives, with low levels of farmer investment, the companies were not in a position to handle the massive growth in milk supply that would occur in the 1990s. Without the backing of the government-sanctioned New Zealand Dairy Board (and the marketing strength it provided) it would have been difficult for the Alpine Dairy Company to accommodate the growth. It is unlikely that an investor-oriented

[64] Personal communication, J. Davison, CRT real estate, (2010).

firm would have responded in a similar manner, as they would not have had the incentives to meet the demand for processing nor been willing to accept the problems that arose. Thus, an integrated cooperative model was a factor in the growth of the Canterbury dairy industry, through providing the processing that allowed entrepreneurs the ability to grow their business.

A key factor to the success of the cooperative was governance. The Alpine Board tackled a number of governance issues including the removal of representation by geographical areas and ensuring that directors were given the opportunity to improve their skills. They were also one of the first dairy cooperatives in New Zealand to engage outside directors and consultants. One observation made by sources was that in a fast growing company you can outgrow the capabilities of board members and management on a regular basis. To protect the cooperative from potential corporate takeovers, the Board changed the voting rights to a ‘one man, one vote’ method for constitutional matters. The Alpine Dairy Company was well served by a strong chairman and board and management in the later years. All sources commented on the ability of the Board to find solutions to problems, to monitor results and to develop a vision for the future.

The 1990s were turbulent times for the South Island industry and the New Zealand dairy industry as a whole. The decade started with improved milk prices and financial stability after the restructuring of the New Zealand economy of the mid-1980s. As shown in Chapter 2, during the 1990s there was a movement towards larger farms, a larger national herd, more cows per farm and increased production in the South Island. These increases put pressure on many aspects of the industry. As the NZDB moved away from ‘make costs’ to the commercial pricing model method of pricing, there became very strong economic reasons for companies to produce a wide range of products. This in turn led to amalgamations and the eventual dominance of the industry by two companies. Active involvement in the evolution of the industry by the Board insured that the cooperative’s members were able to take advantage of the wealth creation potential of the resulting mergers (see Chapter 3).

Although it appears that the company was unsure how to manage growth initially, the implementation of the “growth funding growth” financing mechanism and foresight in the development of new processing capacity allowed the company to strengthen its balance sheet while handling growth in supply. The growth potential in the Canterbury dairy industry created a positive attitude in the industry and attracted new entrants and thus further growth.

A number of quality issues were encountered by Alpine. Management felt that the problem was in the quality of milk coming from the farms and instigated an on-farm TQM programme and higher penalties for poor quality. However, quality problems remained in the processed product due to plant problems. These problems were eventually solved by investment in one large processing plant, rather than the 'add-ons' of the early years. The issue of pesticide levels in the milk and products restricted higher levels of growth in supply to Alpine, and significantly added to the company's cost structure. The funding of the DDE research was an example of farmers taking responsibility for solving their own problems in a deregulated environment. The Board learned that 'good science' was necessary to gain acceptance of proposed measures to mitigate a problem. The experience gained through the DDE problem was valuable when the company encountered other quality problems. An advantage of a cooperative in dealing with quality issues is the incentive to work with producers rather than to set regulatory standards and 'walk away' from producers who could not comply.

The results in Chapter 7 confirmed and added factors that were drivers of the development of the Canterbury dairy industry. However, when examining Alpine Dairy Products it became clear that the cooperative was an enabler of growth rather than a driver. In other words, the growth was not driven by Alpine, but without the enabling effect of the company, growth would have been restricted. Another factor for growth proposed by the participants was the Lincoln University Dairy farm. This extension exercise in the form of a demonstration-farm will be examined in the next chapter.

Chapter 9
The role of an extension dairy farm in the development of the Canterbury dairy industry

9.1 Introduction

In Chapter 2 it was established that there had been significant growth in Canterbury dairy farming (Figure 2.1), that Canterbury dairies farmed more cows per hectare (Figure 2.5), produced more milksolids per cow (Figure 2.7) and achieved higher milksolids production per hectare (Figure 2.8) than other areas in New Zealand. Chapter 5 discussed the importance of diffusion/extension of new technologies in the agricultural sector. A factor mentioned by informants in Chapter 7 was the extension activities of the Lincoln University Dairy Farm (LUDF) in the growth of productivity and profitability of Wave 3. To assess whether extension was important as a driver or an enabler of industry growth; a survey from the perspective of 'the farmer-users' was conducted. Clearly, the development of an industry is very dependent on productivity and profitability and any function which improves net return needs investigating.

In 2001, Lincoln University converted a 185 hectare (ha) dry land sheep property to an irrigated dairy farm with a milking platform[65] of 161 ha. At the same time, the South Island Dairying Development Centre (SIDDC) was formed consisting of six commercial, education and research partners. Management of the Lincoln University Dairy Farm (LUDF) was delegated to SIDDC with the aim of "fostering best practice to South Island dairy farmers". From formation, a number of management techniques were trialled and results reported at focus days (field days), in the media and via the www.siddc.org.nz website. Financial data and benchmarks have been provided for the use of the industry. The LUDF had hosted over 20,000 visitors from its inception through to 2010. Focus days are held four times per year and are typically attended by between 200-400 farmers and agribusiness personnel.

[65] In NZ the milking platform is defined as the effective area grazed by the milking herd. It does not include land used for buildings, fences, roads, other infrastructure or young stock.

In the period through to 2010, the farm ran a high stocking rate system with over 4 cows/ha (versus the national average of 2.8) producing between 1,700 to 1,800 kg of milksolids (ms) per hectare from a grass-based, low supplementary feed system. In the 2005-06 season, this resulted in the harvesting of approximately 16t dry matter (dm) of pasture per ha and an operating profit of $2,240/ha at a $4/kg milksolids payout. This compared favourably with the industry's 'Dairy Base' benchmarks which showed an average operating profit of $1,406/ha for the Marlborough/Canterbury areas (pers. comm., van Bysterveldt and Christie 2006[66]). By the 2009-10 season, the dairy operating profit per hectare was $4,980, primarily due to higher milksolids payments (SIDDC 2010). This was 33% higher than the DNZ Dairybase average for Canterbury of $3,353 per hectare (DairyNZ 2010).

The key objectives for the LUDF - as listed on its website (SIDDC 2007) are repeated below.

1. To develop and demonstrate world-best practice in dairy farm systems and to transfer them to dairy farms throughout the South Island.
2. To operate as a joint research centre with DairyNZ, where the practical application of new technologies and on-farm forage production systems can be tested and developed.
3. To use the best environmental monitoring systems to achieve best management practices under irrigation, which ensure that the industry's 4% productivity gain target is achieved in a sustainable way and that the wider environment is protected.
4. To continue the environmental monitoring programme and demonstrate technologies that will ensure that the 3-year rolling average concentration on nitrate-N in drainage water from below the plant root zone remains below the critical value [16mg N/L] that is specified in Environment Canterbury's [ECan] proposed regional rule as requiring reduction [Rule WQL18].
5. To operate an efficient and well organised business unit.
6. To provide a commercial return on adjusted capital value to Lincoln University, and a defined benefit to each of the stakeholders.
7. To create and maintain an effective team environment at policy, management and operational levels.
8. To assist Lincoln University to attract top quality domestic and international students into the New Zealand dairy industry.

In June of 2008, a postal survey was conducted of dairy farmers in the LUDF's catchment area. The objective of the survey was to determine the demographics of farmers in the area and to gauge whether farmers had adopted the technologies

[66] Adrian van Bysterveldt was the DairyNZ Business Developer assigned to the LUDF and Richard Christie was the Business Manager of SIDDC

demonstrated by the LUDF. The information that was gained is important for this thesis for a number of reasons. First, it will provide data on the adoption of technology, which the literature suggests is important for new industry development. Second, the survey results will help demonstrate the importance of extension to the development of a new industry.

9.2 Methods

An industry organization provided a mailing list of dairy farmers in the prescribed areas. Nearly all farmers deal with this group for herd production testing, herd recording and/or artificial insemination of their herds. Initially 689 contacts were identified; however, this was reduced to 622 through the elimination of multiple ownership farms. A four page questionnaire was prepared and reviewed by SIDDC, staff from the Agricultural Management Group at Lincoln University, DairyNZ consulting officers and business managers and a select group of dairy farmers. The Human Ethics Committee of Lincoln University reviewed the proposal and approval was granted on 16 June 2008 (Appendix F1).

A total of 146 responses were received by August 1, 2008 (24%). The data was analysed using the software SPPS 15. Reported correlations are significant at $p<.05$ unless noted otherwise. Detailed tables are included in Appendix F. Caution is appropriate in drawing conclusions relating to the total population of Canterbury dairy farmers due to the response rate.

9.3 Results

9.3.1 Demographics

The majority of respondents identified themselves as owner/operators (73%), with 50-50 sharemilkers constituting 17% and the balance being farm managers. A large proportion (43%) had attended university, with a further 24% receiving training after high school through polytechnics or the Agriculture Industry Training Organization[67]. The mean age was 45 years and 81% lived within 150 kilometres of the LUDF.

[67] The Agriculture Industry Training Organization (AgIto) is a government and industry funded organization that provides training for those working in agriculture on a part time study basis

The milking platform ranged from 50 hectares to 1,400 hectares, with 239 hectares being the mean. Cows milked ranged from 130 to 5,000, with a mean of 611. The average cow, as estimated by farmers, weighed 480 kg, which would indicate that the majority of herds were tending towards the Friesian breed. However, 38% of farmers believed that their cows weighed less than 400 kg, indicating Jersey herds.

Production per cow averaged 419 kg milksolids and the farms produced 1,441 kg milksolids per ha. This level of production was higher than the Canterbury average of 380 kg milksolids per cow and 1,240 kg milksolids per ha (LIC 2007-08).

In New Zealand, it is common to classify dairy farm intensity according to levels of supplements imported to the property during the milking season, not including feed or grazing for young stock (DairyNZ 2010, p. 5). Most farmers (35%) indicated they were a System 3 farm (10% to 20% imported feed). As farm systems intensified from System 1 (no imported feed) to System 5 (25-55% imported feed), the farms milked more cows, produced more milksolids per cow and more milksolids per ha.

The number of cows milked and hectares farmed were both significantly correlated with level of education, the number of cows milked and hectares farmed. Age and lower educational achievements were both negatively correlated with milksolids per ha. Milksolids per ha increased with herd size.

When asked to rate seven possible reasons for farming using a five point scale from 1 (very important) to 5 (not at all important), the highest rated were ‘cash profit’ and ‘being their own boss’ (Table 9.1).

Table 9.1 Reasons for farming expressed by Canterbury dairy farmers (percentages)

Importance rating	**1**	**2**	**3**	**4**	**5**	**Mean rating**
Cash profit	64	27	7	2	0	1.47
Own boss	61	27	8	4	1	1.57
Life style	43	35	17	3	2	1.85
Family	47	29.9	15.3	6.6	.7	1.85
Quality stock	42	35	19	3	1	1.86
Working outside	39	30	23	6	3	2.03
Capital gain	36	29	31	2	3	2.08

1= highly important, 5 = not at all important

Those farming for capital gain had a significant negative correlation with the aesthetic side of farming (lifestyle, quality stock, or good place for a family).

The majority of respondents (69%) used the services of a professional consultant.

At the time of the survey the profitability of dairy farming for the coming season (2008-09) looked positive. When asked how they would spend a farming surplus a majority indicated that they would pay down debt as their first or second option. However, 48% ranked purchasing land in their top three options. Other common choices were to make improvements to irrigation systems or re-grass more of the farm. Although farmers were given a choice of several personal consumption options (holidays, schooling, improved housing), the majority indicated that they would re-invest in their farming operations.

The significance of these findings to the development of the Canterbury industry is that it provides an indication of the ‘people types’ involved in the industry. The results show that Canterbury farmers rated all the ‘reasons for farming’ highly, but appear to be most driven by cash profits and enjoy being their own boss. The results also indicated that profits would be used to pay down debt or further invest in the business, with a low inclination to spend proceeds on personal consumption.

9.3.2 Awareness of the messages of the LUDF

For the purpose of the survey, staff associated with SIDDC identified a number of messages that they felt had been stressed by the LUDF in its extension activities. Farmers were asked to identify familiarity with these messages (Table 9.2).

Table 9.2 Percentage of farmers familiar with LUDF extension messages

Low grazing residuals	89%
Pasture monitoring	80%
Nutrient and environmental management	64%
Irrigation monitoring	47%
Re-grassing of pastures based on monitoring	41%
Use of reproductive technologies (treating anoestrus cows, synchronizing heifers)	34%
Once a day milking during calving	21%
Once a day calf feeding	9%

Farmer familiarity was high for grazing and environmental messages, which were the messages that had been emphasised when the farm was established in 2001. The messages with less than 50% familiarity had been introduced in later years. The focus on low grazing residuals was a major system change for many Canterbury farmers and thus gained more attention from farmers than other messages that were often minor changes to the farms operation.

9.3.3 Farmer's interaction with the LUDF and other sources of information

An analysis of LUDF focus day attendance over three seasons (Table 9.3) found that in each season over 30% of respondents did not attend any focus days. Between 63-68% of responding farmers attended at least one focus day over the years 2005-06 to 2007-08. A very small percentage attended all four focus days in a season.

Table 9.3 Attendance at LUDF Focus Days (frequency of attendance in percentages)

Year	0	1 Day	2 Days	3 Days	4 Days	Mean
2005-06	32	23	20	18	6	1.4
2006-07	35	19	24	20	2	1.4
2007-08	37	32	19	8	4	1.1

Of those participating in focus days, 80% attended to learn about farming with low grazing residuals, 79% to learn how the LUDF is performing, 76% to compare their farms to the LUDF, 65% to learn about environmental management at the LUDF, 61% to learn about the latest animal management techniques, 58% for the financial information provided, 36% to meet other farmers and have a day off the farm and 13% to meet agri-business personnel.

An analysis of the data pertaining to those who had attended the focus days at least once over the three years versus those who had not attended the focus days is found in Table 9.4. Dairy farmers attending had larger farms, milked more cows and had higher levels of production, although only the difference in MS/cow was statistically significant.

Table 9.4 Demographic and production levels of farmers attending and not attending LUDF Focus Days

	Ha farmed	Cow numbers	MS/cow	MS/ha
Non-attenders (n=29)	211	686	401	1,370
Attenders(n=113)	247	856	422	1,454
difference	+36 ha	+170 cows	+21 kg ms/cow	+84 kg ms/ha
	P=.20	P=.08	P<.03	P=.17

A small number of farmers (23) felt able to comment on the economic value gained through the adoption of the LUDF practices. These farmers stated that they had increased farm income, with the range being from $50,000 to $1,000,000 with a median for respondents of approximately $84,000.

SIDDC operates a website which provides information on the operation of the LUDF, including the weekly farm walk information, data collected and financial performance. Farmers (114) reported their usage of the website from the initiation of the site in 2004 and the survey in 2008. The Figures listed are the percentage of the respondents for each grouping of website visits.

Not used	32%
1-10 times	42%
11-20 times	8%
20-30 times	4%
More than 30 times	15%

9.3.4 Sources of information for farmers

Respondents were asked to rate sources of information for their contribution to knowledge of technology and innovations using a scale from 1 (very important) to 5 (not at all important). All sources rated highly except for sales representatives.

Table 9.5 Farmer's rating of sources of information (row percentages)

Source	Responses	% for each rating					Mean rating
	(n)	1	2	3	4	5	
Demo. farms	135	33	40	20	4	4	2.09
Other farmers	134	31	36	26	6	1	2.10
DairyNZ	136	32	44	17	1	7	2.10
Media	135	31	31	26	7	5	2.25
Consultants	138	28	38	17	9	9	2.36
Conferences	131	22	33	31	10	5	2.44
Sales reps.	131	5	16	24	20	36	3.69

1 = highly important, 5 = not at all important

These findings are relevant to new agricultural industry development as they demonstrate that farmer learning is through a number of sources. Although farmers in the LUDF survey gave the demonstration farm the highest ranking, a number of the other sources were almost equally regarded.

9.3.5 Have farmers adopted the messages from the LUDF?

Low grazing residuals as practised by the LUDF had been adopted by 82% of the respondents, although 15% of the survey respondents said that they had always followed this technique. Ten respondents did not follow the practice as they felt that their cows would not be fully fed by grazing to low residuals.

Re-grassing based on the measurement of poor performing paddocks had been adopted by 74% of respondents; however, 25% of respondents included as adopters reported that they had always re-grassed. It appeared from the answers provided that the question may have been misread as ‘Do you re-grass’, rather than ‘Do you re-grass based on the measurement of poor performing paddocks’.

The policy of synchronizing heifers to calve one week before the herd had only been adopted by 29%. Those who adopted the process did so to get heifer calving finished early and/or to give heifers more time to return to oestrus. The main reasons for not adopting were that heifers are grazed off the property and it was considered too difficult to operate a synchronisation programme. Furthermore, a number reported that they did ‘not believe in the practice’. There were positive correlations between synchronizing heifers to calve early and those who use the website, those who use consultants and kilograms milksolids/ha.

For hormone technology treatment of non-cycling cows, 42% followed the LUDF aggressive intervention system. Of those following the system, nearly 50% of farmers reported that they did so to maximise cycling, conception rates and/or condense calving. Of those not following the practice, 10% farmers said it was too expensive and 27% did not believe in the practice. Others used methods such as once-a-day milking or teaser bulls (14%). A number of farmers felt that they achieved good reproductive results through ‘breeding and feeding’ (14%) and 6% said that they do not have a reproductive problem in their herd.

The LUDF nil induction policy had been adopted by 36%, with 64% continuing to use inductions[68] as a tool. Of those adopting nil induction, 39% did so because they were philosophically opposed for animal welfare reasons. Those continuing to induce reported that they used the practice to 'tidy up' the calving interval, grow herd numbers and reduce cow wastage. A number of sharemilkers pointed out that they needed to induce, as retaining cows increased their wealth.

9.4 Comparison of the Canterbury data to other districts

An analysis of production statistics (LIC 2000-01 to 2009-10) for Canterbury, North Island and South Island dairy farms (Table 9.6) indicates that although production per cow has always been higher in Canterbury from 2000-01 to 2009-10, there has been no consistent pattern of increased production per cow since the formation of the LUDF. However, there was a widening gap in cows per hectare and milksolids per hectare since the LUDF was established, which could reflect the main LUDF message of higher stocking rates and low grazing residuals.

Table 9.6 Differences in milksolids per cow, cows per hectare and milksolids per hectare for Canterbury, the North Island and the South Island.

Year	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10
Milksolids/cow										
Canterbury vs NI	+38.5	+49	+57	+49	+55.5	+42	+51	+73	+37	+51
Canterbury vs SI	+10.5	+18	+28	+16	+22.5	+6	+8	+19	+5	+10
Cows/ hectare										
Canterbury vs NI	+0.2	+0.13	+0.24	+0.26	+0.33	+0.39	+0.42	+0.43	+0.45	+0.58
Canterbury vs SI	+0.3	+0.24	+0.32	+0.34	+0.38	+0.42	+0.43	+0.39	+0.40	+0.43
Milksolids/ ha.										
Canterbury vs NI	+175	+184	+248	+243	+290	+280	+317	+410	+281	+418
Canterbury vs SI	+125	+123	+183	+166	+194	+169	+178	+203	+155	+193

Derived from NZ Dairy Statistics (LIC 2000-01-2009-10).[69]

9.5 Summary and discussion

Given the overall response rate of 24% to the mailed survey, some caution is appropriate in drawing conclusions relating to the total population of Canterbury

[68] The induction of lactation by hormonally treating cows to calve early to gain 'days in milk' has been used for a number of years in NZ.
[69] Production data reported in NZ Dairy Statistics (p. 15) is sourced from NZ dairy companies and is estimated to represent nearly 100% of the industry (pers. comm.., S. Harcourt, LIC analyst).

dairy farmers. A phone survey of a selection of dairy farmers was considered to determine if the survey was representative; however, the industry organization providing the addresses would not divulge the names of farmers.

Those who did respond can be characterised as well educated, high performing farmers who have a strong focus on cash returns and who access information from diverse sources. Among those information sources, the LUDF, DairyNZ events and other farmers all rated highly. Focus days and the use of the SIDDC website were complementary information sources with 68% using each. It would appear that Focus Days were primarily for the appraisal of appropriate technologies with the website used primarily for on-going benchmarking of performance. Farmers were discriminating in their adoption of technology, with adoption being high for technologies that were seen as giving clear economic payoffs (grazing management).

The majority of respondents were aware of the messages given by the farm managers around grazing and environmental issues, but fewer than 50% were aware of other promoted practices (irrigation monitoring, re-grassing, reproductive technologies). The majority of farmers did not follow the reproductive technologies practised at the LUDF.

As farm systems intensified from System 1 to System 5, the respondent farmers milked more cows, produced more milksolids per cow and produced more milksolids/ha. The operators of more intensive farms were more likely to attend DairyNZ events. However, as systems intensified, farmers were less likely to attend LUDF Focus Days to learn about grazing and animal management techniques.

When asked whether the adoption of LUDF technologies had made farming easier or harder, 70% felt that it had made management easier with most of the comments supporting the adoption of low grazing residuals and pasture monitoring. A number of those who said it made management harder commented that adoption was still worth the effort.

The proposal that the LUDF has been a factor in increased productivity in the Canterbury dairy industry was partially supported by the survey findings that the Canterbury farmers who attended focus days and answered the survey have larger farms, higher milk production per cow and higher production per hectare than non-attendees. In addition, Table 9.6 shows that there has been an increase in cows/hectare and milksolids/hectare from 2000-01 to 2009-10 on Canterbury farms as compared to the aggregate of the South Island and the North Island. This could reflect the high stocking rates maintained by the LUDF.

Although the LUDF was identified by informants in Chapter 7 as a driver of growth, in reality, it was not a driver like other factors nor was it an enabler such as the Alpine Dairy Company. It is proposed that the LUDF was a facilitator of growth. This is because growth would have occurred and been enabled by other factors discussed, but the LUDF had a positive effect on growth through contributing to increases in productivity and profitability[70].

[70] In the 2011-12 season the LUDF adopted changes designed to increase productivity and profitability without increasing the farms environmental effects. These steps included a reduction in stocking rate from 4.2 cows per hectare to 3.95 cows per hectare, utilising a mower to maintain pasture quality and intake instead of a higher stocking rate, the creation of two herds of cows for management purposes, with a greater emphasis on attaining higher body condition scores, and the increased use of nitrogen and giberellic acid. The adoption of these changes will be the subject of a future research project.

Chapter 10
Discussion and conclusions

10.1 Introduction

The purpose of this chapter is to present the research findings in relation to the research questions posed in Chapter 1. The concluding statements suggest factors that will contribute to the development of an industry. Section 10.2 contains a discussion on the proposition that industry development was the result of interconnected drivers, enablers and facilitators throughout the waves with the results presented graphically in Figure 10.1. A review of Research Question One as to the characteristics of the establishment and growth of dairy farming in Canterbury is presented in Section 10.3. Section 10.4 details business growth and wealth creation for participants to answer Research Question Two. Section 10.5 discusses Research Question Three as to the factor conditions that drove growth. Section 10.6 compares the development of the Canterbury dairy industry to literature on industry development from Research Question Four and Section 10.7 proposes emergent insights from the development of the Canterbury dairy industry to answer Research Question Five. Section 10.8 proposes the contribution to theory of the thesis. Section 10.9, discusses limitations of the research and Section 10.9 suggests future research.

10.2 Drivers, enablers and facilitators

The review of literature on industry development, extension and industry history led to Figure 6.4, which proposed possible factors for the development and growth of the Canterbury dairy industry. The case study research of industry participants in Chapter 7 amended these factors based on the experience of the participants. It was also recognised in Chapter 7 that development occurred in three waves, roughly occurring in the 1980s, 1990s and 2000s. Chapters 8 and 9 investigated two organisations that the Chapter 7 informants suggested were important for the growth and development of the industry.

Figure 10.1 proposes that within these waves, the factors would not have all been drivers of growth, but could be classified as drivers, enablers or facilitators of growth.

In some cases, the factors fit into two categories. Drivers are defined as factors that caused the growth to occur, with enablers defined as the factors that were necessary for growth and facilitators defined as factors that had a positive influence on growth.

Low land prices in Wave 1 encouraged entrepreneurial dairy farmers (usually from other dairying areas) to purchase land in Canterbury to convert to dairy farming. The lack of profitability in other farming systems drove sheep/cropping farmers to sell their land at low prices. A further driver was the human reasons of establishing an often larger farm in an area seen to have social advantages. Although the development of the irrigation resource was an enabler, it can also be seen as a driver. Informant 1 suggested that once water was added to a property, the highest economic use was as a dairy farm. Wave 2 saw the entry of corporate farmers as industry drivers. With more secure sources of capital and improved farming systems, the corporates converted many farms in pursuit of capital gains. In Wave 3, increased profitability in the dairy industry drove further conversions.

Enablers were the factors that were necessary for the growth to occur. In Wave 1, these included government policies and economic conditions which, in this case, followed the economic restructuring of the New Zealand economy. A further enabler was the industry infrastructure already in place which allowed faster growth, by removing many of the steps necessary for the development of a new industry. The development of the processing cooperatives in Wave 2 was an important enabler, as without the ability to process all the milk produced, growth would have slowed. The finance industry became an enabler of growth in Wave 2 and a facilitator of industry growth in Wave 3 through liberal lending policies.

In Waves 1 and 2 the development and adoption of new technology was an important enabler and facilitator. Informants suggested that improved irrigation technology, cowsheds, farm layouts and machinery were important. Other than irrigation, these technologies were available to the rest of the industry, but were more readily adopted by an area ‘starting from scratch’ with larger land areas.

Facilitators, although not driving or enabling growth, had positive influences. Most of the facilitators were found in Waves 2 and 3 and included new input suppliers, farms that dedicated their system to supporting dairy farms and new business structures that assisted the sourcing of capital for a ‘capital hungry’ industry. The Lincoln University Dairy Farm was a facilitator in Wave 3 that provided a forum for information and discussion that was one of a number of factors in the productivity and profitability increases. A further facilitator was the trend to increasing milk prices, particularly in Wave 3, a result of increased global demand.

It could be argued that there were additional factors that should have been covered in this thesis. For instance, there are a number of papers on labour in the dairy industry (Kyte 2008, Searle 2002, Tipples 2006) and the effect of dairy farming on the environment (Baskaran, Cullen and Colombo 2009, Clark et al., 2007, Tait and Cullen 2006). However, these areas did not feature in the literature on industry development nor did they emerge from the interviews with informants in Chapter 7 or Chapter 8 as being drivers, enablers or facilitators of growth.

Figure 10.1 is a schematic representation of the drivers, enablers and facilitators in the development of the Canterbury dairy industry.

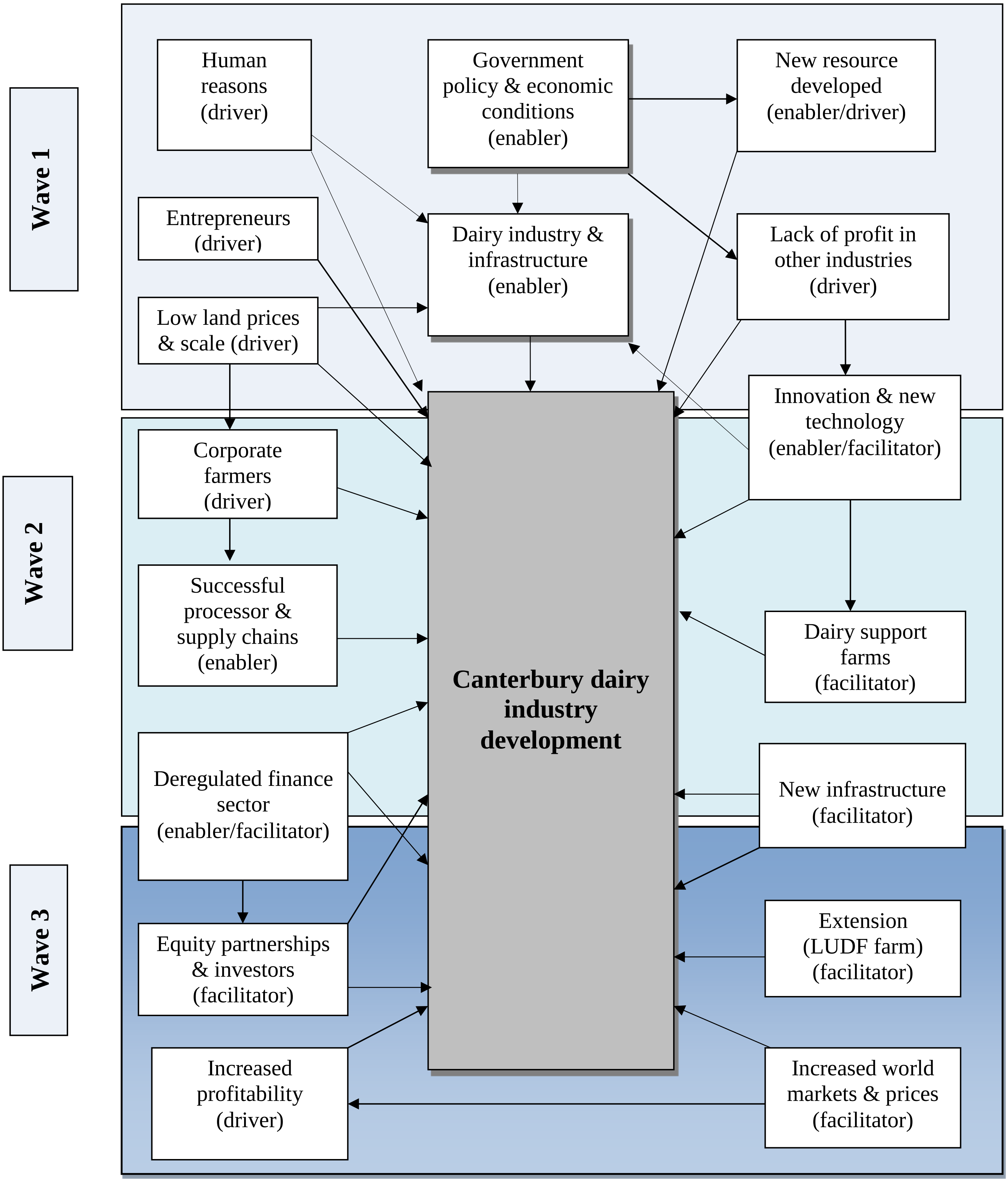


Figure 10.1 Interrelationships of drivers, enablers and facilitators in the development of the Canterbury dairy industry.

10.3 What were the characteristics of the establishment and growth of dairy farming in Canterbury? (Research Question One)

Analysis of the secondary data in Chapter 2 indicated ‘what’ had happened. The information showed that since the late 1980s the area devoted to dairy farming in Canterbury has increased from 20,000 hectares to approximately 200,000 hectares in 2009-10. Production of milksolids increased from 2% of the country’s supply to over 17% in the same period. Between the years 1984-85 to 2009-10, milksolids production increased throughout the country with the North Island increasing 1.5-fold, but Canterbury increasing by 25-fold. Between 1982-83 and 2009-10, the size of farms in Canterbury grew by 4.5% per year (compounded) and these farms in 2009-10 were twice the size of North Island farms. From 1994-95 to 2009-10, stocking rates increased to 3.3 cows per hectare as compared to 2.8 cows per hectare for the rest of the country. From the late 1990s, average production per cow and per hectare was higher than the averages for the North and South Island. Although an increasing real milk price (Figure 2.1) encouraged growth in the entire New Zealand industry, the extent of growth in Canterbury indicated that there were other factors involved.

10.4 How has the development allowed business growth and wealth creation amongst participants? (Research Question Two)

The MAF dataset in Chapter 2 showed that the market value (referred to by MAF as capital investment) in New Zealand dairy farms on a per hectare basis was similar until 2007-08, at which time dairy farms became more expensive in Canterbury. However, given the higher level of milksolids production achievable in Canterbury, capital investment per kg milksolids has always been lower, e.g. $40 per kg milksolids in 2010-11 compared to $48 per kg milksolids for the rest of New Zealand. During this time, debt per hectare was higher in Canterbury, but the higher production per hectare resulted in debt levels that were similar to industry averages on a per kg milksolids basis. Historically, the market value of dairy farms in the rest of the New Zealand industry was higher and debt per hectare was lower than Canterbury. This resulted in higher levels of equity (net worth) per hectare for the rest of New Zealand. But, by 2008-09, the equity levels per hectare were similar, which was a factor of market values per hectare increasing faster in Canterbury than debt per hectare.

Profitability data from MAF surveys suggested that common operating measurements for the aggregate of the New Zealand dairy industry areas were similar to Canterbury until 2000. From 2000, per hectare gross farm revenue increased along with cash farm expenditure in Canterbury. However, the cash farm expenditure per kg of milksolids and cash farm surplus per kg of milksolids were much the same as in other dairying regions and the higher production per hectare caused the cash farm surplus per hectare to also be higher in Canterbury. DairyNZ calculations of operating profit per hectare using a different method showed Canterbury to be more profitable than other areas in years of high milk payments. It is suggested that the ability to rapidly increase production through sourcing readily available supplements in Canterbury combined with the production reliability as a consequence of irrigation contributed to higher profits in high milk payment years.

A leading reason for ‘why’ there has been an increase in dairying is found in Figure 2.19 which shows that the return on capital has been consistently higher in Canterbury since 1999-2000, ranging from 4% to 16%, with an average of 9%. For the aggregate of the New Zealand industry, the return on capital has averaged 4%. The case study farm analysed in Chapter 3 entered the Canterbury dairy industry in late 1987 (Wave 1) and grew real equity (constant value dollars, 2010) at an average of 20% per year with a return on capital averaging in excess of 10% per year, from entry until 2009-10. These gains were largely due to real estate purchases and conversion, but also included growth in other assets such as livestock, cooperative shares and machinery. The case study farmers achieved very high returns from the investment in their processing cooperative during the mergers of the 1990s and early 2000s. The entrepreneurial profits for the case study farmers were largest in Wave 1, through purchasing lower priced assets and securing water rights. This same pursuit of entrepreneurial profits was a factor for the entry of corporate farmers to the industry in Wave 2.

10.5 What factor conditions drove or constrained growth? (Research Question Three)

Informants in Chapter 7 confirmed the role of entrepreneurs particularly in Wave 1. Most informants suggested that the early converters captured significantly more entrepreneurial profits than the later waves. This was confirmed by the case study farm in Chapter 3, which achieved capital gains in all three waves, but the gains were much larger in Wave 1. Several participants stated that the initial analysis of the cost of purchase and conversion in Wave 1 was not always rigorous.

Although it would seem logical that productivity could be higher than elsewhere in New Zealand due to irrigation, production and profit were similar until the new century (see Chapter 2). A number of informants suggested that the major research/extension providers were not interested in the industry until the LUDF was initiated in 2001 (Wave 3). Although a number of factors would influence productivity, informants suggested that there was a positive effect on production and profitability from the establishment of the LUDF.

The informants did not appreciate the effects of international trade negotiations or changes in international markets, as described in Chapter 6. However, informant 7 suggested that the Uruguay Round of WTO negotiations were very good for the dairy industry, but bad for the New Zealand arable sector. If so, then the changes in relative profitability could have encouraged increased conversions to dairying. In late Wave 3, international market prices were influenced by increased demand from Asian markets. Additionally, industry participants (from the governance and management sectors) interviewed by Conforte et al. (2008, pp. 49), suggested that the industry's success in international marketing could be attributed to the support of government through "legislative support and reduced global subsidies".

Informants did not suggest that there was a large involvement of government in the development of the Canterbury industry. Informants could be correct in this regard as the growth occurred after the removal of most government support for agriculture in the 1980s. But, the removal of price supports (particularly to the sheep and cropping industries) meant that these farming systems became less economic and, so were more likely to be sold or converted to other farming systems like dairying. Figure 6.2 details the decline relative to dairy prices for wool and wheat during the three waves. The loss in profitability of the historic sheep/cropping systems was a major driver of development.

The economic conditions of the times were also a driver of change. The restructuring of the New Zealand economy caused land prices to fall in the late 1980s, which led to increased opportunities for established and new land owners. Since the restructuring, farmers have not been able to ‘farm’ subsidies and, in the opinion of informants and the LUDF survey participants, farmers have focused on production and profitability. As well as removing farm price supports, the financial industry was deregulated late in Wave 1. A number of informants discussed the difficulty in obtaining finance in Wave 1, but were able to source capital more easily in Wave 2 and some suggested that the financial institutions were far too liberal in Wave 3. It could be said that the finance industry hindered growth in Wave 1, was an enabler of growth in Wave 2 through more relaxed lending policies and a facilitator of growth in Wave 3 when lending policies became more liberal.

A number of informants expressed the advantages of being involved in large vertically integrated processing/marketing cooperatives. An informant with a history in the cropping industry (I7) mentioned that marketing his milk through a cooperative allowed him to concentrate on production. A survey by Forney[71] (pers. comm.) of Southland sheep and beef farmers who converted to dairy farming found that many left the meat industry because, “Farmers were sick of what they saw as the incapacity of the sheep and beef industries to overcome problems”.

The history of dairy farming in New Zealand and Canterbury meant that there was the human capability to manage dairy farming systems, as well as a history of processing. In particular, the success of the processing cooperative, Alpine Dairy Products was an enabler of growth in Wave 2. The company coped with ever increasing volumes of milk, financing growth and dealing with pesticide and quality issues. At a number of stages in the company’s history, different decisions would have altered the course of

[71] Jeremie Forney completed a post-doctoral fellowship at the University of Otago in 2011.

the Canterbury dairy industry. A number of informants questioned whether Alpine would have been successful without the support of the state sanctioned New Zealand Dairy Board. Several sources interviewed about the Alpine Dairy Company suggested that a cooperative was necessary for development of the industry in Waves 1 and 2, as proprietary companies would not have been as prepared to spend the time and money necessary to solve the problems that arose.

Innovation and new technologies are considered enablers and facilitators of industry development. In Waves 1 and 2, innovations in irrigation technology enabled deeper wells, more labour efficient delivery systems and increased watering efficiency. Facilitators that contributed to growth in Wave 2 were improved methods for organizing the farm layout and cowsheds, and management techniques for large herds. The most widely adopted technology introduced by the LUDF (low grazing residuals) was suggested to have been a facilitator of improved profitability in Wave 3 by some informants and survey participants.

Chance events had negative effects as in the case of DDE contamination, oil price rises and inflation, but the industry always managed to adapt through research and striving for improvements in productivity.

The more intense use of the irrigation resource was considered an important enabler of development. Although irrigation had been part of Canterbury farming since the 1940s, it was seen as a means of coping with drought rather than as a means of increasing farm output. Stewart's (1963) findings that irrigation in itself did not improve farm returns under the farming systems of the time (sheep/cropping) were prophetic when the subsidies supporting these farming systems were removed at the start of Wave 1. Thus, if a farmer had irrigation he was often driven to convert (or more likely sell) his property due to the superior relative economics of the dairy industry - either way there was a financial gain and dairy industry growth.

Human reasons were drivers, particularly in Waves 1 and 2. The developing dairy industry in Canterbury gave individuals the opportunity to purchase farms with the hope of more stable production through irrigation. Informants suggested that Wave 1 converters often moved to Canterbury for a number of reasons not completely associated with the pursuit of profit. Suggestions were that families moved to improve social and educational opportunities, for the challenge of being part of something new and to develop larger farms than would be available in other dairying areas. The lower price of land was an attraction; particularly for North Island farmers who could purchase twice as much land in Canterbury for the same amount of money. In reality, farmers in all waves moved for the very human reasons of improving their lives and financial position. Further research by Forney (pers. comm.) of Southland sheep and beef farmers who had converted found similar human reasons, but added that the Southland farmers also saw conversion as a method of succession planning. The existing farming systems could not support a second family, but a dairy farm could.

The motive of capital gains and profit drove corporate farmers to invest in what they considered to be ‘cheap land’. Informants in Chapter 7 and Chapter 8 commented that corporate farmers developed improved methods for converting farms to dairying, were more financially disciplined and instilled in farmers a positive attitude to multiple farm ownership. Although the initial entities departed the industry within ten years due to low operating profits, they left a legacy of alternative business structures to traditional family farms. These included what is described as ‘family corporates’ and ‘equity partnerships’.

The availability of land for supporting the dairy industry was an important facilitator of industry growth from Wave 2. These blocks allowed a higher stocking rate by removing the replacement heifers from the ‘milking platform’. In addition, support blocks became important for grazing cows in the winter and for the production of supplementary feed. Winter grazing and higher levels of supplementation were an integral aspect of the development of a Canterbury dairying system versus traditional self-contained systems.

Although there were factors that constrained growth during industry development, these were overcome by the enablers.

10.6 Does Canterbury dairy growth compare to industry development theory and forces? (Research Question Four)

10.6.1 How does Canterbury dairy growth compare to industry development theory?

When compared to the definitions of an industry as discussed in Chapter 4, the Canterbury dairy industry does not fit Porter's definition (1980, p. 5) of "a group of naturally selected firms that are producing products that are close substitutes in the market place". The Canterbury dairy industry is a sub-set of a much larger industry that competes on the world stage rather than in the domestic market and produces the same product rather than close substitutes. Likewise, the growth in all waves was not the result of a 'punctuated equilibrium' (Gould and Eldredge 1977, Piore and Sabel 1984).

The findings of the research tended to confirm the theory of Van de Ven and Garud 1989, pp. 195-225, that a new industry must develop an instrumental subsystem, a resource procurement subsystem and an institutional subsystem, although, in this case, not in that particular order. As detailed in Chapter 6, there has been a long history of dairy farming in New Zealand (institutional subsystem), which allowed rapid Canterbury growth since the subsystem was largely in place. The generations of farmers before the development of the Canterbury industry had continually innovated to develop pasture-based systems and a processing/marketing infrastructure. Individual entrepreneurs who began their careers in the industry in other areas, but moved to Canterbury for the reasons listed in Chapter 7, formed the nucleus of the innovators who lead the development that was a necessary part of the instrumental subsystem. However, since most of these technologies were adapted from other areas rather than invented in Canterbury, the instrumental subsystem does not exactly match the Van de Ven and Garud model (ibid). The development of the resource procurement subsystem was a response to the arrival of the entrepreneurs. However, this subsystem did not become fully functional until Wave 2, when the input supply, extension and financial sectors became more involved in the industry. The instrumental subsystem included the Alpine Dairy Products cooperative (Chapter 8), whose success was important for the industry to develop.

The Canterbury industry follows a number of Schumpeter’s theories of “new combinations” (1961, p. 66), in that the development of irrigated dairy farming was a new method of production utilising a new supply of raw material (surface and ground water), as established in Chapter 7.

“Clustering”, as suggested by Baptista (1996) was possibly important for growth as it resulted in the development of skilled workers, input suppliers and the ‘spillover’ of technologies among local farmers through discussion groups, the demonstration-farm and consultants.

A number of the problems for new industries as suggested by Van de Ven et al. (1989) were identified by the informants in Chapters 7 and 8. The farmers, their cooperatives and suppliers were often undercapitalised. Alpine Dairy Products was noted for poor quality product and on-farm production was often lower than predicted at the time of a conversion. Informants in Chapter 7 mentioned that business plans in the early years were either non-existent or wrong. These factors, in addition to the human reasons associated with moving to a new district, leaving family, adapting to a different climate and farming environment, led a number of ‘immigrants’ to depart the area before rapid growth in the industry occurred in Wave 2.

Porter’s comments on the appropriate time to enter a new industry (1998, p. 221) were confirmed by the case study farm (Chapter 3), as the partnership was able to enter the industry at a time of low land prices. The experience gained during these early stages of industry development and the ability to acquire lower priced resources (water, land, cattle) was a considerable advantage in later years. However, early entry has led to a degree of technological obsolescence for the case study farmers in Wave 3. The entrepreneurial profits obtained by early entry have provided the equity necessary to allow the adoption of new technologies.

Porter’s (1990, p. 72) Diamond of National Advantage (Figure 4.1) provides explanations for some of the elements of success in the Canterbury dairy industry. Factor conditions such as human resources, physical resources, knowledge resources and climate have been important for the development, as outlined in Chapters 6 and 7. A long history of farming in the province and dairying in New Zealand have been important for the development of technologies involving farming systems and processing, which Porter (ibid) described as “related and supporting structures”. Porter’s definition of demand conditions does not fit with the New Zealand dairy industry, but Cartwright’s assertion (as quoted by Rugman and Verbeke 1993, pp. 71-84) that international rivalry is more important for small exporting countries is relevant in the context of the New Zealand dairy industry. The strategy of firms and their structures have been important as evidenced by New Zealand farmers supporting cooperatives and vertical integration for many years. Although the informants in Chapter 7 did not state that government input was important, a state sanctioned trading monopoly like the NZDB could have only existed with government support. However, informants did state that government has recently become more involved in the industry through concerns over the environmental effects of dairying, which has, subsequently increased compliance costs.

There have been a number of constraints to industry emergence, as predicted by Porter’s “five forces of industry competition” (1998, p. 4). In early years the Canterbury industry suffered from low product prices due to quality problems and oversupply on the world markets (Chapter 8 and 6). In other words, the buyers had a great deal of control. In Wave 3, suppliers received higher prices due to increased demand, but from a production point of view they faced higher costs due to the competition for the basic resources such as water and land as well as increased production costs.

Although the Porter literature on industry development is informative, the Canterbury dairy industry is different as producers are not competing with each other. Dairy farmers are producing an undifferentiated product at the producer level, which the major cooperative processes and markets. Additionally, there is cooperation at the institutional subsystem level between the cooperatives and the proprietary firms in regard to research, extension and industry legitimisation.

10.6.2 Has innovation and technology development followed the literature?

The definition provided by Afuah (2003, p. 4) suggests that innovations arise from the discovery of a new technology and adoption. However, in the case of the Canterbury dairy industry, on-farm problems tended to arise when transferring established technologies to a new environment. This was compounded by the need to create new technologies to improve and expand irrigation and farm larger herds. Informants (Chapter 7) spoke of successes and failures with these technologies.

Schumpeter (quoted by Afuah 2003, p. 14) originally theorised that small entrepreneurial firms were the leading sources of innovation, but later stated that large firms with monopolistic powers were more important for innovation due to their financial strength and lack of competition. In the case of the Canterbury dairy industry, the monopolistic powers of the NZDB (Chapters 6, 7 and 8) were important in supporting the processing cooperative's development. However, informants in Chapter 7 suggested that entrepreneurial firms (farmers and their suppliers) were more important for developing the on-farm technologies required. These findings support the contention of Van de Ven and Garud (1989, p. 196) that "seldom can such technological innovations be developed by a single firm alone in the vacuum of a community or industrial environment".

Afuah (2003, pp. 37-39) and Van de Ven (1993a, p. 216) have suggested that "people types" were necessary for innovation. The Canterbury industry has had a number of 'champions', 'sponsors' and 'project managers' as detailed in Chapters 7 and 8. The development of a "pool of competence" as suggested by Van de Ven has been encouraged through training organizations, universities and SIDDC. An informant (Chapter 7) felt that dairy farmers in Canterbury were particularly good at adopting innovations due to the calibre of people involved. Although this statement may have been supported by the findings of high levels of education in the LUDF survey, there could have been a bias with more highly educated farmers tending to answer surveys.

An aspect mentioned by informants in Chapter 7 was the social effects of the new industry. In a traditional sheep/cropping area, the arrival of dairy farmers was not always viewed in a positive way. This conforms to Van de Ven's (1986, pp. 592-595) comments that humans are inclined to focus on protecting existing practices rather than moving in new directions. However, he noted that people gradually adapted to changing conditions as shown by many of the farmers in Wave 3 who converted to dairying for purely economic reasons. Perhaps a criticism of the Canterbury industry has been a failure to gain "socio–political legitimation", as discussed by Aldrich and Fiol (1994, p. 648). These authors propose that a constraint to an industry can be where the industry fails to obtain acceptance from the "general public, key opinion leaders and government officials that a venture is "appropriate and right". Although the government has been generally supportive of the dairy industry, mass media publications frequently report on concerns in regard to future industry growth.

From this research it appears that new technologies can be developed endogenously from within the instrumental subsystem (user innovation) or they can be imported via an innovation system of research, development and extension (R, D & E). A third alternative is that innovations are imported from overseas either directly by users or indirectly through the R, D & E system.

10.6.3 Do Canterbury dairy farmers conform to the literature on entrepreneurs?

Schumpeter (1961, pp. 92-93) defined entrepreneurs as: "individuals who carry out new combinations; or the bearers of the mechanism of change". He expressed the view that many entrepreneurs pursue their goals not strictly for financial purposes but to "develop a kingdom, to prove oneself superior or to create". Chapter 7 identified that a number of the Wave 1 farmers fit the description of an entrepreneur in that they were inspired by the challenge of dairying in a new area and the ability to develop large farming ventures utilising lower priced land and irrigation. The slow development of the Canterbury dairy industry until rapid growth in the early 1990s agrees with Van de Ven's assertion (1993a) that there are many innovations and entrepreneurs necessary for a new industry. Waves 2 and 3 farmers were more closely aligned with Stewart's (1998) small business owners than the entrepreneurs of Wave 1, as they were more concerned about income and wealth creation and less likely to be involved for the challenge alone.

The research found that Canterbury dairy farmers are highly motivated. Respondents to the LUDF survey were found to be well educated and high performing with a strong focus on cash returns. They enjoyed being ‘their own boss’. Those who took advantage of the LUDF programmes (68%) had larger farms, higher milk production per cow and per hectare than non-participants. These findings correspond positively with the comments of Nuthall (2010, p. 38) and Kanfer and Ackerman (2000, p. 470) that motivated farmers have a need for achievement and mastery of an endeavour.

10.6.4 How does the Canterbury dairy industry compare to other new agricultural industries?

Woodford (1997, p. 21) cites Wollon (1995) who suggested that new industries arose from an “irregularity that acts to deconfigure the industries deep structure”. The economic restructuring of the New Zealand economy and the effect of changing government policies had a profound effect on the profitability of traditional Canterbury farming systems (Chapter 6). Informants in Chapter 7 suggested that the lack of profit in other agricultural sectors contributed to traditional farmers selling to Wave 1 farmers and the continued lack of profitability in sheep and cropping encouraged the conversions in Waves 2 and 3. The contention of Hyde (1998, pp 2-3) that new industries developed to “improve standards of living and to fulfil an innate personal yearning to do something different or better” was confirmed by the informants in Chapter 7.

The literature on new agricultural industries also stresses the importance of developing markets, managing product quality, developing production techniques, establishing research and development infrastructure and the need for adequate finance. The establishment of markets was not a hindrance for the development of the Canterbury industry, as overseas marketing existed through the NZDB. Although, a research /extension infrastructure existed in the New Zealand dairy industry, informants in Chapter 7 suggested that the established providers did not become involved until Wave 3. However, the informants stated that the LUDF contributed to increased productivity in Wave 3 through the demonstration of a farming system suitable for the Canterbury environment. Wood, Chudleigh and Bond (1994) suggested that an industry champion was not necessary for “high growth rates and gross values”. However, the informants in Chapter 7 identified a history of leadership in the industry starting with the first entrepreneurs in Wave 1 who led by example. Sources in Chapter 8 suggested that Alpine Dairy Products benefitted from strong leadership at the board and management level. Previous authors have commented on the importance of managing product quality. An unanswered question revolves around the development of leadership in a developing industry – were farmers with leadership ability attracted to the new industry or do the events that can affect a new industry (DDE, industry restructuring, economic restructuring) build leadership? At the processing level, poor product quality in the 1980s and early 1990s were a major issue for the local industry. The creation of TQM programmes and research on environmental contamination, along with the incorporation of new processing technology by Alpine Dairy Products, solved these problems.

The literature also suggests the importance of capital. Early converters and their cooperative were often undercapitalised. Innovative financial instruments were required to finance the processor and new business structures have allowed farm businesses to growth.

10.6.5 Has the development of the Canterbury dairy industry followed theories on diffusion, adoption and extension?

Rogers (2003, p. 5) as discussed in Chapter 5 defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. In this case, the innovation of dairy farming in Canterbury was proven to be a viable option to sheep and crop farming by the Winchmore irrigated research farm in the 1950s. However, the government policies and economics of the time allowed traditional farming systems to continue, as pointed out by several informants in Chapter 7. A number of Wave 1 farmers initially considered Canterbury after reading media articles about the potential for dairy farming in the province. A small industry did develop, but several informants in Chapter 7 stated that the growth was not completely supported by the existing consultants. However, there were a number of opinion leaders who became the centre of interpersonal communication networks as outlined in Chapters 7 and 8.

The first wave of growth of the Canterbury dairy industry coincided with the exit of government from extension activities and the devolution of the Ministry of Agriculture to a number of Crown Research Institutes (Chapter 5). Although the NZDB operated discussion groups, there were no private dairy consultants specialising solely in dairy farming until the late 1980s. However, there was a high level of user innovation – facilitated by the NZDB discussion groups. The informants in Chapter 7 indicated that once specialist private consultants became involved in Wave 2, they were very important to development. Although Lincoln University (Chapter 9) had long operated a dairy farm, it was on heavy soils (unlike the conversions) and hence was not a successful extension tool according to the informants in Chapter 7. In the early 2000s a new farm was developed on land similar to many of the conversions of Waves 1 and 2. Operated as a demonstration farm, the LUDF extension messages of low grazing residuals, environmental management and monitoring could be judged a success according to the Chapter 7 informants and the Chapter 9 survey. The involvement of commercial partners in the LUDF was a novel method to provide funding, as government support for agricultural extension was reduced in the economic restructuring of the New Zealand economy.

The development of the Canterbury dairy industry corresponded with the privatisation of the New Zealand economy and the decline of the “linear model of extension” (Paine 1997, p. 37). The LUDF survey in Chapter 9 suggested that farmer’s sources of information were diverse and included extension personnel, demonstration-farms, media and other farmers. However, the key messages of the LUDF were driven by scientists and farm management professionals, thus they incorporated aspects of the linear model. Scientists and experts were involved in the direction of the farm, but because there was also an involvement of farmers through the SIDDC business advisory group, the technique could best be described as co-learning. This ensured that techniques demonstrated were seen as relevant by farmers.

Previous research on the adoption of innovation in New Zealand agriculture has found that management innovations requiring nothing more than more intensive management were more readily adopted than capital intensive innovations. The introduction of a new practice was suggested to be an important motivator of learning by Grey, Parker and Kemp (2003, pp. 116-119), and several authors (Nuthall 2010, p.

91, Flett 2003, p. 2) suggested that the complexity of an innovation and the ability of the farmer to trial and view the results of an innovation were important. The LUDF results (Chapter 9) on the rapid adoption of low grazing residuals confirmed the literature. Rates of adoption were lower for reproductive management procedures that were more expensive to implement, with results that were more difficult to measure.

10.7 What are the emergent insights from the Canterbury dairy industry for industry development theory? (Research Question Five).

10.7.1 Changing levels of profitability

The lack of profit in other farming systems was a driver for dairy industry development in Canterbury. As government subsidies were removed in the 1980s, the traditional farming system of sheep and cropping became less profitable, primarily due to declining prices for wool and wheat (Figure 6.2). Although dairy prices also dropped in the late 1980s, they recovered from 1990 and, along with lamb and beef, have remained more profitable than the wool and crop sectors. Because dairying was more profitable, dairy farmers could pay more for land and with the advent of improved technologies for irrigation, an irrigated dairy industry developed. The higher land prices encouraged the traditional farmers to sell their land to the ‘immigrant’ dairy farmers in Waves 1 and 2. In Wave 3, a number of conversions were from cropping farms due to the ‘push’ of lower crop prices and the ‘pull’ of higher milk prices making dairying a more profitable option. As shown in Chapter 2, Canterbury has shown a high return on capital in the 2000s which would be an obvious driver of growth. Although dairying was different to traditional farming systems operating in Canterbury at the time, a number of basic farming principles are shared (e.g. soil fertility), which allowed more rapid conversion to the new system.

Conclusion: Changing levels of profitability between farming systems was a driver of land use change.

10.7.2 Development of a resource

The development of the irrigation resource was initially an enabler of growth as farmers learned to operate dairy farms with irrigation. Without irrigation, dairy farming on light land was not practical. Not only did irrigation allow dairy farming, but it also resulted in increased production. The increased production documented in Chapter 2 was largely the result of a stable feed source (pasture), due to irrigation. Irrigation became a driver of growth, as the profitability of irrigated dairy farms exceeded competing land uses.

Conclusion: The development of a resource will drive change.

10.7.3 Entrepreneurs

Another driver of growth was the entrepreneurial profits obtained from purchasing Canterbury land with irrigation potential and converting the existing farming system to dairy farming. Figure 7.4 details the differences in prices per hectare for dairy, cropping and fattening land since 1988. In nearly all years land devoted to dairy farming was valued higher and thus a conversion to dairy farming from other uses resulted in gains in land value, which encouraged further investment. Industry development was enabled and driven by the development of the water resource.

Conclusion: The ability to increase wealth through the conversion of other farming systems to dairy farming was a driver of growth.

10.7.4 Human reasons

A number of Wave 1 farmers became Canterbury dairy farmers for reasons other than (or as well as) the pursuit of profit and wealth creation. Informants in Chapter 7 suggested that Canterbury (with Christchurch as an urban centre) provided more educational, sporting and cultural options. Additionally, a number stated that they were challenged by being part of a developing area and a new farming system (irrigated dairy farming). Informants commented that most Wave 1 and 2 farmers moved to the area from other parts of New Zealand or overseas.

Conclusion: Human reasons such as the social and educational opportunities in a new area as well as the ability to fulfil growth and personal objectives are important to drive industry development.

10.7.5 Innovation, technology and extension

In a rapidly growing industry, new technologies and their adoption must also be rapid. In the case of the Canterbury dairy industry, it was particularly helpful that many technologies could be adopted from the existing New Zealand dairy industry. However, the Canterbury climate, soils and larger farms required solutions specific to the area.

Although a research and extension infrastructure existed in the wider dairy industry (Chapter 5), these providers were slow to respond to the growth in Canterbury dairy farming. Informants in Chapter 7 indicated that for Wave 1, ‘user innovation’ was important. By Wave 2, specialised dairy consultants began to have an effect on industry development. In Wave 3, the existing infrastructure established offices, research facilities and demonstration farms in the area. Productivity increased in Wave 3 (Chapter 2), which can be attributed in part to the influence of research and extension. However, as shown in Chapter 9, farmers obtain information from a wide range of sources. The farmer survey established that adoption was higher for clear messages that were simple to understand and implement and which had positive economic benefits. Extension was an important facilitator of growth, but not a driver or enabler. User innovation and the diffusion of those innovations through discussion groups and consultants were important for early Canterbury dairy industry growth.

Conclusion: The development and adoption of new technologies are important enablers/facilitators for the growth of a new industry. Extension was an important facilitator, particularly when the extension methods contributed to productivity and profitability increases.

10.7.6 Cooperatives

The processing industry must be able to accommodate growth for the industry to develop rapidly. It was important for the growth of the Canterbury dairy industry to be able to join an established instrumental subsystem. The local processor organised as a cooperative, was important as the entity was forced to deal with farmers/members and the problems they encountered. It is considered unlikely that a proprietary company would have suffered the economic losses necessary to overcome many of the problems or been willing to construct the infrastructure to accept all the milk produced by farmers. The quality of governance and leadership of the cooperative was deemed very important by the sources in Chapter 8.

Conclusion: Properly governed cooperatives are an appropriate structure for industry development in agriculture. The ability to join an established integrated vertical supply chain was important.

10.7.7 Industry History

The institutional subsystem in place prior to the development in Canterbury allowed rapid growth. In Chapter 6, it was determined that New Zealand had a long history of dairy farming, with the New Zealand government nurturing and supporting the industry since the late 1800s. Throughout this history, industry governance, legitimisation and regulations/standards had been established. The monopoly position of the New Zealand Dairy Board and Fonterra may have been a positive factor in growth. Government activities in relation to trade and market development have been important for industry success. The deregulation of financial markets made a positive contribution to the availability of capital.

Conclusion: An enabler of industry development in a new area is the appropriate political and economic environment. The presence of government support in trade issues is important for an exporting industry.

10.7.8 Support infrastructure

A number of other enablers/facilitators were required as part of the resource procurement subsystem. These included input suppliers and other service providers, as well as farming systems that supported the dairy industry. The acquisition of capital was an important factor in industry development. Chapter 7 informants spoke of the difficulty of obtaining finance in Wave 1, but by Wave 3 liberal lending caused problems. The entry of corporate farmers was an early source of capital with investors becoming involved in Waves 2 and 3.

Conclusion: The development of a resource procurement subsystem is necessary to provide the inputs needed for an industry. The acquisition of capital for investment in the industry is particularly important.

10.8 Contribution to theory

The theoretical insights that have emerged from this thesis are presented in this section within a generic framework that has the potential to assist investigations of industry development in other contexts. Some of the insights presented in this section emerged directly from the data and others emerged from a process of a comparative analysis of data with existing theory.

Given the constructivist nature of this thesis, theoretical insights are seen as giving rise to constructs. The value of these constructs is to make sense of complex and 'messy' situations. Accordingly, theory development is seen as a continuous process in which existing theory is modified in the light of further evidence (Eisenhardt, 1989). Since theory is never complete it is expected that the constructs presented here will themselves be further developed and modified by further studies. It is hoped that the structural framework and associated constructs presented here, can assist the process of sensitisation for researchers investigating industry development in other contexts.

A key insight emerging from this thesis is the importance of the resource and institutional subsystems as defined by Van de Ven and Garud (1989). Although these concepts are not new, they have not received as much attention as the instrumental subsystem. For example, Porter, and his successors focus primarily on what is essentially the productive and processing sector.

A second key insight that emerges from this thesis is that most of the drivers directly influence entrepreneurial and subsequent participants in the instrumental subsystem. However, most of the enablers and facilitators lie within the resource procurement and institutional subsystems.

The entrepreneurs, and business developers that follow them, typically have little direct influence on the institutional and resource procurement subsystems - upon which they are dependent. Accordingly, if policy makers wish to influence industry development, then consideration needs to be made to removing constraints within the institutional and resource procurement subsystems. This is achieved by focusing on policies that enable and facilitate.

The comparison of the research results with the theoretical framework and literature leads to an enhanced generic framework (Table 10.1). Although influencing factors might be found in any of the boxes within this table, the more likely placements are denoted with 'X's.

The key drivers are essentially economic. These include product prices, factor costs (land, labour and capital) and the comparative economics of alternative enterprises. The industry initiators are typically entrepreneurial, however, in subsequent waves of the development process, the entrants may be less entrepreneurial in nature, and therefore respond to drivers in a different way.

The issue of marketing infrastructure is particularly important. In the case of the Canterbury dairy industry the presence of a strong processor together with the marketing infrastructure provided by the New Zealand Dairy Board was of major importance. Conversely, the failure of many industries to break through the initiation phase can be explained in terms of failure of the marketing component of the value chain (Wood, Chudleigh and Bond 1994, Hyde 1998, Greer, Greer and Zwart 2000).

The availability of the factors of production such as land, labour and capital, together with technology, is important in the resource subsystem to provide the inputs needed for a developing industry. These factors are similar to Schumpeter's theory of "new combinations" (1961). Although these factors lie within the resource procurement system, their availability is influenced by the institutional system.

The institutional subsystem is dominated by the enabling role of government in setting policies that create a supportive economic environment, as well as industry structures that legitimise and set standards for the industry. Extension can be a facilitator of growth for the instrumental subsystem, with the literature further indicating the importance of educational systems.

Table 10.1 An enhanced theoretical framework of industry development

	Instrumental subsystem			Resource procurement			Institutional subsystem		
	driver	enabler	facilitator	driver	enabler	facilitator	driver	enabler	facilitator
Economics:									
product prices	X								
factor costs	X								
comparative economics	X								
Processing infrastructure		X							
Marketing infrastructure		X							
Factors of production:									
land					X				
labour					X				
finance					X				
Technology					X				
Trade environment									X
Finance environment									X
Physical regulatory environ.									X
Labour laws									X
Research									X
Extension									X
Education									X

It is important to distinguish between key resources, such as finance, and the institutional subsystem which determines the availability of these resources. For example the changes to the New Zealand financial institutional system in the mid-1980s had a direct impact on the availability of finance in the resource procurement subsystem. Similarly, liberalisation of trade rules within the institutional environment can then impact directly on product prices which then flow through as drivers.

The innovation system is essentially part of the institutional subsystem, although user innovation may also occur within the instrumental system. Elements of the innovation system include research, extension and education. Industries typically emerge without a structured innovation system, but the subsequent development of an innovation system can play an important facilitation role. The absence of such a system may eventually lead to industry failure due to a lack of competitive advantage.

In summary, this research has built upon existing theory by proposing an enhanced framework that integrates a series of developmental waves within closely linked instrumental, resource procurement and institutional subsystems. The development drivers are economic opportunities that lead to actions by entrepreneurs who initiate the industry development largely within the instrumental subsystem. Although the focus of these entrepreneurs is often on production activities, there is a fundamental requirement for the development of a value chain that integrates production, processing and marketing. Further, the success of these initial entrepreneurs and later businesses that may follow in subsequent waves of development will be determined not only by their own endeavours, but also by the presence of enabling and facilitating factors. These business decision makers typically have little direct influence over enablers and facilitators; however, these factors can often be influenced by policy makers.

In particular, it is policy makers who determine the regulatory environment as it impacts upon land, labour, capital and product markets. In addition they establish the ‘rules of the game’ as they apply to the physical environment and land use changes. In terms of enablers, one is not more important than the other, because the absence of a single enabler can prevent the industry from developing.

For those concerned with the development of industries, it is important that consideration be given to the likelihood that the waves of development will have different characteristics and that there is a need for the alignment of the enablers, facilitators and drivers within each wave to the specific characteristics and needs of instrumental decision makers.

10.9 Limitations of research

The research was a mixture of quantitative and qualitative methods. Chapters 2 and 3 were quantitative. Chapters 7 and 8 were qualitative, with some elements of numeric data. Chapter 9 was quantitative within the hypothetico-deductive framework.

A problem with the quantitative data in Chapter 2 was the reliance on a series of non-linked static 'snapshots' of the industry at specific points in time. Therefore, results were only valid for internal comparison between years and regions within the specific data set. In addition, four years data was missing for some of the measures leaving a gap in the results. The quantitative information in Chapter 3 was only for one farm and although most data can be verified through accountant-prepared reports or published secondary sources, at times the chapter relied on data supplied by the case study farmer with no form of validation available.

Case study research has been frequently criticised for lack of rigour, often because the researcher has allowed ambiguous evidence or biased views to influence the findings. Other concerns have been that case studies provide little basis for scientific generalisation, that they take too long to conduct and result in large, unreadable documents (Yin 2009, p. 10). In this thesis every attempt was made to minimise these problems. Chapters 7 and 8 were case studies utilising information provided by industry participants, thus comments were the participant's 'story' of their involvement. Generic opinions were avoided unless it was in an area where the informant had a level of expertise. Some comments were removed during writing when they could be proven to be erroneous. The informants in Chapter 7 were purposively selected to cover the entire development period Although there were fifteen informants farming in Wave 3, only two of these were new entrants during Wave 3. Hence, there is a particular limitation surrounding the generalisations relating to the motivations of Wave 3 entrants. It is also possible that the leading questions asked in Chapter 7 to verify another informant's statements, influenced responses. When available, figures and tables were prepared to support statements gathered in the interviews.

Chapter 9 was a mail survey of farmers in the catchment of the Lincoln University Dairy Farm. The purpose of the survey was to gain information on farmer demographics, sources of information, learning styles and their interaction with a demonstration farm. The survey suffered from a low participation rate, but 146 responses (24% of survey) still provided valuable information for understanding the role of diffusion in a developing agricultural industry.

The thesis has been influenced by the author's involvement with the industry since 1987, as well as providing the base data for Chapter 3. Although every attempt has been made to justify all propositions and provide empirical data when possible, the thesis, at times, may have been affected by the author's experiences.

As previously discussed on p. 194, there are additional areas that have not been covered in this thesis, as they were not identified by the literature as potential factors of growth or by informants as drivers, enablers or facilitators of growth. These include the industry's effect on the environment and issues around labour management. It is recognized that these issues may have been a constraint to growth at the farm level, but they did not appear to be a constraint at the industry level.

10.10 Future research

In regard to the Canterbury dairy industry, the insights drawn within this thesis are not necessarily exhaustive of the insights that could be drawn, given additional fieldwork and investigations that go beyond the limits of one Ph.D. study. Additional studies, drawing on specific disciplinary lenses and associated perspectives may find further insights. There is also scope for a further study of the LUDF as an extension tool, given the change of farm system in 2011/12.

Possible research beyond the Canterbury dairy industry could include:

1) Applying the findings of this study within other dairy regions of New Zealand such as Southland.
2) Further studies of innovation within the New Zealand dairy industry, with a particular focus on source of innovations (NZ research, overseas research, commercial technology, and end-user innovation) and their dissemination.
3) The scope for applying the findings of this study beyond New Zealand in relation to innovation and industry development.

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Appendix A

Statistics used to prepare graphs in Chapter 2

Statistics used for Figure 2.1

Milksolids price (constant value dollars, 2010)

Years	Dollars
1990-91	3.62
1991-92	4.95
1992-93	5.34
1993-94	4.79
1994-95	4.70
1995-96	5.41
1996-97	4.86
1997-98	4.50
1998-99	4.73
1999-00	4.89
2000-01	6.29
2001-02	6.54
2002-03	4.41
2003-04	5.00
2004-05	5.24
2005-06	4.51
2006-07	4.81
2007-08	7.96
2008-09	5.23
2009-10	6.37

Statistics used for Figure 2.2

Canterbury dairy hectares

Years	Hectares
1982/83	15,594
1983/84	17,480
1984/85	17,875
1985/86	19,840
1986/87	20,190
1987/88	16,832
1988/89	20,007
1989/90	23,232
1990/91	16,357
1991/92	26,648
1992/93	40,082
1993/94	44,496
1994/95	53,336
1995/96	58,438
1996/97	64,548
1997/98	74,760
1998/99	84,592
1999/00	90,350
2000/01	90,560
2001/02	111,134
2002/03	120,432
2003/04	124,936
2004/05	131,127
2005/06	137,424
2006/07	146,413
2007/08	160,016
2008/09	188,235
2009/10	194,862

Statistics used for Figure 2.3

Trends in milk production

Years	NI	SI	Canterbury
1984/85	93%	7%	2%
1985/86	92%	8%	2%
1986/87	92%	8%	2%
1987/88	93%	7%	2%
1988/89	92%	8%	2%
1989/90	92%	8%	2%
1990/91	93%	7%	1%
1991/92	91%	9%	3%
1992/93	88%	12%	4%
1993/94	87%	13%	4%
1994/95	85%	15%	5%
1995/96	83%	17%	5%
1996/97	82%	18%	6%
1997/98	81%	19%	7%
1998/99	78%	22%	8%
1999/00	70%	30%	8%
2000/01	77%	23%	8%
2001/02	74%	26%	10%
2002/03	72%	28%	11%
2003/04	71%	29%	11%
2004/05	70%	30%	12%
2005/06	69%	31%	12%
2006/07	68%	32%	13%
2007/08	64%	36%	15%
2008/09	64%	36%	15%
2009/10	61%	39%	17%

Statistics used for Figure 2.4

Hectares per farm

Years	NI	SI	Canterbury
1982/83	64	70	69
1983/84	65	72	76
1984/85	63	71	72
1985/86	64	74	78
1986/87	64	75	75
1987/88	64	75	74
1988/89	65	75	81
1989/90	66	82	96
1990/91	69	84	95
1991/92	71	87	97
1992/93	72	91	98
1993/94	74	98	103
1994/95	77	109	118
1995/96	78	112	122
1996/97	81	119	132
1997/98	82	123	140
1998/99	84	130	156
1999/00	86	135	163
2000/01	88	137	160
2001/02	93	151	181
2002/03	100	164	193
2003/04	99	166	194
2004/05	102	171	201
2005/06	104	174	205
2006/07	107	179	213
2007/08	110	183	220
2008/09	113	191	223
2009/10	115	194	219

Statistics used for Figure 2.5

Cows per herd

Years	NI	SI	Canterbury
1980/81	131	100	89
1981/82	135	107	99
1982/83	139	112	110
1983/84	142	117	124
1984/85	147	127	150
1985/86	151	135	163
1986/87	152	145	187
1987/88	153	150	183
1988/89	158	151	187
1989/90	160	160	200
1990/91	166	170	209
1991/92	169	173	237
1992/93	179	188	226
1993/94	185	209	244
1994/95	186	249	307
1995/96	190	264	331
1996/97	197	283	366
1997/98	205	311	403
1998/99	212	330	424
1999/00	216	347	453
2000/01	232	354	463
2001/02	246	394	517
2002/03	256	422	561
2003/04	270	449	592
2004/05	280	470	623
2005/06	285	484	645
2006/07	296	505	683
2007/08	305	526	711
2008/09	314	546	719
2009/10	345	565	730

Statistics used for Figure 2.6

Cows per hectare

Years	N.Z.	SI	Cant.
1982/83	2.20	1.70	1.88
1983/84	2.25	1.74	1.95
1984/85	2.40	1.86	2.17
1985/86	2.40	1.95	2.30
1986/87	2.42	1.99	2.42
1987/88	2.46	2.05	2.43
1988/89	2.38	2.01	2.32
1989/90	2.40	2.00	2.05
1990/91	2.40	2.10	2.20
1991/92	2.45	2.15	2.30
1992/93	2.50	2.20	2.40
1993/94	2.50	2.30	2.53
1994/95	2.50	2.40	2.65
1995/96	2.50	2.40	2.80
1996/97	2.50	2.40	2.85
1997/98	2.60	2.60	2.95
1998/99	2.70	2.60	2.90
1999/00	2.70	2.70	2.95
2000/01	2.70	2.60	2.90
2001/02	2.67	2.58	2.82
2002/03	2.61	2.55	2.87
2003/04	2.75	2.68	3.02
2004/05	2.78	2.74	3.12
2005/06	2.77	2.75	3.17
2006/07	2.81	2.80	3.23
2007/08	2.83	2.86	3.25
2008/09	2.83	2.87	3.27
2009/10	2.81	2.91	3.34

Statistics used for Figure 2.7

Milksolids per cow

Years	N.Z.	SI	Cant.
1982/83	252	240	240
1983/84	270	259	266
1984/85	266	261	250
1985/86	275	271	262
1986/87	242	252	255
1987/88	270	250	260
1988/89	250	242	242
1989/90	257	258	248
1990/91	259	271	260
1991/92	274	279	285
1992/93	259	277	274
1993/94	265	274	272
1994/95	271	272	271
1995/96	283	279	273
1996/97	301	296	289
1997/98	292	291	283
1998/99	256	266	285
1999/00	288	311	320
2000/01	310	338	349
2001/02	307	338	356
2002/03	315	344	372
2003/04	322	355	371
2004/05	308	341	364
2005/06	325	361	367
2006/07	330	373	381
2007/08	307	361	380
2008/09	323	355	360
2009/10	327	368	378

Statistics used for Figure 2.8

Milksolids per hectare

Years	NZ	SI	Canterbury
1982/83	553	408	453
1983/84	607	452	506
1984/85	628	487	541
1985/86	669	532	600
1986/87	585	499	617
1987/88	667	515	644
1988/89	595	483	557
1989/90	610	501	513
1990/91	610	546	592
1991/92	632	570	619
1992/93	653	593	647
1993/94	708	653	741
1994/95	671	635	707
1995/96	705	674	769
1996/97	741	711	822
1997/98	748	744	833
1998/99	685	725	820
1999/00	759	829	945
2000/01	825	868	993
2001/02	824	875	998
2002/03	828	882	1065
2003/04	889	953	1119
2004/05	862	940	1134
2005/06	907	997	1166
2006/07	934	1046	1224
2007/08	873	1037	1240
2008/09	921	1018	1173
2009/10	920	1069	1262

Statistics used for Figure 2.9

Gross farm revenue

Years	New Zealand	Canterbury
1988-89	143996	222730
1989-90	154444	193070
1990-91	126653	174212
1991-92	159939	215645
1992-93	139826	259343
1993-94	180033	279506
1994-95	182264	282013
1995-96		420280
1996-97		436664
1997-98		451990
1998-99		527573
1999-00	295754	610500
2000-01	406954	937500
2001-02	467380	1090900
2002-03	378527	881100
2003-04	446019	961000
2004-05	486191	1127030
2005-06	536685	1130400
2006-07	566816	1187065
2007-08	1021886	2234002
2008-09	750000	1575300
2009-10	931703	1912800
2010-11	1146118	2212648

Statistics used for Figure 2.10

Cash farm expenditure per hectare

Years	New Zealand	Canterbury
1988-89	2,182	2,227
1989-90	2,451	1,931
1990-91	1,863	1,742
1991-92	2,352	2,156
1992-93	2,026	2,593
1993-94	2,572	2,795
1994-95	2,604	2,169
1995-96		3,233
1996-97		2,817
1997-98		2,916
1998-99		3,404
1999-00	3,215	3,591
2000-01	4,423	5,357
2001-02	4,869	6,061
2002-03	3,711	4,763
2003-04	4,289	5,005
2004-05	4,155	5,780
2005-06	4,363	5,797
2006-07	4,499	5,848
2007-08	7,801	10,638
2008-09	5,556	7,501
2009-10	6,751	9,109
2010-11	8,128	10,536

Statistics used for Figure 2.10

Cash farm expenditure per hectare

Years	New Zealand	Canterbury	
1988-89	1,004	717	
1989-90	1,111	1,194	
1990-91	945	786	
1991-92	1,140	988	
1992-93	1,098	1,232	
1993-94	1,369	1,402	
1994-95	1,397	1,150	
1995-96		1,955	
1996-97		1,737	
1997-98		1,950	
1998-99		2,049	difference
1999-00	1,756	1,933	10%
2000-01	1,971	2,506	27%
2001-02	2,267	3,113	37%
2002-03	2,572	3,236	26%
2003-04	2,496	3,094	24%
2004-05	2,445	3,388	39%
2005-06	2,654	3,577	35%
2006-07	2,941	3,968	35%
2007-08	3,576	5,005	40%
2008-09	3,916	5,399	38%
2009-10	3,566	5,039	41%
2010-11	4,088	5,589	37%
			32% average

Statistics used for Figure 2.11

Cash farm expenditure per kg ms

Years	New Zealand	Canterbury
1988-89		
1989-90	1.77	2.19
1990-91	1.58	1.38
1991-92	1.83	1.70
1992-93	1.04	2.01
1993-94	1.16	1.85
1994-95	1.21	1.44
1995-96		2.26
1996-97		2.08
1997-98		2.29
1998-99		2.28
1999-00	2.13	2.12
2000-01	2.44	2.51
2001-02	2.77	2.99
2002-03	2.89	2.85
2003-04	2.73	2.64
2004-05	2.80	2.78
2005-06	2.77	2.83
2006-07	2.91	3.00
2007-08	3.61	3.68
2008-09	3.86	4.05
2009-10	3.50	3.63
2010-11	3.93	4.15

Statistics used for Figure 2.12

Cash farm surplus per hectare

Years	New Zealand	Canterbury
1988-89	1178	1510
1989-90	1341	737
1990-91	918	956
1991-92	1212	1168
1992-93	930	1361
1993-94	1203	1393
1994-95	1207	1019
1995-96		1278
1996-97		1080
1997-98		966
1998-99		1355
1999-00	1459	1658
2000-01	2453	2851
2001-02	2602	2947
2002-03	1139	1527
2003-04	1792	1911
2004-05	1711	2392
2005-06	1709	2220
2006-07	1558	1879
2007-08	4225	5633
2008-09	1640	2103
2009-10	3185	4070
2010-11	4041	4948

Statistics used for Figure 2.13

Cash farm surplus per kg ms

Years	New Zealand	Canterbury
1989-90	2.14	1.35
1990-91	1.54	1.67
1991-92	1.94	2.01
1992-93	0.88	2.22
1993-94	1.02	1.83
1994-95	1.05	1.27
1995-96		1.48
1996-97		1.29
1997-98		1.13
1998-99		1.51
1999-00	1.77	1.82
2000-01	3.04	2.85
2001-02	3.18	2.83
2002-03	1.28	1.35
2003-04	1.96	1.63
2004-05	1.96	1.96
2005-06	1.78	1.76
2006-07	1.54	1.42
2007-08	4.26	4.14
2008-09	1.62	1.58
2009-10	3.12	2.93
2010-11	3.89	3.67

Statistics used for Figure 2.14

DNZ operating profit per hectare

Years	Waikato	Canterbury	Taranaki	NI	SI
2005-06	1,440	1,396	905	1,217	1,303
2006-07	1,068	973	835	873	1,085
2007-08	2,382	4,708	2,552	2,409	3,876
2008-09	689	615	1,077	685	915
2009-10	1,684	3,353	2,103	1,708	2,451

Statistics used for Figure 2.15

Total farm capital investment per ha

Years	New Zealand	Canterbury
1999-00	17,451	15,335
2000-01	17,728	17,685
2001-02	22,141	23,428
2002-03	24,561	24,878
2003-04	30,031	26,523
2004-05	30,474	30,815
2005-06	34,303	35,771
2006-07	38,118	38,120
2007-08	45,361	44,022
2008-09	53,111	58,407
2009-10	48,463	57,366
2010-11	47,958	54,070

Statistics used for Figure 2.16

Total farm capital investment per kg ms

Years	New Zealand	Canterbury	
1999-00	21.15	16.82	-20%
2000-01	21.98	17.69	-20%
2001-02	27.07	22.49	-17%
2002-03	27.64	21.92	-21%
2003-04	32.78	22.63	-31%
2004-05	34.89	25.28	-28%
2005-06	35.79	28.30	-21%
2006-07	37.77	28.80	-24%
2007-08	45.75	32.32	-29%
2008-09	52.38	43.79	-16%
2009-10	47.52	41.33	-13%
2010-11	46.11	40.11	-13%
averages	35.90	28.46	-21%

Statistics used for Figure 2.17

Debt per hectare

Year	New Zealand	Canterbury
1999-00	5,334	4,865
2000-01	4,617	5,000
2001-02	4,875	5,306
2002-03	6,123	9,162
2003-04	8,375	9,883
2004-05	7,552	9,931
2005-06	7,769	10,316
2006-07	9,870	15,764
2007-08	12,023	15,524
2008-09	16,595	24,649
2009-10	19,650	26,044
2010-11	19,707	26,458

Statistics used for Figure 2.18

Debt per kg milksolids

Year	New Zealand	Canterbury	% diff.
1999-00	6.46	5.34	-17%
2000-01	5.73	5.00	-13%
2001-02	5.96	5.09	-15%
2002-03	6.89	8.07	17%
2003-04	9.14	8.43	-8%
2004-05	8.65	8.15	-6%
2005-06	8.11	8.16	1%
2006-07	9.78	11.91	22%
2007-08	12.13	11.40	-6%
2008-09	16.37	18.48	13%
2009-10	19.27	18.76	-3%
2010-11	18.95	19.63	4%
average			-1%

Statistics used for Figure 2.19

Equity per hectare

Year	New Zealand	Canterbury	% diff.
1999-00	12,117	10,471	14%
2000-01	13,111	12,685	3%
2001-02	17,265	18,122	-5%
2002-03	18,438	15,716	15%
2003-04	21,656	16,640	23%
2004-05	22,922	20,883	9%
2005-06	26,535	25,455	4%
2006-07	28,248	22,356	21%
2007-08	33,338	28,498	15%
2008-09	36,516	33,758	8%
2009-10	28,812	31,322	-9%
2010-11	28,251	27,612	2%
		average	8%

Statistics used for Figure 2.20

Return on capital

Year	New Zealand	Canterbury	
1999-00	8%	11%	
2000-01	8%	16%	
2001-02	6%	13%	
2002-03	5%	6%	
2003-04	4%	7%	
2004-05	4%	8%	
2005-06	3%	6%	
2006-07	3%	5%	
2007-08	2%	13%	
2008-09	2%	4%	
2009-10	2%	7%	
2010-11	2%	9%	
	4%	9%	average

Appendix B

Additional information for Chapter 3

B1. Timeline of case study farm growth

A summary of steps in the development of the business are listed below:

1993-94 - property converted to dairying with the construction of a 26 aside Herringbone cowshed. The first milk was sold from the property in November and 25,500 kg milksolids were produced in the partial season.

1994-95 - milked 220 cows for 70,000 (318 per cow), re-bordered, re-seeded, increased fertility to new blocks.

1995-96 - drilled well to 73 metres to water 17.8 ha of the ‘new dry land’ block using a small Briggs irrigator. Milked 300 cows for 95,000 kg milksolids (316 milksolids per cow), leased 25 ha to the west of the farm for winter feed production.

1996-97 - milked 350 cows for 120,000 kg milksolids (342 milksolids per cow), changed Briggs irrigator to ‘long line laterals’ to allow spray irrigation to increase to 39 ha.

1997-98 - purchased 30 ha to the west of the farm (included the 25 ha leased earlier), cultivated, increased fertility, re-grassed, deepened well to 93 metres, milk production remained the same.

1998-99 - installed K lines[72] to block west of the farm, production increased to 140,000 kg milksolids from 400 cows (350 milksolids per cow).

1999-2000 - production increased to 160,000 kg milksolids from 400 cows (400 milksolids per cow), converted ‘long line’ laterals to K lines.

2000-01 - production increased to 177,972 kg milksolids from 435 cows (409 milksolids per cow), extended milking shed to 36 aside herringbone.

2001-02 - production increased to 184,119 kg milksolids from 425 cows (433 milksolids per cow), purchased adjoining 20 ha and installed K lines.

2002-03 - production increased to 195,496 kg milksolids from 450 cows (434 milksolids per cow), borderdyked 5.9 ha on riverbed.

2003-04 - production increased to 218,320 kg milksolids from 525 cows (416 milksolids per cow).

[72] K lines are an irrigation system consisting of ‘pods’ (generally 10) attached to alkathene hose.

2004-05 - sold cows to 50-50 sharemilker, production increased to 238,798 kg milksolids from 575 cows (415 milksolids per cow), cleared 30 ha of riverbed from gorse/broom, borderdyked another 14.6 ha on riverbed, doubled the number of water troughs per paddock.

2005-06 - production increased to 258,700 kg milksolids from 620 cows (417 milksolids per cow), winter milked 100 cows, developed further 20 ha of riverbed, purchased new farm of 145 ha (raised P levels and pH, cleared land, re-fenced, applied for water rights).

2006-07 - production increased to 267,142 kg milksolids from 635 cows (421 milksolids per cow), developed another 30 ha of riverbed to give a total of 80 ha. At the 144 ha farm constructed a water storage pond, cleared 15 ha of trees and 29.5 ha of an old plantation, more phosphorus and lime to ex-plantations, re-fenced the property.

2007-08 - production increased to 284,185 kg milksolids from 693 cows (410 milksolids per cow), cultivated and drilled 80 ha of riverbed into permanent dry land pasture mix. On new farm installed centre pivot and fixed grid irrigation systems[73], built cattle yards, purchased empty cows for future herd and purchased yearlings.

2008-09 - production of 270,070 kg milksolids from 675 cows (400 milksolids per cow). At the 144 ha farm built employee houses, built lower order sharemilker house, built 50 bale rotary milking shed, planted shelter trees, finished applying capital fertiliser, purchased future herd, reared 100 calves. Installed pump, mainlines and irrigator for 20 ha of riverbed irrigation.

2009-10 - production of 284,148 kg milksolids on original farm from 650 cows (437 milksolids per cow) and 197,932 kg milksolids on new farm from 490 cows (404 milksolids per cow), built water storage pond on old farm and added K lines, built bunker to hold feed (palm kernel expeller) and purchased feeding wagons for following season for the 144 ha farm.

[73] A fixed grid system consists of posts placed approximately 25 metres apart with a sprinkler attached to the top. The advantage of this system is that they do not have to be shifted daily. The system is very suitable for use in paddocks where the paddock shape does not suit traditional irrigation systems.

Appendix B2. Comparative balance sheets based on per hectare real estate valuations (1988-2010)

Balance Sheet based on per ha valuation for Canterbury from QV											
year ended May 31	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
cattle	202920	18656	61618	93830	100643	134195	178040	222652	251227	277640	267100
plant, eqpt., vehicles	20000	27800	34800	15050	16050	24800	36942	76276	73846	83426	72575
cash/share investments	11000	116876	94331	162771	148011	160847	59526	7137	2156	2519	4489
real estate	135000	150000	42500	160000	210000	210000	483429	974217	1071723.6	1125348.9	1279238
Dairy company shares	0	0	0	0	0	0	1380	7186	32768	59627	114446
Other ag. Shares	0	0	0	0	0	0	743	2216	4157	8880	8880
less cash injections		-55000									
TOTAL ASSETS	368920	258332	233249	431651	474704	529842	760060.05	1289684	1435877.6	1557440.9	1746728
TOTAL LIABILITIES	264292	120997	20000	33700	82800	175800	300000	300000	385062	552376	600000
NET WORTH (nom.)	104628	137335	213249	397951	391904	354042	460060	989683.6	1050815.6	1005064.9	1146728
NET WORTH (real)	180512	226964	327319	594223	579680	516723	664397	1366410	1422225	1345391	1509287
DEBT/ASSET	72%	47%	9%	8%	17%	33%	39%	23%	27%	35%	34%
% annual growth (nom.)		31.3%	55.3%	86.6%	-1.5%	-9.7%	29.9%	115.1%	6.2%	-4.4%	14.1%
average % growth thru 2010 (nom.)		27.4%									
ending net worth/beginning net worth (nom.)		77.90									
compounded annual growth thru 2010 (nom.)		21.89%									
% annual growth (real)		25.7%	44.2%	81.5%	-2.4%	-10.9%	28.6%	105.7%	4.1%	-5.4%	12.2%
average % growth thru 2010 (real)		24.0%									
ending net worth/beginning net worth (nom.)		45.15									
compounded annual growth thru 2010 (real)		18.91%									

Balance Sheet based on per ha valuation for Canterbury from QV												
year ended May 31	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
cattle	329249	411978	686366	644193	438829	466650	188780	48796	252612	565765	694575	917886
plant, eqpt., vehicles	87873	158671	190109	183185	167466	178277	250293	206973	377704	503791	688829	618248
cash/share investments	5844	2020	2711	0	5000	5000	5000	5000	6467	6500	6500	6500
real estate	1423442	1388899	1991628	2888000	3271678	3976093	7674768	7810414	6698732	10224330	9400935	10922866
Dairy company shares	194289	226226	533916	708858	865032	1023921	1299061	1500460	1813894	1582910	1220716	2179002
Other ag. Shares	12161	14124	15843	18681	23475	37496	42209	42880	44953	53106	42291	52183
TOTAL ASSETS	2052858	2201918	3420573	4442917	4771481	5687436	9460111	9614523	9194362.4	12936402	12053846	14696685
TOTAL LIABILITIES	755185	828147	690000	1127500	1127500	1127500	817688	2592688	3388688	3842688	5447688	6546229
NET WORTH	1297673	1373771	2730573	3315417	3643981	4559936	8642423	7021835	5805674	9093714	6606158	8150456
	1714114	1778297	3425684	4048493	4386347	5359754	9873204	7716996	6255330	9419408	6716159	8150456
DEBT/ASSET	37%	38%	20%	25%	24%	20%	9%	27%	37%	30%	45%	45%
% annual growth (nom.)	13.2%	5.9%	98.8%	21.4%	9.9%	25.1%	89.5%	-18.8%	-17.3%	56.6%	-27.4%	23.4%
% annual growth (real)	13.6%	3.7%	92.6%	18.2%	8.3%	22.2%	84.2%	-21.8%	-18.9%	50.6%	-28.7%	21.4%

Appendix B3. Comparative balance sheets based on per kg milksolids real estate valuations (1988-2010)

Balance Sheet based on value per kg of milksolids from QV for Canterbury

year ended May 31	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
cattle	202920	18656	61618	93830	100643	134195	178040	222652	251227	277640	267100
plant, eqpt., vehicles	20000	27800	34800	15050	16050	24800	36942	76276	73846	83426	72575
cash/share investments	11000	116876	94331	162771	148011	160847	59526	7137	2156	2519	4489
real estate	135000	150000	42500	160000	210000	210000	442234	1122000	1405321	1887550	1615888
Dairy company shares	0	0	0	0	0	0	1380	7186	32768	59627	114446
Other ag. Shares	0	0	0	0	0	0	743	2216	4157	8880	10393
less cash injections		-55000									
TOTAL ASSETS	368920	258332	233249	431651	474704	529842	718865	1437467	1769475.4	2319642	2084891
TOTAL LIABILITIES	264292	120997	20000	33700	82800	175800	300000	300000	385062	552376	600000
NET WORTH (NOM.)	104628	137335	213249	397951	391904	354042	418865	1137467	1384413.4	1767266	1484891
NET WORTH (REAL)	180512	226964	327319	594223	579680	516723	604905	1570448	1873732	2365683	1954366
DEBT/ASSET	72%	47%	9%	8%	17%	33%	42%	21%	22%	24%	29%
% annual growth (nom.)		31.3%	55.3%	86.6%	-1.5%	-9.7%	18.3%	171.6%	21.7%	27.7%	-16.0%
average % growth thru 2010 (nom.)		33.3%									
ending net worth/beginning net worth (nom.)		145.66									
Compounded annual growth thru 2010 (nom.)		25.41%									
% annual growth (real)		25.7%	44.2%	81.5%	-2.4%	-10.9%	17.1%	159.6%	19.3%	26.3%	-17.4%
average % growth thru 2010 (real)		28.5%									
ending net worth/beginning net worth (real)		84.43									
Compounded annual growth thru 2010 (real)		22.34%									

Balance Sheet based on value per kg of milksolids from QV for Canterbury

year ended	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
cattle	329249	411978	686366	644193	438829	466650	188780	48796	252612	565765	694575	917886
plant, eqpt., vehicles	87873	158671	190109	183185	167466	178277	250293	206973	377704	503791	688829	618248
cash/share investments	5844	2020	2711	0	5000	5000	5000	5000	6467	6500	6500	6500
real estate	1849222	1980807	2883146	4544772	4353141	4420668	9142369	9942599	9060660	16531740	12075272	18012856
Dairy company shares	194289	226226	533916	708858	865032	1023921	1299061	1500460	1813894	1582910	1220716	2179002
Other ag. Shares	12161	14124	15843	18681	23475	37496	42209	42880	44953	53106	42291	52183
TOTAL ASSETS	2478638	2793826	4312091	6099689	5852943	6132012	10927712	11746708	11556290	19243812	14728183	21786675
TOTAL LIABILITIES	755185	828147	690000	1127500	1127500	1127500	817688	2592688	3388688	3842688	5447688	6546229
NET WORTH	1723453	1965679	3622091	4972189	4725443	5004512	10110024	9154020	8167602	15401124	9280495	15240446
	2276532	2544500	4544153	6071595	5688130	5882309	11549809	10060268	8800191	15952720	9435027	15240446
DEBT/ASSET	30%	30%	16%	18%	19%	18%	7%	22%	29%	20%	37%	30%
% annual growth (nom.)	16.1%	14.1%	84.3%	37.3%	-5.0%	5.9%	102.0%	-9.5%	-10.8%	88.6%	-39.7%	64.2%
% annual growth (real)	-10.5%	11.8%	78.6%	33.6%	-6.3%	3.4%	96.3%	-12.9%	-12.5%	81.3%	-40.9%	61.5%

Appendix B4. Spread sheet of inputs for return on capital calculation based on a per ha valuation

per ha valuation		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
real net worth		-180512										
less w.o.m. (real)		-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000
less off farm salaries		0	0	-46047	-44796	-44374	-43785	0	0	0	0	0
net cash flows		-230512	-50000	-96047	-94796	-94374	-93785	-50000	-50000	-50000	-50000	-50000
ROC		11%										

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
											8150456
-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000
0	0	0	-22468	-22149	-21627	-21020	-20222	-19825	-19059	-18706	-18400
-50000	-50000	-50000	-72468	-72149	-71627	-71020	-70222	-69825	-69059	-68706	8082056

Appendix B5. Spread sheet of inputs for return on capital calculation based on a per kg milksolids valuation

per kg ms valuation		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
real net worth		-180512										
less w.o.m. (real)		-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000
less off farm salaries		0	0	-46047	-44796	-44374	-43785	0	0	0	0	0
net cash flows		-230512	-50000	-96047	-94796	-94374	-93785	-50000	-50000	-50000	-50000	-50000
ROC		15%										

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
											15240446
-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000	-50000
0	0	0	-22468	-22149	-21627	-21020	-20222	-19825	-19059	-18706	-18400
-50000	-50000	-50000	-72468	-72149	-71627	-71020	-70222	-69825	-69059	-68706	15172046

Real net worth was calculated from the operations net worth at June 1, 1988 and adjusted as per the Consumer Price Index provided by the Reserve Bank of NZ. As this was the initial investment it is shown as a negative number.

WOM (wages of management) was set at $50,000 per year.

Off farm salaries were the dollars received by the primary partner for services rendered to a number of companies. Off farm salaries were annually converted to 2010 dollars.

Appendix B6. Spread sheet of inputs to determine wealth generation from investing in cooperatives.

							1993-94 to 2009-2010											
	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	salvage
nominal	-1380	-5806	-11241	-18381	-30213	-1500	-31936	-23423	-40243	-49246	-43666	-114274	-119509	-56133	0	-13279	-63632	1284349
constant value 2010	-1991	-8013	-15209	-24595	-39766	-1981	-41359	-29384	-49131	-59247	-51319	-130584	-131340	-60480	0	-13500	-63632	1284349
nominal irr	10%																	
constant value irr	8%																	
							pre fonterra (1993-94 to 2000-01)											
	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	salvage
nominal	-1380	-5806	-11241	-18381	-30213	-1500	-31936	557339										
constant value 2010	-1991	-8013	-15209	-24595	-39766	-1981	-41359	557339										
nominal irr	60%																	
constant value irr	49%																	
							post fonterra (2000-01 to 2009-10)											
	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	salvage
nominal								-533916	-40243	-49246	-43666	-114274	-119509	-56133	0	-13279	-63632	1284349
constant value 2010								-669175	-49131	-59247	-51319	-130584	-131340	-60480	0	-13500	-63632	1284349
nominal irr	3%																	
constant value irr	1%																	

Appendix C

Statistics used in Chapter 6

Statistics used to produce Figures 6.1 and 6.2

Year	Wool $ per kg	Index	Lamb $ per head	Lamb weights	$/kg	Index
1980/81	225	1000	16.30	13	1.24	1000
1981/82	293	1299	21.48	13	1.62	1298
1982/83	293	1302	20.86	13	1.58	1266
1983/84	291	1291	22.04	14	1.62	1301
1984/85	338	1501	23.63	13	1.89	1517
1985/86	313	1386	13.19	13	0.98	791
1986/87	370	1641	20.12	13	1.56	1253
1987/88	404	1790	16.13	14	1.18	946
1988/89	454	2016	18.73	13	1.45	1167
1989/90	406	1800	30.43	14	2.22	1785
1990/91	308	1366	26.96	14	1.94	1559
1991/92	281	1248	27.26	14	1.93	1554
1992/93	279	1237	40.14	15	2.68	2151
1993/94	266	1179	38.98	15	2.53	2034
1994/95	354	1570	29.61	15	2.00	1608
1995/96	321	1424	33.60	16	2.17	1742
1996/97	281	1244	41.46	16	2.61	2096
1997/98	277	1228	35.94	16	2.32	1864
1998/99	259	1150	38.02	16	2.41	1934
1999/00	270	1197	47.20	17	2.84	2285
2000/01	318	1409	63.25	17	3.79	3044
2001/02	328	1455	70.20	17	4.15	3338
2002/03	346	1537	63.11	17	3.71	2984
2003/04	305	1352	63.28	17	3.64	2923
2004/05	285	1263	65.45	18	3.74	3006
2005/06	259	1148	54.27	17	3.17	2551
2006/07	266	1178	53.79	17	3.18	2558
2007/08	260	1155	55.95	17	3.39	2725
2008/09	258	1146	85.85	18	4.85	3898

Year	Milksolids $	Index	2.5 yr steers $/head	Steer weights	$/kg	Index
1980/81	1.52	1000	344	268	1.29	1000
1981/82	1.95	1283	359	260	1.38	1074
1982/83	2.11	1388	402	257	1.57	1218
1983/84	2.09	1375	514	277	1.86	1445
1984/85	2.33	1533	628	281	2.23	1735
1985/86	2.29	1507	505	290	1.74	1357
1986/87	2.03	1336	530	281	1.88	1465
1987/88	2.34	1539	482	291	1.66	1290
1988/89	3.28	2158	580	267	2.17	1690
1989/90	3.59	2362	715	280	2.56	1988
1990/91	2.42	1592	758	282	2.69	2091
1991/92	3.34	2197	788	283	2.78	2163
1992/93	3.66	2408	843	277	3.04	2366
1993/94	3.32	2184	856	291	2.95	2291
1994/95	3.4	2237	682	289	2.36	1834
1995/96	3.99	2625	536	287	1.87	1451
1996/97	3.63	2388	505	296	1.71	1328
1997/98	3.42	2250	566	291	1.95	1513
1998/99	3.58	2355	658	288	2.29	1779
1999/00	3.78	2487	845	293	2.88	2240
2000/01	5.01	3296	1074	295	3.64	2831
2001/02	5.35	3520	1155	290	3.98	3095
2002/03	3.66	2408	938	288	3.26	2533
2003/04	4.25	2796	918	291	3.15	2451
2004/05	4.58	3013	963	292	3.29	2563
2005/06	4.1	2697	952	301	3.16	2462
2006/07	4.46	2934	1020	298	3.42	2660
2007/08	7.67	5046	984	276	3.57	2777
2008/09	5.14	3382	1060	276	3.84	2987

Year	Wheat cents/kg	Index	Inflation rate	Index
1980/81	18.3	1000	15.65	1000
1981/82	20.3	1109	15.55	1157
1982/83	22.7	1240	12.325	1336
1983/84	27.4	1497	4.175	1501
1984/85	24	1311	11.45	1564
1985/86	20	1093	13.05	1743
1986/87	19.5	1066	16.725	1970
1987/88	29	1585	9.8	2300
1988/89	31	1694	5	2525
1989/90	29	1585	7.625	2651
1990/91	27.6	1508	4.3	2853
1991/92	29	1585	2.275	2976
1992/93	29	1585	1.925	3044
1993/94	28.5	1557	1.65	3102
1994/95	28.8	1574	2.375	3154
1995/96	31.7	1732	2.175	3229
1996/97	28.5	1557	2.05	3299
1997/98	26	1421	1.7	3366
1998/99	25.5	1393	1.25	3424
1999/00	26.5	1448	1.525	3466
2000/01	30	1639	3.325	3519
2001/02	32.5	1776	2.4	3636
2002/03	31.5	1721	2.325	3724
2003/04	29.5	1612	1.775	3810
2004/05	28.5	1557	2.725	3878
2005/06	31.5	1721	3.475	3983
2006/07	35	1913	2.65	4122
2007/08	47	2568	3.1	4231
2008/09	39.7	2169	3.35	4362

Table C2 Selected statistics for the NZ sheep industry from 1985-86 to 2008-09

Year	Wool (tonnes greasy)	Wool price (nominal cents/kg)	Lamb weights (kg/head)	Tonnes lamb exported	% Lambs per ewe	# of ewes (000)	Kg of lamb per ewe
85-86	358	344	-	413,754	103	47,491	9.5
90-91	305	317	13.9	297,822	102	36,631	9.8
95-96	269	372	15.5	297,961	104	33,447	11.1
01-02	229	385	17	286,556	113	26,785	14.9
05-06	225	298	17	311,641	122	26,905	16.5
08-09	205	315	17.7	305,199	113	-	16.9

Source: derived from Meat and Wool New Zealand Economics Service NZ (Gonzalez-Macuer 2010) and Statistics NZ

Table C3 Percentage of gross income of a model NZ sheep/cattle farm from normal enterprises, 1985-86 to 2008-09

	Wool	Sheep meat	Cattle	Dairy grazing	Deer + velvet	Cash crop	other
85-86	40%	23%	18%	0%	1%	15%	3%
90-91	30%	30%	26%	0%	1%	9%	2%
95-96	26%	34%	20%	2%	3%	10%	4%
01-02	14%	48%	25%	1%	2%	6%	3%
05-06	14%	47%	25%	2%	1%	8%	3%

Source: derived from Meat and Wool New Zealand Economic Service (Gonzalez-Macuer 2010)

C4. Statistics used to prepare Figure 6.3 (2009 constant value dollars)

Year	farm values $/hectare
1990/91	9877
1991/92	11185
1992/93	13680
1993/94	17697
1994/95	19477
1995/96	18790
1996/97	17458
1997/98	15347
1998/99	14962
1999/00	14646
2000/01	18437
2001/02	18844
2002/03	20907
2003/04	22629
2004/05	25359
2005/06	29281
2006/07	31800
2007/08	38323
2008/09	32976
2009/10	29528

Appendix D
Additional information for Chapter 7

D1. Opinions of informants as to the future of the Canterbury Dairy Industry

At the conclusion of the interviews, each source was asked for their opinion on the future of the dairy industry in Canterbury. Their responses were as follows:

Future farms will need to be concerned with the timing of nitrogen, develop overwintering systems, adopt nitrogen mitigation practices, improve cow efficiency and use different plants to achieve goals (In16). Informant 13 felt that the environmental effects of dairying have become prominent. Farmers will need to be more concerned about effluent usage, plant trees, use nutrient budgets and fence off rivers.

Several sources commented on the attitude of other NZers to dairy farming. Informant 7 had noticed that NZers seem to want a reversion to wilderness, whereas Europeans subsidise farmers to prevent a reversion to wilderness. Informant 14 felt that there is a very big difference in attitudes between districts towards future development. Whereas mid Canterbury is very supportive of the new Barrhill-Chertsey irrigation scheme, the areas encompassing Christchurch appear antagonistic to the Central Plains irrigation scheme.

A number of interviewees commented on the trend to feeding grain to dairy cows. Although some question the ability to produce enough grain, In9 said that at current grain production levels only 30 hectares in grain would be required to feed a herd of 500 cows, two kilograms per day during the milking season. Informant 20 mentioned that if farmers move to larger Friesian cows (as has been proposed by some researchers to reduce stocking rates and, therefore, excess nitrogen from urine), that grain feeding will be required due to the higher energy requirement of the cow. Several sources (In14, In15) felt that the trend to grain feeding will require farmers to develop new skills for when to feed or not to feed, so as to avoid pasture wastage.

Informants 6 and 8 feel that there will be increased pressure on the dairy industry from the NZ government to allow investment in the industry by the public of NZ. However, most of the sources prefer to retain their cooperative as they do not trust a publicly listed country to look after their interests. Informant 4 said, “Farmers don’t trust the rest of the country to be business partners, because they have made short sighted and bad decisions in the past”. Another statement was “the strength of NZ agriculture is the family farm—agriculture needs motivated people and the people must be in control of the action to get the motivation” (In6).

A major constraint to growth will be the availability of irrigation (In7). Informant 18 commented that changes in irrigation technology will have a big effect on the future of the dairy industry and it will be critical to the industries environmental footprint. I16 suggested that crops and processed foods could very well over take dairy farming as they will give a better return for the litres of water used.

D2. Statistics used to prepare figures in Chapter 7

Statistics used for Figure 7.1

NAMV of a Friesian cow as a percentage of land values in Canterbury.

Year	$namv/$ha
1988	8.8%
1989	14.1%
1990	9.9%
1991	14.0%
1992	10.5%
1993	8.7%
1994	9.9%
1995	9.1%
1996	9.9%
1997	7.0%
1998	7.5%
1999	8.0%
2000	11.0%
2001	9.2%
2002	5.6%
2003	4.2%
2004	3.6%
2005	3.7%
2006	4.6%
2007	4.2%
2008	6.1%
2009	4.1%

D.3 Statistics used in preparation of Figure 7.2

Relationship of milksolids payout and hectares in dairy farming in Canterbury.

Years	Canterbury land (ha)	Milk price (real $)
1982-83	15,594	6.21
1983-84	17,480	5.87
1984-85	17,875	5.61
1985-86	19,840	5.00
1986-87	20,189	3.72
1987-88	16,831	4.04
1988-89	20,007	5.43
1989-90	23,232	5.51
1990-91	16,357	3.61
1991-92	26,647	4.94
1992-93	40,082	5.34
1993-94	44,496	4.79
1994-95	53,336	4.69
1995-96	58,438	5.40
1996-97	64,548	4.86
1997-98	74,760	4.50
1998-99	84,592	4.73
1999-00	90,350	4.90
2000-01	90,560	6.29
2001-02	111,134	6.53
2002-03	120,432	4.40
2003-04	124,936	4.99
2004-05	131,127	5.23
2005-06	137,424	4.51
2006-07	146,413	4.81
2007-08	160,016	7.94
2008-09	188,235	5.23
2009-10	194,862	6.37

D4. Statistics used in preparation of Figure 7.3

Debt service as a percentage of gross farm revenue for NZ dairy farmers

Year	Interest and rent % GFR
2000-01	13%
2001-02	12.3%
2002-03	18.4%
2003-04	18.3%
2004-05	18.4%
2005-06	23.5%
2006-07	24.3%
2007-08	17.6%
2008-09	30.4%
2009-10	25.5%

Statistics used in preparation of Figure 7.4

D5. Values per hectare of Canterbury dairy, arable and fattening land from 1988 to 2009

Years	Arable	Dairy	Fattening
1988	4351	6852	1833
1989	2647	4301	2931
1990	4544	7947	1897
1991	4505	6307	2072
1992	5415	6947	2085
1993	5937	15349	2684
1994	6761	14668	3448
1995	7750	12598	4116
1996	8476	11841	3416
1997	8132	13105	3650
1998	7631	11386	2782
1999	7799	12732	3898
2000	8574	10190	2514
2001	9528	17950	4257
2002	13087	26947	3800
2003	13645	23833	6087
2004	16580	26445	7982
2005	19162	33441	8847
2006	21284	28246	8065
2007	24819	32075	8930
2008	31254	36771	13024
2009	33295	32150	11757

D6. Statistics used in the preparation of Figure 7.5

Percentage of 50-50 sharemilkers in Canterbury

	50-50	lo	total farms
2003	132	73	643
2004	127	69	652
2005	121	78	672
2006	128	85	688
2007	126	92	704
2008	130	117	793
2009	136	135	891

Appendix E

Additional information for Chapter 8

Table E1 Raw milk quality results for Alpine Dairy Products (in percentages)

	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98
Finest	97.1	95.2	96.6	95.7	98.2	98.4	97.9	98.4	98.1	97.9	98
First	1.85	.88	1.1	1.1	.48	.38	1.79	1.14	1.15	1.31	1.36
Second	1.05	3.90	2.3	3.33	1.37	1.23	.27	.43	.64	.68	.62
Reject	0	0	0	0	0	0	.04	.05	.11	.08	.03
% increase in finest		-2.0	1.0	-1.0	3.0	0.2	-0.5	0.5	-0.3	-0.2	0.1

Source: derived from annual accounts of the Alpine Dairy Products (1987-1998)

Table E2 Table of the number of grade types, problems and suppliers

	91-92	92-93	93-94	94-95	95-96	96-97	97-98
Total # grades in season	1190	1153	1394	1538	1852	2221	2562
APC/bacteria	451	501	557	520	779	1320	1026
Thermodurics	322	179	471	595	354	394	927
Coliform	199	192	208	117	145	130	137
Inhib. sub.	79	116	43	77	93	72	34
Somatic cells			40	140	419	237	311
Senses	46	16	21	21	34	32	70
Colostrum		16	20	4	8	7	2
Sediment	90	119	34	15	20	8	15
supplier		4.09	4.66	4.54	5.09	5.77	5.58
Grade free suppliers	39	44	55	63	45	46	71
Greater than 10 grades	28	22	31	40	44	59	67
Greater than 20 grades	3	7	8	8	14	18	20
No. of suppliers	271	281	299	339	364	385	459

Source: derived from Alpine Supplier Newsletters 1997 and 1998

E3. Proposed benefits of the merger of Alpine Dairy Products and the Southland Cooperative Dairy Company

The Business Development Project (BDP). The BDP of the NZDB was based on the Commercial Pricing Model (CPM), which replaced the standard cost model approach for payment to dairy companies. Under the standard cost model, the NZDB set a price that would be paid to the cooperatives based on the NZDB's assessment of the cost of manufacturing a particular product. However, the CPM used international commodity prices for the eight major product groups to determine returns to dairy companies. It was felt that through the CPM returns to dairy companies would be more closely linked to market prices which, in turn, would increase market responsiveness at the dairy company level. The advantage of this change for SIDC would be that the company would have a more diverse product mix, which would allow it to better "chase" improvements in the market price for specific commodities.

Security. The newly formed South Island Dairy Cooperative (SIDC) would be the third largest company in the NZ dairy industry, thus being better able to protect the interest of its shareholders. The merger would allow economies of scale and increased financial strength. The new entity with a projected turnover of $485 m would be the fourth largest company in the South Island of NZ, behind Foodstuffs (groceries), Alliance (meat) and Christchurch City Holdings.

Enhanced Returns. It was proposed that there would be "significant synergies and capital and operational efficiencies". Cost savings were estimated to be 1 cent/kg milksolids in 1998/99, 3 cents in 1999/00, 7 cents in 2000/01 and 3 cents in 2001/02 or about $20 m. Milk growth was forecast to average 8% for the ensuing five years. It was proposed that there would be additional capital efficiency through the ability to transfer milk and secondary products between sites, so as to delay or eliminate additional building projects.

E4. Dealing with Japanese Thermoduric Bacteria

The Dairy Research Corporation (DRC) found the following.

-the problem was caused by environmental contamination with mesophilic bacteria
-75% of suppliers did not experience any rise in thermoduric levels
-the problems with the spores were largely seasonal and occurred in the autumn when silage was fed to extend lactation as grass growth slowed
-entry of the spores into the bulk milk tank was via the teat
-spores are spread on the ground and pasture via cow faeces
-teat washing made the problem worse
-silage made and held in a pit or stack had a 10-fold increase in the spores
-the length of time that silage is uncovered influences the spore levels

A letter to suppliers from Supplier Liaison Officer Nadine Smith during the winter of 1998 (Smith 1998), noted the following points of importance:

-"You will increase spores in milk (thermoduric count) if using a high-pressure hose to wash cows without proper teat cleaning and paper towel drying."
-"The only way to reduce the level of spores being ingested by the cow is to remove the top layer off the pit/stack and any mould off the baleage."
-"White mould can contain more spores than the top layer gunge."
-"Some pit/stacks appear to have a visually excellent top layer, but, in fact, may not. If you are experiencing thermoduric problems with no obvious plant/silo problems and appear to have good silage—your silage may still have high spore levels."
-"In my experience with spores, the silage that is left uncovered for a period of time or poorly covered is almost certain to cause an increase in thermoduric levels in milk."

E5. Scoping report for the merger of Alpine Dairy Products and the Southland Cooperative Dairy Company to form the South Island Dairy Company

Stage 1—Preparation of Scoping Report

- Credit Suisse First Boston was appointed to provide independent advice regarding the ownership structure that would allow the maximum level of identified benefits to be captured for the companies and their shareholders.
- The scoping report concluded that significant benefits would arise from closer co-operation and that a merger was the most effective means of realising these benefits.
- Each board reviewed the report in August 1997. The boards then approved the Steering Committee to commence the formal merger process.

Stage 2---Due Diligence Investigation

- Each company carried out a due diligence investigation of the other company which comprised: an engineering audit, an environmental assessment, an audit of financial accounts by Price Waterhouse and a legal inquiry by Buddle Findlay.

Stage 3---Stand Alone Valuation of Alpine and Southland

- Each company was valued by Credit Suisse First Boston.
- The assumptions underlying the forecasts were benchmarked to insure that they were consistent. The management of each company then reviewed the other company's financial forecasts.
- Based on the standalone valuations of each company, Credit Suisse First Boston recommended that a distribution be made to Alpine shareholders.

Stage 4---Negotiations of Final Merger Terms

- Subcommittees of each board were established to negotiate the final merger terms and conditions based on the recommendations of Credit Suisse First Boston.
- The negotiation process was delayed by the announcement of the NZDB's Business Development Project which included the proposal for the Commercial Pricing Model. The potential effect of this project on the proposed merger terms and potential merger benefits was assessed by each company. It was felt that the new pricing system would have a similar impact on each company and that the previously agreed financial forecasts were a reasonable basis for agreeing to merger terms.
- The subcommittees agreed on the merger terms and conditions presented. These terms were then ratified by the Boards.
-

(from Proposal for the Merger of Southland Cooperative Limited and Alpine Dairy Products Limited to South Island Dairy Cooperative Limited 1998).

Appendix F

Additional information for chapter 9

F1. Human Ethics Committee Approval

Lincoln University
Te Whare Wānaka o Aoraki

HUMAN ETHICS COMMITTEE

Application No: 2008-13 **16 June 2008**

Title:	**Survey of Canterbury and North Otago Dairy Farmers in regards to the perception of the Lincoln University Dairy Farm and South Island Dairying Development Centre**
Applicant:	**Mary Pangborn for the South Island Dairying Development Centre (SIDDC)**

The Lincoln University Human Ethics Committee has reviewed the above noted application.

Dear Mary

Thank you for your recent response.

I am satisfied on the Committee's behalf that the issues of concern have been satisfactorily addressed.

Please ensure that the very last paragraph of the letter appears on the same page as the remainder of the letter content.

I am pleased to give final approval to your project and may I, on behalf of the Committee, wish you every success in your research.

Yours sincerely

Bob Gidlow

Bob Gidlow
Temporary Acting Chair, Human Ethics Committee

Copies to: *Richard Christie (SIDDC)*

PLEASE NOTE: The Human Ethics Committee has an audit process in place for applications. Please see 7.3 of the Human Ethics Committee Operating Procedures (ACHE) in the Lincoln University Policies and Procedures Manual for more information.

F2. Specific objectives of the LUDF for the season 2007/08

1. To deliver an Operating Profit of $6,844/ha and Return on Dairy Assets of 15.3% from a $6.40 payout - with budgeted milksolids production of 294,700 kg with Cash Farm Working Expenses of $2.85/kg milksolids.
2. To improve water use efficiency for better integrating the technologies currently existing on the farm by ensuring useable decision making data is accessible to the farm management in a timely manner.
3. To increase the land area that effluent is applied to so that nutrients are better distributed and there is an increased range of contingency plan options. Also, ensure that nitrate losses are not greater on effluent areas than on non-effluent areas, and that there is no significant microbial contamination of the shallow aquifers.
4. To manage pastures and grazing so milkers consume / harvest as much metabolisable energy [ME] as practicable, with a target of 200 GJ/ha ME, using less than 200 kg of N/ha applied. For example, this could be achieved by consuming / harvesting 16t DM/ha with average ME 12.5.
5. To optimise the use of the farm automation system [Protrack] and demonstrate / document improved efficiencies and subsequent effect on the business.
6. To achieve an in-calf rate of not lower than 88% [i.e. 12% empty] after 12 weeks mating, i.e. nine weeks of AM mating plus three of natural mating. All AB matings to result in crossbred replacements including replacements from yearlings.
7. To continue to document and measure LUDF's influence on changes to defined management practices on other dairy farms.
8. To ensure specific training is adequate and appropriate to enable staff members to contribute effectively in meeting the objectives of the farm.
9. To actively seek labour productivity gains through adoption of technologies and practices that reduce labour requirements or make the work environment more satisfying.

F3. Letter to farmers for survey participation

To Canterbury and North Otago Dairy Farmers

Dear Sir/Madam

In 2001 Lincoln University converted a 185 ha dry land sheep property to an irrigated dairy farm. The South Island Dairying Development Centre (SIDDC) was formed consisting of six commercial, education or research partners. Management of the Lincoln University Dairy Farm [LUDF] was delegated to SIDDC with the aim of fostering best practice, using the LUDF as a commercial demonstration-farm of high relevance to SI dairy farmers.

Over the past seven years, a number of management techniques have been trialled and results reported at Focus Days, in the media and via the www.siddc.org.nz website. Financial data and benchmarks have been provided for the use of the industry. The LUDF has had over 13,000 visitors. We would like to invite you, as a dairy farmer, to inform us of your perceptions of the LUDF.

The enclosed survey is being conducted by SIDDC in conjunction with the Agriculture Group of the AGLS Division of Lincoln University. The objective of the survey is to determine whether you have benefitted from the LUDF work, whether these technologies have been adopted on your property, and any suggestions you may have for future activities on the LUDF. The survey is being sent to all dairy farmers in Canterbury and North Otago

We hope the enclosed questionnaire will only take a few minutes of your time. A self-addressed and stamped envelope has been enclosed for your convenience. The results of the survey will be available on the SIDDC website in late spring. All answers will be confidential and the researchers will not be able to identify any respondents. Your contact details were obtained through the cooperation of the Livestock Improvement Corporation.

Thank you for your time in considering this request and in completing the form. Your answers will be vital to measurement of the LUDF's past performance and future direction. If you have any questions, please feel free to contact the writers at the numbers listed below.

Yours sincerely

Richard Christie, Executive Director
South Island Dairying Development Centre
(03) 325 3884

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Lincoln University
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This project has been reviewed and approved by the Lincoln University Human Ethics Committee.

F4. LUDF QUESTIONNAIRE

CANTERBURY DAIRY QUESTIONNAIRE - JUNE 2008

Part 1 Demographics:

Please circle one for each question.

1.1 Position of person answering questions:
Owner/operator 50/50 sharemilker Lower Order Sharemilker Manager Other

1.2 Highest level of formal education
High school AgIto/Polytechnic University

Please enter the number in box at right:

1.3 Age of person answering questions (years):

1.4 Approximate distance from Lincoln University Dairy Farm (kms. one way):

1.5 Size of milking platform (hectares):

1.6 Number of cows milked at peak:

1.7 Average cow weight (kg):

1.8 Production per cow (kg milksolids):

1.9 Production per hectare (kg milksolids):

1.10 DairyNZ has identified five types of farming systems, please circle the one that best describes your operation:

System 1: All grass, self-contained.

System 2: Feed imported either as supplement or grazing off and fed to dry cows (4-14% of feed imported).

System 3: Feed imported to extend lactation and for dry cows (10-20% of feed imported).

System 4: Feed imported and used at both ends of lactation and for dry cows (20-30% of feed imported).

System 5: Imported feed used all year (30-40% of feed imported).

1.11 How often do you attend DairyNZ events? (excluding LUDF Focus Days)
- times per year in box ☐

1.12 Do you use a private consultant? **Y or N in box** ☐

1.13 Assuming you have a farming surplus in the coming year, please rank the top five areas in which you would like to spend your surplus. (1 being the first choice)

___ paying down debt	___ improving irrigation systems
___ increasing the herd	___ remodelling or building new cowshed
___ purchasing more land	___ other buildings
___ upgrading machinery	___ holidays
___ upgrading effluent systems	___ more or improved housing
___ more fertiliser to increase farm fertility	___ fencing waterways
___ increased re-grassing	___ education for children or self

___ Others (please list)____

1.14 Please indicate the importance of the following in regards to your personal priorities in farming (1 is very important, 5 is not at all important):

	1	**2**	**3**	**4**	**5**
Cash profit	☐	☐	☐	☐	☐
Life style	☐	☐	☐	☐	☐
Potential for capital gain	☐	☐	☐	☐	☐
Quality stock	☐	☐	☐	☐	☐
Like being own boss	☐	☐	☐	☐	☐
Like working outside	☐	☐	☐	☐	☐
Good place to raise family	☐	☐	☐	☐	☐

Other, please detail ____

Part 2 The Lincoln University Dairy Farm (LUDF) and the South Island Dairy Development Centre (SIDDC)

2.1 How often did you attend any of the four LUDF Focus Days in these seasons?

2005/06 ☐ **2006/07** ☐ **2007/08** ☐

2.2 If you have attended a LUDF Focus Day, why do you attend? Please tick any or all.

___ to meet other farmers and have a day off of the farm
___ to learn about latest grazing management techniques
___ to learn about the latest animal management techniques
___ for the financial information provided
___ to visit with Agri business people (bankers, suppliers, etc.)
___ to learn how the LUDF is performing
___ to learn about environmental management at the LUDF (irrigation, effluent, fertiliser, etc.)
___ to compare your farm to the LUDF
___ other reasons, please detail

____

2.3 When you think of the LUDF farming systems, what comes to mind? (please tick any or all)

___ Low residual grazing
___ Nutrient and environmental management
___ Reproductive technologies - treating anoestrus cows before start of mating
___ Synchronisation of R2yr heifers before start of mating
___ Once per day milking during calving
___ Once per day calf feeding
___ Pasture monitoring and feed wedge
___ Irrigation monitoring
___ Re-grassing of pastures
___Other____

2.4 If you can put an economic value on any of the changes in question 2.3, please list with your estimate of $ value

____
____
____
____

Some key findings from the LUDF are listed below. Indicate your use of them by putting a "Y" or "N" in the box, and comment why, or why you haven't, adopted these technologies.

2.5 Low grazing residuals ☐
Reasons:

____
____
____
____

2.6 Re-grassing based on measurement of poor performing paddocks ☐
Reasons:

____
____
____
____

2.7 Synchronising of heifers to calve one week before herd ☐
Reasons:

____
____
____
____

2.8 Aggressive use of hormone intervention non-cycling technologies ☐
Reasons:

____
____
____
____

2.9 Nil induction policy ☐
Reasons:

____
____
____
____

2.10 If you have made any changes, have they made your farm management easier or more difficult?

____
____
____
____
____
____

2.11 How important are the following sources to learn about the results obtained at the LUDF? (1 is very important, 5 is not at all important):

	1	2	3	4	5
Focus Days	☐	☐	☐	☐	☐
Consultants	☐	☐	☐	☐	☐
Discussion Groups	☐	☐	☐	☐	☐
Website	☐	☐	☐	☐	☐
Dairy News (Dairynewz)	☐	☐	☐	☐	☐
The Dairy Exporter	☐	☐	☐	☐	☐
Other Farming publications	☐	☐	☐	☐	☐
Other Farmers	☐	☐	☐	☐	☐

2.12 If you have used the LUDF website, how often do you visit the site in a year (times)? ☐

2.13 When you think of learning about new technology or innovations, please rank the following as sources of information by ticking the relevant box in each row:

(1 is very useful, 5 is not at all useful)

	1	2	3	4	5
Media (TV, magazines, newspapers)	☐	☐	☐	☐	☐
DairyNZ events (inc. discussion groups)	☐	☐	☐	☐	☐
Demonstration-farms	☐	☐	☐	☐	☐
Conferences	☐	☐	☐	☐	☐
Other farmers	☐	☐	☐	☐	☐
Sales representatives	☐	☐	☐	☐	☐
Consultants	☐	☐	☐	☐	☐

2.14 Do you have any suggestions for areas to investigate, or future projects, for the LUDF?

____
____
____
____
____

F5. Results of LUDF Survey

Part 1 Demographics

1.1 Position of person answering questions:

	Per cent
Owner/Operator	73.4
50/50 Sharemilker	16.8
L.O. Sharemilker	1.4
Managers	7.0
Other	1.4

1.1 Highest level of formal education

	Per cent
High School	33.1
AgIto/Polytechnic	23.9
University	43.0

1.2 Age of person answering questions:

Mean: 44.6 years
Range: 22 to 72 years

	Per cent in each group
20's	7.6
30's	24.0
40's	38.4
50's	23.4
60's	7.0
70's	1.4

1.3 Approximate distance from Lincoln University Dairy Farm

Mean: 104.65
Range: 6 km to 350 km

	Per cent
Under 50 km	31
51-100 km	28.2
101-150	22.2
151-200	4.2
176-200	3.5
201-250	7.1
250+	3.5

81.4 % live within 150 km of the LUDF

Size of milking platform

Mean: 238.47
Range: 50 to 1400

	Per cent
Under 100 ha	9.6
100-200 ha	45.2
201-300 ha	26.0
301-400 ha	8.9
400-500 ha	4.1
Over500 ha	6.2

1.4 Number of cows milked at peak

Mean: 611
Range: 130 to 5000

	Per cent
Under 220	4.8
221-320	5.5
321-420	6.1
421-520	10.3
521-620	16.5
621-720	11.6
721-820	11.0
821-920	6.8
921-1020	6.2
1021-1120	3.4
1121-1220	5.5
Over 1221	12.3

1.5 Average cow weight

Mean: 479.95
Range: 400 to 750

	Per cent
Under 350	7.1
351-400	30.5
401-450	43.3
Over 450	19.1

1.6 Production per cow

Mean: 418.5
Range: 300 to 525

	Per cent
Under 350 kg ms	7.1
351-400	30.5
401-450	43.3
450 +	19.1

1.**9 Production per hectare**

Mean: 1441.4
Range: 698 to 2180

	Per cent
Under 1100	3.6
1101-1150	12.3
1151-1200	5.1
1201-1250	5.1
1251-1300	3.6
1301-1350	4.4
1351-1400	10.1
1401-1450	5.8
1451-1500	8.7
1501-1550	5.1
1551-1600	7.9
1601-1650	4.4
1651-1700	8.7
1701-1750	4.0
1751-1800	4.7
Over 1800	6.5

There was a highly significant negative correlation between age and business structure (-.377**) - as age decreased there were less owner/operators. There was also a highly significant negative correlation between age and education (-.260**). milksolids/ha were negatively correlated to increasing age (-.225**).

There were significant positive correlations between increased education and hectares controlled (.185*) and cows milked (.189*). Milksolids/ha increased with cow numbers (.220**) and milksolids/cow increased with cow weight (.296**).

1.10 The Five Farming Systems

		Per cent
System 1	(no imported feed)	8.5
System 2	(0-10% imported feed)	22.5
System 3	(10-20% imported feed)	35.2
System 4	(20-30% imported feed)	28.2
System 5	(over 30% imported feed)	5.6

As farm systems moved from System 1 towards System 5, there were positive correlations to cow numbers (0.185*), milksolids produced (0.261**) and milksolids/ha (0.484**). There was a significant correlation (0.174*) between the higher input systems and attendance at DairyNZ events.

There was a negative correlation between those who farmed for capital gain and higher input systems (-0.225**) and for those who attended LUDF Focus Days to learn about LUDF grazing management techniques (-0.189*) and animal management techniques (-0.221*).

1.11 How often do you attend DairyNZ events (excluding LUDF)?

Mean = 2.78 events/year

Number of attendances	Per cent
0	21.5
1	13.2
2	24.3
3	13.9
4	7.6
5	4.9
6	5.6
7 or more	9.0

Attendance at DairyNZ events were negatively correlated to age (-0.217**) and those farming for capital gains (-0.177*). Those who attend DairyNZ events were less likely to use the LUDF website (-0.226*).

There was a positive correlation between attendance at DairyNZ events and milksolids/ha (0.204*) as well as those using higher input systems (0.174*). There were also positive correlations between those who attended DairyNZ events and those who attended LUDF Focus Days in all three years surveyed (0.189*,0 .218** and 0.268**).

1.12 Do you use a private consultant?

No	31.5 %
Yes	68.3 %

There was a positive correlation of dairy farmers using consultants and production of milksolids/ha (0.238**) and a positive correlation to those who ranked farming as a lifestyle highly (0.170*). There were further positive correlations between consultant use and low grazing residuals (0.224*) and heifer synchronization to calve a week before the herd (0.350**).

1.13 Assuming that you have a farming surplus in the coming year, please rank the top five areas in which you would like to spend your surplus (1 being the first choice).

#1 use (130 responses)

	Per cent
Pay down debt	43.8
Purchase more land	16.9
Improve irrigation	15.4

#2 use (129 responses)

	Per cent
Purchase land	17.1
Improve irrigation	14.7
Pay down debt	12.4

#3 use (125 responses)

	Per cent
Purchase land	14.4
Improve irrigation	14.4
Re-grass	10.4
Holidays	10.4

#4 use (119 responses)

	Per cent
Re-grass	16.8
Improve irrigation	10.9
Increase herd size	8.4

#5 use (108 responses)

	Per cent
Upgrade machinery	13.9
Holidays	12.0
Improved housing	10.2

1.14 Please indicate the importance of the following in regard to your personal priorities in farming (1 is very important, 5 is not at all important)

Responses were 146, results shown in percentages

	1	2	3	4	5
Cash profit	63.7	27.4	6.8	2.1	0
Life style	43.2	34.9	17.1	2.7	2.1
Capital gain	35.6	28.8	30.8	2.1	2.7
Qual. stock	42.1	35.2	18.6	2.8	1.4
Own boss	61.0	26.7	7.5	3.5	1.4
Working outside	39.3	29.7	22.8	5.5	2.8
family	47.4	29.9	15.3	6.6	.7

Being their own boss was positively correlated with all other reasons for farming. However, those farming for capital gains were less inclined to be positively correlated to the other reasons for farming.

Part 2 The Lincoln University Dairy Farm (LUDF) and the South Island Dairy Development Centre (SIDDC)

2.1 How often did you attend any of the four LUDF Focus Days in these seasons?

Responses were 142, all results shown in percentages

	0	1	2	3	4
2005/06	32.4	23.2	20.4	18.3	5.6
2006/07	34.5	19.0	23.9	20.4	2.1
2007/08	37.0	31.9	18.8	8.0	4.3

2.2 If you have attended a LUDF Focus Day, why do you attend?

Responses were 118; results are the % who gave an affirmative answer to the reason.

Per cent	Reasons
36.2	To meet other farmers and have a day off of the farm
79.7	To learn about latest grazing management techniques
61.0	To learn about the latest animal management techniques
57.6	For the financial information provided
12.7	To visit with Agribusiness people (bankers, suppliers, etc.)
78.8	To learn how the LUDF is performing
65.3	To learn about environmental management at the LUDF (irrigation, effluent, fertiliser, etc.)
76.1	To compare my farm to the LUDF

2.3 When you think of the LUDF farming systems, what comes to mind?

There were 141 responses; results are the % who gave an affirmative answer.

Per cent	Responses
89.4	Low grazing residuals
79.4	Pasture monitoring and feed wedge
63.8	Nutrient and environmental management
46.8	Irrigation monitoring
41.1	Re grassing of pastures
34.3	Reproductive tech.—treating anoestrus cows, synchronizing heifers
20.7	OAD milking during calving
9.3	OAD calf feeding

2.4 If you can put an economic value on any of the changes in question 2.3, please list with your estimate of $ value.

Responses = 23, results are number of respondents in each category

	Responses
Lost money	1
up to $50,000	5
$50,001 to $100,000	8
$100,001 to $500,000	7
up to $1,000,000	2

Some key findings from the LUDF are listed below. Indicate your use of them by putting a “Y” or “N” in the box, and comment why, or why you haven’t, adopted these technologies.

2.5 Low grazing residuals (129 responses)

82.2% have adopted (106)

17.8% have not (23)

19 respondents have always followed this practice

43 respondents felt that the practice gives better quality pasture and better utilization

6 respondents felt it was a more profitable way to farm

10 respondents did not adopt the practice, because they felt that their cows would not be fully fed

2.6 Re-grassing based on measurement of poor performing paddocks (130 responses)

73.8% have adopted (96)
26.2% have not (34)
32 respondents have always re-grassed
16 respondents felt that the practice results in improved pastures
14 respondents felt that the practice increased production and quality

6 respondents did not re-grass due to being a new conversion

2.7 Synchronizing heifers to calve one week before the main herd (135 responses)

28.9% followed practice (39)
71.1% did not (96)

18 respondents followed the practice to get the heifer calving over early
12 respondents followed the practice to give heifers more time to cycle
16 respondents did not follow the practice due to logistics (heifers away from farm, lack of facilities, etc.)
6 respondents felt that it was too expensive
3 respondents synchronise their heifers, but not to calve before the main herd
12 respondents calve heifers early, but do not synchronise
15 respondents do not believe in the practice of synchronizing heifers

2.8 Aggressive use of hormone intervention non-cycling technology (135 responses)

42.2% use aggressive technologies
57.8% do not

29 respondents used the technologies to maximise cycling, conception and compact calving
8 respondents said the practice is too expensive
23 respondents said that they did not believe in intervention12 respondents felt that they achieved good results through breeding and feeding10 respondents used other methods like OAD milking, teaser bulls, etc.
5 respondents said that they do not have any reproductive problems

2.9 Nil Induction policy (138 responses)

36.2% (50) indicated that they followed the nil induction policy
63.8% (88) indicated that they did not

3 respondents felt that the practice of induction was too expensive
9 respondents were philosophically opposed to inductions
11 respondents felt that inductions violated animal welfare
20 respondents induced for reasons including: tidying up the calving pattern of a new herd and to grow the herd numbers

28 felt that it was too costly to waste cows through not inducing late calvers
5 respondents were share milkers who felt that they could not afford not to induce

There was a negative correlation (-0.243**) between the adoption of the nil induction policy and milksolids/ha.

2.10 If you have made any changes, have they made your farm management easier or more difficult? (57 respondents)

70.2% said easier (40)
24.6% said harder (14)---however, some said it was worth it though
5.3% said no effect (2)

2.11 How important are the following sources to learn about the results obtained at the LUDF (1 is very important, 5 is not at all important) (137 respondents)

Results in %'s

	Responses	1	2	3	4	5
Focus days	**137**	**45.3**	**22.6**	**15.3**	**6.6**	**10.2**
Consultants	**137**	**20.4**	**27.0**	**29.2**	**9.5**	**13.9**
Disc. Group	**128**	**20.3**	**34.4**	**23.4**	**10.9**	**10.9**
Website	**123**	**29.3**	**22.8**	**21.1**	**12.2**	**14.6**
DairyNewz	**127**	**21.3**	**27.6**	**35.4**	**7.9**	**7.9**
Exporter	**138**	**31.9**	**29.7**	**28.3**	**6.5**	**3.6**
Other publications	**127**	**18.9**	**22.8**	**36.2**	**14.2**	**7.9**
Other farmers	**125**	**23.2**	**33.6**	**29.6**	**7.2**	**6.4**

2.12 If you have used the LUDF website, how often do you visit the site in a year (times)? (114 responses)

Not used	31.6%
1-10 times	42.1%
11-20 times	7.9%
20-30 times	3.5%
more than 30 times	14.9%

2.13 When you think of learning about new technology or innovations, please rank the following as sources of information by ticking the relevant box in each row: (1 is very useful, 5 is not useful at all)

Results in percentages

	Responses	1	2	3	4	5
Media	**135**	**31.1**	**31.1**	**25.9**	**6.7**	**5.2**
DairyNZ	**136**	**31.6**	**44.1**	**16.9**	**.7**	**6.6**
Demo farms	**135**	**32.6**	**39.3**	**20.0**	**3.7**	**4.4**
conferences	**131**	**22.1**	**32.8**	**30.5**	**9.9**	**4.6**
Other farmers	**134**	**31.3**	**35.8**	**26.1**	**6.0**	**.7**
Sales reps	**131**	**4.6**	**16.0**	**23.7**	**19.8**	**35.9**
consultants	**138**	**27.5**	**38.4**	**16.7**	**8.7**	**8.7**

Responses to Question 2.14: Do you have any suggestions for areas to investigate, or future projects, for the LUDF?

These results are transcribed as written:

<u>Communication comments:</u>

- more field days away from LUDF
-better communication with farmers who are "not on your back door"
-more focus days in the wider region
-set up a subscription service for focus day hand outs for those who can't attend

<u>Feeding comments:</u>

-dry cow feeding systems (grass/straw, kale/straw, kale/grass silage, kale/cereal silage, green feed crops/straw)
-higher production through imported feed
-trials on grain feeding, OAD, robots
-work on transition feed pre and post calving
-meal feeding
-grain feeding in autumn
-investigate the feasibility of putting in a meal feeding system into the shed to maximise milksolids/ha and maybe reduce supplementary feeding costs
-I think it would be good to investigate the effects of increasing grain or meal feeding to cows in a well-managed pasture based system. Can pasture production be maintained? What are maximum cow capacities? What are the financial parameters?

-milking on brassicas. Can the cows be fed 100% before tainting occurs? Will grain feeding reduce the risk - what else would help?

Suggestions for Systems research:

-put “young herd” on OAD for a whole season
-how would this farm perform if all animals came home on August 1st
-look at growing supplementary crops on the farm
-feeding silage in early spring being part of a defined plan
-look at rotation length to staying at 20 days until February, then use supplements to extend rotation. Rely on irrigation for summer grass
-on-farm winter crops or maize silage to mitigate effluent
-development of profitable, self-contained dairy using summer/winter crops on milking platform
-how can new technology be used to increase productivity
-the extrapolation of information gathered on centre pivot irrigated farms to non-irrigated farms
-pre-wilting of summer grass when dry matter content is low

Reproduction:

-better reproductive performance---this farmer added that he follows the LUDF grazing system, but has to induce because he feels that the LUDF hasn’t got on top of reproductive problems
-getting cows in calf
-trial sexed semen
-work on high fertility cows that recover quickly and produce 400 kg milksolids on grass
-be honest about fertility in LIC bulls and what bulls you select. How can you be honest when the companies sponsor you?
-improving cow fertility
-look at reproduction vs. production
-increase reproductive work
-cow fertility
-link Jim Gibbs’ lameness work with in-calf rates
-trial a limited induction policy vs. the current nil induction policy
-keep up the very good work. I still tend to think your aggressive/obsessive approach to pasture management compromises your ability to get cows in calf—it is good for everything else, i.e. profit, production, etc.—but it is no good blaming the cows that were purchased or anything else to do with the cows except maybe the national 1% yearly decline in fertility
-need to look closer at LUDF system to explain foetal losses and feet problems

Fertiliser:

-look at farming without fertiliser
-use of liquid fertilisers through a fertigation system
-due trials with 250 and 300 kg N to check leaching under best practice application technology
-investigate a low or nil N system

-look at lower inputs of N due to cost
-application of eco-n thru pivot
-investigate fine lime or fertiliser
-why use chemical fertilisers? Trials away from this would be very useful - biotech and use of effluent, fertiliser and how cows can give out less greenhouse gases
-stop the silly nonsense about using low rates of urea and instead reconcile N use with actual water nitrate levels in conjunction with eco-n and/or other nitrification inhibitors
-soil sodium levels in relation to bloat

Labour and automation:

-automation of the milking process and labour
-labour efficiency
-areas in saving labour or making better use of expensive labour
-OAD milking
-dairy shed automation, particularly robotics
-automated heat detection
-robotic milking
-robotic milkers
-human resources - hours, housing, training
-use of technology and the refining of efficient work place practices

Environment:

-continue environmental research to counter negativity to dairy industry (2 similar responses)
-keep profile of good dairy farming in the media
-carbon sequestration in soils
-help improve dairy farmers understanding and use of irrigation
-managing with less irrigation water

Compliments:

-please do not get into research, maintain the accent on-farm systems
-keep up the good work, it’s great for benchmarking
-work to date has been hugely valuable
-keep up the good work - it’s nice to see the road frontage tidied
-several nice comments about Adrian van Bysterveldt
-keep farm simple, look at profitability not production/ha

Others:

-ways to maximise net profit
-animal management
-animal health
-integrated pest management
-trial grasses from other firms
-mastitis
-heifer mastitis

-You need to look seriously at your dry matter calculations of growth and cover because they do not stack up with the information provided, e.g. growth rates about 60+ (maybe was t) and overall farm cover and production achieved with the farm covers available. I have regular information on growth and production and the Farm Right consultant agree it cannot be fact
-look at wealth creation
-soil compaction in relation to dry matter production
-investigate 1700/2700 grazing technique worked back to kg me/ha and compare with LUDF grazing technique and measure the actual ME intake possible for a dairy cow without compromising intake. How much does that last .5 ME cost as in lost intake/mating performance, etc. You might find that eating not so hard and bringing in that extra ME is cheaper, plus you will grow more ME/ha (reply #27, a system 5 farmer)
-perform research on Pro-Gibb