

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

**PHYSICAL AND FINANCIAL CHARACTERISTICS
OF HIGH INPUT AND LOW INPUT DAIRY
FARMS IN NEW ZEALAND**

Research project for thesis, to be presented in partial
fulfilment

of the requirements for the degree of

Master of Science (MSc)

in

Animal Science



Institute of Veterinary Animal
and Biomedical Sciences
M a s s e y U n i v e r s i t y
Palmerston North, New Zealand

By: David Silva-Villacorta

**Supervisors: Colin Holmes
Nicola Shadbolt**

2003

This thesis is dedicated to my parents

Luis Angel Silva Velasquez and Doraliza Villacorta Oblitas

ABSTRACT

Silva, D. (2004). Physical and Financial characteristics of high input and low input dairy farms in New Zealand. MSc Thesis. Massey University. Palmerston North. New Zealand.

In recent years the use of supplements in New Zealand dairy farms has increased, but there is little information about the way in which this extra feed has influenced the dairy system. This research work aimed at analysing the effect of extra feed input on the physical and financial performance of dairy farms. ProfitWatch data corresponding to 915 owner-operated dairy farms were analysed. The data was classified according to dairy season (1998/99, 1999/00, 2000/01, 2001/02), extra feed offered per cow (low input systems: <50kg DM extra feed/cow; Intermediate input system: between 50-500 kg DM extra feed/cow; High input systems: >500kg DM extra feed/cow) and quartiles according to EFS/ha. The definition of extra feed comprised supplements imported, winter grazing and maize grown in the farm. The statistical analysis comprised analysis of variance (ANOVA) and regression analysis done in SAS. In all 4 dairy seasons, high input systems had higher stocking rates (2.7-2.8 vs 2.4-2.5 cows/ha), lower comparative stocking rate (83-86 vs 92-83 kg LWT/t DM), higher milksolids production per cow (293-341 vs 249-295 kg MS/cow) and per hectare (826-921 vs 616-744 kg MS/ha), and higher use of nitrogen fertiliser per hectare (85-116 vs 53-67 kg N/ha/year) than low input systems. During the period of study, milksolids payout increased from \$3.58/kg MS in 1998/99 to \$5.30/kg MS in 2001/02. High input systems had higher Gross Farm Income per hectare (\$3287/ha vs \$2374/ha in 1998/99; and \$5377/ha vs \$4362/ha in 2001/02) and higher Farm Working Expenses per hectare (\$2519/ha vs \$1760/ha in 1998/99, and \$3259/ha vs \$2187/ha in 2001/02) than low input systems. There were not significant differences in EFS/ha, Return on Assets (%) and Return on Equity (%) between farms in the 3 feed input systems. Within each feed input system, farms in the top quartile for EFS/ha had higher stocking rates and higher estimated pasture consumed per hectare than their corresponding farm system in the bottom quartile. Regression analysis of all the farms (915 farms) showed that across all farms, the marginal (average of 4 years) response to the extra feed used was 50g MS/cow/kg DM extra feed per cow. But the marginal response per hectare to extra feed was higher (96g MS/ha/kg DM extra feed per hectare) due to associated increases in stocking rate and other inputs. The operating cash surplus per hectare increased by approximately \$0.07 to \$0.12/kg DM of extra feed used per hectare, but EFS/ha was not significantly affected by these differences in cash operating surplus.

Keywords: low, intermediate and high input systems; extra feed.

ACKNOWLEDGEMENTS

Although I am the author of this work, the realization of this thesis was only possible due to the help of many people. First I would like to thank my supervisors Colin Holmes and Nicola Shadbolt for their time, patient, suggestions and orientations during this time. You both challenge me and encourage me to improve the quality of this work.... THANK YOU VERY MUCH for your supervision!.

This work would not have been possible without the help of Mark Blackwell, Chris Glassey and Warwick Prewer at Dexcel. They gave me access to ProfitWatch data, which is the base of this study. Thanks Warwick Prewer and Chris Glassey for their time, assistance, orientation and suggestions in the realization of this work. I hope the information contained in this research work is helpful and contributes to a better understanding of the effect of the use of supplements on New Zealand dairy farms. Especial thanks to Nicolas Lopez-Villalobos for his help in the statistical analysis of the data for this research work. Your orientation, suggestions and comments help me very much to convert the numbers into meaningful and useful data, thank you Nicolas.

I want to thank to my friends in New Zealand for their help, time and never-ending encouragement. To Alfredo, Federico, to named only 2, and the rest of my friends thank you for your accompaniment and for making my time in New Zealand a memorable experience. I also want to thank my family in Peru for their help in the distance and words of encouragement. Mum, Dad, los quiero mucho!. Thanks to Brian and Vilay, Annita and Gavin and mi amor Sarah for being my family here in New Zealand.

Last but not least, I want to thank the Ministry of Trade and Foreign Affairs of New Zealand for the scholarship.... All this personal and professional experience would not have been possible without the NZODA program. THANK YOU VERY MUCH.

TABLE OF CONTENTS

Abstract	ii
Acknowledgements.....	iii
Table of contents	iv
List of Tables	vi
List of Figures	x
CHAPTER 1 INTRODUCTION	1
CHAPTER 2 LITERATURE REVIEW	6
2.1 INTRODUCTION	6
2.2 THE NEW ZEALAND DAIRY INDUSTRY	7
2.3 PHYSICAL CHARACTERISTICS OF NEW ZEALAND PASTORAL DAIRY SYSTEMS	9
2.3.1 Pasture production	9
2.3.2 Cows	10
2.3.3 Dairy systems	12
2.3.3.1 Low input dairy systems.....	12
2.3.3.2 High input dairy systems.....	18
2.3.3.2.1 Effect of supplements on the system.....	18
2.3.3.2.2 Response to supplementary feeding	19
2.3.3.2.3 Inclusion of supplements into the system	20
2.3.3.2.4 Milksolids production in high input systems	22
2.3.4 Breed and genetic merit in dairy farms	23
2.4 FINANCIAL CHARACTERISTICS OF NEW ZEALAND DAIRY FARMS (KEY FINANCIAL INDICATORS)	24
2.4.1 Economic Farm Surplus per hectare (\$/ha)	25
2.4.1.1 Economic Farm Surplus per hectare (EFS/ha) and the dairy system	26
2.4.1.2 Economic Farm Surplus per hectare (EFS/ha) and feed input	28
2.4.1.3 Changes in farm income and expenditure over time	30
2.4.1.3.1 Gross Farm Income per hectare (GFI/ha)	30
2.4.1.3.2 Farm Working Expenses per hectare (\$/ha).....	31
2.4.2 Cost of Milksolids Production (\$/kg MS)	34
2.4.3 Return on Assets (RoA) and Return on Equity (RoE)	37
CHAPTER 3	
PHYSICAL CHARACTERISTICS OF LOW INPUT AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND	42
ABSTRACT	42
3.1 INTRODUCTION	43

3.2 MATERIALS AND METHODOLOGY	44
3.3 RESULTS	52
3.4 DISCUSSION	62
3.5 CONCLUSIONS	68
CHAPTER 4	
FINANCIAL CHARACTERISTICS OF LOW INPUT AND HIGH	
INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND	69
ABSTRACT	69
4.1 INTRODUCTION	70
4.2 MATERIALS AND METHODOLOGY	71
4.3 RESULTS	78
4.4 DISCUSSION	88
4.5 CONCLUSIONS	96
CHAPTER 5	
PHYSICAL AND FINANCIAL PERFORMANCE OF LOW INPUT	
AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS	
IN NEW ZEALAND, ACCORDING TO THEIR EFS/HA	97
ABSTRACT	97
5.1 INTRODUCTION	98
5.2 MATERIALS AND METHODOLOGY	99
5.3 RESULTS	101
5.4 DISCUSSION	114
5.5 CONCLUSIONS	121
CHAPTER 6	
RELATIONSHIP BETWEEN FEED INPUT AND OTHER PHYSICAL	
AND FINANCIAL FARM PARAMETERS	122
ABSTRACT	122
6.1 INTRODUCTION	123
6.2 MATERIALS AND METHODOLOGY	124
6.3 RESULTS	126
6.4 DISCUSSION	134
6.5 CONCLUSIONS	137
CHAPTER 7: GENERAL DISCUSSION	139
CHAPTER 8: GENERAL CONCLUSIONS	142
REFERENCES	144
APPENDICES	150

LIST OF TABLES

CHAPTER 2 LITERATURE REVIEW

Table 2.1	Changes in milksolids payout, milksolids production per cow and per hectare and Economic Farm Surplus, between 1998/99 and 2001/02 (Source: LIC, 2003; Dexcel, 2003)	6
Table 2.2	Changes in the dairy industry in New Zealand (Source: LIC, 2003).....	8
Table 2.3	Differences between owner operators and sharemilkers in 2001/02 (Source: LIC, 2003; Dexcel, 2003)	8
Table 2.4	Pasture production in different regions of New Zealand (From: Holmes et al. 2002)	9
Table 2.5	Pasture quality during spring and summer (Adapted From: Kolver, 2000)	10
Table 2.6	Effect of genetic merit on animal performance (From Holmes, 1999)	10
Table 2.7	Influenced of physiological factors (liveweight, pregnancy and milksolids production) on feed demand (t DM/ha/year), feed conversion efficiency (kg MS/t DM), and milksolids production per kilogram of liveweight (kg MS/kg LWT) (Adapted from: Holmes, 2000).....	11
Table 2.8	Effect of feed input on milksolids production per cow and per hectare (Reid, 1997)	22
Table 2.9	Ration for dairy cows in some high input systems in New Zealand (From: Holmes, 2000)	22
Table 2.10	Average stocking rate and milksolids production in the high input farmlets of the 1.75t MS/ha trial (Macdonald, 1999)	23
Table 2.11	Calculation of Economic Farm Surplus (From Dexcel, 2003b)	25
Table 2.12	Financial characteristics of Waikato and Bay of Plenty dairy farms (135 dairy farms) classified according to their EFS/ha (From Holmes, 2000) ..	26
Table 2.13	EFS/ha of 64 owner-operated commercial dairy farms in Taranaki (From: Howse and Leslie, 1997)	27
Table 2.14	Cost of supplements for dairy cows (From Brookes, 2002)	33
Table 2.15	Influence of land value and pasture production on cost of pasture production (From Penno et al., 1996)	33

Table 2.16	Effect of the proportion of pasture in the diet on the cost of milksolids production (From: Hurley, 1995)	36
Table 2.17	Change in average farm working expenses (excluding interest payments) per cow, per hectare and per kg MS, between 1992/93 and 2001/02, in owner operators (From Dexcel, 2003)	36
Table 2.18	Physical and financial performance of case study farms in the lower North Island (From: Rawlings and Shadbolt, 2000)	39
Table 2.19	Effect of return on assets (RoA) and cost of funding (i) on return on equity (RoE) (From: kay and Edwards, 1999)	40
Table 2.20	Return on capital (excluding capital appreciation) and return on equity in owner operators and sharemilkers (From Dexcel, 2003)	41

CHAPTER 3

PHYSICAL CHARACTERISTICS OF LOW INPUT AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND

Table 3.1	Physical Characteristics of dairy farms, between 1998/99 and 2001/02, according the amount of extra feed input per cow	53
Table 3.2	Reproductive characteristics of dairy farms, between 1998/99 and 2001/02, according to their level of extra feed input per cow	59
Table 3.3	Estimated pasture consumed per hectare (t DM/ha) and use of nitrogen fertiliser (kg N/ha) in dairy farms, between 1998/99 and 2001/02, according to their level of extra feed input per cow	59
Table 3.4	Supplements made on farm (kg DM/ha) and feed imported per hectare (kg DM/ha) in dairy farms, between 1998/99 and 2001/02, according the their level of extra feed input per cow	61
Table 3.5	Comparison of farm size, herd size, stocking rate, kg MS/cow and kg MS/ha found in this study with data from dairy Statistics (LIC, 2003). ...	62

CHAPTER 4

FINANCIAL CHARACTERISTICS OF LOW INPUT AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND

Table 4.1	Financial characteristics of dairy farms, in 1998/99 and 2001/02, according the their level of extra feed input	78
Table 4.2	Return on Assets (excluding capital appreciation) and Return on Equity of low, intermediate and high input dairy farms in 1998/99 and 2001/02 .	85

Table 4.3	Costs of production per hectare and per kg of MS in low, intermediate and high input systems, in 1998/99 and 2001/02, classified according to their level of extra feed input	86
Table 4.4	Changes in milksolids payout, gross farm income per hectare, farm working expenses per hectare and cash surplus in owner-operated dairy farms in New Zealand, between 1992/93 and 2001/02 (From Dexcel, 2003)	88

CHAPTER 5
PHYSICAL AND FINANCIAL PERFORMANCE OF LOW INPUT
AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS
IN NEW ZEALAND, ACCORDING TO THEIR EFS/ha

Table 5.1	Physical characteristics of low and high feed input dairy farms in the top and bottom quartiles for EFS/ha, in 1998/99 and 2001/02	101
Table 5.2	Reproductive characteristics of low and high feed input dairy farms in the top and bottom quartiles for EFS/ha, in 1998/99 and 2001/02 (Low input <50kg DM extra feed/cow, Intermediate input 50-500 kg DM extra feed/cow; High input: >500kg DM extra feed/cow)	105
Table 5.3	Financial characteristics of low and high feed input dairy farms in the top and bottom quartiles for EFS/ha, in 1998/99 and 2001/02	106
Table 5.4	Return on assets and Return on Equity in low and high feed input dairy farms in the top and bottom quartiles for EFS/ha, in 1998/99 and 2001/02	112
Table 5.5	Cost of milksolids production in low and high feed input dairy farms in the top and bottom quartiles for EFS/ha, in 1998/99 and 2001/02	113
Table 5.6	Farm working expenses per hectare, per cow and per kilogram of milksolids in high and low input systems in 1998/99 and 2001/02	117
Table 5.7	EFS per farm in low, intermediate and high input systems in New Zealand, between 1998/99 and 2001/02	119

CHAPTER 6
RELATIONSHIP BETWEEN FEED INPUT AND OTHER PHYSICAL
AND FINANCIAL FARM PARAMETERS

Table 6.1	Regression equation for the prediction of milksolids production per hectare from stocking rate and extra feed input (Average of 4 years, $R^2=0.6881$; $P<.0001$).....	128
Table 6.2	Regression equation for the prediction of \$GFI/ha from milksolids payout and milksolids production per hectare (Average of 4 years, $n=915$) ($R^2=0.9148$; $P<.0001$).....	129
Table 6.3	Regression equation for the prediction of GFI/ha ($R^2=0.5676$; $P<.0001$) and FWE/ha ($R^2=0.5146$; $P<.0001$) from stocking rate and extra feed input in 1998/99 ($n=237$).....	132
Table 6.4	Regression equation for the prediction of GFI/ha ($R^2=0.7021$; $P<.0001$) and FWE/ha ($R^2=0.5483$; $P<.0001$) from stocking rate and extra feed input in 2001/02 ($n=192$).....	132

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

Figure 1.1	The pastoral dairy system	1
------------	---------------------------------	---

CHAPTER 2 LITERATURE REVIEW

Figure 2.1	Factors that influence milk production (From: Holmes et al, 2002).....	7
Figure 2.2	Seasonal Pastoral System (From Holmes, 2002)	13
Figure 2.3	Effect of 4 pasture heights (8, 15, 18, 30 cm) and 3 pasture mass (0.7, 1.5, 2.7 mg/cm ³) on intake of cattle grazing paspalum swards (From Woodward, 2002)	13
Figure 2.4	Strategic application of Nitrogen fertiliser (Roberts and O'Connor, 1992)	16
Figure 2.5	Immediate and long term effects of the use of supplements. (Adapted from Holmes et al., 2002)	19
Figure 2.6	Inclusion of extra feed into the pastoral system (Adapted From: Holmes, 2002)	21
Figure 2.7	Cash Changes in income and expenditure in owner-operated dairy farms between 1992/93 and 2001/02 (From: Dexcel, 2003)	24
Figure 2.8	Influence of milksolids production per hectare and farm working expenses per kilogram of milksolids on cash surplus per hectare at \$3.60/kg MS payout (From: Hedley and Bird, 2003)	35
Figure 2.9	Structure of the dairy business (From: Rawlings and Shadbolt, 2000)	37

CHAPTER 3

PHYSICAL CHARACTERISTICS OF LOW INPUT AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND

Figure 3.1	Distribution of owner-operated dairy farms in New Zealand according to the amount of extra feed input per cow (Low input <50kg DM/cow; Intermediate input 50-500 kg DM/cow; High input >500kg DM/cow).....	52
Figure 3.2	Average farm size (Eff. Ha), herd size and herd breeding worth between 1998/99 and 2001/02	54
Figure 3.3	Farm size (Eff. Ha) in low, intermediate and high input farms	54
Figure 3.4	Average herd size (N cows) in low, intermediate and high input farms ...	54
Figure 3.5	Average stocking rate between 1998/99 and 2001/02	55

Figure 3.6	Average comparative stocking rate between 1998/99 and 2001/02	55
Figure 3.7	Stocking rate (cows/ha) in low, intermediate and high	55
Figure 3.8	Comparative stocking rate in low, intermediate and high input farms	56
Figure 3.9	Average milksolids production per cow between 1998/99 and 2001/02 ...	56
Figure 3.10	Average milksolids production per ha between 1998/99 and 2001/02	56
Figure 3.11	Milksolids production per cow in low, intermediate and high input farms	57
Figure 3.12	Milksolids production per hectare in low, intermediate and high input farms	58
Figure 3.13	Use of nitrogen fertiliser (kg N/ha) in low, intermediate and high input farms	60

CHAPTER 4

FINANCIAL CHARACTERISTICS OF LOW INPUT AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND

Figure 4.1	Average gross farm income per hectare between 1998/99 and 2001/02 ...	79
Figure 4.2	Gross farm income per hectare in low, intermediate and high input systems	79
Figure 4.3	Average farm working expenses per between 1998/99 and 2001/02	80
Figure 4.4	Farm working expenses per hectare in low, intermediate and high input systems	80
Figure 4.5	FWE/kg MS in low, intermediate and high input systems	81
Figure 4.6	FWE/kg MS (excluding labour) in low, intermediate and high input systems	81
Figure 4.7	Labour costs per kg MS in low, intermediate and high input	82
Figure 4.8	Animal costs excluding labour (animal health, herd improvement, farm dairy and electricity) in low, intermediate and high input systems.....	82
Figure 4.9	Fertiliser costs (\$/ha) in low, intermediate and high input	83
Figure 4.10	Feed costs in low, intermediate and high input	83
Figure 4.11	Overhead costs in low, intermediate and high input systems	83
Figure 4.12	Average EFS/ha in low, intermediate and high input systems	84
Figure 4.13	Actual changes in EFS/ha in low and high input systems between 1998/99 and 2001/02, and hypothetical EFS/ha if milksolids payouts would have remained constant at \$3.58/kg MS and \$5.30/kg MS	85

Figure 4.14	Percentage of Return on Assets (Excluding capital appreciation) in low (L), intermediate (I) and high (H) input systems	86
Figure 4.15	Percentage of Return on Equity in low (L), intermediate (I) and high (H) input systems, between 1998/99 and 2001/02	86
Figure 4.16	Variable costs per kg MS in low, intermediate and high input systems ...	87
Figure 4.17	Fixed costs per kg MS in low, intermediate and high input systems	87
Figure 4.18	Cost of milksolids production in low, intermediate and high input systems	87

CHAPTER 5

PHYSICAL AND FINANCIAL PERFORMANCE OF LOW INPUT AND HIGH INPUT PASTURE-BASED DAIRY SYSTEMS IN NEW ZEALAND, ACCORDING TO THEIR EFS/ha

Figure 5.1	Average farm size of low, intermediate and high input farms in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	102
Figure 5.2	Herd size of low, intermediate and high input farms in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	102
Figure 5.3	Herd breeding worth of low, intermediate and high input farms in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	103
Figure 5.4	Average stocking rate of low (L), intermediate (I) and high (H) input farms in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	103
Figure 5.5	Milksolids production per cow in low (L), intermediate (I) and high (H) input farms in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	104
Figure 5.6	Milksolids production per hectare in low (L), intermediate (I) and high (H) input farms in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	104
Figure 5.7	Estimated pasture consumed per hectare (t DM/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	106
Figure 5.8	Estimated pasture consumed per hectare (t DM/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	107

Figure 5.9	Stock income per hectare (\$/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	107
Figure 5.10	Farm Working Expenses per hectare (\$/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	108
Figure 5.11	Farm Working Expenses per kilogram of milksolids (\$/kg MS) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	108
Figure 5.12	Cows per labour unit in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	109
Figure 5.13	Labour costs (\$/cow) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	109
Figure 5.14	Fertiliser costs (\$/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	110
Figure 5.15	Feed costs (\$/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	110
Figure 5.16	Overhead costs (\$/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	111
Figure 5.17	Economic Farm Surplus (\$/ha) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	111
Figure 5.18	Return on Assets (%RoA) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	112
Figure 5.19	Return on Equity (%RoE) in low (L), intermediate (I) and high (H) input farms, in the top or bottom quartiles for EFS/ha, between 1998/99 and 2001/02	112

Figure 5.20	Cost of milksolids production in low (L), intermediate (I) and high (H) input farms in the top and bottom quartiles for EFS/ha, between 1998/99 and 2001/02	113
-------------	---	-----

CHAPTER 6

RELATIONSHIP BETWEEN FEED INPUT AND OTHER PHYSICAL AND FINANCIAL FARM PARAMETERS

Figure 6.1	Relationship between extra feed input per cow and milksolids production per cow in owner- operated dairy farms (Average of 4 years, n=915).....	126
Figure 6.2	Relationship between Comparative Stocking Rate and milksolids production per cow in owner- operated dairy farms (Average of 4 years, n=915	127
Figure 6.3	Relationship between extra feed input per hectare and milksolids production per hectare in owner- operated dairy farms (Average of 4 years, n=915)	127
Figure 6.4	Relationship between extra feed input per hectare and milksolids production per hectare in owner- operated dairy farms (Average of 4 years, n=915)	128
Figure 6.5	Relationship between Comparative Stocking Rate and milksolids production per hectare in owner- operated dairy farms (Average of 4 years, n = 915	129
Figure 6.6	Relationship of milksolids production per hectare with GFI/ha and FWE/ha in owner-operated dairy farms in 1998/99 (n=237).....	130
Figure 6.7	Relationship of milksolids production per hectare with GFI/ha and FWE/ha in owner-operated dairy farms in 2001/02 (n=192)	130
Figure 6.8	Relationship of extra feed input per hectare with GFI/ha and FWE/ha in owner-operated dairy farms in 1998/99 (n=237)	131
Figure 6.9	Relationship of extra feed input per hectare with GFI/ha and FWE/ha in owner-operated dairy farms in 1998/99 (n=192).....	131
Figure 6.10	Relationship between extra feed input per hectare and EFS/ha in owner-operated dairy farms in 1998/99	133
Figure 6.11	Relationship between extra feed input per hectare and EFS/ha in owner-operated dairy farms in 2001/02	133

Figure 6.12	Relationship between comparative stocking rate and EFS/ha in owner-operated dairy farms in 2001/02.....	133
Figure 6.13	Relationship between extra feed input per hectare and the %RoA in owner-operated dairy farms (Average of 4 years, n = 915).....	134
Figure 6.14	Relationship between extra feed input per hectare and the %RoE in owner-operated dairy farms (Average of 4 years, n = 915).....	134

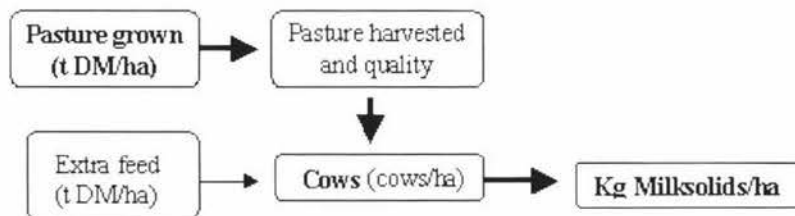
CHAPTER 1

INTRODUCTION

Approximately 10% of the milk produced in the world occurs in pastoral systems (World Animal Review, 1995; In: Holmes, 2000). This is because the optimum weather conditions (rain, temperature) and soil fertility necessary for pasture growth during the whole year occur only in a few countries.

The pastoral dairy system, simple in structure (See figure 1), is a dynamic system in which all parameters are related and influence each other. In this system, pasture growth is greatly influenced by weather conditions, pasture cultivars, the use of fertilisers and grazing management (Holmes et al., 2002). The performance of the dairy cow is influenced by her genetic merit and the environment, especially the feeding environment (Kolver, 2000). Healthy cows, with high feed conversion efficiency and longevity are essential for high milksolids production per cow.

Figure 1.1: The Pastoral Dairy System



Stocking rate influences the level of pasture utilisation, the feed intake of the cow and milksolids production per cow (McGrath, 1997). When pasture production is not enough, supplementary feeds can be used to meet the feed requirements of the herd (See Figure 1.1).

The New Zealand pastoral dairy system is characterised by its low cost of production and the lack of subsidies from the government. Between 90% and 95% of the milk produced in this country is exported (Burton, 2001; NZOY, 2000), at a price

that varies from year to year. Maintaining low costs of production is necessary to remain competitive in the global market (Parker, 1998; Holmes, 2000). But keeping low costs of production can also limit farm profitability during periods of high milksolids payouts (McCall et al., 1999).

In New Zealand, the strategic management of grazing, stocking rate, calving and dry-off dates, fertilisers and supplementary feed have resulted in a system with a high degree of synchrony between feed demand and feed supply. However, this system also constrains milksolids production per cow (Penno et al., 1996). This is due to the variability in pasture growth and pasture quality during the year, and to the limits that grazed pasture imposed on dry matter intake (Holmes et al., 2002; Kolver, 2000). While in the USA and Europe the average milk production per cow is 8000 - 9000 kg per lactation (USDA, 2003; Zwald et al., 2001; Perkins, 2002), in New Zealand milk production per cow is on average 3500 – 4000 kg per lactation (Zwald et al., 2001; Perkins, 2002).

Since in New Zealand farm income is related to milksolids production per hectare, strategies oriented to increase milksolids production per hectare can potentially increase farm profitability. The inclusion of extra feed into the pastoral system can increase farm profitability by increasing milksolids production per cow and per hectare. Changes in stocking rate and in calving and dry-off dates are necessary when extra feed is used in order to maximise feed utilisation and the conversion of feed into milksolids (Holmes et al., 2002). However, the effect of feeding supplements on farm profitability can vary depending on the milksolids response to the extra feed, the costs associated with feeding the supplements, and the milk price (Penno, 2003).

In New Zealand, strategies aimed at increasing milksolids production must not be separated from profit. Recently there has been an increase in milksolids production per cow and per hectare, due in part to higher inputs of fertilisers and extra feed into the pastoral system (MAF, 2001). However, increases in milksolids production per hectare have not always resulted in higher farm profits per hectare due to the increase in production costs (Van der Poel, 1996).

1.1 AIMS AND GENERAL DESCRIPTION OF THE RESEARCH

In recent years there have been major debates about the profitability of the inclusion of extra feed into the dairy system. However, there is little information about the effect that the inclusion of extra feed has had on commercial dairy farms. The general objective of this work was to analyse the influence that extra feed has had on commercial dairy farms in recent years.

This research work starts with the revision of literature related to the physical and financial characteristics of low input and high input dairy farms in New Zealand (Chapter 2). This chapter shows that the dairy system should be adapted to the amount of extra feed input and that milksolids production, per cow and per hectare, is influenced by the use of extra feed. This chapter also shows that the reports about the profitability of low input or high input dairy farms in previous research works are contradictory.

This thesis comprises the analysis of ProfitWatch data corresponding to 4 dairy seasons (between 1998/99 and 2001/02). To analyse the effect of extra feed on the dairy system, dairy farms in ProfitWatch were classified according to the amount of extra feed offered per cow. The definition of extra feed, for the classification of dairy farms, comprised supplements imported, pasture imported as winter grazing and maize grown in the farm. Three feed input systems (low input: <50 kg DM extra feed/cow; Intermediate input: 50-500 kg DM extra feed/cow; High input: >500 kg DM extra feed/cow) were formed and analysed.

The first part of the results describes the physical characteristics of low, intermediate and high input systems between 1998/99 and 2001/02 (Chapter 3). In this chapter the objective was to describe how the inclusion of extra feed influenced the farm system (farm size, stocking rate, comparative stocking rate), milksolids production, per cow and per hectare; pasture production and the use of nitrogen fertiliser. This information helps to understand the influence that the inclusion of extra feed has had on farm size, stocking rate, milksolids production (per cow and per

hectare), some reproductive characteristics of the herds and pasture production per hectare.

The second part of the results describes the financial characteristics of low, intermediate and high input systems between 1998/99 and 2001/02 (Chapter 4). In this chapter the objective was to describe how the use of extra feed influenced Gross Farm Income (\$/ha), Farm Working Expenses (\$/ha), Economic Farm Surplus (\$/ha), Return on Assets (%), Return on Equity (%), and the cost of milksolids production (\$/kg MS). This chapter helps to understand how the inclusion of extra feed into the system, and the adaptation of the dairy system to this extra feed, have affected the profitability of dairy farms (EFS/ha, RoA, RoE). The financial analysis of low, intermediate and high input dairy systems also helps to understand the effect of extra feed on Gross Farm Income per hectare and Farm Working Expenses per hectare.

The third part of the results (Chapter 5) analyses the physical and financial characteristics of low, intermediate and high input dairy farms in the top and bottom quartiles for EFS/ha. In this chapter the objective was to determine the physical (stocking rate, comparative stocking rate, milksolids production, pasture production) and financial (Gross Farm Income, Farm Working Expenses, Return on Assets and Return on Equity, cost of milksolids production) characteristics of farms in the top and bottom quartiles for EFS/ha. The classification of the 3 feed input systems into quartiles for EFS/ha helps to identify the characteristics that make low, intermediate and high input farms profitable. The inclusion of extra feed requires the adaptation of the system. For this reason, the characteristics of low, intermediate and high input farms in the top quartile for EFS/ha help to clarify the adaptations that are necessary in the dairy system in order to maximise profitability.

The last part of the results (Chapter 6) comprises simple and multiple regression analysis of the whole data. In this chapter, instead of classifying the dairy farms in 3 feed input systems, all dairy farms were used for the regression analysis. The objective of this chapter was to determine the relationships between milksolids production (per cow and per hectare), Gross Farm Income (\$/ha), Farm Working Expenses (\$/ha), Economic Farm Surplus (\$/ha), Return on Assets (%) and Return on Equity (%) with the amount of extra feed used per cow or per hectare. This chapter

helps to clarify the relationships between different farm parameters and the inclusion of extra feed.

This study provides a better understanding of the effect of extra feed input on New Zealand dairy farms in recent years. By knowing the effects of extra feed on the system, it will be possible to advise dairy farmers on the profitable inclusion of extra feed into their farms.