AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

BABCOCK INSTITUTE DISCUSSION PAPER
No. 2004-3

THE DAIRY SECTORS OF NEW ZEALAND AND AUSTRALIA: A REGIONAL STUDY

Louis Armentano
William Dobson
Edward Jesse
Norman Olson

The Babcock Institute for International Dairy Research and Development
University of Wisconsin, College of Agricultural and Life Sciences
240 Agriculture Hall, 1450 Linden Drive
Madison, Wisconsin 53706-1562

Acknowledgements

The authors of this report are indebted to the Babcock Institute for providing financial support for this project.

We also wish to express our sincere appreciation to Australia and New Zealand dairy industry experts for their superb hospitality and assistance in this endeavor. Special thanks are extended to Jay Waldvogel, Lawrie Creamer, and numerous other representatives of Fonterra, Doren Chadee and other faculty of the Department of International Business, University of Auckland, John Carradus and other Dexcel staff, Mike Matthews, Tatua Cooperative, Anton Meister and other Massey University faculty, New Zealand Ministry of Agriculture and Forestry and Ministry of Foreign Affairs and Trade Staff, David Rosenbloom and other US Embassy staff in Wellington, Rob Pettit and other Dairy Australia staff, Allan Burgess, Australian Dairy Farmers, Peter Owen, United Dairy Farmers of Victoria, Wayne Sanderson and Ross Greenaway, Murray-Goulburn Cooperative, Dale Ashton and other Australian Bureau of Agricultural and Resource Economics staff, Greg Williamson, Australian Department of Agriculture, Forestry and Fisheries, and Scott Turner, National Farmers Federation.

We also wish to recognize Gillian Magnin and other New Zealand Ministry of Agriculture and Forestry staff for their comprehensive review of an early draft of this report.

The Babcock Institute for International Dairy Research and Development
is a joint program of the
University of Wisconsin-Madison College of Agricultural and Life Sciences
University of Wisconsin-Madison School of Veterinary Medicine
University of Wisconsin Extension Cooperative Extension Division

Funding for this study was provided by CSRS USDA Special Grant 02-34266-12789

The views expressed in Babcock Institute
Discussion Papers are those of the authors;
they do not necessarily represent those of the
Institute, nor of the University.

ISBN 1-59215-090-X

The Babcock Institute
College of Agricultural and Life Sciences
240 Agriculture Hall, 1450 Linden Drive
Madison, Wisconsin 53706

Phone: 608-265-4169; Fax: 608-262-8852
Email: babcock@calshp.cals.wisc.edu
Internet: http://babcock.cals.wisc.edu

© 2004 Board of Regents of the University of Wisconsin System

Table of Contents

Introduction **1**

I. General Regional Background **2**
- Geography and Population 2
- Political Economies 3
- Resource-Based Economies 3
- Exchange Rate Impacts 4
- Integration of the New Zealand and Australian Economies 5
- The Agricultural Policy Environment in New Zealand and Australia 5
- The Importance of Dairying and Dairy Exporting in New Zealand and Australia 6

II. On-Farm Production – New Zealand **8**
- Dairy Production Trends 8
- New Zealand Dairy Production System 9
- Pasture Management and Feeding 11
- Seasonality of Milk Production 13
- Costs of Production 14
- Producer Prices 17
- Research and Outreach Support 17
- How Much Can New Zealand Expand Milk Production? 18
- Major New Zealand Dairy Production Issues 19

III. On-Farm Production – Australia **22**
- Dairy Production Trends 22
- Production Systems 25
- Costs of Production 26
- Producer Prices 27
- Research and Outreach Support 27
- How Much Can Australia Expand Milk Production? 30

IV. Processing Sector **32**
- General Description 32
- New Zealand 32
- Australia 36

V. Strategic Behavior in the New Zealand and Australian Dairy Processing Sector **41**
- New Zealand 41
- Australia 49

VI. Concluding Observations **53**
- Farm Production Sector 53
- Processing Sector 53
- Strategic Behavior 54

References - Print Publications **57**

References - Web sites **59**

List of Tables

Table 1. Selected statistics for Australia and New Zealand with US comparisons 3
Table 2. Value of Agricultural Exports and Total Exports for New Zealand, 2003 6
Table 3. Value of Agricultural Exports and Total Exports for Australia, 2003.....6
Table 4. Principal Dairy Exporters and Share of World Dairy Trade, 2002-03.....7
Table 5. New Zealand Milk Production Budget (Per Cow Basis).....15
Table 6. Milk Production Costs per Cow: Australia, New Zealand and Wisconsin 28
Table 7. Principal Fonterra Brands.....42
Table 8. Selected results achieved by Fonterra, 2001-02 and 2002-03.....44

List of Figures

Figure 1. Map of Australia and New Zealand.....2
Figure 2. Australia and New Zealand Exchange Rates 4
Figure 3. New Zealand: Milk Solids Production.....8
Figure 4. New Zealand: Herds and Cows.....9
Figure 5. Percent of New Zealand Dairy Herds by Region, 2002-03 Season.....10
Figure 6. New Zealand Dairy: Herd Size Distribution, 2002-03 10
Figure 7. New Zealand Milk Production by Month 1998/99-2002/03 Average 13
Figure 8. New Zealand Milk Prices.....16
Figure 9. Australian Dairy Industry Regions 22
Figure 10. Australia Dairy: Milk Production.....23
Figure 11. Australia Dairy: Milk Cows and Milk per Cow 23
Figure 12. Australia Dairy: Dairy Farms and Cows per Farm.....24
Figure 13. Australia Dairy: Fluid and Manufacturing Milk by State, 2002-03.....25
Figure 14. Australia and New Zealand Milk Prices.....26
Figure 15. Relationships 29
Figure 16. Destination of New Zealand Dairy Exports, 2002-03 33
Figure 17. Composition of New Zealand Dairy Exports, 2002-03.....33
Figure 18. Domestic versus Export Sales of Australian Dairy Products, 2002-03 36
Figure 19. Utilization of Australian Milk, 2002-03 36
Figure 20. Composition of Australian Dairy Product Exports, 2002-03 37
Figure 21. Destination of Australian Dairy Exports, 2002-03.....37
Figure 22. Fonterra's Structure.....43

THE DAIRY SECTORS OF NEW ZEALAND AND AUSTRALIA: A REGIONAL STUDY

Louis Armentano, William Dobson, Edward Jesse, Norman Olson*

Introduction

This is the first of a planned series of Babcock Institute reports on the dairy sectors of leading dairy exporters and importers. These are comprehensive studies summarizing information relating to the competitiveness and likely future strategies of selected foreign dairy producers, processors, exporters and government agencies. This information is intended to help US firms and policymakers develop appropriate strategies and policies to exploit export opportunities and to accommodate the actions of foreign dairy companies and foreign governments in exporting countries.

New Zealand and Australia were selected as the first study region. These two countries comprise the largest dairy exporting block in world markets. Measured by 2002 tonnage (and excluding intra-European trade), Australia and New Zealand accounted for 46 percent of world exports of skim and whole milk powders, 56 percent of butter exports, and 36 percent of cheese exports. New Zealand is the leading source of US imports of milk protein concentrates.

The dairy industries of both countries have geared up in recent years to expand production of dairy products. Australia has deregulated its dairy industry to become more competitive in international dairy markets. New Zealand has expanded milk production in the country's South Island and has merged the country's two largest cooperatives with the New Zealand Dairy Board to form a new processing and exporting firm called Fonterra. How much these actions will affect milk production, competitiveness of dairy exporting companies in the two countries, and strategies of firms in the two countries is not clear. Given the importance of Australia and New Zealand in competing for the US domestic dairy market, such information seems critical to US dairy interests.

To conduct this study, an interdisciplinary study team was assembled consisting of Louis Armentano (Dairy Science), Norman Olson (Food Science), and William Dobson and Edward Jesse (Agricultural and Applied Economics). Our procedure included a review of data and information available in print and on-line combined with in-country interviews and meetings conducted during a two-week visit in February 2004.

What we learned is synthesized in this report. The material is organized as follows: First, we provide a general overview of the political economies of New Zealand and Australia. This is followed by descriptions of the farm and processing sectors and an assessment of the strategic behavior of major dairy firms. Finally, we identify some issues pertinent to the US dairy sector.

* Louis Armentano is Professor and Chairman, Department of Dairy Science, UW-Madison. William Dobson is Professor Emeritus, Department of Agricultural and Applied Economics and Agribusiness Economist for the Babcock Institute, UW-Madison. Edward Jesse is Professor and Extension Dairy Marketing Specialist, Department of Agricultural and Applied Economics, UW-Madison/Extension. Norman Olson is Professor Emeritus, Department of Food Science, UW-Madison.

I. General Regional Background

This section consists of background information on economic and other characteristics of New Zealand and Australia. The material presented here helps to place in perspective certain information on the dairy industries of the two countries. It has particular relevance to the concept of competitive strategy since, as pointed out by Professor Michael Porter of Harvard's Business School, "The essence of formulating competitive strategy is relating a company to its environment [38, p.3]." Thus, this material shows the domestic environment within which firms like Fonterra of New Zealand and Murray Goulburn of Australia operate and why exporting is a dominant part of their businesses.

Geography and Population

New Zealand's land area is 268.7 thousand square kilometers, an area about 1.6 times the size of Wisconsin. The administrative divisions for New Zealand consist of 16 regions, but there are no designated states. Australia's land area is 7.7 million square kilometers, making it only slightly smaller than the contiguous 48 US states. Australia has six states and two territories.

Australia's population of 19.7 million people was approximately five times larger than that of New Zealand in 2003 (Table 1). The populations of Australia and New Zealand are equal to about 6.8 percent and 1.4 percent, respectively, of the US population. Thus, both countries have relatively small domestic markets. Both New Zealand and Australia have population growth rates of about one percent per year. Both have positive net migration rates exceeding four percent, identifying the countries as magnets for immigration from a number of countries.

Figure 1. Map of Australia and New Zealand

Table 1. Selected statistics for Australia and New Zealand with US comparisons*

Item	Australia	New Zealand	United States
1. Population (2003 est.)	19,731,984	3,951,307	290,342,554
2. Population Growth Rate (%)	0.93	1.09	0.92
3. Net Migration Rate (%) (Migrants per 1,000 population)	4.05	4.26	3.52
4. GDP/Capita (PPP in US$)	26,900	20,100	36,300
5. GDP Growth Rate (%)	3.6	3.3	3.1
6. Unemployment Rate (%)	6.3	5.3	6.0
7. Inflation Rate (Consumer prices, %)	2.4	1.8	2.3
8. Corruption Perceptions Index**	8.6	9.5	7.7

*Sources: US Central Intelligence Agency, 2003 for items 1-6 New Zealand and Australia and Items 1-4 for the US Items 5-7 for the US were obtained from Global Insight. Item 7, inflation rates for New Zealand and Australia were obtained from the Reserve Banks of the two countries. The Corruption Perceptions Index values were obtained from Transparency International, 2003. Population, population growth figures, and inflation figures for New Zealand, Australia and the US are for 2003. US figures for GDP growth rate and unemployment are also for 2003. All other statistics are for 2002.

**10 = highly clean, 0 = highly corrupt.

Political Economies

New Zealand and Australia have modern, western-style capitalist economies with advanced educational systems and sophisticated infrastructures. Literacy rates are near 100 percent in both countries.

Australia's Gross Domestic Product (GDP) per capita (PPP) of US$26,900 in 2002 was about a third higher than the US$20,100 figure for New Zealand in 2002 (Table 1)[1]. The per capita GDP (PPP) of Australia and New Zealand are about 74 percent and 55 percent, respectively, of the comparable US figure for 2002.

The World Bank has developed GDP per capita income rankings for developed countries [30]. For 2002, these rankings placed the US, Australia, and New Zealand in the second, ninth, and twentieth positions, respectively. Australia rose from position 16 in the rankings to position nine from 1990 to 2002. During this same period, New Zealand declined modestly from position 18 to position 20. The US held the number two position in both 1990 and 2002. The assumptions made in calculating such rankings are questionable in some respects. Therefore, the rankings should be regarded as only approximate.

GDP growth rates and unemployment rates for New Zealand and Australia were roughly similar to those of the US in 2003. Inflation, while low in the two countries, was also similar to that of the US in 2003.

The last item in Table 1 shows the corruption perceptions index compiled by Transparency International for 2002. Both New Zealand and Australia have relatively high index figures, identifying them as relatively clean countries in which to do business. Both countries have cleaner Corruption Perception Indexes than the US, which recorded a figure of 7.7 for 2002. These figures must be interpreted with some caution since they are based on survey of a generally small number of business people, academics, and analysts.

Resource-Based Economies

The economies of both New Zealand and Australia are, to an important extent, resource-based. Australia is partially dependent on mining and agriculture. New Zealand depends partly on farm and forestry products. Both countries are export dependent.

[1] The per capita GDP figures are expressed in Purchasing Power Parity (PPP) to take into account differences in the cost of living in the two countries. The figures reflect differences in the level of economic development in the two countries.

Australia—to the annoyance of many in the country—has been irreverently referred to as a "quarry and a farm" [30]. Analysts less given to annoying characterizations point out that resource-based economies are ill-equipped to compete in a global economy, noting that dependence on commodity exports leaves such economies vulnerable to sharp variations in commodity prices and long-term declines in those prices. In this connection, the US Central Intelligence Agency has hypothesized that New Zealand has failed to achieve per capita income growth equal to that of the four largest European Union countries because of the country's heavy dependence on agricultural commodity exports.

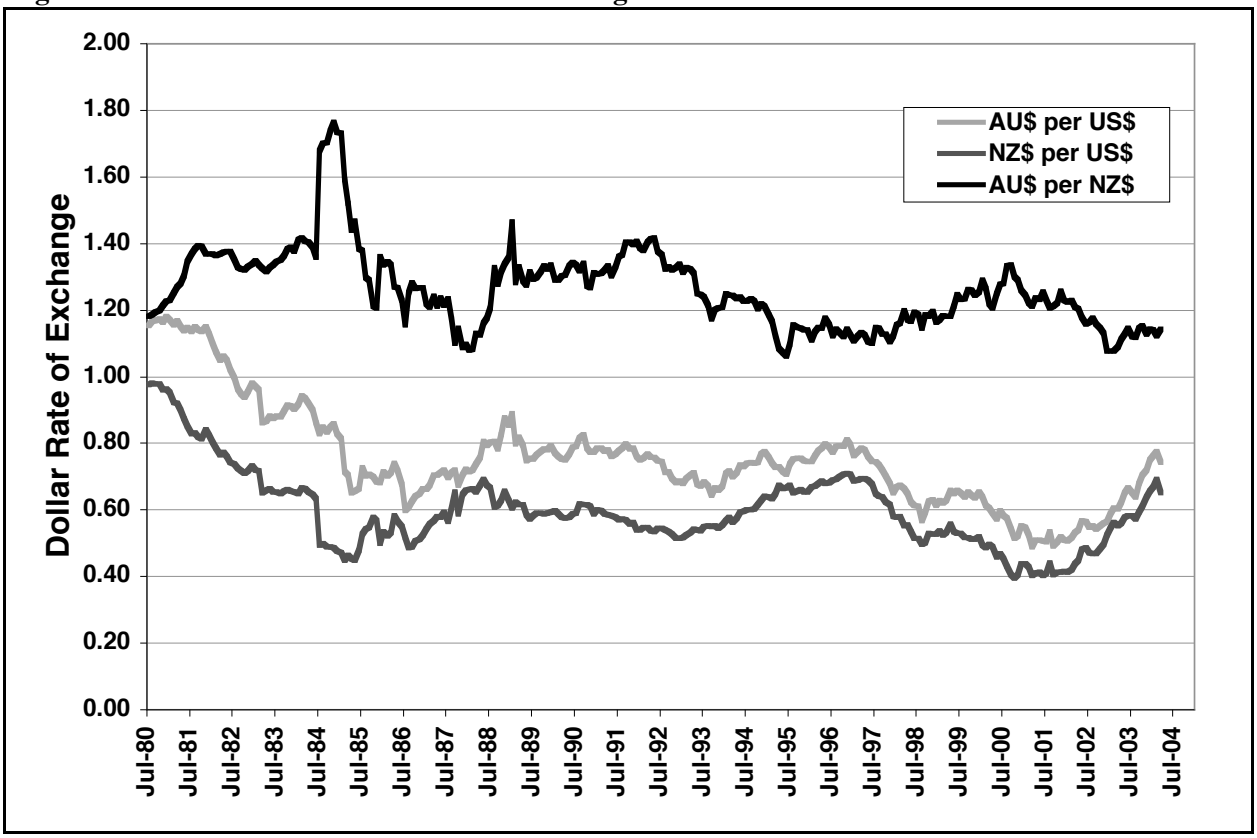
Exchange Rate Impacts

Prospects for export dependent economies are of course affected by movements in exchange rates. Both the New Zealand and Australian dollars appreciated in foreign exchange markets in 2003 and early 2004. The New Zealand dollar, for example, rose from US$0.42 in 2001 to US$0.70 in February 2004 (67 percent). While it rose at a less spectacular 52 percent rate during this period, the increase in the value of the Australian dollar in foreign exchange markets was substantial. While these recent currency increases against the US dollar have received considerable attention, it should be noted that current exchange rates are at or near those observed during much of the period since 1980, raising the question of whether current rates are aberrant or simply returning to "normal."

New Zealand's Ministry of Agriculture and Forestry explains the rise in the value of the New Zealand dollar as follows [44, p.20]:

- The US dollar has weakened against other major currencies. This is probably the result of reduced foreign investment flows into the US and an expanding US current account deficit. This point is certainly relevant for explaining the rise in the value of the Australian dollar.

Figure 2. Australia and New Zealand Exchange Rates*



*Source: Reserve Bank of Australia.

- Interest rate differentials between New Zealand and overseas have widened.
- The New Zealand economy has continued to perform well relative to other economies and investor attitudes toward risk have shifted in favor of New Zealand.

The impact of the run-up in the value of the New Zealand and Australian dollars on farm milk prices in the two countries is substantial. Most dairy exports are priced in US dollars. Thus, the decline in the value of the US dollar would, other things being equal, increase exports of dairy products from countries such as New Zealand and Australia. However, when exports priced in US dollars are converted to the domestic currencies of New Zealand and Australia, the returns available to pay milk producers are substantially reduced. Companies such as Fonterra can hedge against exchange rate losses, at least in the short run, but the ability to eliminate losses traceable to a weak US dollar are subject to limits.

Integration of the New Zealand and Australian Economies

The economies of New Zealand and Australia have become closely connected through employment and trade. The integration is not surprising—both countries are mainly English speaking and members of the British Commonwealth. Proximity is another factor—only 1,450 or so miles of the Tasman Sea separate them. Movement of workers between the two countries is common. Many New Zealanders, in particular, have found employment in Australia in times when job prospects were bleak at home.

The Closer Economic Relations (CER) Agreement helped to foster the relatively tight integration in trade and services that exists today between the two economies. The CER Agreement was passed in 1983 with provision for systematic review and expansion. Actions taken following the review of progress under the CER in 1988 accelerated the elimination of barriers to trade in goods between the two countries. By mid-1990 all tariffs, import licensing, and quantitative restrictions and export incentives on Trans-Tasman trade that satisfied rules of origin were eliminated [29]. A 1988 protocol extended the CER to trade in services. The result is that there is now almost complete freedom in trade of both goods and services between the two countries.

The CER raised concerns in parts of Australia's dairy industry. There were fears in Australia that New Zealand's low-cost industry would take markets away from Australian dairy businesses. The loss of market to New Zealand's dairy industry was substantially less than feared by some in Australia. Indeed, the competition from New Zealand appears to have strengthened Australia's dairy industry, much as predicted by strategy gurus such as Michael Porter.

The Agricultural Policy Environment in New Zealand and Australia

Few government subsidies are provided to the agricultural economies of New Zealand and Australia. The deregulation of New Zealand's agricultural economy began in earnest in mid-1984 after the Labour government came to power and launched a program of economic liberalization. Australia's agricultural economy has witnessed a decline in the role of government—particularly government influence via statutory marketing authorities—in the past two to three decades. The governments of New Zealand and Australia have used deregulation to give firms incentives to become more competitive in international agricultural markets.

The dairy industries of the two countries have felt the full impact of deregulation. New Zealand's Dairy Board was stripped of subsidies (interest subsidies and tax advantages) as part of the deregulation that began in the mid-1980s. However, the Board retained its single desk (monopoly) exporting privilege for New Zealand dairy products in this phase of deregulation. As noted later, the Dairy Board was merged with the New Zealand Dairy Group and Kiwi Cooperative to form Fonterra in October 2001. In this later phase of deregulation, New Zealand's government stripped the merged organization of the monopoly exporting privilege enjoyed by the Dairy Board but allowed Fonterra to

retain full or partial quota rights to US and European Union dairy markets for 10 years.

The full deregulation of Australia's dairy industry occurred in mid-2000, making Australia's dairy industry arguably the most deregulated in the world. This deregulation was spearheaded by Victoria's powerful dairy cooperatives. As discussed later, the Victoria cooperatives believed that deregulation would make them more competitive in dairy export markets that they regarded as growth markets.

As largely unsubsidized exporters, New Zealand and Australian farmers and processors are keenly interested in progress under the Doha Round of World Trade Organization negotiations, which began in November 2001, and in bilateral trade talks. Fonterra officials believe that progress toward trade liberalization will be made under the Doha Round and that dairy export subsidies—especially those of the European Union—are likely to be reduced substantially in the Doha Round. However, Fonterra has adopted strategies to protect the firm's interests in the event that substantial further liberalization of world dairy markets fails to materialize. Australia has recently completed a free trade agreement with the US that will give Australia's dairy exporters a modest increase in access to the US dairy market.

The Importance of Dairying and Dairy Exporting in New Zealand and Australia

Dairying is the leading source of farm income in New Zealand and the third most important generator of farmgate receipts in Australia, trailing only the beef and wool industries as a source of farm revenue. New Zealanders export about 95 percent of the dairy products produced in the country. As discussed in more detail later, Fonterra—New Zealand's dominant milk processor and exporter—accounts for about 20 percent of New Zealand's merchandise export receipts and seven percent of the country's GDP. Australia exports the equivalent of about 60 percent of its milk production.

The importance of dairy exporting to New Zealand is indicated by the summary statistics

Table 2. Value of Agricultural Exports and Total Exports for New Zealand, 2003*

Product	Value (NZ$000)	Percent of Total
Dairy Products	5,637,790	20.0%
Live Animals, Meat and Meat Products	4,319,289	15.3
Wool	935,983	3.3
Other Pastoral Products	1,131,204	4.0
Horticultural Products	1,981,145	7.0
Other Agricultural Products	427,223	1.5
Total Agricultural Products	14,432,634	51.1
Total Non-Agricultural Products	13,808,985	48.9
Total New Zealand Exports	28,241,619	100.0

* Source: New Zealand Ministry of Agriculture and Forestry, 2003 (figures for year ending June 30, 2003).

Table 3. Value of Agricultural Exports and Total Exports for Australia, 2003*

Product	Value (AU$000)	Percent of Total
Dairy Products	2,378,000	2.1%
Live Animals, Meat and Meat Products	5,978,000	5.2
Wool	3,548,000	3.1
Grains and Oilseed	4,775,000	4.1
Cotton, Sugar and Wine	4,966,000	4.3
Other Agricultural Products	5,394,000	4.7
Total Agricultural Products	27,037,000	23.4
Total Non-Agricultural Products	88,403,000	76.6
Total Australia Exports	115,442,000	100.0

* Source: Australian Commodity Statistics, 2003. Figures are for year ending May 31, 2003.

in Table 2. Dairy exports accounted for about 20 percent of total New Zealand exports in 2003, exceeding other exports by a substantial margin except for live animals, meat and meat products. Forecasts from New Zealand's Ministry of Agriculture and Forestry indicates that dairy exports will be still more dominant by 2007, as more farmers shift into dairying away from beef and sheep farming [44].

Australian dairy exports are considerably smaller than New Zealand exports, both in absolute and relative terms (Table 3). Dairy exports from Australia represented less than 10 percent of Australian agricultural export value in 2002-03, and were only two percent of Australia's total export value.

New Zealand and Australia have gained major shares of world dairy markets, as noted in Table 4. While New Zealand and Australia dairy exporters have gained market share—mainly at the expense of European Union exporters—the share of world milk that is exported is relatively small, only equivalent to six to seven percent of global milk production.

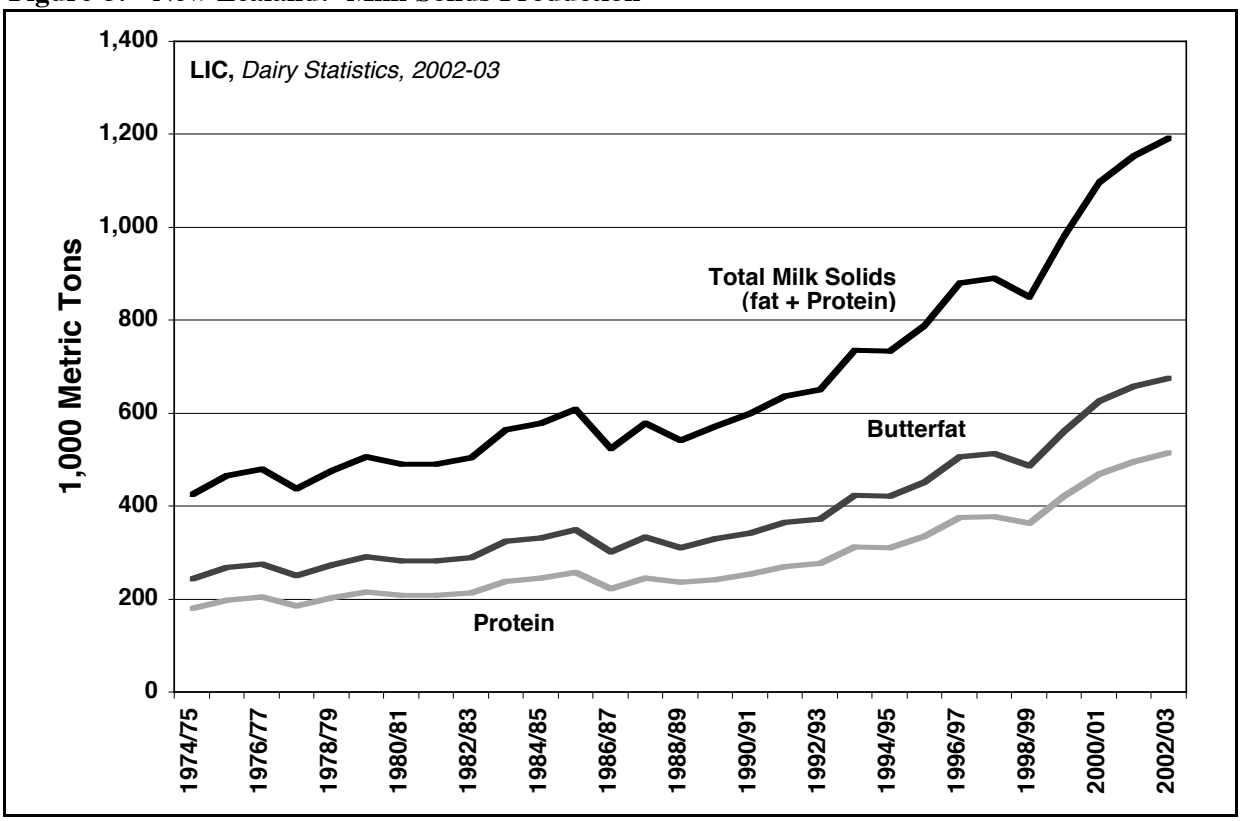
Table 4. Principal Dairy Exporters and Share of World Dairy Trade, 2002-03*

Exporter	Market Share
New Zealand	36
European Union	31
Australia	17
United States	3
Other	13
Total	100

* Source: Dairy Australia.

II. On-Farm Production – New Zealand

Figure 3. New Zealand: Milk Solids Production



Dairy Production Trends

New Zealand's production of milk and milk solids has increased dramatically over the last 20 years.[2] Production measured in volume of milk increased from six million metric tons (MT) in 1982-83 to nearly 14 million MT in 2002-03. Production of milk solids increased over the same time span from 500,000 MT to 1,200,000 MT (Figure 3).

Increased production has come from increased production per cow as well as increased cow numbers. Annual milk production per cow increased from 3,047 liters in 1982-83[3] to 3,718 liters in 2002-03 (22 percent). Milk solids production per cow increased from about 240 kg per season in 1982-83 to about 320 kg 2002-03 (33 percent). Much of this increased yield can be attributed to crossbreeding New Zealand Jersey and Friesian cows using international Holstein genetics. About one-fourth of the New Zealand dairy herd consists of Holstein-Jersey crossbreds.

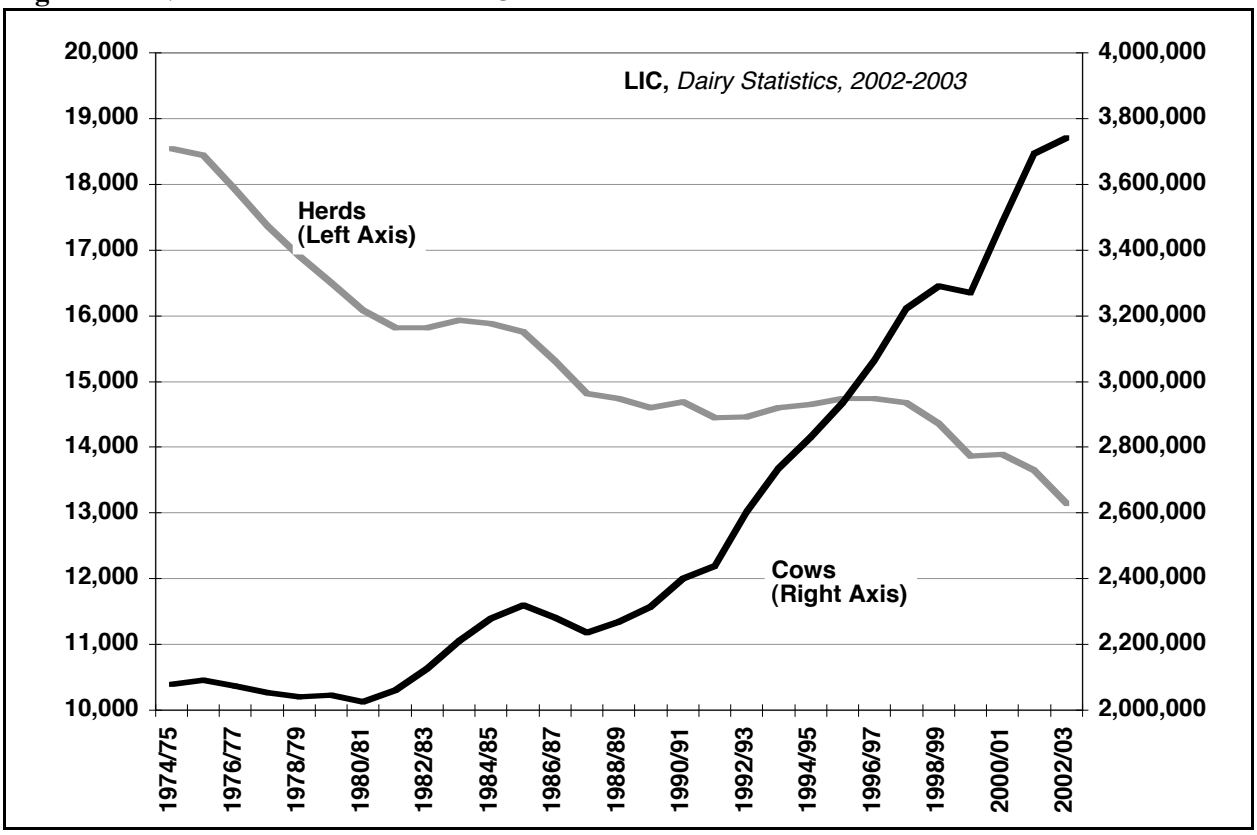
Cow numbers rose from 2.1 million in 1982-83 to 3.7 million in 2002-03 (76 percent). Based on *Stock Units* (1 Stock Unit = 1 ewe = about 0.15 cows), projections indicate dairy cow units will exceed sheep, the current dominant livestock species, in 2006.[4]

[2] Production statistics for New Zealand are reported mainly in volume of milk solids (defined as the sum of butterfat and protein in milk). New Zealand's emphasis on milk solids rather than total milk volume is related to its extensive production of milk powders for export—drying costs place a premium on high milk solids per unit of milk.

[3] The New Zealand dairy marketing year is defined as June-May.

[4] As milk production per cow increases the use of a static conversion factor for stock units does not seem reasonable as a higher producing cow must eat more feed. It is not clear whether stock units

Figure 4. New Zealand: Herds and Cows



Currently, New Zealand dairies are concentrated on the North Island (83 percent of herds), with two regions—South Auckland (Waikato) and Taranaki—accounting for just under half of total New Zealand herds. Herds on the South Island are much larger, averaging 422 cows per herd in 2002-03 compared to 256 on the North Island. With 17 percent of New Zealand herds, the South Island accounted for 26 percent of the 2002-03 dairy cow population. Industry growth in recent years has been primarily on the South Island, where the number of herds has been increasing despite a reduction at the national level (Figure 5).

There is a trend towards concentration of cows into fewer operations, with herd size increasing from about 135 cows/farm in 1982-83 to 285 cows per herd in 2002-03. More than half of New Zealand dairy herds are between 100 and 250 cows. Only five percent are smaller than 100 cows. Among regions, average herd size in 2002-03 ranged from 205 head (Central Auckland) to 591 head (South Canterbury). There were a reported 155 herds exceeding 1,000 cows—most of them in the South Island (Figure 6).

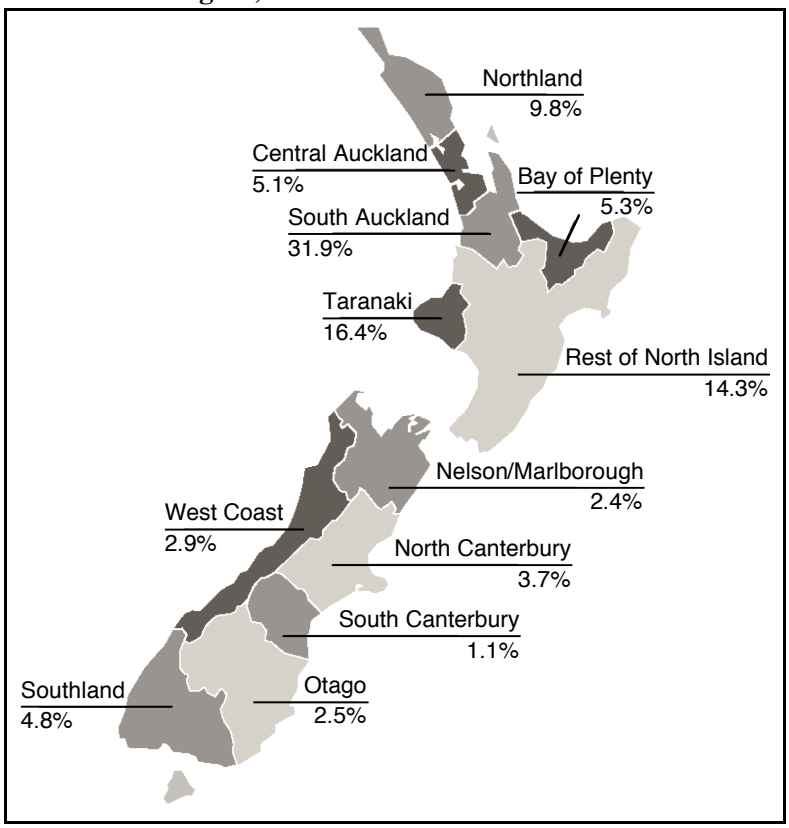
account for this gradual change of per cow productivity and, presumably, feed intake, but it is clear that dairy cattle have replaced sheep and beef cattle, and continue to do so.

New Zealand Dairy Production System

New Zealand is the epitome of pastoral dairying. Blessed with abundant sunshine, year-round warm temperatures, rich volcanic soils, and generally adequate rainfall, New Zealand grows great grass and grazed grass is the exclusive or dominant feed for dairy cattle.

A typical rainfall-dependent New Zealand dairy farm consists principally of a milking parlor and a ***milking platform***—grazing paddocks and lanes for moving cows among paddocks and to and from the milking parlor. Buildings include a functional shed to house the parlor and usually a shed to store equipment and unwrapped hay bales.

Figure 5. Percent of New Zealand Dairy Herds by Region, 2002-03 Season*

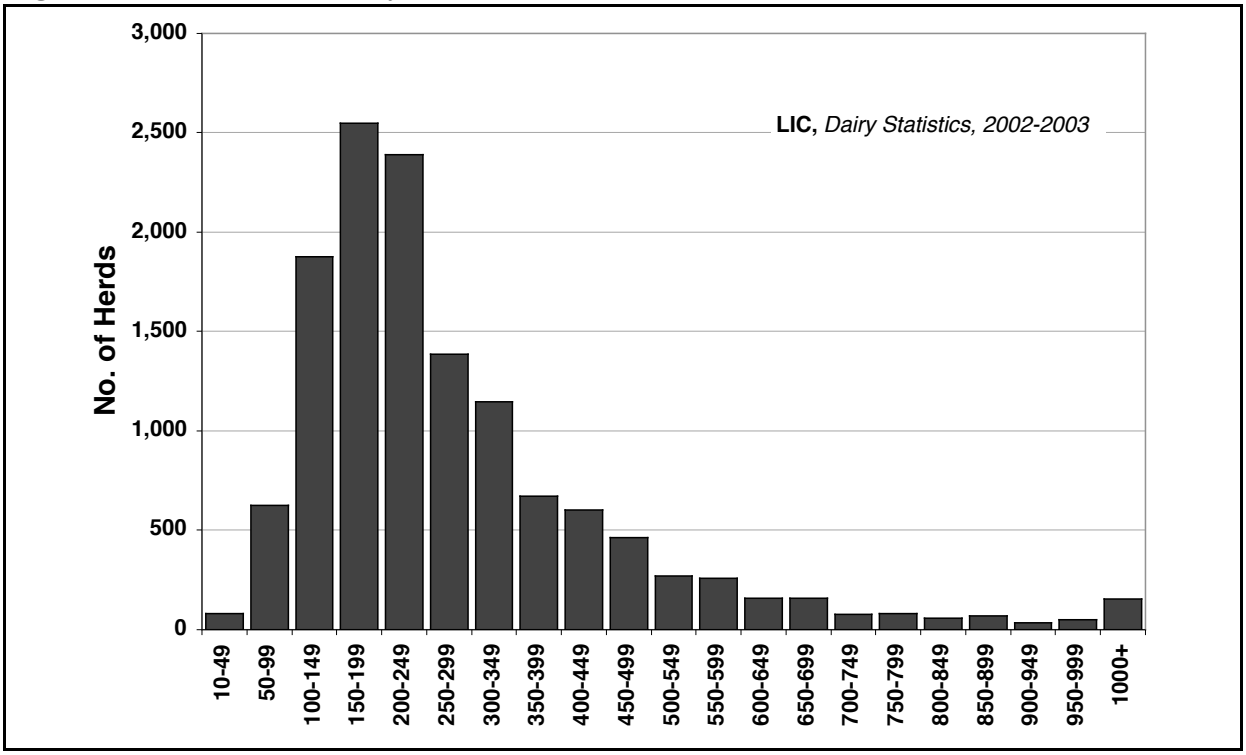


* Map courtesy of Livestock Improvement Corporation (LIC) [28].

Reliance on custom cropping and not feeding mixed rations minimizes machinery needs. Machinery normally consists of one or two tractors, one with a front-end loader to handle haylage and corn silage, a feed wagon to transport and distribute supplemental forages, a fertilizer spreader and a boom sprayer. Other equipment would include trailers and off-road motorbikes or ATVs. Ensiled forage (hay or corn silage) is typically stored on bare ground or in a trench and covered by plastic. Stored forage is fed on the paddock in most cases.

Parlors are generally sized to hold milking time to two hours or less. Double-sided pit parlors with a single set of machines switched from side to side (swing parlors) are common. These are typically "parabone" arrangements where cows stand at about an 80-degree angle to the pit and are milked between the rear legs. This angle is

Figure 6. New Zealand Dairy: Herd Size Distribution, 2002-03 [28]



somewhere in between the smaller angle in US herringbone parlors where cows are milked from the side, and the 90 degrees used in a parallel parlor where cows are milked between the rear legs.

To achieve fast milking times, the parlors have a large number of stalls on each side. The length of the parlor is minimized by using a nearly perpendicular angle. Generally, cows enter parlors at one end and exit at the other—that is, the parlors do not have a rapid-exit design. With a single machine shared side-to-side, this arrangement makes sense even for large groups of cows. Low production per cow, large sides and minimal prep time allow these parlors to turn over the herd in a short period of time. Simply lengthening an existing parlor of this type can accommodate herd expansion and the parlors are relatively simple.

Rotary parlors were also observed. In the rotary, minimal cow prep means only two milkers are needed, one to attach units and one to tend the cows at exit. Average milking time on the rotary is about seven minutes, with some cows retained for a second ride.

Labor demands during calving provide some justification for short total milking times, as does the managing of the cows in a single group that cannot be in the parlor for an extended period and still have adequate grazing time. Nonetheless, significant investment in parlors would suggest greater incentives to operate them at closer to capacity. Cows are milked twice a day, although once-a-day milking is employed on some farms, generally during the latter part of the lactation.

New Zealand dairy cows are predominantly Holstein-Friesian (52.4 percent in 2002-03), Jersey (14.9 percent) and crossbred Holstein-Jersey (24.4 percent). Investment per cow is very low relative to the United States—reportedly about NZ$800-1,000. New Zealand would certainly seem to be a good place for international buyers looking for inexpensive heifers. The spread between the salvage value of a cow for beef and one sold for dairy is very narrow—New Zealand cull for beef prices are similar to US values after adjusting for body weight.

In contrast, investment in land is very high for New Zealand dairies. Average land values for dairy farms sold in the first six months of 2003 exceeded NZ$15,000 per hectare [28].[5] Using the exchange rate applicable then, the equivalent US$ price per acre is more than $3,400. The very high land cost combined with low cow prices explains the emphasis on milk solids production per hectare rather than milk per cow—New Zealand dairy farmers attempt to maximize returns to their scarcest (most costly) resource.

Total investment per cow in New Zealand was estimated at about NZ$8,600 per cow in 2002 [13]. Using a stocking rate of 2.55 cows per hectare and land costs of NZ$15,000 per hectare, this indicates that about 70 percent of New Zealand dairy farm assets were in land.

Pasture Management and Feeding[6]

Long-term experience with grazing in New Zealand has provided substantial insights and "rules of thumb" with respect to the arrangement and management of paddocks. Paddocks must be reasonably close to the milking parlor to keep walking distance relatively short and to maximize the time that cows can graze. If grazing lands were arranged in a perfect square with the milking parlor in the center, a two by two kilometer square would provide four million square meters or 400 hectares. Lanes, building sites and, most importantly, layout, would reduce the functional land area significantly. However, in the ideal set-up, the farm could support 1,000 cows at 2.5 cows/hectare. Total walking distance would be a maximum of eight kilometers per day for a herd milked twice per day, plus walking during grazing. Since, in any given day, cows would likely be rotated to two paddocks—one near and one far—the maximum distance would be less than this.

In traditional dairy areas, farms undergoing expansion would be challenged

[5] One hectare = 2.47 acres, or one acre = 0.405 hectares.

[6] This section draws heavily on Holmes [23] and Holmes et al. [22].

by geometry if they acquired a neighbor's land and sought to milk all cows in a single existing shed centered on the home farm. A worst-case scenario can be imagined as a linear layout of paddock with the parlor located on the opposite end of the milking platform from where the new land is acquired.

Cattle stocking rate (cows per hectare in the milking platform) is ultimately determined by the annual herbage yield on the pastures, and hence will be greater on well-watered, well-fertilized, physically sound soils. For 2.5 cows per hectare eating 17 kilograms of dry matter per cow, this would balance at a pasture growth rate of 42.5 kg of dry matter per hectare per day. Herbage growth is maximized by removing grass before it fully matures, but by leaving enough grass to ensure a solid turf that can withstand cattle foot traffic, even when wet. The goal is to provide about 2,700 kg dry matter per hectare in the pre-grazed pasture, and reduce it to about 2,100 post grazing. Grazing to a lower density than this would reduce intake and subject pastures to more damage, while allowing more accumulation would reduce daily yields.

Under constant conditions, 600 kg is removed by placing 35 cows per hectare in the pasture for one day. The 600 kg of dry matter is recovered in 14 days on average; so 14 one-hectare paddocks maintain a herd of 35 cows (that is 2.5 cows/ha). When growth rates exceed this, excess herbage is available and herbage yield and quality suffer if not harvested mechanically (MJME/KgDM). When growth rates fall below this, milk production and cattle body condition suffer if not adequately supplemented.

In a completely pastoral system using no supplemental dry matter from off-farm feed, maximum stocking rate can be achieved by harvesting excess grass during peak growth (as hay or silage) and using it to supplement pasture during low growth periods. Cows can graze longer on some paddocks, freeing up other paddocks to accumulate enough grass for mechanical harvesting.

A slight deviation from this system involves rotating some of the paddocks in the milking platform to maize (corn) for silage production. This has modest benefits in terms of increased total forage dry matter yield per hectare, but more importantly, it provides an easily ensiled crop with high energy content for use during slow grass growth. Generally, maize for silage is custom planted and harvested to avoid capital investment in machinery. Silage is most often fed in the paddock where cows are currently grazing, but specialized feed yards do exist on larger, more capital-intensive farms.

By feeding silage, remaining grass paddocks can be more heavily stocked at a rate closer to herbage balance during the peak production months of spring. Feeding of both excess grass and maize silage represents time shifting of forage production to provide a more constant stream of intake for the cow.

From growing maize silage on the milking platform, it is a simple step to growing maize silage on land distant from the milking platform and transporting it onto the milking platform. This allows a more compact milking platform on an expanded farm and a higher stocking density if land devoted to maize silage is ignored. Off-platform production of maize silage or hay represents a spatial as well as temporal move of dry matter. It allows higher stocking density while maintaining cow productivity and body condition, but at a higher cost than in the pure pastoral system. Because of the higher costs associated with growing and feeding maize silage versus grazing, it is economically justified only at relatively high milk solids prices. This practice also introduces more nutrients to the soil, which could have detrimental environmental affects if fertilization is not adjusted to compensate.

Alternatives to dealing with seasonal variation of grass production are to bring non-milking stock on and off the milking platform to use excess feed. Synchronization of lactation and dry periods with the annual grass/pasture growth pattern enables New Zealand dairy farmers to best match the nutritional requirements of cows to the available pasture supply. Dry cows can be moved off the milking platform (agisted) in late winter to allow grass to accumulate for

early spring feeding of lactating cows. During early winter, drying off of some animals (first lactation animals, low producers, cows in poor condition) and agistment allows decreased forage removal.

Obviously, there are variations with time and among paddocks that render rotational grazing an art dependent on frequent observation of the pastures and the cows. Body condition scoring and pasture density measurements are the primary tools used to monitor this adjustment. Supplemental feeds and adjusting fertilizer rates are the primary tools used to compensate for limitations in the rotation pattern.

Seasonality of Milk Production

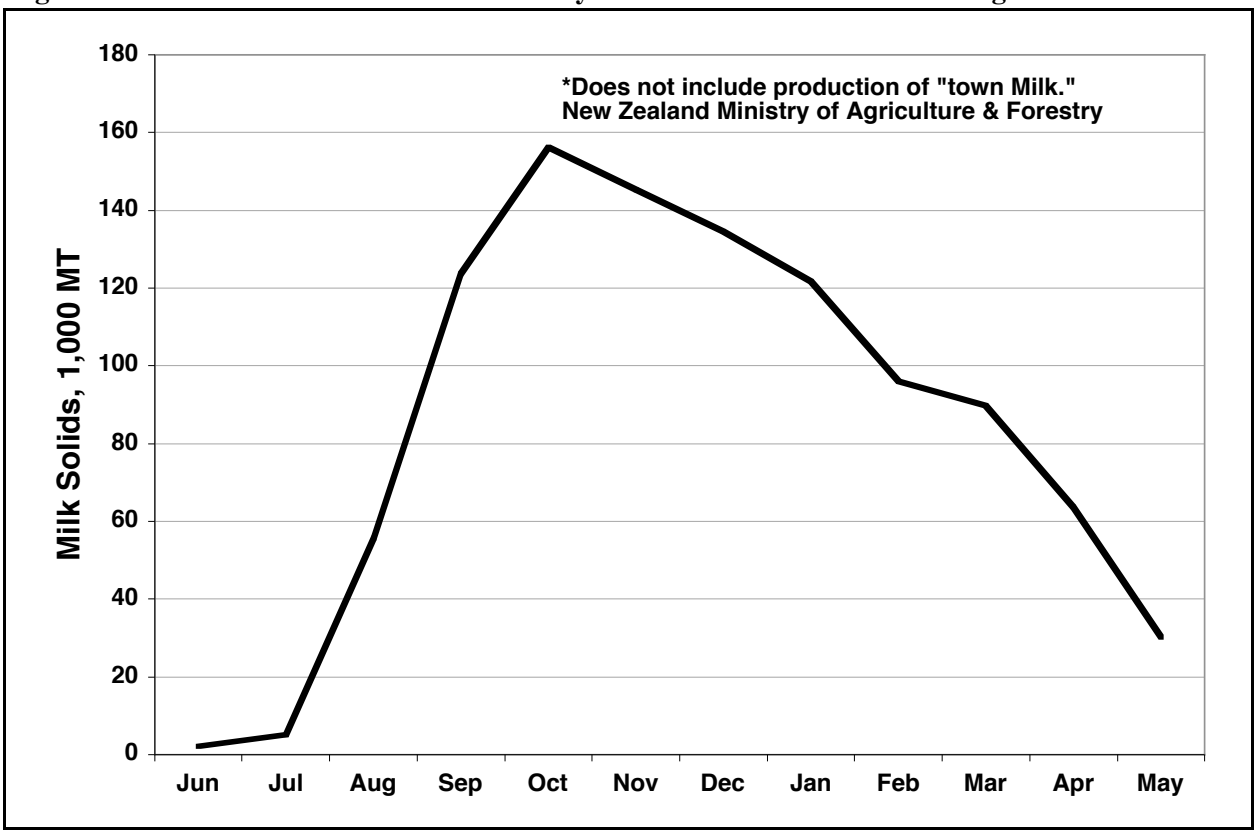
Due to grass availability and the lactation curve of seasonally bred cows, New Zealand milk production is highly seasonal. The milking season begins with cows freshening in August. Production peaks in October and falls to near zero by mid-May. Grass is available year round to at least maintain the animals, but some animals may be removed from the milking platform in winter to minimize pasture damage.

Some of the milk produced year round supplies the "town milk" market, but almost 95 percent of New Zealand milk is ultimately exported as dairy products. This portion of the total milk supply is essentially zero during mid-winter (June and July), thus idling many processing plants. Milk solids production for manufacturing export products from September through January represents two-thirds of annual production.

Herbage yield from pasture varies from 15 kg dry matter per hectare per day in winter, to a peak of 70 kg at peak production in the spring (September and October). Yield drops to 20 kg dry matter per hectare per day depending on water in summer (February), and rebounds to about 30 in the fall (April).

For comparison purposes, US herbage yield of orchard grass in the northern Midwest on rotationally-grazed, well-fertilized

Figure 7. New Zealand Milk Production by Month 1998/99-2002/03 Average*



pastures for May through October, may be found in the table at the right. There is no yield the rest of the year. Total annual yields would be roughly 12 metric tons per hectare in New Zealand and seven in Wisconsin. A single crop of corn silage may yield eight to 14 tons of dry matter in Wisconsin (100 bushel per acre corn is about 11 metric ton of corn silage harvested per hectare). New Zealand winter yields of 15 kg/ha/day are enough to support two dry cows per hectare at maintenance feed requirement levels.

Herbage yield of orchard grass in US northern Midwest

Month	Yield (kg dry matter/ha/day)
May	47
June	82
July	35
August	23
September	35
October	11

Costs of Production

New Zealand is renowned in the international dairy community for having enviably low costs of milk production. Because of the more-or-less "pure" pastoral nature of its dairy production system and its long history of research and experience in how to profitably exploit that system, New Zealand's costs cannot be consistently matched anywhere else in the world.

Table 5 reproduces estimated New Zealand dairy costs of production for owner-operator dairy farms reported in farm management surveys and compares them with cost estimates from Wisconsin derived using comparable survey procedures. Wisconsin estimates are for herds between 151 and 250 cows in order to match the average herd size in the New Zealand survey.[7]

For most categories of costs, the New Zealand and Wisconsin definitions were identical or similar. A notable exception is "Pasture and Supplements," which for Wisconsin includes all costs associated with purchasing or growing feeds. In a few cases, category definitions were sufficiently different to list separately for New Zealand and Wisconsin.

New Zealand costs were expressed in US dollars by applying the 12-month average exchange rate for June 2001–May 2002, the New Zealand marketing year. It should be noted that the marketing year average exchange rate was 2.36 New Zealand dollars per US dollar. In March 2004, the exchange rate was about 1.4 NZ$ per US$. Consequently, using exchange rates from early 2004 would increase New Zealand costs in terms of US$ by 60 percent from those shown. The New Zealand payout for milk solids would be similarly decreased.[8]

The comparison shows remarkable differences:

- Land per cow is about 0.4 hectares for New Zealand (2.55 cows per hectare stocking rate) versus 1.25 hectares per cow for Wisconsin (0.8 stocking rate). This points out the relatively heavy use of land required to produce high-energy feeds for dairy cattle and also the relatively short growing season in Wisconsin.
- Wisconsin cows produce double the milk solids of New Zealand cows, emphasizing the much larger production potential per cow with grain-based rations. Milk solids per hectare are 824 kg for New Zealand and 518 for Wisconsin.

[7] Comparing costs across all herd sizes for New Zealand to costs for larger than average herd sizes for Wisconsin may appear suspect. However, the size distribution of Wisconsin herds is heavily skewed toward herds much smaller than the New Zealand average herd size. Consequently, using averages for Wisconsin would involve comparing apples to oranges. Moreover, net farm income per cow for the 151- to 250-cow Wisconsin herd size category is nearly the same as the average across all herds in the sample.

[8] It should also be noted that the record milk payout and good production season in 2001-02 probably increased New Zealand farmers' discretionary expenditures from normal.

Table 5. New Zealand Milk Production Budget (Per Cow Basis)*

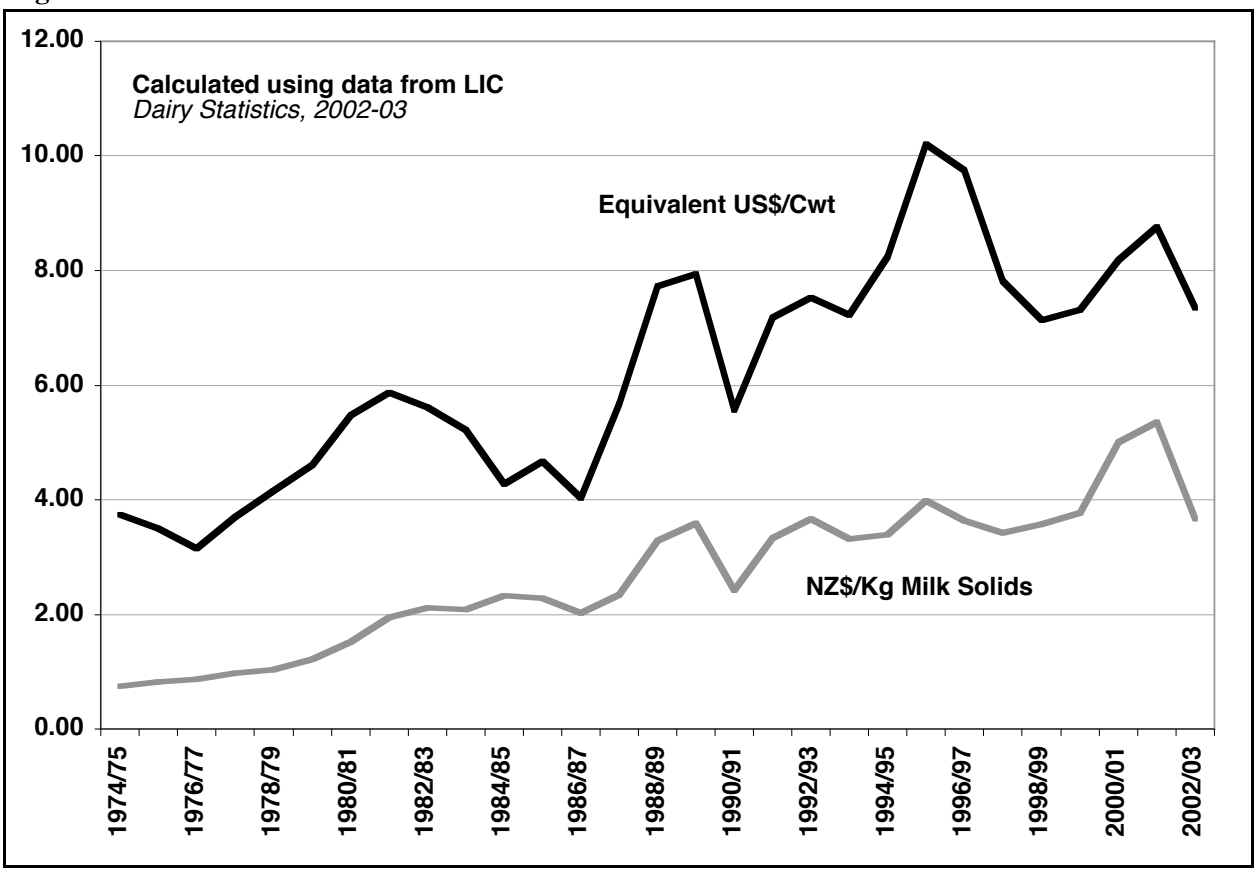
Item	New Zealand 2001-02**		Wisconsin 2002
Number of cows		227	192
Farm size (Ha)		89	241
Milk solids per cow (kg)		323	650
	NZ$	**US$*** **	**US$**
Total Assets	8,570.00	3,635.75	7,834.00
Total Equity	5,706.00	2,420.61	4,904.00
Cash Receipts			
Milk sales	1,705.00	732.32	2,652.73
Net stock sales	161.00	68.30	207.96
Change in livestock value	90.00	38.18	67.89
Other	19.00	8.06	325.55
Total Receipts	**1,975.00**	**837.86**	**3,254.13**
Cash Expenses			
Wages	118.00	50.06	429.28
Animal health	62.00	26.30	97.18
Breeding and herd testing	28.00	11.88	41.56
Farm dairy expenses	21.00	8.91	81.05
Electricity	21.00	8.91	69.53
Pasture and supplements	185.00	78.48	910.74
Fertilizer	154.00	65.33	48.95
Weed and pest	12.00	5.09	34.52
Repairs and maintenance	99.00	42.00	165.77
Vehicle expenses	54.00	22.91	8.89
Freight	9.00	3.82	34.40
Interest	203.00	86.12	11.10
Other	10.00	4.24	209.48
Administration	31.00	13.15	
Standing charges	81.00	34.36	
Rent/Lease expenses			129.12
Insurance			40.23
Property taxes			32.67
Marketing/Hedging			41.53
Total Cash Expenses	**1,088.00**	**461.56**	**2,566.00**
Net Cash Income	**887.00**	**376.29**	**688.13**
Non-Cash Costs:			
Depreciation	93.00	39.49	393.05
Change in Prepaid Exp./Accts. Payable			72.58
Other:	29.00	12.30	
Total Non-Cash Costs	122.00	51.76	465.63
Total Costs	**1,210.00**	**513.42**	**3,031.63**
Net Farm Income	**765.00**	**324.54**	**222.50**
Unpaid labor, including operator	251.00	106.48	221.63
Return to Equity and Mgt.	**514.00**	**218.06**	**0.87**

* Source for New Zealand data is *Economic Survey of New Zealand Dairy Farmers, 2001-2002,* Dexcel: 2003. Source for Wisconsin data is Center for Dairy Profitability, University of Wisconsin-Madison, *Agriculture Financial Advisor* (http://cdp.wisc.edu/AgFA.htm), 151-250 cow category.

** New Zealand dairy marketing year is defined as June 1-May 31. Wisconsin data are for calendar year 2002.

*** Based on marketing year average of exchange rates using monthly rates reported by the Reserve Bank of Australia (http://www.rba.gov.au/Statistics/exchange_rates.html).

Figure 8. New Zealand Milk Prices



- Farm assets and equity for New Zealand are about half the Wisconsin values, pointing out the heavy investment in field equipment as well as larger investments in cows and facilities in Wisconsin.
- Wisconsin farmers enjoyed total farm revenue per cow about four times that shown for New Zealand. Milk income was about three times as large. Additional sources of income were also relatively larger, especially "other," which includes sale of excess crops.
- Under cash expenses, Wisconsin costs are higher for all comparable categories except fertilizer (demonstrating high pasture fertilization in New Zealand) and vehicle expenses (obligatory motorcycles, pickups, and ATVs). The largest cash expense differences are for labor and feed, with Wisconsin farmers spending about 10 times as much as New Zealand farmers. Wisconsin total cash expenses per cow are more than 10 times those for New Zealand.
- Because of higher depreciation (more depreciable assets), non-cash costs were also 10 times higher for Wisconsin.
- Net farm income per cow in New Zealand was about $100 higher than in Wisconsin. But higher imputed family labor charges in Wisconsin widened the gap in returns to management and equity to $220 per cow in favor of New Zealand.

From a parochial Wisconsin viewpoint, these are sobering numbers. They show higher net incomes to New Zealand dairy farmers despite milk returns per cow that are only 27 percent of Wisconsin returns per cow. However, the pastoral production system yielding New Zealand's low costs of production is simply not reproducible in Wisconsin.

New Zealand dairy experts indicated that their dairy farmers could cash flow at around NZ$3.50 per kg milk solids. The budget above confirms that observation. At NZ$3.50/kg milk solids, net cash income would be NZ$313 per cow and net farm income would be NZ$191. Indeed, the breakeven milk solids price for this budget (net cash income = zero) is NZ$2.53/kg.[9] At the other extreme, a milk solids price of NZ$5.10 would cover all costs (cash, non-cash, and imputed value of operator/family labor) plus return eight percent on owner equity.

Using fat and protein tests of 3.7 and 3.1 percent, respectively, one kilogram of milk solids for an average Wisconsin cow is equivalent to 0.32 hundredweight of milk (6.8 pounds of milk solids per hundredweight equals 3.08 kg). Based on an exchange rate of 2NZ$ = 1US$, the New Zealand break-even price range of NZ$2.53 to NZ$5.10 per kg of milk solids translates to US$4 to US$8 per hundredweight of milk.

Producer Prices

New Zealand dairy farmers are paid separately for volume of protein and butterfat, although prices are usually expressed in terms of milk solids. The current ratio of the protein to butterfat payment rates is about three to one. Farmers also receive volume adjustment for the water content of milk relative to the average for the receiving plant. The adjustment is positive (premium) for milk with water content less than average and negative (discount) for milk with higher than average water content.

New Zealand industry-average milk prices have been steadily increasing, from less than NZ$1.00 per kg of milk solids in the mid-1970s to over NZ$5.00 in 2000-01 and 2001-02. The milk solids price fell below NZ$4.00 in 2002-03 and is expected to stay under that level unless the New Zealand dollar weakens against the US dollar.

Research and Outreach Support

Dairy InSight and the federal government are the primary sources of funding for dairy production R&D and dairy industry education.

Dairy InSight is a mandatory check-off program created in mid-2002. All dairy farmers contribute to Dairy InSight through a mandatory levy of NZ$0.034 per kg milk solids. The levy is to be reviewed every six years and voted on by dairy producers in a continuance referendum. Funding is used for R&D, technology transfer, industry promotion (not milk promotion), education and training, and research on animal health.

Federal government funding is principally provided through the Foundation for Research, Science and Technology (FRST). FRST supports research within specified broad areas. Pertinent to dairy in 2002-03 were "Sustainable Development and Biological Industries." AgResearch (one of several Crown Research Institutes) is a major beneficiary of FRST funding, receiving NZ$54.4 million of its total 2002-03 budget of NZ$129 million from FRST. Most of AgResearch's other funding is from commercial sources. It specializes in basic research and commercialization of laboratory findings.

Dairy InSight funds grants for programs and projects conducted by staff at several institutions with expertise in dairying. Major recipients are Dexcel (a private, non-governmental entity), Livestock Improvement Corporation (the cooperative herd recording and semen provider, and a "sister" organization of Dexcel), and faculty at Massey University (Palmerston North on the North Island) and Lincoln University (Christchurch on the South Island). The total Dairy InSight budget in 2002-03 was NZ$31.6 million.

Dexcel receives about one-third of the total Dairy InSight levy. In 2002-03,

[9] Breakeven analyses conducted by the New Zealand Ministry of Agriculture and Forestry (MAF) show similar results. For 2003, MAF estimated a national breakeven price of NZ$3.30/kgMS. Corresponding breakeven prices for the Waikato and Canterbury regions were NZ$3.13 and NZ$2.83, respectively.

Dexcel's Dairy InSight allocation included NZ$1.8 million for industry education, NZ$5.2 million for industry extension and NZ$4.3 million for industry research. Dexcel researchers received $3.4 million from FRST. Commercial funding (NZ$2.8 million) and farm revenue from 1,300 cows on 500 hectares made up the rest of Dexcel's 2002-03 total budget of about NZ$20 million.

Dexcel is a specialized integrated research-outreach-vocational education unit dedicated to the dairy production sector headquartered in Hamilton. It is a new organization that was created in 2000 by the New Zealand Dairy Board. It was established because the dairy industry wanted to control, and preferably own, the required core competencies to achieve a four percent annual productivity (read: efficiency) improvement. Our impression is that control has been achieved by "renting" rather than "owning" these competencies through relatively short-term, but renewing, commitments to research and extension programs.

Dexcel's core competencies are on-farm systems and component research, dairy farm extension, and vocational training. It places great emphasis on strategic leadership and integration among other industry players. Integration with rural professionals and professional consultants was stressed but we did not really have a chance to observe that. Integration of extension and research is also stressed. Dexcel's interaction with Universities was clearly evident by its housing of some Dexcel specialists in offices on the Massey Campus and near the Lincoln campus. However, most Dexcel personnel are housed in Hamilton. Total Dexcel staff in 2003 totaled 190, with 78 identified in research, and 52 in extension, and 41 farm employees. Of these, 135 are in the Hamilton area and 21 have PhD degrees. There has been some consolidation of dairy research farms at Hamilton. There is a very high quality set of barns, one for intensive digestion research and one for stall-feeding of small groups of cows in a free-stall set-up.

There was a clearly visible working and funding relationship with the Lincoln University's new dairy herd and Dexcel used a Lincoln University facility for outreach programs. Dexcel also makes use of a "trust" farm in Taranaki via the PhD scientist stationed at Massey University.

There is active competition among Dexcel investigators, AgResearch investigators and university investigators for funding. Dexcel investigators must fund their own salaries through grants. We met several research personnel who had left AgResearch (or similar state research facilities in Victoria, Australia) to come work under these conditions, so there is apparently strong belief by the investigators that the model will be sustainable.

A possible shortcoming of New Zealand dairy research support is the separation of research and extension from university undergraduate, and especially graduate, training. Because most of the Dexcel research is "industry good" research, it is likely that this problem can be addressed with cooperative research. The biggest barrier might be the physical separation of the main Dexcel research facility at Hamilton from Massey and Lincoln Universities.

The US practice of using research funding to support graduate training has its problems, but we believe these are clearly outweighed by the advantages. Dexcel's attitude and goal toward being an industry facilitator, the need for 'hands' to conduct intensive research at the Dexcel Hamilton research facility, and the general lack of any detectable animosity between Dexcel people and university staff all suggest formal integration of research and graduate training.

How Much Can New Zealand Expand Milk Production?

Answers to this question were understandably ambiguous and inconclusive. The only quantitative estimates we obtained were published by the Ministry of Agriculture and Forestry (MAF) [47]. MAF predicts a fairly slow rate of growth in New Zealand production of milk solids, from the 1.2 million kg produced in 2002-03 to 1.4 million kg in 2006-07 (four percent annual gain).

A primary regulator of future milk production will be the relative value of lamb (and wool to a much lesser extent) and beef relative to milk. Currently, there appears to be a reasonably close balance in the profitability of these enterprises, which may underlie the MAF's conservative estimate of future dairy growth.

Most of the land currently suitable for dairying on the North Island is already being used for dairy. Consequently, growth there will likely come from expanded stocking rates or increased milk solids yields. A possible wild card is whether land currently devoted to forestry could be converted to dairy grazing upon harvest. A large forest tract in the central North Island will be harvested in a few years. Some predicted that land would become dairy land while others suggested it was largely unsuitable.

The Southland region of the South Island is probably the largest area naturally suited to dairy that still has considerable sheep population. There are some additional lands that could support dairy with improvements, most notably by irrigation of lands in the Canterbury plain of the South Island. This region receives about 25 inches of rain annually and dairying there is dependent on supplemental irrigation from river or ground water. There are other lands currently dedicated to sheep that are not suitable for large dairy farms because of topography.

As a theoretical (and unrealistic) upper limit, replacing all the beef, sheep and deer stock units with dairy cattle could increase milk solids production to 250 percent of its current level, to more than three million MT. The marginal cost for this increased production would, no doubt, be higher than existing costs. How much higher would depend on the relative suitability for dairying of land that is currently used to support other species. It is probably unreasonable to expect that much of the rugged land currently supporting sheep could be used for dairy.

In our judgment, the growth in New Zealand dairy will most likely match the MAF forecast, unless world market prices for dairy products improve substantially from current levels. This could happen with major progress in multilateral trade negotiations, but we do not deem it likely.

With higher prices, relatively higher dairy profitability will result in some limited displacement of land used by sheep and cattle. There would also be expanded supplementation with corn silage to increase stocking rates on the dairy land base.

If milk solids prices rose high enough, grain feeding would be encouraged. This would allow expanded milk production without a corresponding increase in land or stocking rate. New Zealand cost of cereal grain was quoted as NZ$0.25 to 0.35 per kg of dry matter, which equates to about US$4.50 per bushel of corn.[10]

Perhaps a more important question than the potential for expanded milk production in New Zealand is how many New Zealand-like hectares exist in the world outside of Oceania? In other words, are there significant areas that could, with time, develop grass-based, low-cost dairy and become competitive exporters of dairy products? Where are they and what are they being used for now? What is the timeline for cultures in those areas to develop the type of infrastructure observed in New Zealand?

Major New Zealand Dairy Production Issues

What follows are observations that are not easily categorized within the topics above. They relate to emerging issues facing New Zealand dairy farmers. Some may also affect industry growth potential.

- **Getting high production per cow with the reproductive efficiency required in a seasonal system.**

  Seasonal calving requires a high level of reproductive efficiency. Ultrasound is routinely used to diagnose pregnancy and heat synchronization is also used. There

[10] The indicated corn price seems out of line with US corn export prices in recent years of $2.50-3.00 per bushel (fob vessel Gulf ports). It is not obvious why grain is so expensive in New Zealand.

is a desire to reduce induced calving to avoid animal rights scrutiny.

- **Hired management versus share-milkers.**

  There appears to be a movement away from traditional sharemilker arrangements toward hired management. Common sharemilker arrangements involve the sharemilker providing labor, management, and plant and equipment (excluding the milking shed) in return for 25 percent of milk receipts, or providing these inputs as well as cows in return for 50 percent of receipts. The latter arrangement involves sharing of risk and incentives for good management that would need to be replaced in a hired management system.

- **Increasing land prices.**

  Much of the justification for high land prices has been the excellent (often unrealized) return on land as an investment. Many dairy farmers view land investment, at least implicitly, as a separate enterprise from dairy farming. If the rate of increase in land values diminished, then farmers might assign interest payments on land (or the opportunity cost of land owned outright) to the cost of milk production. A stagnation or decline in land prices with a stagnant or falling milk price would prove a difficult challenge for most dairy producers.

- **Cost of entry.**

  Fewer milk sharing positions, the high cost of land, and the cost of Fonterra stock represent significant barriers for new or expanding producers. One individual calculated the cost of entry (land and Fonterra stock only) at NZ$20-25 per kg of milk solids. This is five to seven times the annual milk solids price anticipated over the next few years and represents a significant impediment to entry. Greater amounts of borrowed capital are needed, most invested in cows and land, which have low risk for lenders.

- **Availability of water.**

  Most New Zealand dairy farms rely on rainfall. The west coast of the South Island has more water than needed. Farms in the rest of the country expect water shortages in the height of summer and deal with it through use of preserved grass harvested from pasture, by using corn silage rotated with pasture or bought from off-farm plots, and through grazing a summer crop of Brassica (such as whole turnips). Only the Canterbury Plain is dependent on irrigation and there are signs that use of ground water and river water is becoming limiting. River water is in demand for hydroelectric power generation. Problems with nitrate contamination of ground water were also noted. Pumping rates are granted by "consent" and the lack of strategic evaluation of Canterbury's ground water supply (and subsequent restriction of consents) was under discussion during our visit. We were told that 60 percent of New Zealand's total water usage occurred in Canterbury. Irrigation in Canterbury takes place from October to March. Costs per hectare for pumping water might be NZ$200 per year, plus another NZ$100 to NZ$150 for maintenance and depreciation of irrigation equipment. The modern irrigation scheme involves large (500 meters or more) booms that roll over spring-loaded electric pasture fences.

- **Johne's.**

  This did not seem to be high on anyone's radar screen as a problem. Perhaps the kinds of stresses imposed by the New Zealand dairy system minimize the clinical incidence of Johne's. However, it appears that the group feeding of calves with raw milk would be a high risk factor for spread of the disease. The New Zealand industry prides itself on "clean, green and safe." Their assessment of Johne's presence appears to be at the stage Wisconsin was in a few years back where it was better not to know it was there. It is not clear that the presence of Johne's is a major cost in either our system or theirs, nor is there an obvious human health issue. Nonetheless, the situation merits monitoring and open assessment.

- **Once-per-day milking.**

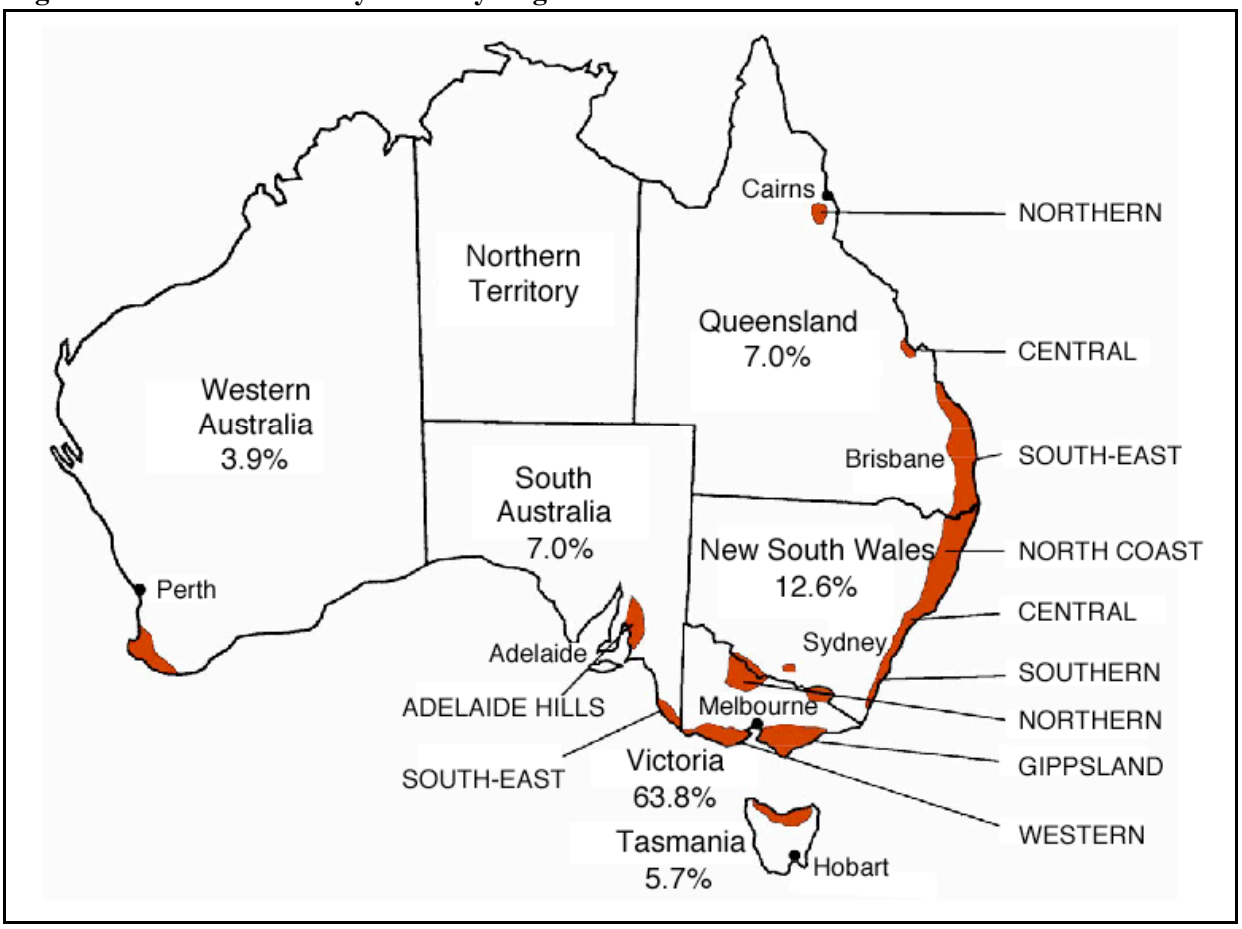
  We noted considerable interest in once-a-day milking, especially for late-lactation and first-lactation cows. This practice prevents body condition loss (fewer kilometers walking to the milking shed) and reduces labor requirements. Research was insufficient to demonstrate whether these gains offset lower milk production.

- **Use of biotechnology: Maintaining a clean, green and safe image.**

  Major products of biotechnology, including recombinant derived chymosin, bovine growth hormone and GMO feed crops, are not used in the New Zealand dairy industry. Apparently there are active research programs involving genetically modified pasture species and New Zealand is very active in bovine genomics. Research in GMO pastures at the field level is done outside New Zealand by New Zealand researchers partnering with international (presumably North American) collaborators. This approach will keep options for the industry open in the event that GMO pastures become feasible.

III. On-Farm Production – Australia

Figure 9. Australian Dairy Industry Regions*



Our description of Australian dairy production characteristics is abbreviated relative to New Zealand and focuses mainly on the state of Victoria, which accounts for about two-thirds of Australia's milk supply and an estimated 80 percent or more of dairy exports. Our relative brevity is primarily because the Australian industry, while smaller than New Zealand's, is much more diverse. Production systems range from New Zealand's "pure" pastoral system to intensively-managed dairy feedlots similar to those seen in the western US. Australia's large population compared to New Zealand means that a larger proportion of milk production is utilized domestically, especially in regions remote from the southeastern part of the country. The need for relatively large volumes of year-round fluid milk is a principal factor explaining the significant presence of grain-based non-seasonal dairy systems in Australia.

Dairy Production Trends

Australian national milk production in 2002-03 marketing year was 10.3 billion liters.[11] This is about 2.5 billion liters less than New Zealand's production during the same season, and roughly equivalent to Wisconsin's calendar year 2003 milk production of 10.1 billion liters. Australian 2002-03 milk solids production was 752 million kilograms based on average butterfat and protein tests of 4.06 and 3.22 percent, respectively.

[11] In contrast to New Zealand, Australian production figures are usually quoted in terms of volume of milk rather than volume of milk solids.

Figure 10. Australia Dairy: Milk Production

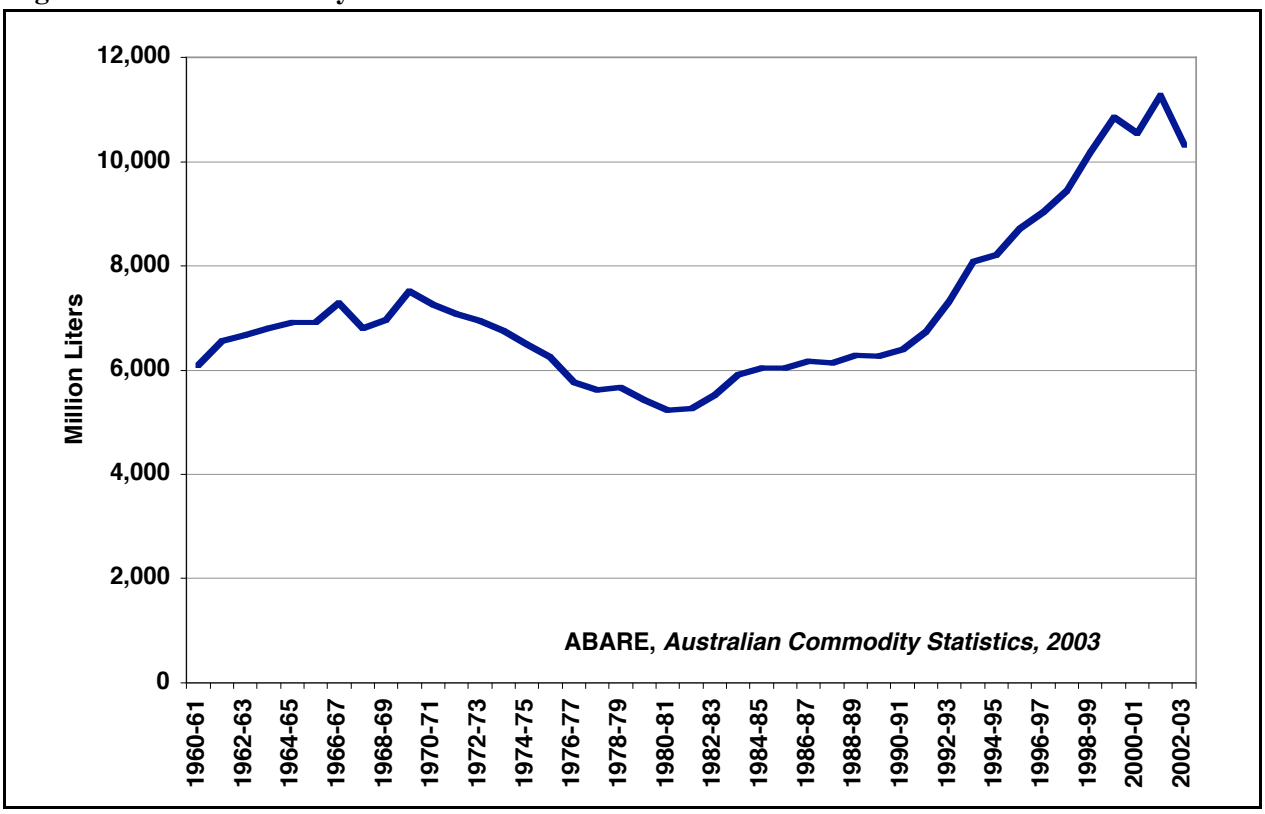


Figure 11. Australia Dairy: Milk Cows and Milk per Cow

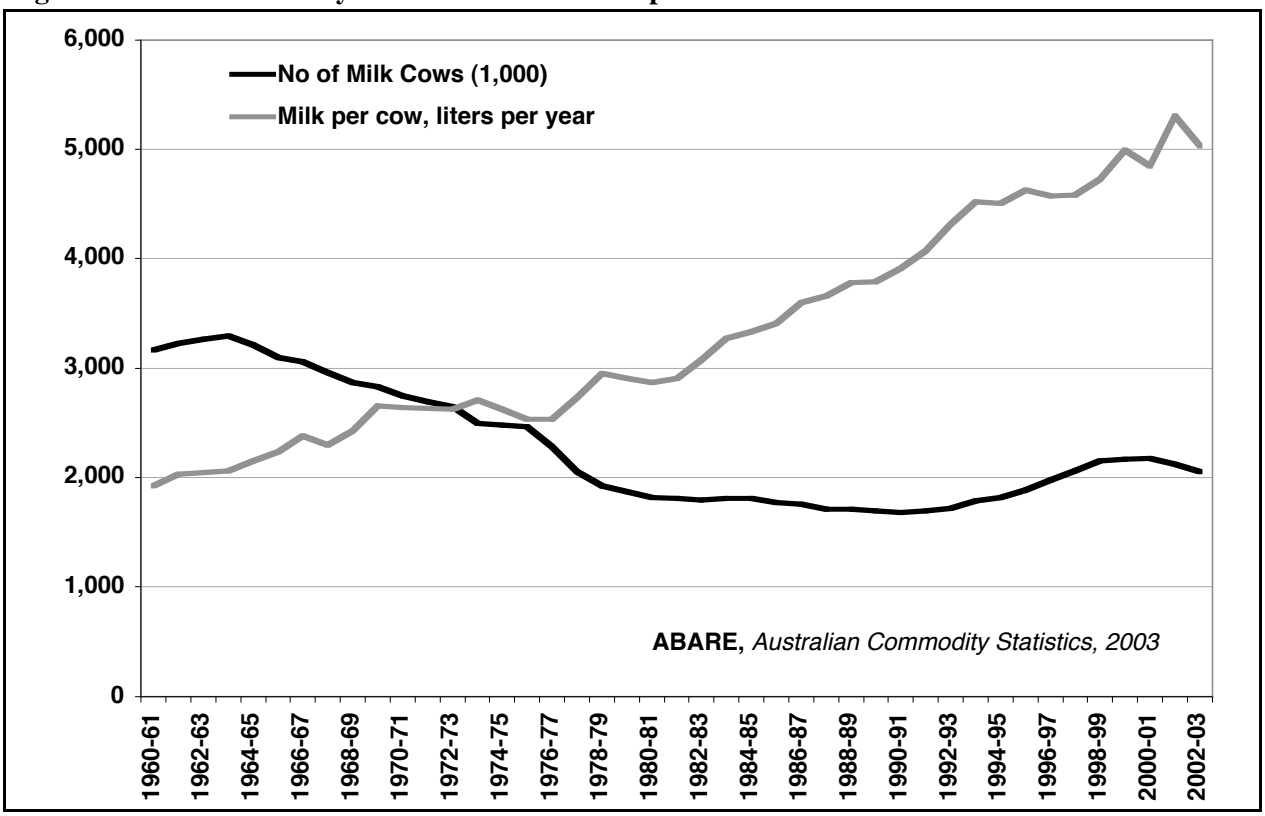
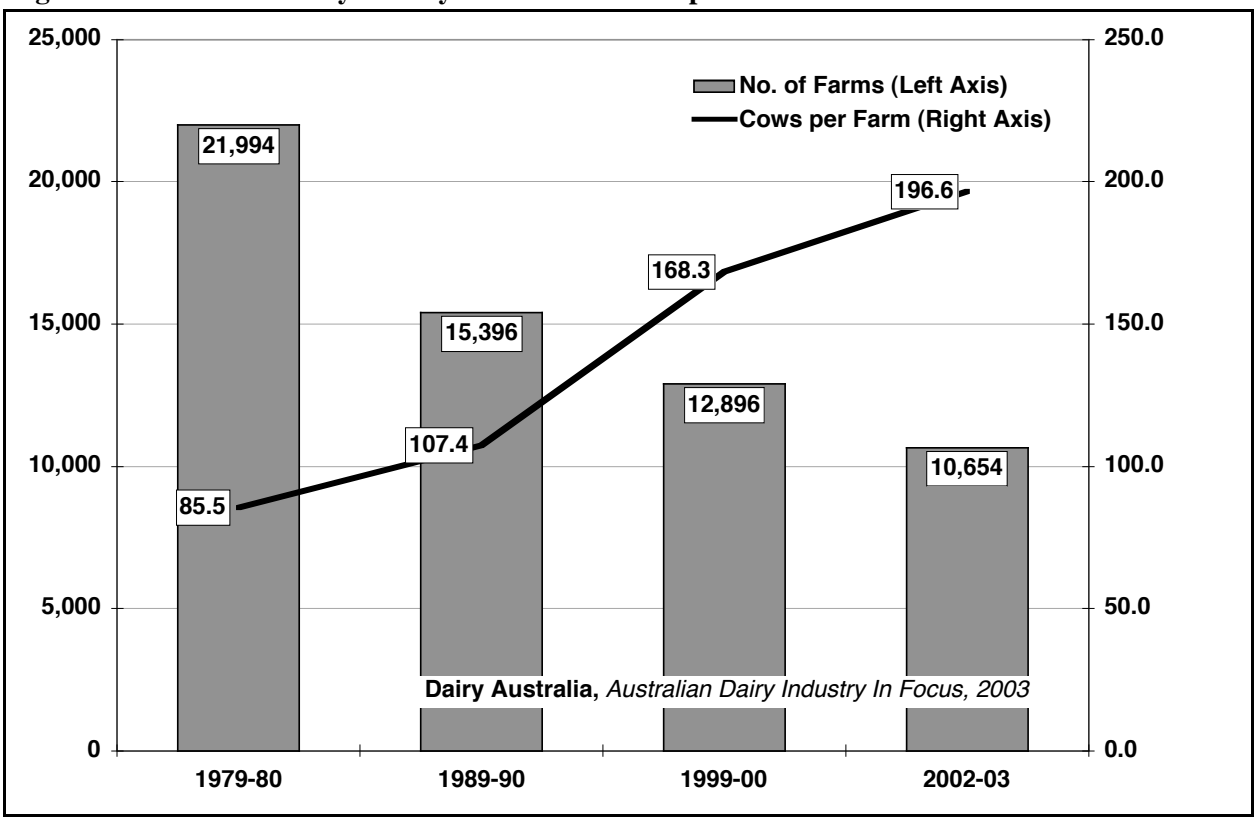


Figure 12. Australia Dairy: Dairy Farms and Cows per Farm



Milk production trended strongly upward through 1999-2000, with an annual average rate of increase from 1982-83 to 1999-2000 of more than four percent. The falloff in 2000-01 can be attributed to industry deregulation in 2000, which accelerated dairy farm exits by providing annual payments that could be received as a lump sum payment. Production was sharply reduced in 2002-03 due to a severe and widespread drought that cut milk yield and cow numbers to accommodate a diminished feed supply. Lingering effects of the drought are expected to constrain 2003-04 milk production at or below 2002-03 [24].

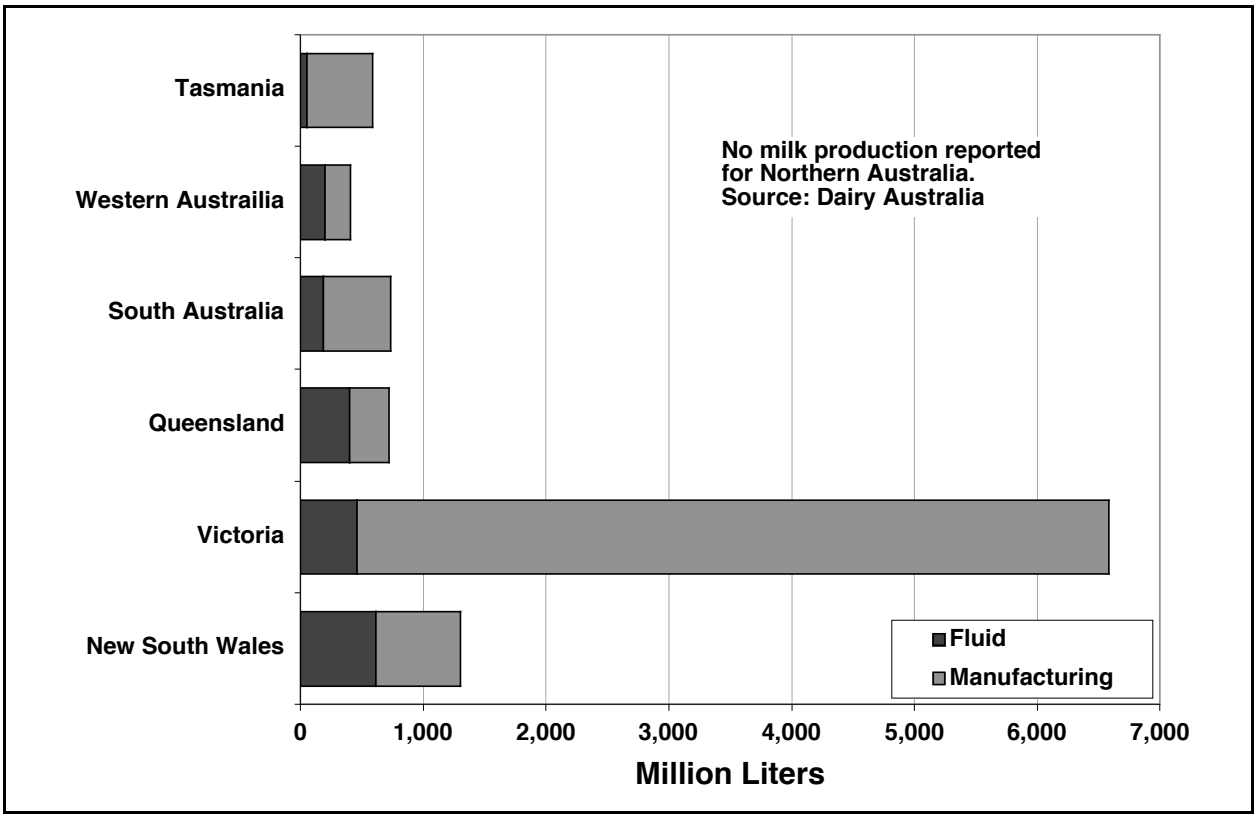
The source of expanding milk production is both more cows and more milk per cow. After decreasing for nearly 20 years, milk cow numbers stabilized starting in the early 1980s, and then grew by 300,000 in the late 1990s. Current cow numbers are just under 2.1 million. Milk per cow has increased at an annual average rate of 2.4 percent since 1960, about the same rate of increase as in the US. Current milk yield is about 5,000 liters per year.

Dairy farm numbers have fallen steadily, totaling 10,654 in 2002-03 compared to almost 22,000 in 1979-80. Over the same time, average herd size climbed from 86 to 196 cows per farm.

Milk production is concentrated in the southeastern states, with Victoria and New South Wales accounting for more than three-fourths of 2002-03 volume. States vary considerably with respect to how milk is used. About half of the milk production of the states of Western Australia (Perth), Queensland (Brisbane and Cairns), and New South Wales (Sydney) is used to provide fluid milk (market milk).[12] We presume that some portion of the milk designated as manufacturing milk in these three states goes into soft manufactured dairy products (designated "fresh products") that are

[12] Note that there is no reported milk production in the Northern Territory.

Figure 13. Australia Dairy: Fluid and Manufacturing Milk by State, 2002-03



consumed within Australia. This makes Victoria a very large player in non-perishable export products.

Because of the importance of local markets for fresh milk and perishable manufactured products, Australian milk production is not nearly as seasonal as in New Zealand. For the country as a whole, peak monthly production (October) is just over twice the production in the lowest months (May-July). In Victoria, October production is three times greater than production in the May through July period.

Production Systems

There are three general categories of Australian dairy farms: *Miser Farms* use grazing exclusively as their source of feed. *Gap Feeders* use some supplemental feeds to balance seasonal differences in grass growth with animal needs. *System Feeders* use grain supplementation to boost per cow productivity. System feeders do not rely exclusively on grazing even during peak grass production. Across these farm types, grass accounts for about 60 percent of dairy cows' diets.

This range in dairy farming systems is partly due to climate differences and partly to the need for a considerable volume of year-round milk to supply fluid markets. Climates range from Mediterranean to subtropical [32]. Irrigation is common—30 percent of dairy farms in Victoria use irrigation. Western and northern Victoria are drier (250-500 mm rain/year) than Gippsland in eastern Victoria (500-800 mm rain/year). Water is regulated on a state-by-state basis, and usage rules and rates vary.

Maize (corn) silage was a less important supplement than in New Zealand because of the greater availability of other supplemental feeds including grains (barley, triticale and wheat in that order), forage sorghums, turnips, rape and millet. Grain-growing areas in northern Victoria have a straw supply that may also be used as feed. Alternative uses of straw are for feeding other ruminants or export. Some straw is burned in the field.

Good crop yields (ton DM/ha) were quoted as 10 to 12 tons corn silage, 10 tons turnips, 10 tons winter cereals, or 15 tons of grass (with about 80 percent utilization as feed by the grazing animal). In Gippsland, pasture consumption was about eight tons per hectare per year with natural rainfall, and nine tons per hectare per year for irrigated farms. The most productive irrigated farms were reported to achieve yields as high as 12 tons per hectare per year. Research is exploring three strategic goals a producer could pursue with different cropping systems:

1) Maximum annual DM yield,
2) Even DM yield throughout the year,
3) Production of high quality DM that best meets needs of a lactating cow.

Over the past 25 years, purchased fodder use has increased from five percent of cash costs for milk production to 35 percent. The ratio of milk price to feed wheat price is about 1.75, but fell dramatically during the recent drought. Wheat prices have recently ranged from AU$125 to AU$235/ton.

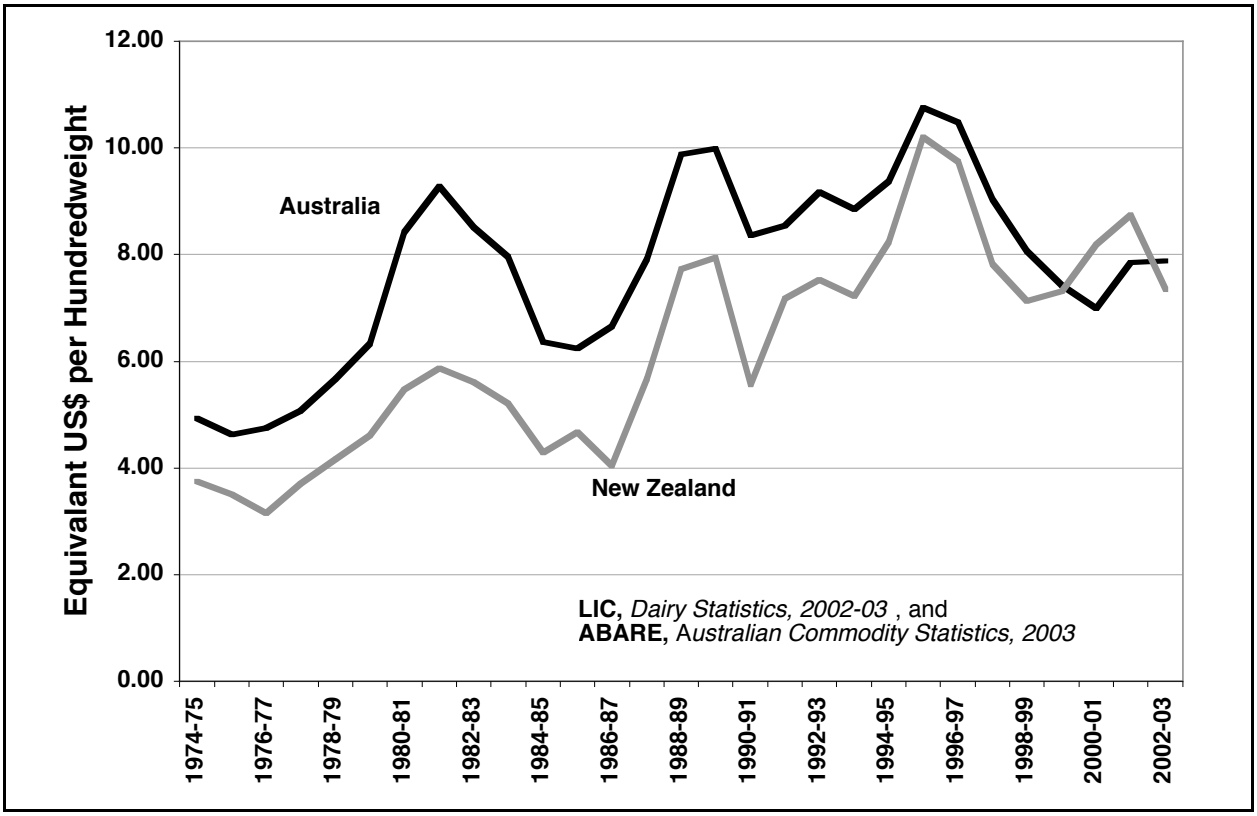
Costs of Production

Table 6 compares costs of production and other characteristics among Australia, New Zealand, and Wisconsin. Again, the Wisconsin data for a subset of sample herds in the 151-250 cow range to provide a more direct comparison with the larger average herd sizes in Australia and New Zealand. The comparison uses marketing year average exchange rates to convert costs and other monetary values to a common US$ base.

Compared to New Zealand, Australian dairy farms on average have nearly three times the land area. Milk solids production is slightly larger. Both assets and debt are larger than New Zealand, but the debt-to-asset ratio in Australia is only one-third the level in New Zealand. Both milk and non-dairy receipts are greater in Australia, putting total revenues about $200 per cow greater but still less than one-third of the revenue per cow in Wisconsin.

Milk production costs in Australia and New Zealand are very similar. The largest

Figure 14. Australia and New Zealand Milk Prices



difference is in pasture and supplements, with Australian costs being more than $100 per cow higher. This reflects the more common use of grain in Australian dairy rations.

Producer Prices

Expressed in US dollars, Australian producer milk prices averaged US$1.75 per hundredweight higher than New Zealand prices between 1974-75 and 1999-00. But since the Australian industry was deregulated in 2000, the price difference has been in favor of New Zealand in two of the last three years. The Australian price trend was strongly positive until the mid-1990s, when rapidly increasing export sales at prices well below prices for domestic usage caused the weighted average price to trend downward.

Dairy industry deregulation on July 1, 2000 ended many years of price-setting for "market" or fluid milk. Elimination of price regulation was accurately forecast to significantly reduce farm-level returns, particularly in areas where much of the milk produced was consumed locally. To reduce the revenue impact, the Australia Parliament passed the Dairy Structural Adjustment Package (DSAP).

The initial package called for AU$1.63 billion to be paid out in annual installments over eight years to dairy farmers who were in business on September 28, 1999. The total allocation was later increased to more than AU$2 billion, and an option was provided for a lump-sum payment of up to AU$45,000 for producers who wanted to exit dairying. The average annual payment for farmers remaining in business was about AU$16,000 in 2001-02 [5].

DSAP payments are funded by an assessment on fluid milk sales of AU$0.11 per liter collected from milk processors. So, fluid milk consumers are bearing the cost of easing the transition of all dairy farmers to an unregulated market.

Because it is more costly to produce milk year-round, suppliers of market milk still receive a premium over seasonal suppliers of milk for manufacturing export products, at least during periods of low milk production. But the premium is driven by the marketplace instead of by government authorities.

Research and Outreach Support

Dairy research, outreach, and education in Australia involves numerous institutions and organizations and a mix of state and federal funding. To rationalize and coordinate various industry support activities, Dairy Australia was created on July 1, 2003 as a consolidation of the Australian Dairy Corporation and the Dairy Research and Development Corporation. Dairy Australia is funded through a compulsory levy on dairy farmers of AU$0.31 per hectoliter (100 liters) of milk (2003-04).[13] The research and development portion of its budget (up to a maximum of AU$15 million) is matched by federal funds. Just over half of Australia's dairy farmers pay the levy.

Dairy Australia's overall mission is "to improve the Australian dairy industry's competitiveness and profitability." Besides research and development at both the farm and manufacturing levels, Dairy Australia's activities include promoting international trade in dairy products, providing industry intelligence/communications, managing dairy industry issues such as biosecurity and animal welfare, and promoting domestic consumption of dairy products. Dairy Australia's total budget is about AU$50 million, with $35 million from the industry levy and AU$15 million from matching government R&D grants. About AU$30 million of the total budget goes to R&D funding.

Dairy Australia's research budget is used to fund competitive grants to a host of public and private sector applicants. These grants are often used to augment or supplement funding on dairy-related research from other sources, making it difficult to estimate total dairy industry research funding. There are many interrelationships, as illustrated by the diagram in Figure 15 below pertaining to manufacturing R&D [43].

[13] In addition to the Dairy Australia levy, there is a mandatory milk check assessment of AU$0.04 per hectoliter to support animal health programs.

Table 6. Milk Production Costs per Cow: Australia, New Zealand and Wisconsin*

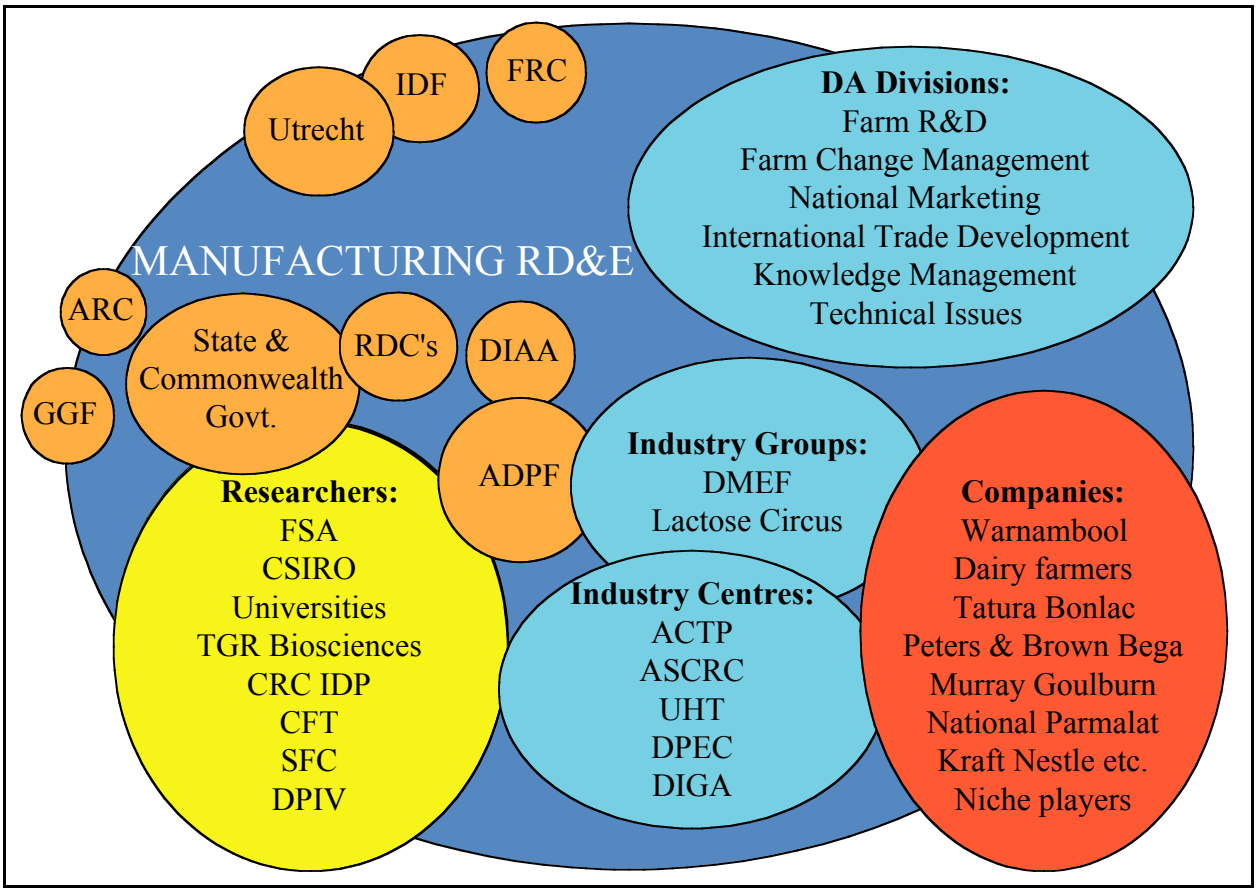
Item	Australia 2001-02**	New Zealand 2001-02**	Wisconsin 2002**
Number of cows	197	227	192
Farm size (Ha)	257	89	241
Milk solids per cow (kg)	358	323	650
	US$* **	**US$*** **	**US$**
Total Assets	4,165.83	3,635.75	7,834.00
Total Equity	3,704.86	2,420.61	4,904.00
Cash Receipts			
Milk sales	856.19	732.32	2,652.73
Net stock sales	76.53	68.30	207.96
Change in livestock value	54.29	38.18	67.89
Other	46.61	8.06	325.55
Total Receipts	**1,033.62**	**837.86**	**3,254.13**
Cash Expenses			
Wages	39.39	50.06	429.28
Animal health	74.86	26.30	97.18
Farm dairy expenses	16.78	8.91	81.05
Electricity	16.91	8.91	69.53
Pasture and supplements	197.40	78.48	910.74
Fertilizer	53.04	65.33	48.95
Weed and pest	4.51	5.09	34.52
Repairs and maintenance	61.83	42.00	165.77
Vehicle expenses	23.25	22.91	8.89
Interest	57.71	86.12	11.10
Other	1.59	4.24	209.48
Livestock materials	17.73		
Other materials	18.90		
Contracts	17.79		
Rates	23.31		
Milk levies	9.77		
Payments to sharefarmers	31.16		
Rent/Lease expenses	13.88		129.12
Breeding and herd testing		11.88	41.56
Freight		3.82	34.40
Administration		13.15	
Standing charges		34.36	
Insurance			40.23
Property taxes			32.67
Marketing/Hedging			41.53
Total Cash Expenses	**679.82**	**461.56**	**2,566.00**
Net Cash Income	**353.80**	**376.29**	**688.13**
Non-Cash Costs:			
Depreciation	66.34	39.45	393.05
Change in Prepaid Exp./Accts. Payable			72.58
Other:		12.30	
Total Non-Cash Costs	**66.34**	**51.76**	**465.63**
Total Costs	**746.15**	**513.42**	**3,031.63**
Net Farm Income	**287.47**	**324.54**	**222.50**
Unpaid labor, including operator	125.83	106.48	221.63
Return to Equity and Mgt.	**161.64**	**218.06**	**0.87**

* Sources: Australia [5]. New Zealand [12]. Wisconsin [51], 151-250 cow category.

** The Australian marketing year is July 1 – June 30 and the New Zealand dairy marketing year is June 1 - May 31. Wisconsin data are for Calendar 2002.

*** Based on marketing year average of exchange rates using monthly rates reported by the Reserve Bank of Australia (http://www.rba.gov.au/Statistics/exchange_rates.html).

Figure 15. Relationships



The Commonwealth Scientific and Industrial Research Organization (CSIRO) is the principal federal research agency. Agriculture is only a small part of CSIRO's research portfolio of nearly AU$1 billion. The annual investment in meat, dairy and aquaculture research is about AU$60 million annually. This is separate from any levy matching dollars. The livestock industries division has specialized field and laboratory facilities at Armidale in New South Wales, Rockhampton and Brisbane in Queensland, Floreat Park in Western Australia and the Australian Animal Health Laboratory (AAHL) in Geelong, Victoria. CSIRO Livestock Industries is also part of the Queensland Bioscience Precinct, a joint venture with the University of Queensland. CISRO has identified three research areas addressing dairy production—livestock disease, dairy nutrition and management and livestock improvement.

The Australian Bureau of Agricultural and Resource Economics (ABARE), a quasi-governmental unit housed with the Department of Agriculture, Fisheries, and Forestry in Canberra principally conducts economic research related to dairy. ABARE conducts regular farm surveys to estimate farm production costs on an annual basis. ABARE has conducted extensive research on dairy trade liberalization.

State agencies also fund farm-level research, much of this at research and demonstration centers. In Victoria, the State Division of Primary Industries operates three dairy research centers, two (Ellinbank and Kayabram) with experimental farms. Ellinbank is undergoing a $12.5 million dollar renovation and expansion, including a replacement building for the research staff, and a new barn and milking parlor. The barns provide facilities for metabolism work (fecal and urine collection), respiratory

calorimetry, freestalls with the capacity for single animal segregation, and lockups for feeding and working with pasture-based cows. The 1999-00 budget for Ellinbank was about AU$4 million. About half of this budget was direct state support, and half came from the Dairy Research and Development Corporation, a predecessor organization to Dairy Australia [11].

The total Australian levy on milk is similar to New Zealand's levy, but more of the levy is directed to research and there is a better match by the government. However, much of the Australian research is related to manufacturing, which is funded separate from the levy by New Zealand farmers through Fonterra.

The Australian dairy research and extension structure is quite complicated, with multiple funding sources and considerable partnering. The strong role of states in research and extension brings in a player that is not present in the New Zealand models. Although the Australian levy gives dairy producers control of a great deal of the production and processing R&D, they do not have an organization like Dexcel to perform these functions and therefore they rely on partnering with state, federal, university and commercial cooperators in various partnerships. The Ellinbank research station was clearly involved in extension as well as research. Staff noted a method of funding whereby producers could receive short-term training through agricultural colleges, and this brought college instruction into the extension mix as well.

How Much Can Australia Expand Milk Production?

Despite a much larger land mass, the opportunities for expanded milk production in Australia would appear less than in New Zealand. The principal constraint is water. About 60 percent of farms use irrigation and one third of producers irrigate more than 60 percent of their property. Of the water used for irrigated agriculture, one-third is for dairy production—mostly in Northern Victoria. About half of the total water used by Australia's dairy industry is used in Northern Victoria.

The recent drought highlighted the vulnerability of the Australian industry. With a rapidly growing population, urban-rural competition for water will intensify. When this happens, urban demand usually wins.

Other environmental concerns could serve to slow the rate of growth in Australian milk production. The dairy industry is estimated to produce two to three percent of greenhouse gas emissions [9]. Reduced river flows from irrigation, fertilizer leaching and run-off have also been criticized.

This is not to say that Australian milk production will stagnate. Growth will continue through greater productivity within the constraints imposed by water availability. And, significant productivity gains are possible as Australia continues its shift from pure pastoral dairying to forage and grain-based rations. Much depends on world market prices. Trade liberalization leading to higher world market prices for milk could stimulate a significant increase in grain feeding. Growth will be more modest if trade barriers remain high.

Dairy Australia recently projected Australian milk production to grow at an annual rate of four percent between 2003-04 and 2008-09, reaching 12.5 billion liters by 2008-09 [9]. Over the same time period, cow numbers and yield per cow are each expected to increase at an annual rate of two percent. This would place cow numbers at 2.3 million and yield at 5,400 liters in 2008-09.

At its March 2004 agricultural outlook conference, the Australian Bureau of Agricultural and Resource Economics (ABARE) projected 2008-09 Australian milk production at only 10.8 billion liters, which is 433 million liters less than 2001-02 production [24]. ABARE forecast 2008-09 cow numbers at 2,125,000 (the same as 2001-02) and milk per cow at 5,100 liters (compared to 5,309 liters per cow in 2001-02).

ABARE's forecasts seem very low, perhaps strongly influenced by the drought of

the last two years. Dairy Australia's milk production forecast appears to be more reasonable, though perhaps still a bit pessimistic. We expect that dairy cow numbers in Australia will stabilize at about 2.2 million cows, but we anticipate that the annual average increase in Australian milk production per cow will be between two and four percent, depending on milk price levels. Using 2002-03 milk-per-cow numbers of 5,030 liters as a base, this would yield total milk production in 2008-09 of 12.5 to 14.0 billion liters.

IV. Processing Sector

General Description

The dairy product manufacturing industry in Oceania, especially New Zealand, is similar to that in Wisconsin in several respects. It has a long history and is a dominant sector of the total agricultural industries. A substantial portion of the production of dairy products is marketed outside of the state/country boundaries. Cheese manufacturing is an important segment of the total dairy manufacturing sector, both historically and in its contribution to the total product sales.

Differences in dairy product manufacturing between Oceania and Wisconsin arise primarily from the systems of milk production on farms and from methods of product distribution and marketing. Pasture feeding with resultant substantial seasonality of milk production in Oceania has necessitated the structuring of manufacturing plants and scheduling to most efficiently accommodate large variations in amounts of milk processed per day over the milk season. It has also created variations in milk composition and properties that had to be dealt with through research, adjustments of manufacturing procedures, increased mechanization of manufacturing, higher capacity manufacturing plants and choice of products to be manufactured. Product shipment by ocean transport from New Zealand and Australia has influenced product mix. This factor has not limited the choice of products manufactured in Wisconsin, which are distributed principally by highway transport.

Although there are many similarities between the dairy product manufacturing sectors in New Zealand and Australia, there are differences created by factors such as climate, size of internal (home) market, and diversity of ethnic groups. Dairy manufacturing tends to be concentrated in certain geographical areas—particularly in the state of Victoria in Australia and the North Island of New Zealand, with increasing manufacturing on New Zealand's South Island. One large cooperative dominates dairy product manufacturing in each country but especially in New Zealand. A number of smaller cooperatives and private firms operate in each country, with primary emphasis on non-commodity products.

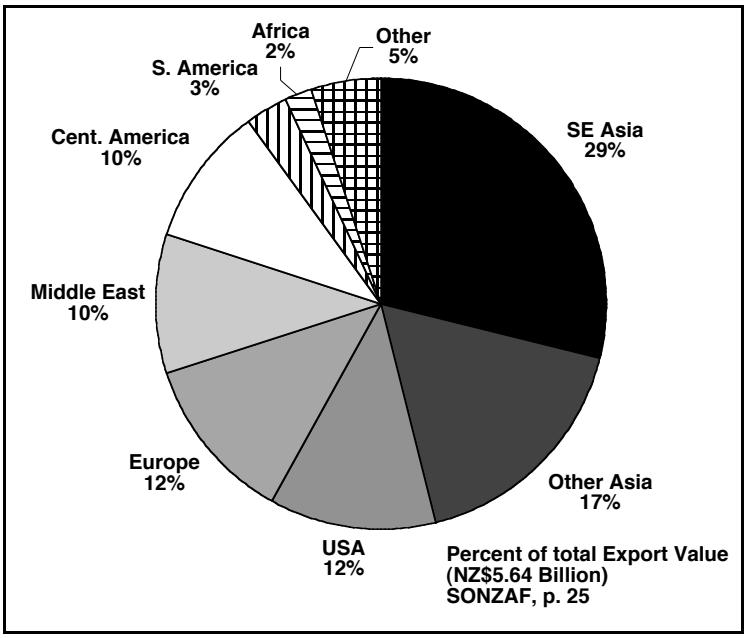
Dairy foods research and product development has been emphasized in both New Zealand and Australia over the past 50 years. This has included basic research on the chemistry of milk components and dairy products, the physiology of bacteria, and modifying properties of dairy products. Applied research has focused on enhancing efficiencies of manufacturing, mechanization (especially of cheese manufacturing), and engineering of processes to manufacture products and separate milk components. Strong central research organizations were developed in both countries. The New Zealand Dairy Research Institute (NZDRI) was funded largely by milk producers; the dairy foods section of the Commonwealth Scientific and Industrial Research Organization in Australia was funded primarily through governmental sources. The major dairy states in Australia also had dairy foods research facilities, but these have diminished in size and changed focus over the past 25 years.

New Zealand

Butter and cheese exported to the United Kingdom markets sustained the industry during its early development and expansion. Several New Zealand dairy companies established a company in 1927 in the UK. Restructuring of the UK market with the formation of European Community (later the European Union) forced the industry to seek additional markets and to manufacture a wider array of products for these new markets.

In 2002-03, the major export markets were the US, EU, Pacific Basin countries (Japan, China and Southeast Asian Countries), Mexico and Australia. The US was the largest single country market for New Zealand, with exports valued at NZ$679 million. However, exports to Southeast Asian countries were 2.4 times greater than those to

Figure 16. Destination of New Zealand Dairy Exports, 2002-03



the US, and these countries are perceived to be major outlets in the future (Figure 16).

Cheese manufacturing and export increased until the 1980's but has been replaced as the major export commodity by whole milk powder. Products manufactured for export in 2002-03, expressed as a percent of total export value of NZ$5.64 billion, are shown below in Figure 17.

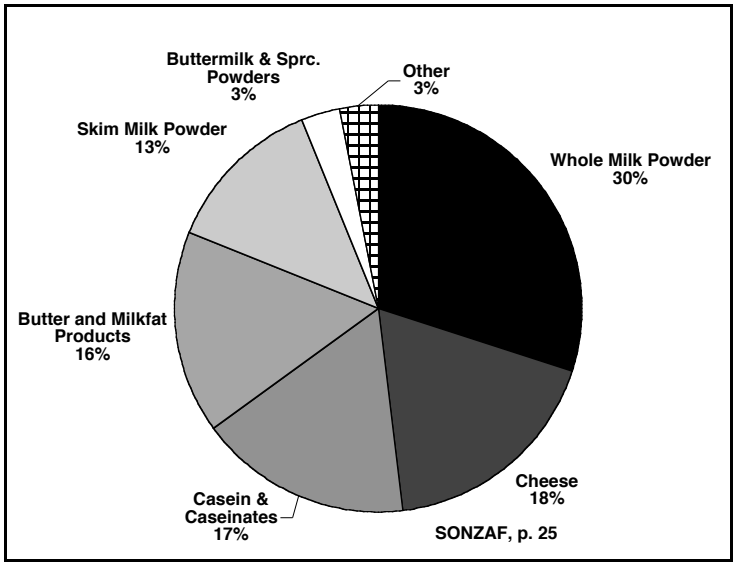
Farmer-owned cooperatives have always been dominant in New Zealand; most of the dairy factories by the early 1900's were owned by cooperatives. Three cooperatives account for most of the manufacturing sector: Fonterra, Tatua, and Westland. There are about 70 smaller companies producing products primarily for the domestic market but some for export. These firms supply non-commodity cheeses, fresh and cultured milks, specialty milk powders, ice cream and edible fats. Two firms, New Zealand Dairy Foods, Ltd. and Mainland Products Ltd. (part of Fonterra), account for 40 and 35 percent, respectively, of the domestic market.

The size of manufacturing plants varies with the type of product and the particular company but very high-capacity plants are typical for exported commodity products. Such plants would process several million pounds of milk per day during the height of the lactation period. Seasonality of milk production requires over-capacity of production equipment during periods of lower production. This variation in throughput in plants has also necessitated maximum mechanization and reduction of labor in processing plants.

The essential processing technologies are similar to those in large US dairy plants. Exceptions would be modifications of drying processes to produce whole milk powder, greater variety of high-protein products, and mechanized systems for Cheddar cheese.

The "stirred curd" procedure for making Cheddar cheese used in numerous US operations does not seem to be practiced in New Zealand. Rather, continuous, mechanized systems for fusing, draining and cheddaring the curd are common, reflecting the choice of capital investment to reduce

Figure 17. Composition of New Zealand Dairy Exports, 2002-03



labor costs. This approach may also be influenced by the concern about maintaining the "traditional" method of making Cheddar cheese for the export market. The same technologies for processing dairy products are available in all countries. Success depends upon well-known techniques such as fine-tuning the processes, matching the outputs of the processes to the market (or vice versa), maximizing returns for the major products and for by-products from a process, and reducing costs while maximizing quality.

Fonterra[14]

Fonterra is New Zealand's largest firm, processing the milk from about 12,600 of New Zealand's 13,140 dairy farmers in 2003. Fonterra operates 29 manufacturing sites in New Zealand and 35 overseas, and manufactures milk powders, cheese, butter, and a full range of specialty consumer and food ingredient products. Fonterra's revenues totaled NZ$13.9 billion (US$6.6 billion) and NZ$12.5 billion (US$7.2 billion) in 2001-2002 and 2002-2003, respectively. The cooperative employs about 20,000 people in New Zealand and overseas.

Fonterra is the world's largest exporter of dairy products, exporting 95 percent of its two million metric tons of production to approximately 140 countries. Fonterra is the largest supplier of dairy ingredients in the world and is responsible for manufacturing and supplying over 1,000 products to be used as food ingredients. There are 12 branded product lines that are exported or used internally.

Fonterra has two major manufacturing and marketing divisions, New Zealand Milk and NZMP. The former provides dairy based consumer and food service branded products and the latter ingredients for the food industry.

New Zealand Milk employs over 12,000 persons worldwide in 30 operating companies, and manufactures and markets seven brands of dairy foods. Butter and milk powders are marketed under the Anchor brand. Fernleaf also handles milk powders, but emphasizes higher fat products and a brand with higher calcium levels. Annum formulates milk powders with added nutrients for mothers who are breast-feeding and during pregnancy. Essential fatty acids have been added to Annum milk powders for certain markets to enhance the development of babies. Anlene manufactures nonfat dry milk formulated for adults that has higher calcium levels and one-half the lactose content of regular milk. Natural cheese is manufactured and marketed under the Mainland brand. Process cheese products are manufactured and marketed by Chesdale.

Besides being its largest firm, Fonterra is also New Zealand's largest private sector investor in research and development with an annual budget of approximately NZ$95 million. Fonterra also receives government funding of around NZ$3.2 million via the Foundation for Research, Science and Technology.

The dairy product and processing R&D program is the responsibility of the Marketing & Innovation group. This group was formed in 2003 through the amalgamation of Fonterra Research Center (previously named New Zealand Dairy Research Institute), FonterraTech and New Zealand Milk Products Marketing & Strategy.

The research center has a full range of modern chemistry, microbiological, and technology laboratories, plus a modern sensory evaluation facility equipped with computerized scoring and reporting. It contains one of the world's largest dairy pilot plants equipped to carry out almost all dairy processes. The Center houses a facility (ISO 9002 accredited) to manufacture and distribute lactic starter cultures to the New Zealand dairy industry for cheese and casein manufacturing.

Dairy research by Fonterra's predecessors began in 1927 with the formation of the New Zealand Dairy Research Institute (NZDRI). Basic and

[14] The material in this section draws heavily from the Fonterra and Fonterra Research and Development web sites.

applied research on lactic starter, chemistry of milk during the lactation period, and development of technologies to fit the seasonal milk production and needs of marketing were the areas of emphasis during the early history of the NZDRI. Extensive research and development by NZDRI to develop mechanized systems for mechanized Cheddar cheese curd handling equipment were initiated in the 1960's. Some of this equipment is presently in operation but other commercial mechanized systems are also used. The growing international market and need for greater diversity and tailor-making of products shifted the NZDRI research program to more direct support of marketing needs with the consolidation of research activities.

Response to new challenges is exemplified by the formation of ViaLactia Biosciences, which is a biotechnology company operating as a fully owned subsidiary of Fonterra. The goals of ViaLactia are the identification, discovery and commercialization of methods of selection and of genes important to the dairy industry, including those affecting pasture grasses, milk production and composition, and animal health. Tailoring milk for specific uses through genetic manipulation is a major goal, and present emphasis appears to be increasing the protein content of milk.

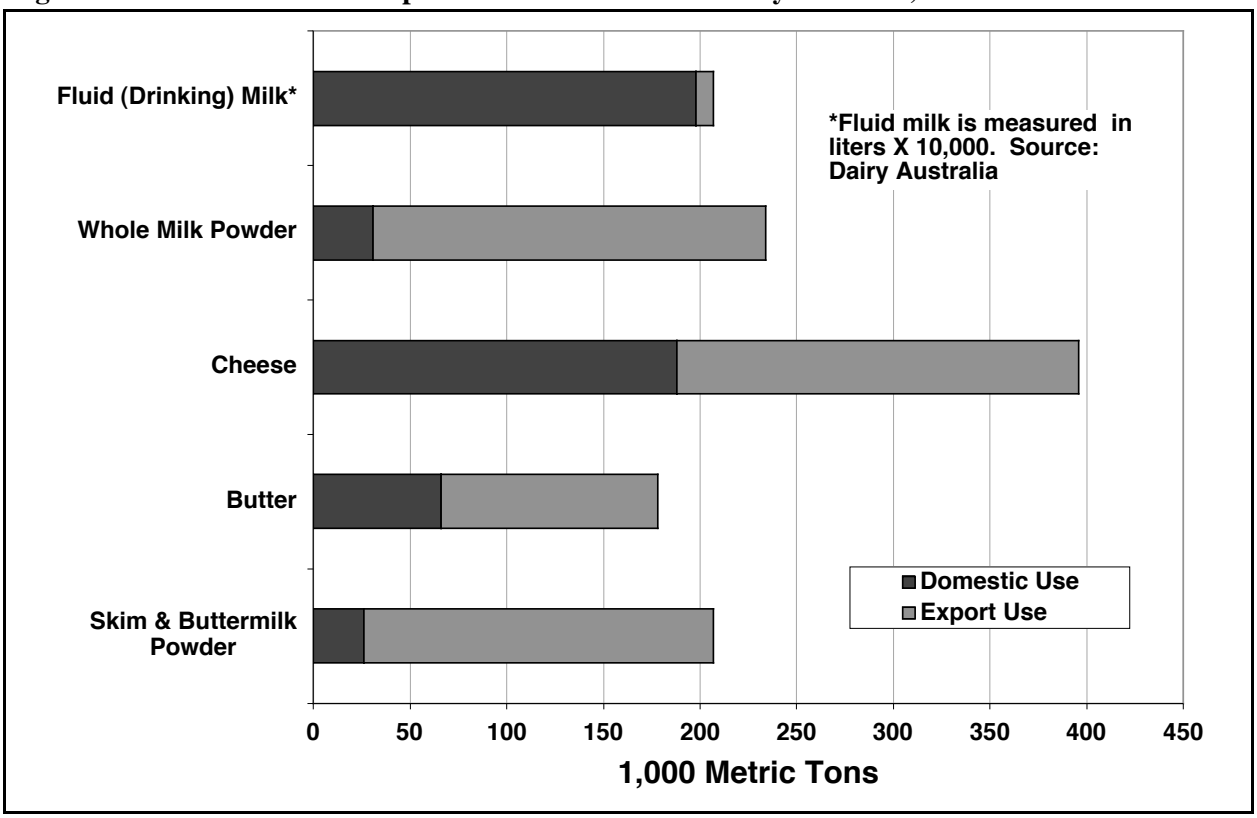
Tatua and Westland

The farmer-owners of these cooperatives voted to remain independent during the negotiations to form Fonterra. Tatua is located on the North Island and Westland is located in the South Island. Both are quite small compared to Fonterra and probably will focus on unique products and niche markets. Their emphasis will likely be on development and implementation of new products and processes [63].

Tatua has 138 farmer-members who ship approximately 135 million metric tons of milk per year. About 90 percent of its products are exported to six regions of the world. The product line is divided into two divisions, Tatua Foods and Tatua Nutritionals. Tatua Foods markets UHT liquid food products to consumer and food-service outlets. Some of the products are aerosol canned cream, butter oil mist, bag-in-box whipping cream, cheese sauce, liquid pre-mixes for products like milk shakes and sundaes, and UHT flavored milks. Packaging to fit market needs is emphasized. For example, packages for cheeses sauces for food-service range in size from 20-kg bags to one metric ton bag-in-box bulk packages. Products in the Nutritionals Division range from caseinates and 80 percent protein whey protein concentrate to specialized products such as lactoferrin, lactoperoxidase, casein phosphopeptides, and glycomacropeptide. The specialized products are designed for health care products, infant formulas, cosmetics and food and feed ingredients.

Westland cooperative is larger than Tatua having about 380 suppliers and apparently produces more commodity products. Westland processed about 2.5 percent of New Zealand's milk in the 2002-2003 season [40]. Recent articles in New Zealand dairy publications indicate that two new anhydrous milk plants are being constructed. A new milk powder packaging and handling facility has also been constructed. However, there certainly will be an emphasis on development and implementation of new products and processes to maximize returns and to minimize direct competition in the commodity product area [65].

Figure 18. Domestic versus Export Sales of Australian Dairy Products, 2002-03



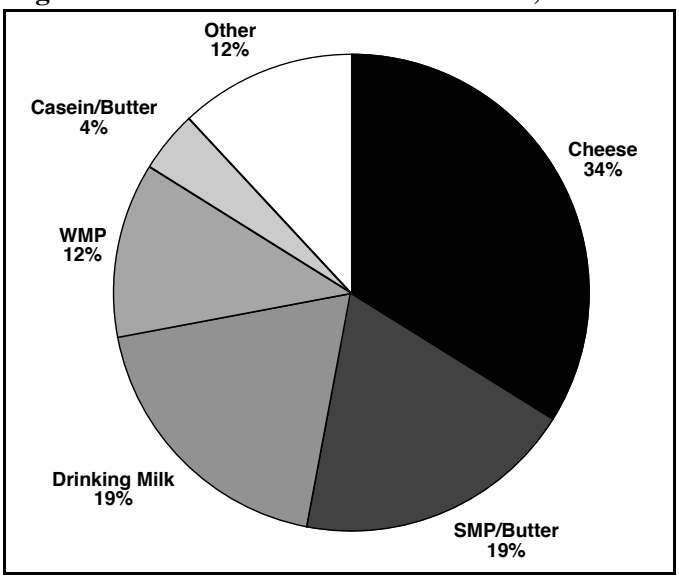
Australia

The profile of Australian dairy products differs from New Zealand because of the larger home market and diversity of the population. Utilization between domestic and export markets varies substantially across markets. For cheese, which absorbs the highest percentage (34 percent) of milk of all Australian dairy products, 47 percent of this production is consumed within Australia. In contrast, only 12 percent of Australia's 2002-03 skim milk powder production was used domestically [52].

Cheddar cheese dominates cheese production, but fresh cheeses (i.e. cream and cottage cheeses) and stretched cheeses (i.e. mozzarella and provolone cheeses) rank second and third in production. Tonnage of each type is approximately one-fourth that of Cheddar cheese. Milk is also used for other products, such as skim milk powder with concomitant butter production (19%), whole milk powder (12%), casein with by-product butter (4%), and other products (12%).

The home market for dairy products has been fairly static for the past 20 years. Milk has been utilized to a greater extent for exported dairy products. The percentage of milk used for this purpose increased from 30

Figure 19. Utilization of Australian Milk, 2002-03*



* Source: Dairy Australia.

percent in 1980-81 to almost 60 percent in 2002-03. Principal export products are cheese and milk powders.

Australia accounts for 17 percent of the world trade in dairy products, ranking behind only New Zealand and the EU. The largest portion of its exports go to Southeast Asia but other Asian countries, Japan and the Middle East are important importers. Like New Zealand, Australia views mainland China as a major future outlets for its dairy products.

Milk processing is carried out by a diverse group of cooperatives and private companies including several large international corporations. A general description of Australia's major dairy processors follows:

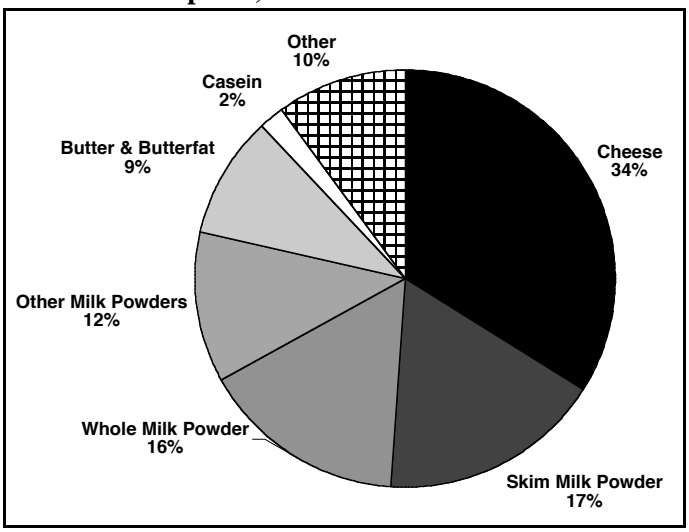
- **Murray Goulburn**.

  Established in 1950, this largest of Australian dairy cooperatives was supplied by about 3,500 member producers in 2001-02. The Cooperative has approximately 2,200 employees and manufactures dairy products at seven sites located throughout Victoria. Murray Goulburn's revenues totaled AU$2.0 billion and AU$1.7 billion, respectively, in 2002 and 2003 [34]. The lower revenues for 2003 reflected the impact of Australia's drought on milk throughput. Murray Goulburn exports to over 100 countries and accounts for about eight percent of the world dairy trade.

- **Dairy Farmers Group**.

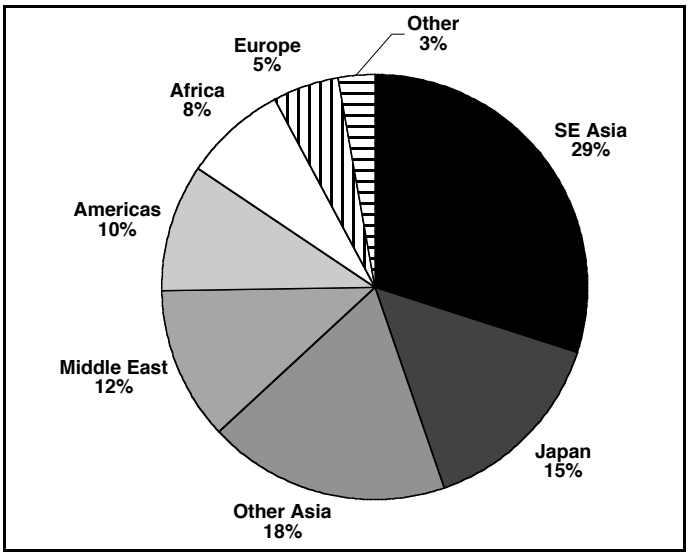
  A product of numerous mergers, the original Dairy Farmers cooperative was established in 1900. The cooperative's recent annual sales have totaled about AU$1.3 billion. Dairy Farmers purchased 1.3 billion liters of milk from approximately 1,500 member-suppliers in 2002-2003. About 58 percent of Dairy Farmers' milk was sold as fresh, longlife, or flavored milk, and the remainder was manufactured into cheese, yogurt, custard, milk powders, and butter in 2002-2003. Dairy Farmers sells under established brands including the international Cracker Barrel cheese brand and Danone yogurt brand. Dairy Farmers has extensive domestic marketings and growing international sales. The firm has expressed interest in buying Parmalat's Australian dairy processing operations.

Figure 20. Composition of Australian Dairy Product Exports, 2002-03*



*Percent of total 2002-03 Export Value (AU$2.5 Billion).
Source: ABARE, Australian Commodity Statistics, 2003.

Figure 21. Destination of Australian Dairy Exports, 2002-03*



*Percent of total 2002-03 Export Value (AU$2.5 Billion).
Source: Dairy Australia.

- **Bonlac**.

  This Melbourne-based cooperative has experienced financial troubles for the past five to six years. While it remains the fourth largest dairy company in Australia, management of the firm has been effectively ceded to Fonterra of New Zealand. In 2000, the New Zealand Dairy Board (NZDB) acquired a 25 percent equity interest in Bonlac. At the time of the NZDB's acquisition, Bonlac had about 3,000 producer suppliers and purchased about a quarter of the milk produced in Australia [16]. Bonlac's producer numbers had declined to about 1,800 by 2003 [26]. In 2003, Fonterra increased its stake in Bonlac to 50 percent under a partnership agreement that calls for Bonlac to focus on milk collection and processing and for Fonterra to purchase and market Bonlac Foods' products [39].

- **Warrnambool Cheese and Butter Factory (WCBF).**

  Established in 1888 with six producer suppliers, WCBF had 605 suppliers in 2003 [10]. Located in Southwestern Victoria, WCBF manufactures cheese, butter, milk powder, whey and nutritional dairy ingredients. The firm has witnessed increases in exports exceeding 20 percent per year recently, and in 2003 obtained about 60 percent of sales revenue from overseas markets. Major markets for WCBF products include Singapore, Malaysia, China, Thailand, the Philippines, Taiwan, US, South Korea, and Japan. WCBF maintains a strong R&D focus.

- **National Foods**.

  Melbourne-based National Foods is Australia's biggest supplier of fresh milk and only publicly listed dairy company. The company generates nearly AU$2 billion in yearly revenue and supplies about 40 percent of Australia's fresh milk [35]. It sells fresh milk under the well-known Pura brand and yogurt under the Yoplait brand. Fonterra, Dairy Farmers, and (until recently) Danone, respectively, owned 18 percent, 9.2 percent and 10 percent of National Foods. Danone sold its 10 percent share of the company in March 2004 [2]. National Foods also has expressed an interest in buying Parmalat's dairy processing business in Australia.

- **Parmalat.**

  Queensland-based Parmalat is Australia's third largest fluid milk processor, trailing National Foods and Dairy Farmers. Parmalat came to prominence in Australia when it purchased Paul's Ltd. for AU$436 million in 1998 [19]. Parmalat Australia had sales of about AU$690 million in 2003 [19]. At the time of this study, there were reports that Parmalat Australia would be sold as part of the restructuring of the bankrupt Parmalat of Italy. However, later reports indicate that Parmalat Australia will be retained as part of the restructured parent company. Hence, the status of Parmalat Australia is unclear. If Dairy Farmers acquired Parmalat's Australian fluid milk business, this would elevate the cooperative's sales to near parity with National Foods. Alternatively, National Foods would achieve dominance in Australia's fluid milk business if it made the acquisition.

- **Kraft Foods**.

  A subsidiary of Kraft Foods International, U.S.A., Melbourne-based Kraft Foods (Australia) Ltd. is a diversified food company that produces cheese, mayonnaise, salad dressings, canned meats, meat and vegetable extracts, pre-packed dinners, and snack foods. The firm's industry involvement includes dairy product manufacturing and dairy produce wholesaling [57]. The firm maintains six manufacturing facilities and state sales offices in Australia [60]. In 2002, Kraft Foods had about 1,700 employees in Australia [60].

- **Nestle Australia Ltd**.

  Nestle Australia is a subsidiary of the Switzerland-based Nestle Corporation. The parent corporation is the world's largest food manufacturing company with 500 factories in 85 countries [62]. Nestle Australia is ranked 83rd among the top

2000 companies in Australia and had about 3,700 employees in 2002 [58]. The firm's dairy-related activities in Australia include ice cream manufacturing, dairy product manufacturing, and dairy produce wholesaling. Nestle Australia's dairy brands include Sunshine Milk Powder and Peter's ice creams.

Dairy processing plants producing commodity products are large and highly mechanized as in New Zealand. One manager of a cheese plant observed that Australian cheese plants are characterized by high capital costs but low labor costs whereas US plants are characterized by lower capital costs. Seasonal milk production in Australia undoubtedly is a dominant factor in choosing this processing approach. Automation is emphasized in "non-cheddar" plants where a number of continuous curd-forming and handling systems (Alpma from Europe) have been installed. The rapid expansion of mechanization occurred in the 1970's and 1980's so capital expenditures may be necessary in the future.

Full and efficient use of milk components is, of course, recognized as an important goal by the manufacturing sector. As an example, Murray Goulburn Cooperative produces a full range of conventional dairy products, including milk powders, milk protein concentrates, whey protein concentrates and isolates, caseinates, various cheese varieties (but primarily Cheddar cheese), and butterfat products. But the cooperative has also identified promising new niche markets and has established a wholly owned subsidiary, MG Nutritional, to produce an array of non-traditional dairy products. These include whey protein isolate with an enhanced concentration of glycomacropeptide, whey protein isolate with an increased level of beta-lactoglobulin, whey fractions rich in lactoferrin, pure lactoferrin, dairy colostrum, blends of whey protein isolates and colostrum, and natural milk minerals. Applications for these products are in sports nutrition, clinical nutrition, infant nutrition, nutritional supplements, and functional foods. Other Australian cooperatives and companies also produce similar products depending upon their technical capabilities, funds for capital investments and marketing strategies [31].

Product Research and Development

Product and processing research and development have been re-organized recently similar to the trends in New Zealand [53]. Various research-oriented organizations such as the Australian Dairy Research and Development Corporation were consolidated under Dairy Australia. Divisions carrying out research are Manufacturing R&D and R&D Operations. Food safety and product integrity are handled under the Technical Issues Division. It is likely that further reorganization will occur in the future.

The foci of Manufacturing R&D are continuing emphasis on commodity and newly differentiated products, strong commitment to export products, and being customer-oriented. Research will be realigned to increase funding for strategic and fundamental sciences, human nutrition, bioscience and environmental issues. There will be a reduction in product development and process optimization; these activities will presumably be shifted to companies and cooperatives. The research structure will include various research centers and increased co-investment by the dairy industry.

Four programs will comprise the research portfolio:

1) Dairy products,
2) Dairy chain innovation,
3) Resource management, and,
4) Technology and human resource development.

Sub-programs within dairy products are UHT and short shelf life products, cheese and starters, and whey and lactose. Milk components, bioactivity, and human health and nutrition are the sub-programs within dairy chain innovation.

Five research centers provide support for the program:

1) UHT Center,
2) Australian Starter Culture Research Center,

3) Australian Cheese Technology Center,
4) Dairy Ingredients Group of Australia, and,
5) Dairy Product Engineering Center

Most of these programs will be funded by a blend of funds from a levy on milk production, grants from private industry, and by government funding. The dairy product research will be conducted by the above centers, university scientists, private companies, governmental laboratories and combinations of these units.

V. Strategic Behavior in the New Zealand and Australian Dairy Processing Sector

Both the New Zealand and Australian dairy processing sectors have evolved into concentrated industries that focus heavily on the production and export of manufactured dairy products. New Zealand's dairy industry has a small fluid milk-processing segment that serves Auckland, Wellington, Christchurch and other smaller cities. Australia's fluid milk processing sector is larger, claiming about 20 percent of the nation's milk production.

Fonterra, a large producer cooperative, dominates New Zealand's manufactured milk processing sector. Smaller operators specializing in production of differentiated dairy items make up the rest of New Zealand processors. Murray Goulburn, Bonlac (owned 50 percent by Fonterra), Dairy Farmers, and a few smaller cooperatives dominate Australia's dairy industry, accounting for over 75 percent of milk processed in the country. Propriety firms—National Foods, multinationals (Parmalat, Kraft, and Nestle), and small niche manufacturers—process much of the remainder of Australia's milk [48, p.8]. Major players in Australia's fluid milk processing business are National Foods, Dairy Farmers, and Parmalat [8, p.17].

New Zealand

Fonterra processes over 95 percent of the milk produced in New Zealand and has purchased interests in Australian dairy companies. It dominates New Zealand's dairy industry and is one of the top-10 dairy firms in the world in terms of sales. Accordingly, most of the remaining discussion of strategic behavior in New Zealand's milk processing sector focuses on the creation, operation, and future plans of Fonterra.

This emphasis on Fonterra does not mean that the fortunes of Tatua and Westland Cooperatives are unimportant. Indeed, the latter two cooperatives appear to be successful producers of differentiated or partially differentiated dairy products. It will be useful to follow the progress of these two smaller cooperatives to assess whether smaller firms can thrive in New Zealand's dairy industry. But in view of the limited amount of information on the potential profitability of Westland, in particular, over the longer-run and the dominance of Fonterra, primary emphasis is placed on evaluating the performance of Fonterra.

The Emergence of Fonterra

The October 2001 merger of the New Zealand Dairy Group and Kiwi Cooperative formed Fonterra. The merged cooperatives then absorbed the New Zealand Dairy Board, which prior to the merger, had served as the single desk (monopoly) exporter of New Zealand's dairy products.

Certain legal changes needed to permit the formation of Fonterra were included in Dairy Reform Legislation passed by New Zealand's parliament in 2001. Thus, an industry that had included about 168 dairy companies in 1961 became a concentrated industry that four decades later consisted mostly of three cooperatives—Fonterra, Westland, and Tatua Foods. The latter two cooperatives opted not to become part of Fonterra in 2001.

The merger of the New Zealand Dairy Group and Kiwi Cooperative was a mega-merger similar to some that have occurred elsewhere in the world. Many dairy companies in other parts of the world have merged in recent years to achieve processing economies, realize other efficiencies, and gain market power. These considerations were involved in the New Zealand Dairy Group-Kiwi Cooperative merger. There was widespread support for the merger that created Fonterra—85 percent of the members of the New Zealand Dairy Group and 83 percent of Kiwi Cooperative's members voted to approve the merger in 2001 [49].

However, merging the New Zealand Dairy Board (NZDB) with the New Zealand Dairy

Table 7. Principal Fonterra Brands

Brand Name	Scope of Sales
ANCHOR	Global
ANLENE	Global
MAINLAND	New Zealand and Australia
PETERS AND BROWNES	Australia
ANMUM	Global
TIP TOP	New Zealand, Australia, and Pacific
CARABOBO	Venezuela
CHESDALE	Global
BEGA	Australia
TARARUA	New Zealand
SOPROLE	Chile
MEADOWFRESH	New Zealand

Group and Kiwi Cooperative was noteworthy. Prior to the merger, the NZDB was the largest private dairy exporting firm in the world and had scored important exporting successes during its approximately 40-year life from 1961 to 2001. In particular, it had developed sophisticated marketing and branding practices, and successful risk management procedures for entering foreign dairy markets [14]. Fonterra has identified its 12 most valuable brands as those listed in Table 7 [17]. Most of these brands were developed by the NZDB in collaboration with supplier cooperatives.

The decision to merge the Board with the New Zealand Dairy Group and Kiwi Cooperative was based, in part, on the following considerations:

- To some extent, the NZDB had come to be regarded as an unnecessary layer between foreign buyers and New Zealand's domestic processors. Moreover, New Zealand's big cooperatives had developed the ability to export dairy products on their own.
- While the Board had efficient procedures for allocating production orders for export sales with New Zealand's cooperatives, the NZDB was unable to optimize New Zealand's dairy export product mix when it operated separately from the cooperatives. Understandably, the cooperatives produced milk to further their own interests rather than those of the entire New Zealand dairy industry under the old structure.
- It was reasoned that coordination of industry activities throughout the value chain would be facilitated by merging the NZDB with the New Zealand Dairy Group and Kiwi Cooperative.
- Removal of the Board's monopoly exporting privilege was expected to facilitate new competition and new strategies in New Zealand's dairy industry.
- The Board's monopoly exporting privilege had been criticized by some members of the World Trade Organization.

In addition, New Zealand's government favored the merger of the two big cooperatives with the Dairy Board as a way to facilitate movement away from the producer board structure.

The 2001 Dairy Reform Legislation passed by New Zealand's parliament eliminated the monopoly exporting privilege enjoyed by the NZDB and included measures to protect consumers and independent processors from Fonterra's dominance. As part of the consumer protection package, the government indicated that Fonterra must sell NZ Dairy Foods to provide competition in the domestic market. To protect independent processors, Fonterra was required to sell up to 400 million liters of milk per season to independent processors at a default raw milk price. The default price is set retrospectively based on Fonterra's payout adjusted to remove the "bundled" dividend component.

Moreover, Fonterra's suppliers can sell up to 20 percent of their weekly production to other processors without penalty. While this provision is a potentially important safeguard for producers, it is unclear whether a Fonterra producer could actually sell 20 percent of his/her production to other processors without penalty. The near monopoly position of Fonterra as a milk buyer would seem to have a chilling effect on a producer's decision to divert part of his/her milk to another dairy processor if Fonterra did not favor this.

Fonterra retained a valuable aspect of the monopoly exporting privilege held by the NZDB. Specifically, the government awarded Fonterra the privilege of serving dairy product quota markets for six years after the end of the NZDB's monopoly exporting privilege [49]. These rights then will be phased out over the subsequent four years. The right to serve the US and EU quota markets, in particular, is a valuable asset that gives Fonterra preferred entry into these high-priced markets.

Elimination of the monopoly exporting privilege does present Fonterra with a challenge. In particular, foreign firms no longer will be precluded from integrating backward into New Zealand to acquire low-cost raw product. Of course, foreign firms could have integrated backward into New Zealand prior to the formation of Fonterra, but the integrators would have been required to export through the NZDB. The NZDB then could have extracted most, if not all, of the profits the integrator might secure from acquiring low-cost raw milk in New Zealand in return for performing the exporting function. This prospect removed most incentives for backward integration into New Zealand by foreign dairy firms. Mr. Jay Waldvogel, Chief Operating Officer of Fonterra, said that backward integration by foreign dairy firms into New Zealand is unlikely and will occur in the future only if Fonterra fails to perform as expected.

How has Fonterra Performed?

Fonterra's management did many things to successfully merge the New Zealand Dairy Group, Kiwi Cooperative, and the NZDB into the structure shown in Figure 22. A new management team representing the legacy firms was created. Duplication was eliminated. Staff was trimmed. Businesses of the cooperative were reorganized to create New Zealand Milk Products (NZMP) and New Zealand Milk and measures were taken to achieve synergies between the two units.

Figure 22. Fonterra's Structure

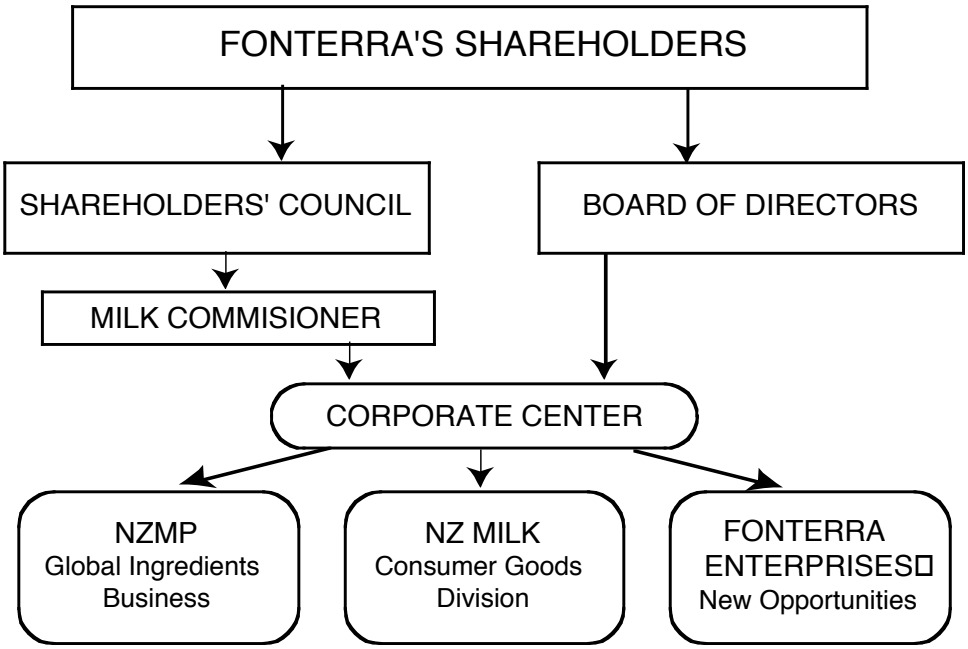


Table 8. Selected results achieved by Fonterra, 2001-02 and 2002-03*

Item	2001-02	2002-03	Difference
Net payout (NZ $/kg of milk solids)	$5.33	$3.60	-$1.73
Operating revenue (NZ$ billion)	$13.90	$12.50	-$1.40
New Zealand milk, EBIT (NZ$ million)	$302.00	$387.00	+$85.00
Annualized merger benefits delivered (NZ$ million)	$74.00	$206.00	+$132.00
Milk collected (billions of kg of milk solids)	1.11	1.148	+0.038

* Sources: Fonterra Annual Reports, 2001-02 [17] and 2002-03 [18]. Figures are for the year ending on May 31.

The characteristics and main functions of NZMP and New Zealand Milk are as follows:

- **NZMP**. This large dairy ingredients organization is the largest business within Fonterra. The scope of its operations includes milk collection from 12,600 producers, the manufacture and packaging of more than 1,000 product specifications, and the operation of a global supply chain linking production plants in New Zealand and offshore with customers in more than 100 markets worldwide. Among NZMP's customers are multinational marketers of consumer milk products, including Nestle, Kraft, and New Zealand Milk. NZMP had about 6,900 employees in 2001-2002.
- **New Zealand Milk**. This business is Fonterra's consumer goods business. New Zealand Milk has in its portfolio most of the 12 brands listed earlier in Table 7. The business operations of New Zealand Milk are in sales, marketing, and distribution. In addition, it owns and operates plants offshore—especially in Latin America and Asia—that pack bulk dairy and non-dairy products into branded consumer products.

The Shareholders Council represents an important component of Fonterra. This Council advises the Board of Directors and management. Elections to the Council are structured so that all geographic areas of Fonterra's milkshed are represented. It provides a valuable mechanism for communicating with producers in this large, newly formed cooperative. Massey University analysts interviewed by the authors indicated that the communication function provided by the Council is highly important since producers have expressed concerns that Fonterra's size might make it remote.

Fonterra completed a host of other tasks to achieve efficiencies and increase profits, e.g., sales functions in certain foreign markets were reorganized and a joint venture with Nestle was completed to extend the firm's international reach. But, as indicated in Table 8, sound efforts will not necessarily produce consistently hoped-for results.

It was obviously an important achievement to successfully merge the New Zealand Dairy Group, Kiwi Cooperative and the NZDB and deliver a substantial portion of the expected financial gains from the merger. Indeed, Fonterra by May 2003 had achieved some two-thirds of the total expected annual gains of NZ$310 million from the merger.

Moreover, a record payout to Fonterra's suppliers of NZ$5.33 per kg of milk solids was obtained for 2001-2002, the first partial year of Fonterra's operations. This payout reflected effects of strong international prices for dairy products and a relatively weak New Zealand dollar. For example, the New Zealand dollar traded for about US$.43 for June 2001-May 2002. Fonterra's exports, many of which were priced in US dollars in 2001-2002, provided high returns to the firm's farmer suppliers when converted to New Zealand dollars.

However, the end of record producer payouts was already evident in late 2002. International prices for manufactured dairy products had fallen sharply while the New Zealand dollar was strengthening. This reduced Fonterra's operating revenues by about 10 percent and the payout to farmers by a third to NZ$3.60 per kg of milk solids in 2002-2003 (Table 8). Fonterra's Board Chairman, Henry van der Heyden, explained the developments as follows [18]:

> The New Zealand dollar, which began the season at 48¢ to the US$, closed near 58¢. The impact of this variable alone eroded earnings by $850 million—the equivalent of 74¢ per kilogram of milk solids. This was partially offset in the year under review by hedging gains of $640 million—the equivalent of 56¢ per kilogram of milk solids. Global commodity prices were at their lowest in more than a decade for the first four months of the year. On average, commodity prices were 24 percent lower than in the previous year.

New Zealand Milk provided counter-cyclical benefits for the organization during this difficult period. This business, which produces and markets branded and other differentiated dairy items, recorded higher revenues for 2002-2003, partly because the business purchases bulk raw products at prevailing international prices but sells differentiated products into retail markets, which react less and more slowly to changes in international prices. This facilitated expanded sales by New Zealand Milk in 2002-2003, and partially offset the effects of lower prices obtained by NZMP for commodity exports.

While Fonterra's management appears to have delivered a suitable performance under difficult conditions, the organization was criticized by farmer suppliers and others for the sharp decline in producer payout for the 2002-2003 year. Many developments contributed to the decline in producer payout in 2002-2003. But, mostly it showed that, when international prices for dairy products fall and/or the New Zealand dollar strengthens, this has a harsh impact on Fonterra. This is a dilemma that has faced Fonterra's legacy firms for decades and one that those firms had attempted to remedy for years. For example, in 1989 Mr. Dryden Spring, then Chairman of the NZDB, said that the core strategy of the firm for dealing with the problem was to "lift the 30 or 40 percent of (New Zealand) milk which is sold as value-added (differentiated) products to as close to 100 percent as we can get as soon as possible [42]."

The strategy Dryden Spring describes has been difficult to implement in the face of New Zealand's increasing milk production. Production of milk solids in New Zealand approximately doubled from 1989-1990 to 2002-2003. A recent study commissioned by New Zealand Trade and Enterprise indicated that the value-added component for New Zealand dairy exports was about 35 percent [40]. Thus, New Zealand's dairy industry has kept the percentage of milk sold as differentiated products approximately constant while witnessing a doubling of milk production. It is remarkable that New Zealand's dairy industry could achieve such a result while witnessing about a 100 percent increase in milk production. However, it also underscores how difficult it will be for Fonterra to sell a substantially larger percentage of the milk supplied by Fonterra's members in the form of differentiated products, particularly if milk production continues to increase strongly.

Problems associated with Fonterra's dependence on commodities are indicated by the difference in payout between Tatua and Fonterra. Tatua, which produces highly differentiated dairy products, generated a payout for producer-suppliers of NZ$5.60 per kilogram of milk solids for 2002-2003, in sharp contrast with the NZ$3.60 paid to Fonterra suppliers [44, p.25]. One of Tatua's top officers said it was unfair to compare the payouts of Tatua and Fonterra because the two are very different businesses. However, the difference in payout does underscore the benefits for producers associated with being a supplier to a successful producer of differentiated dairy products.

In the wake of developments that produced the lower revenues and lower producer payout, Mr. Craig Norgate, Fonterra's first CEO, found that his contract would not be renewed by the cooperative. Mr. Andrew Ferrier, a former officer of Tate and Lyle, a major international sugar company, was hired as Fonterra's new CEO and assumed his duties in September 2003. Under Mr. Ferrier, additional restructuring aimed at achieving greater efficiencies, trimming of staff, and reorganizations has occurred. However, Andrew Ferrier said that the organization "was not badly broken" and accordingly avoided making sweeping changes [69].

Fonterra's Current Strategies

Fonterra in its 2002-2003 Annual Report indicated that it has adopted strategies that will concentrate efforts in seven areas to enable the firm to be:

1) The lowest cost supplier of commodity dairy products,
2) The leading price and inventory manager in the global market,
3) The leading specialty milk components innovator and solutions provider,
4) The leading consumer nutritional milks marketer,
5) The leading dairy marketer to foodservice in key markets,
6) An effective developer of dairy ingredient partnerships in selected markets,
7) An effective developer of integrated strategies for the four key regional markets of China, Eastern Europe, India, and the economic grouping of Chile, Brazil, and Argentina.

These strategies are based on an assessment of global market needs and seek to expand the value-added (differentiated product) component of Fonterra's output. With some variation, other large dairy firms with a global thrust could logically pursue these strategies. Fonterra's new CEO said that the seven basic strategies would continue to be pursued under his leadership.

These strategies are being pursued subject to two potentially conflicting constraints. Producer members of Fonterra wish to retain essentially complete control of the organization while achieving a revenue growth objective of 15 percent per year. As noted later in this paper, achieving these objectives simultaneously may be difficult over the longer run.

Strategies 1 and 2 in the list are part of being a low-cost producer. Fonterra and legacy firms have strong experience in these areas that should allow the firm to continue to excel in low-cost production and global marketing logistics.

Strategies 3, 4 and 5 are part of the effort to increase sales of differentiated dairy products. Excellent R&D capabilities and export marketing skills are needed to successfully pursue these strategies. As discussed elsewhere in the study, Fonterra has an integrated R&D system that should deliver successful new product development. Export marketing skills of legacy firms—especially those retained from the NZDB—should be useful for achieving additional sales of differentiated products in foreign markets. However, as noted earlier, Fonterra will find it challenging to expand the percentage of products sold in differentiated form if New Zealand's farmers continue to increase production strongly.

Fonterra will likely continue to secure the benefits of being a low-cost producer and a producer of differentiated dairy products. These important benefits are additive. Such additive benefits are not available to many major global dairy firms. For example, while many European giants in the dairy business are skilled in product differentiation, these firms do not have access to low-cost raw product.

Strategies 6 and 7, of course, have elements of the earlier-mentioned strategies built into them and could be discussed in connection with the other strategies. However, **Strategy 6**, *Effective developer of dairy ingredient partnerships in selected markets,* relates closely to partnerships with the US dairy industry and thus warrants special attention.

DairyAmerica. One of the more noteworthy partnerships under Strategy 6 is the NZMP-DairyAmerica agreement. In 2001, NZMP signed agreements with DairyAmerica to become the major exporter of US nonfat dry milk (NDM) [7]. DairyAmerica is an association of seven US producer-owned dairy cooperatives, namely: Dairy Farmers of America, California Dairies, Land O'Lakes, Agri-Mark, United Dairymen of Arizona, O-At-KA Milk Producers, and Maryland and Virginia Milk Producers.

DairyAmerica markets 100 percent of the milk powder produced by the member cooperatives. Under the NZMP-DairyAmerica agreement, NZMP receives a commission from DairyAmerica for NDM sold in export markets on behalf of the federated marketing company.

NZMP has unquestioned ability as an exporter of NDM. In most situations, NZMP should be able to secure nearly the highest available prices for DairyAmerica's NDM. Mr. Jay Waldvogel, Fonterra's Chief Operating Officer, added that the agreement is advantageous for DairyAmerica since it allows the US cooperatives to shift the job of exporting to Fonterra and to concentrate on doing what they do best—market dairy products in the US domestic market. The agreement appears to be a particularly favorable for Fonterra since it gives the cooperative greater control over world milk powder markets and prevents US NDM from undercutting prices in Fonterra's Asian markets in particular. In years past, New Zealand's dairy industry complained about losses of market to subsidized US exports of milk powder into Asia under the US's Dairy Export Incentive Program. Fonterra undoubtedly no longer suffers such loss of sales in its important Asian markets under the present agreement.

The arrangement could be a win-win proposition for both the US cooperatives and Fonterra. It appears to be an unambiguously good arrangement for Fonterra. It also may be a good arrangement for US cooperatives if they get good value for the commission they pay to Fonterra for handling NDM exports. Questions have been raised about whether the commission is too high given the benefits that the arrangement conveys to Fonterra.

DairiConcepts. Another prominent partnership between Fonterra and US-based companies is DairiConcepts, which was created by Fonterra's legacy organizations in 2000 and continued under Fonterra. The DairiConcepts joint venture is a 50-50 limited partnership between Dairy Farmers of America (DFA) and NZMP. This alliance combines DFA's manufacturing capacity with Fonterra's innovation and advanced R&D. DairiConcepts has manufactured cheese and other dairy ingredients for industrial customers, including McCormick, Nestle U.S.A., and Frito-Lay.

A prominent initiative under the DariConcept joint venture involves production of milk protein concentrate at a DFA plant in Portales, New Mexico. Mr. Craig Norgate, Fonterra's former CEO, described milk protein concentrate (MPC) production under the joint venture as follows [46]:

> The New Mexico plant will feature the first commercial production of milk protein concentrate in the United States. It will also produce other dairy ingredients for many market applications in the fastest growing food sector in the US—convenience foods.

Mr. Gary Hanman, DFA CEO, said that establishing a domestic source of high-end milk protein products is an important step for DFA's farmers, noting that [46]:

> Domestically produced MPC will offset imports now being used by many or our customers as an economic and efficient ingredient in the processing of many dairy-based food and beverage products. It is time for DFA members to share in the market of this valued ingredient and, ultimately, utilize more DFA-produced milk.

Both CEOs agreed that the expanded DairiConcepts relationship represented a key strategic move. The expansion of DairiConcepts to include MPC production in the US suggests that DFA has a high regard for Fonterra's R&D and technical prowess. DFA also appears to regard the domestic MPC production initiative as an important import substitution initiative.

Dairy Partners Americas (DPA) is a joint venture between Fonterra and Nestle in Brazil that went into operation on January 1, 2003. Agra Europe described plans for the joint venture as follows in 2002 [1]:

> The alliance…will operate in all countries of the America's and will cover branded chilled products, and liquid milk, ingredient milk powders and milk management. First year turnover will be in the region of US$1.4 billion and the alliance will have an initial staff of approximately 10,000. Fresh milk for the

> venture will be sourced in the America's and dairy ingredients from New Zealand. Joint venture companies will have access to brands of both companies. Fonterra's board was confident that the alliance was the best path forward to build Fonterra's position in the America's US$100 billion annual dairy market.

In a report issued later in 2002, the FAS-USDA Agricultural Counselor in Brazil described the plans and functions of DPA as follows [41]:

> The company will have its headquarters in Brazil, and will operate in Latin American countries. During 2003, DPA plans to operate only in Argentina, Brazil, and Venezuela, expanding later to Chile, Ecuador, Colombia, and the Caribbean Islands. In 2004, DPA plans to initiate sales to the NAFTA countries. DPA officials estimate sales of dairy products, mostly powdered milk, in the first year of operation at US$420 million. Nestle's seven milk plants in Brazil will serve as the production base for DPA.

DPA's plans have been scaled back and expansion has been delayed. But Fonterra's new CEO said the alliance was paying good dividends for the cooperative and regards DPA as a good way to gain fuller access to American dairy markets, especially for protein-based ingredients.

The material on the alliances suggests that Fonterra's strategies (and those of legacy firms) have expanded from orthodox efforts to increase exports of differentiated dairy products to a more nuanced strategy that also emphasizes profit seeking by applying the industry's management expertise in the dairy industries of other countries via alliances. The alliances carry the advantage of conserving capital. As noted earlier, Fonterra's ambitious expansion plans call for 15 percent per year revenue growth. It is unclear how the cooperative can raise the capital needed to finance such an expansion effort. However, using alliances rather than foreign direct investment will lessen the amount of capital required to reach such an objective.

The alliances will not eliminate the capital constraint, however. Achieving 15 percent growth per year will necessitate additional foreign direct investment and additional costly outlays for expanding the marketing of differentiated products. While Fonterra has an excellent reputation in international credit markets, it will at some point exhaust its borrowing capacity and need to explore other avenues for raising expansion capital. This will test whether New Zealand's dairy farmers can keep essentially complete control of the organization or whether they will need to tap additional equity markets and give up some control.

The seventh strategy—*Develop integrated strategies for China, Eastern Europe, India, and South America*—appears to involve getting ahead of competitors for serving these major growth markets. Fonterra already has a significant presence in Chile, Brazil, and Argentina, partly through the Dairy Partners America's joint venture with Nestle. Fonterra also has an initiative in India (through a joint venture with Brittania Industries) and has expanded sales in China. It is unclear how prominent Fonterra's involvement in Eastern Europe will be, although the area is likely to emerge as a growth market.

China is clearly an important market to Fonterra and other international food companies. Helmut Maucher, a former Nestle CEO, said the following about China's market [3]:

> In spite of free market reforms…China (continues to be) a difficult and uncertain place to do business. Yet, even with the risks, the potential gains are so great that no major food company can afford *not* to enter the market.

This consideration may provide a partial explanation for Fonterra's interest in China. Moreover, the experience of the NZDB in entering risky foreign markets successfully may give Fonterra a leg up on other companies planning to expand dairy product sales in China.

One of Fonterra's strategies—protecting access to the Australian market, which Fonterra considers to be part of its domestic market—fails to fit neatly into the categories

discussed above. As discussed later, Fonterra increased its ownership stake in Bonlac of Australia from 25 percent to 50 percent in 2003. This prevented competitor consolidation from jeopardizing Fonterra's strategic position in Australia. Among other things, it foreclosed the opportunity for a Bonlac-Murray Goulburn merger which would have controlled 80 percent of Australia's dairy exports and 50 percent of Australia's milk production. Fonterra has paid a price for consolidating its stake in the Australian market. Bonlac has been financially troubled and will require financial resources from Fonterra to deliver strong results.

Australia

The IBISWorld website describes Australia's dairy product manufacturing sector as a group of mature businesses that generally grow at the same rate as the Australian economy [56,57,58,59]. According to this same source, the capital/labor intensity is high in the sector and the uptake of new technology occurs at a medium rate.

Like dairy processors in New Zealand, Australia's milk processors have been affected recently by deregulation that has made Australia's dairy industry arguably the most deregulated in the world. Strategies of firms in the sector reflect this development, as seen in the growing international focus of the industry, and increasing concentration in the sector.

As Harvard Business strategy guru, Michael Porter, points out, "the essence of formulating competitive strategy is relating a company to its environment [38, p.3]." Adjustments to changes in the economic environment are evident in the strategies of Australian dairy processors.

The Closer Economic Relations (CER) Agreement

Australia's dairy processors first felt the strong impact of freer trade and associated deregulation as a result of the CER agreement reached by Australia and New Zealand in 1983. This agreement and its extensions produced essentially free trade in goods and services between the two countries. Australia's milk producers and processors initially feared that competition from New Zealand's low-cost industry under the CER would damage their industry. However, Australia's dairy farmers and milk processors became more efficient and adjusted reasonably well to new competition from New Zealand and became a stronger industry. Moreover, Australia's fluid milk businesses were protected to some extent from competition from New Zealand by distance and the high cost of shipping fluid milk products across the Tasman Sea to Australia.

The Deregulation of Australia's Industry

On June 30, 2000, Australia's government ended the country's Domestic Market Support (DMS) program for manufacturing milk producers and state market milk programs for fluid milk producers [15]. Under state pricing systems, Australian farmers had received prices for fluid milk during the 1990s that were approximately double those received by manufacturing milk producers. The higher fluid milk prices that existed prior to deregulation in mid-2000 were made possible in part by milk production quotas employed in New South Wales, Queensland, and Western Australia.

The DMS scheme, terminated in mid-2000, was a federal program that placed levies on all fluid milk sold domestically (paid by fluid milk producers) and all milk used to produce manufactured dairy products sold in Australia's domestic market (paid by processors). Proceeds from the levies were distributed to Australia's manufactured milk producers.

Victoria's powerful dairy groups spearheaded the end of government regulation of milk prices in Australia partly because:

- Dairy export markets were regarded as growth markets and Victoria's dairy groups believed they could be more

competitive in export markets if the DMS program was ended.

- Australia's dairy exports had increased from about 35 percent of production in the early 1990s to nearly 60 percent of production in 2002-2003 [48, p.10]. Hence, the reason for the belief that dairy exports were a growth market.
- State milk control practices had prevented or discouraged Victoria's dairy industry from selling fluid milk in other states.

Producers in market milk states (Queensland, New South Wales, South Australia, and Western Australia) were powerless to resist deregulation, mainly because Victoria's producer organizations (representing nearly two-thirds of the milk produced in Australia) presented them with an offer that was difficult to refuse: either accept deregulation of state market milk pricing with compensation for farmers or get deregulation without compensation.

A restructuring package was made available to Australian milk producers after deregulation that helped them adjust to unregulated markets. The funds needed to finance the restructuring package were provided by an AU$0.11 per liter government levy on all fluid milk products (including imported items) sold in Australia's domestic market. Restructuring payments were approved for farmers amounting to about AU$0.46 per liter for producers of fluid milk and about AU$0.09 per liter for manufacturing milk produced in the 1998-99 base year. These payments were to be made quarterly for eight years, beginning in mid-2000. It was estimated that the average milk producer in the relatively high fluid milk utilization state of Queensland would receive about AU$110,000 to help him/her adjust to a deregulated industry.

The Australian Dairy Council negotiated with banks to establish an industry facility that permitted an individual farmer to obtain the discounted present value of his/her quarterly payments as an upfront payment regardless of whether the farmer planned to continue farming or leave the industry. Many considered upfront payments to be more valuable to dairy farmers than quarterly payments stretched out over eight years for buying land, remodeling milking facilities, and making other adjustments needed to operate in a deregulated environment.

Market prices for fluid milk were set by commercial negotiations after deregulation. Market prices for manufacturing milk after deregulation continued to be heavily influenced by dairy product prices in international markets. It was widely anticipated that milk production would concentrate on larger farms in low-cost product areas and that the number of dairy farms would decline by 25 to 30 percent after deregulation.

Ian Langdon, Chairman of the Dairy Farmers Group, reported the following impact of deregulation on milk production in market milk (fluid milk) states [27, p.3]:

> Deregulation of the market milk farm gate price from July 1st 2000 resulted in a 12 percent decline of milk production in Queensland for the two year period to June 30th, 2002, a four percent decline in New South Wales with South Australian milk production remaining unchanged.
>
> …ADC (Australian Dairy Corporation) statistics indicate an approximate 25 percent reduction in the number of dairy farms in each of New South Wales and Queensland compared to a seven percent reduction in combined milk production. In the same two-year period there was a 20 percent reduction in dairy farms in South Australia that maintained a constant volume of milk.

These statistics are not surprising. They mainly suggest that the farmers remaining in business after deregulation focused on getting bigger and more efficient.

After noting that small differences in farmgate prices in the different states are to be expected, Langdon commented as follows about the impact of deregulation on farm milk prices [27, p.7]:

> In the year prior to deregulation the blended price in New South Wales and Queensland was approximately 50 to 60 percent higher than Victorian prices…In the

> first two years after deregulation the blended average prices in all three states (New South Wales, Queensland, and Victoria) were approximately equal as Victorian prices rose quickly in line with international commodity prices and northern prices fell.
>
> In the current year (2003) milk prices for the Northern States are approximately 23 percent higher than Victorian prices and South Australian prices approximately 17 percent higher."…Milk price expectations in the future must be that they will progressively move into alignment with Victorian prices but with less volatility and a small premium due to the lower seasonality. Current (positive) gaps of up to seven cents per liter are not sustainable.

Australia's Bureau of Agricultural and Resource Economics reported in 2004 that deregulation had produced lower consumer prices and lower supermarket profit margins on milk, as follows [ABARE 2004]:

> Following deregulation in July 2000, the Australian Competition Consumer Commission report into retail milk prices found that lower farmgate prices for milk were being passed on to consumers through lower retail milk prices, and that the profit margins of supermarkets on milk products had fallen by 19 percent following industry deregulation with lower retail milk prices still benefiting consumers.

Mr. Max Ould, Managing Director of National Foods, commented as follows regarding the impact of deregulation on consumer prices [37]:

> Australian consumers of fresh liquid milk have noticeably been the winners following deregulation where they are now paying an average of 6 cents per liter less than they were three years ago and this is after contributing to the…levy of 11 cents per liter.

The impact of deregulation on Australia's dairy processing sector is difficult to separate completely from the effects of the severe drought in 2003 and problems associated with the high value of the Australian dollar in 2004. But some strategic responses by processors are apparent.

In the lead-up to deregulation and the uncertainty that it created regarding the availability of milk supplies, some processors shifted production of manufactured dairy products to Victoria or areas bordering Victoria. In addition, deregulation appears to have limited processors' investments in the Northern States mostly to fluid milk processing and distribution facilities [27].

Langdon indicated in 2003 that, with the exception of investments made by Dairy Farmers Cooperative, there has been little investment in milk manufacturing in Northern New South Wales and Queensland during the past decade, describing the situation as follows [27, p.5]:

> Taking Queensland as an example the only investment in manufactured products has been by the Dairy Farmers Group, which has invested AU$54.5 million during the past five years, 60 percent of this investment has been in cheese processing, the balance in liquid milk. For the current 2002-2003 year, the cooperative will produce approximately 22,000 tons of cheese, mainly mozzarella in Queensland.
>
> The importance of these statistics is that without a manufacturing product base there will be no opportunity of on-farm production growth for Queensland or Central and Northern New South Wales farmers. Without such an option then there would be no opportunity for farmers to improve their efficiencies as required in the deregulated environment.

Langdon's main observations are noteworthy. He indicates that (a) differentials for fluid milk of as much as AU$0.07 per liter in the former fluid milk states over the Victoria farm gate prices are not sustainable over the long-run and (b) the only real options for on-farm growth and increased efficiencies in the former fluid milk states in the deregulated environment reside with production for an expanded manufacturing milk product sector.

Mr. Max Ould, Managing Director of National Foods, described problems that milk processors have encountered as a result of deregulation, as follows [37]:

> Processors by and large have not fared as well (as producers under deregulation). Although total revenues are up about 15 percent over the past three years, cash earnings are down three percent. This can be fundamentally attributed to higher milk costs being paid by the processor sector to farmers (16 percent more) and ***the inability to raise wholesale prices in a deflationary domestic environment*** (emphasis supplied). Debt increased by almost 50 percent in this same period as reinvestments continue by the processors seeking greater efficiency and operational capabilities…
>
> Had pricing just kept pace with inflation we would have been receiving more than 20 cents per liter additional—what a difference that would have made to the industry.

Ould's comments describe the effects of deregulation on returns to fluid milk processors rather than specialized producers of manufactured dairy products. Economic returns to the latter group would be heavily influenced by prices in international markets rather than profit squeezes in the domestic market. However, Ould's comments suggest that specialized fluid milk processors have encountered difficult times under deregulation and that they may find it advisable to diversify into production of manufactured dairy products, as suggested by Langdon.

Other Adjustment Strategies

Other strategic adjustments made by Australia's milk processors include those made to deal effectively with large supermarkets (e.g., Coles and Woolworths) and powerful foreign customers. The market power needed to effectively deal with large customers is more readily available to processors with scale, strong brands, and national (and frequently international) processing, distribution, and logistics capabilities.

Murray Goulburn has developed important efficiencies and capabilities in R&D, processing, and exporting. The firm with its 2,200 employees exports dairy products to over 100 countries and accounts for about eight percent of world dairy trade. This compares to Fonterra's use of 20,000 employees to achieve about a 36 percent share of the world dairy trade. Thus, Murray Goulburn employs 275 employees for each percentage of the world dairy trade while Fonterra employs about 555 employees for each percentage point of world dairy trade. This comparison of course is rough and does not take into account important differences in the nature of the two businesses. However, the size of the difference in labor use revealed by the comparison raises questions about the efficiency of labor employed in the exporting businesses by Fonterra.

Fonterra's decision announced in May 2004 to cut 700 staff as part of a long-term strategy will reduce—to about 536—the amount of labor employed by the firm for each percentage point of world exports [71]. The staff cut will produce only a modest change and questions will remain regarding the efficiency of Fonterra's labor deployment.

Dairy Farmers Cooperative has begun to diversify more aggressively into production of manufactured dairy products. In addition, as indicated earlier, the firm has expressed an interest in buying the Australian assets of Parmalat. Dairy Farmers has good strategic reasons for the diversification and interest in purchasing the Parmalat's Australian fluid milk business. However, Dairy Farmers has found it difficult to obtain the capital needed for such ambitious endeavors. Accordingly, the cooperative's management has sought to persuade member-producers to convert the cooperative into a public limited company and sell publicly-traded shares. At this writing, it was unclear whether this effort to raise additional capital will succeed.

VI. Concluding Observations

Farm Production Sector

Our overall impression of the New Zealand and Australia dairy production sectors is that New Zealand is and will remain largely a "pure" grass-clover based grazing industry. Their system will continue to be characterized by seasonal calving and only limited, strategic use of low-cost forage supplements. Supplementation is generally designed to offset shortages of grass that occur in summer due to dry conditions and in winter due to short days and cool weather.

New Zealand's strategic use of forages also involves economics. Implicitly or explicitly, New Zealand dairy farmers adhere closely to the profit-maximizing principle of equating marginal revenue and marginal cost. When milk solids prices increase (marginal revenue increases), farmers respond by increasing their use of corn silage to boost production (marginal cost increases). When times get tight and prices fall, they move back down their marginal cost curve, cutting supplementation and reducing stocking rates and returning to more or less pure grazing.

Options in Australia are more complex and their ability to use more varied supplementation strategies (of forages and concentrates) for their pasture-based system is greater due largely to lower domestic prices for grains.

Milk prices are not subsidized or regulated *per se* in either country. With its small population and large milk supply, New Zealand relies almost completely on export sales for its dairy revenue. Australia has a larger domestic market and regional specialization between producing milk for domestic use and milk for manufacturing export products. With deregulation, it will be interesting to observe how regional patterns of milk production will shift in response to different fluid and manufacturing needs.

Both New Zealand and Australia would benefit substantially from liberalization of international trade in dairy products. However, we do not anticipate that either export subsidies or border protection will decline dramatically over the next several years. Consequently, we expect that growth in milk production in both New Zealand and Australia will be moderate.

New Zealand and Australia dairy farmers invest more heavily in farm-level research than their US counterparts. This is partly because public funds for such research are more limited than in the US, especially at the university level.

Interest and experience in grazing has increased markedly in Wisconsin and other states. Adoption of some Oceania dairy production practices has proven to be feasible and profitable. But pastoral dairying as practiced in Oceania cannot be replicated in Wisconsin because of differences in climate. And, even if it could, differences in milk prices and high-energy feed prices suggest other production systems may be more profitable.

Processing Sector

Wisconsin dairy industry and dairy industries in other states have to deal with the following questions pertaining to the manufacturing sectors in New Zealand and Australia:

- **Can Wisconsin processors compete on a price basis with high-volume, shelf-stable commodities produced in Australia and New Zealand?** It is unlikely that Wisconsin can do so because of differences in milk prices and the efficiencies of manufacturing in New Zealand and Australia. The California dairy industry may be able to do so, but marketing becomes an obstacle because both large and medium-sized cooperatives in New Zealand and Australia are establishing or have established marketing agencies and co-ventures in most important importing countries and regions.

- **Can these industries compete in the exporting of specialty dairy products?** This is a better possibility for Wisconsin and some regions of the US but price is still a factor. Sufficient research and development is essential to develop such products and to maintain consistent quality. Both New Zealand and Australia have made substantial investments in dairy research, considering the volume of milk produced in each country. These investments are continuing with reorganization and consolidation of research activities, presumably to make the research investments more productive and to enhance the application of the research.
- **What are the limitations faced by New Zealand and Australia to export dairy products?** As discussed in the section of the report on milk production, there are limitations to the increases that can occur in each country. If milk product consumption can be increased world-wide or in a number of regions of the world, other exporters have an obvious opportunity. The other limitation faced by New Zealand and Australia is uneven production of milk products over time. This creates the need to produce products with sufficient shelf stability or to impart that stability by processing. The U.S dairy industry might evaluate the potential for products that have limited stability but can be provided uniformly throughout the season from the US. This would reduce the cost and impact of processing to impart sufficient stability. Seasonality of production also creates variations in composition and characteristics of milk. Considerable research has been done in Oceania and Ireland to eliminate or minimize those limitations. This may provide some openings for products or product characteristics from US milk that has more consistent composition and characteristics.

Strategic Behavior

Fonterra, New Zealand's dominant dairy processing and exporting firm, appears to have adjusted well to the environment that it faces. The firm's strategies take advantage of the its access to low cost raw product and capitalize on the experience gained by one of its legacy firms, the NZDB, in export markets. The firm's overall strategies are more nuanced than in the past, when heavy reliance was placed on expanding exports of differentiated products. The nuanced strategy recognizes that it is difficult for the firm to increase the percentage of exports sold as differentiated products when New Zealand's milk production increases strongly.

Fonterra has achieved diversification via several avenues, which will reduce risks facing the firm and enhance revenues. Its exports are spread across more than 100 countries. It also has diversified its revenue sources to include funds from joint ventures and other alliances in foreign markets and agreements with processors in foreign markets. The alliances with firms such as Nestle of Switzerland and DFA in the US have helped the firm gain access to foreign markets that would otherwise be unavailable or prohibitively expensive to serve with conventional dairy exports. In addition, the alliances permit the firm to gain revenues from sale of its technical expertise to alliance partners; tariffs or non-tariff barriers do not limit such expertise.

The alliances entered into by Fonterra carry an additional benefit for the firm. Fonterra has come to be recognized as a more dependable supplier for multinational firms such as Kraft because Fonterra can access product from multiple sources. Thus, if product desired by a multinational is not available from New Zealand sources, Fonterra may be able to access the product from an alliance partner such as DFA. Fonterra officials reported that this is an important strength associated with alliances.

Murray Goulburn officials in Australia raised questions about the efficiency of labor use by Fonterra. It was noted earlier that Fonterra employs about 20,000 people in New Zealand and its foreign operations. Murray Goulburn employs only about 2,200 people and appears to have achieved a substantially higher export total per employee than Fonterra. While Murray Goulburn and

Fonterra are substantially different businesses and Fonterra plans to ultimately cut its employment by 700, the difference between the two firms in world exports per employee raises questions about whether Fonterra has excess capacity in its exporting operations.

Fonterra, of course, faces many of the same challenges being encountered by other dairy exporters. The difficulties that arise when the country's currency increases sharply in value relative to the US dollar were noted at length in the report. Fonterra has technical skills to hedge against currency losses, but the protection provided by hedging is not complete. As a small country with finite foreign currency reserves and constraints on interest rate policy, there is also relatively little that New Zealand's government can do to remedy this problem.

Capital constraints appear likely to be the most difficult challenge facing Fonterra over the longer-run. The firm has an excellent reputation in international credit markets that enables the firm to obtain debt capital and other capital in international credit markets at reasonable interest rates. However, the amount of capital available from such sources is likely to limit the ability of the firm to achieve its ambitious revenue growth objectives (around 15 percent per year) in future years.

Like members of farmer cooperatives in the US and many other countries, Fonterra's farmer members are reluctant to convert the firm into a cooperative/public limited company in order to raise additional capital. Such a conversion would place some control of the firm in the hands of non-farm investors. This is a distasteful prospect for Fonterra's member suppliers. Fonterra's management, of course, is keenly aware of this preference of farmer suppliers and the firm has attempted to conserve capital by practices such as entering into foreign alliances that consume less capital than foreign direct investment. However, gaining needed expansion capital is likely to be an important problem for the firm in the not-too-distant future.

There is a widely held view that the Australian and New Zealand dairy processing industries will become more closely integrated in the future. This might occur primarily through additional acquisitions by Fonterra in Australia's dairy industry. As noted earlier, Fonterra already has a 50 percent equity interest in Bonlac Foods. Fonterra also has 100 percent ownership of Australasian Food Holdings, consisting of Peters & Browns, Mainland Cheese, and Bonland Foods [27, p.2]. There was speculation in 2003 that Fonterra would seek to expand its ownership share in National Foods beyond the 18 percent presently held by the cooperative [36]. This development failed to materialize. Such acquisitions by Fonterra may occur if the firm can find ways of obtaining additional expansion capital.

Multinationals, including Nestle, Kraft and Danone, have established dairy businesses in Australia. The strong brands and other product differentiation efforts of these companies will provide vigorous competition for Australian cooperatives. If the cooperatives choose to engage in head-to-head competition with these firms, they will need to put additional resources into R&D and product differentiation.

Australia's dairy processors face challenges encountered by processors located elsewhere in the world and at least one challenge that is unique to Australia. This challenge relates to maintaining a milk supply in the face of drought conditions of the type witnessed in 2002 and 2003. As noted elsewhere in the study, irrigation water for the dairy industry is likely to become increasingly costly as other agricultural and urban uses compete vigorously for available water supplies. This may limit milk throughput for Australian processors and produce reductions in revenue of the type experienced by Murray Goulburn during the drought of 2002-2003.

Australian cooperatives, which process about 75 percent of the milk in Australia, face another challenge that is not unique to Australia. Cooperatives find it difficult to raise the capital needed to compete effectively against proprietary firms that have access to

equity capital in the share markets. This point is underscored by the situation facing Dairy Farmers Cooperative, which needs additional capital to expand the firm's manufacturing capacity and possibly compete for Parmalat's fluid milk business in Australia. Farmer members of Australia's dairy cooperatives will find it necessary to grapple with the question of whether to convert their cooperatives to public limited companies in order to acquire additional capital in the process and give up some control of the cooperatives that this action would entail. The cooperatives, of course, have other options for obtaining capital, but those options may not produce the capital required for operating in the environment facing Australia's dairy processors.

REFERENCES

Note: The references listed below comprise a comprehensive listing of formal publications, special reports and presentations, and web sites used by the study team in drafting this report. Text references are selective and do not include all of the materials listed.

Print Publications

1. Agra Europe, Dairy Markets, "Nestle, Fonterra Formally Establish America's Alliance," March 28, 2002, p. 3.
2. Agripress, "Danone's Australia Move Stirs Dairy Buzz," March 3, 2004.
3. Ashcroft, E., "Nestle and the Twenty-First Century," Harvard Business School Case No. 9-596-074, March 18, 1996.
4. Australian Bureau of Agriculture and Resource Economics [ABARE], Australian Commodity Statistics, 2003.
5. Australian Bureau of Agricultural and Resource Economics [ABARE], Australian Farm Surveys Report, 2003.
6. Australian Department of Agriculture, Forestry and Fisheries, Australian Dairy Regulation, Document prepared for Visit By USDA Deputy Secretary Jim Mosely, February 5-10, 2004.
7. Curran, C., "Dairy Discussion Group Analysis of DairyAmerica," January 29, 2002, Madison, Wisconsin.
8. Dairy Australia, Australian Dairy Industry in Focus 2003, December 2003.
9. Dairy Australia, Strategic Plan, 2004-09, December 2003.
10. The DairyAustralian, "Partnerships, Innovation Drive Export Success," International Edition, December 2003.
11. Department of Natural Resources & Environment, Agriculture Victoria-Ellinbank. 2000-2001 Review, 2002.
12. Dexcel, Economic Survey of New Zealand Dairy Farmers, 2001-2002. 2003: Hamilton.
13. Dann, L., "Westland Beats Fonterra Payout to Farmers for Third Years," The New Zealand Herald, December 19, 2003.
14. Dobson, W., "The Competitive Strategy of the New Zealand Dairy Board," Agribusiness—An International Journal, 6(1990): 541-558.
15. Dobson, W.D. and J. Wagner, "The Deregulation and Rationalization of Australia's Dairy Industry—Implications for the U.S. and World Dairy Industries," Babcock Institute Discussion Paper No. 2000-3.
16. Eurofood, "NZDB, Bonlac Foods of Australia to Join Forces," May 11, 2000.
17. Fonterra Cooperative Group, Annual Report, 2001-2002.
18. Fonterra Cooperative Group, Annual Report, 2002-2003.
19. Gale, J. "National Foods Courts Parmalat Unit," International Herald Tribune, December 11, 2003.
20. Goldberg, R.A. and J. M. Porraz, "Fonterra: Taking on the Dairy World," Harvard Business School Case N2-903-413, September 2, 2002.
21. Global Insight, U.S. Executive Summary, January 2004.
22. Holmes, C.W., I.M. Brookes, D.J. Garrick, D.D.S. Mackenzie, T.J. Parkinson and G.F. Wilson, Milk Production from Pasture: Principles and Practices, Massey University, Palmerston North.
23. Holmes. C.W., Low Cost Production of Milk from Grazed Pastures, Massey University, Palmerston North.

24. James, Brad, Dale Ashton and John Hogan, "Dairy Outlook to 2008-09," Australian Bureau of Agriculture and Resource Economics [ABARE], Australian Commodities 11:1, March 2004.

25. Journal of Agric. & Food Chem., Vol. 50, pp. 7187-7193, 2002.

26. Keeling, R., "Fonterra Ups Bonlac Stake," Rural News, June 9, 2003.

27. Langdon, I., "Pathways to Growth in Dairying: Dairy Farmers Group Perspective," Outlook Speakers Papers, 2003, Abareconomics.

28. Livestock Improvement Corporation Limited [LIC], Dairy Statistics 2002-03.

29. Lloyd, P.J., "An Australia/US Free Trade Agreement—Opportunities and Challenges, CER Lessons," Address presented at Australian APEC Studies Centre, Canberra, June 21, 2001.

30. Macfarlane, I.F., "Economic Opportunities and Risks over the Coming Decades," Reserve Bank of Australia Bulletin, December 2003.

31. MG Nutritionals, Murray Goulburn Co-operative Co. Limited.

32. Murphy, Chris, On-farm update, Presentation to UW-Madison Study Group, Dairy Australia, February 16, 2004.

33. Murray Goulburn Co-operative Co. Limited, Facts at a Glance 2001/02.

34. Murray Goulburn Co-operative Co. Limited, 53rd Annual Report, 2003.

35. National Foods Limited Concise Annual Report 2000.

36. New Zealand Herald, "Fonterra Dismisses Takeover Speculation," October 2, 2003.

37. Ould, M., "Drivers of Change in the Australian Dairy Industry," Outlook Speakers Papers, 2003, Abareconomics.

38. Porter, M.E., Competitive Strategy—Techniques for Analyzing Industries and Competitors, The Free Press, New York, 1980.

39. Rosenbloom, D., and S. Koops, New Zealand Agricultural Situation, April-May 2003, GAIN Report #NZ3011, 6/25/2003.

40. Rosenbloom, D. and S. Koops, "New Zealand Dairy and Products Annual, 2003," FAS-USDA GAIN Report No. NZ3019, 9/29/2003.

41. Silva, J.F. and W.W. Westman, "Brazil Dairy and Products Annual 2002, "FAS-USDA GAIN Report #BR2614, 10/25/2002.

42. Spring, D., Statement Made at Dairy Industry Toward 2000 Conference in Hamilton, New Zealand in August 1989, reported in Agra Europe, September 1, 1989.

43. Steer, John. Manufacturing R&D, Presentation to UW-Madison Study Group, Dairy Australia, February 16, 2004.

44. SONZAF 2003, Ministry of Agriculture and Forestry, Situation and Outlook for New Zealand Agriculture and Forestry.

45. Transparency International, Corruption Perceptions Index, 2003.

46. Weidner, J., "DFA, Fonterra to Produce Milk Protein Concentrate in Portales, New Mexico," Dairy Farmers of America News Release, March 1, 2002.

47. Wharton, Tony, and Gillian Mangin, Joint presentation to UW-Madison Study Group. New Zealand Ministry of Agriculture and Forestry, February 13, 2004.

48. Wilson, Peter, The Australian Dairy Industry – A Market-Driven Industry, Presentation to UW-Madison Study Group, Dairy Australia, February 16, 2004.

49. Young, D. and S. Benson, "New Zealand Dairy and Products, Dairy Mega-Merger Approved," FAS-USDA GAIN Report #NZ1027, Jan. 19, 2001.

Web sites

50. The Age, "Bonlac Vote Becomes a Survival Test," September 1, 2003, www.theage.com.au/articles/2003.html
51 Center for Dairy Profitability, University of Wisconsin-Madison, cdp.wisc.edu/AgFA.htm
52. Dairy Australia, www.dairyaustralia.com.au/template_home.asp
53. Dairy Good, Research, www.dairy.com.au/research/index.html
54. Fonterra, www.fonterra.com/default.jsp
55. Fonterra, Research and Development, www.fonterra.com/content/aboutfonterra/whatwedo/default.jsp#
56. IBISWorld, Dairy Product Manufacturing (Australia), Industry Conditions, www.business.channel.vic.gov.au/web/bc/bcnis.nsf/industries/C2129
57. IBISWorld, Kraft Foods Australia Limited, Industried of Involvement, www.ibisworld.com.au/enterprise.detail.asp?enterprise_id=4403
58. IBISWorld, Nestle Austalia Ltd., Company Details, www.seek.co.nz/if.asp?loc=ibis
59. IBISWorld, Nestle Australia Ltd., Company Details, Industries of Involvement, www.ibisworld.com.au/car/detail.asp?enterprise_id=807
60. Kraft, Career Opportunities, test.stagingkraft.de/aboutUs/index.cfm?Page=career
61. OANDA, www.oanda.com/convert/fxhistory
62. PROFILE, Nestle SA (Switzerland), www.mind-advertising.com/ch/nestle_ch.htm
63. Tatua Dairy Cooperative Company Ltd, www.tatua.com
64. United States Central Intelligence Agency, The World Factbook, 2003, www.cia.gov/cia/publications/factbook/geos/as.html
65. Westland Milk Products, www.westland.co.nz
66. www.dairyfarmers.com.au/internet/s05_aboutus/aboutus.jsp
67. www.dairyfarmers.com.au/internet/s05_aboutus/milkquantities.jsp
68. www.dairyfarmers.com.au/internet/s05_aboutus/compstructure.jsp
69. www.stuff.co.nz (October 30, 2003)
70. www.stuff.co.nz/stuff.html. "Australian Dairy Farmers Co-op Starts Down IPO Path," March 5, 2004.
71. www.stuff.co.nz, (May 4, 2004).