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STRUCTURAL ADJUSTMENT IN
DAIRYING IN THE MANASATU

A thesis presented in partial fulfilment of
the requirements for the degree of
Master of Agricultural Science in
Agricultural Economics

at

Massey University

M.J. FOUNTAINE

1972

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- (i) The references for the tables and for the text are independent, e.g. where Ibid. appears in a table reference, it refers to a previous table reference.
- (ii) The signs listed below have been used throughout the thesis and have the following interpretation:
- $<$ less than
 - $\leq$ less than or equal to
 - $>$ greater than
 - $\geq$ greater than or equal to

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CHAPTER I

A BACKGROUND TO THE STUDY

1.1 INTRODUCTION

The United Kingdom (U.K.) market has traditionally been a prosperous, continuous and major market for New Zealand's dairy exports.

Prior to the 1972 Luxembourg Agreement, New Zealand (N.Z.) exported approximately 62 per cent (by value) of its total dairy exports to the United Kingdom. Under the Luxembourg Agreement however, N.Z. dairy products sold to the U.K. will decline as from 1973. The reduction in dairy exports to the U.K. will occur gradually over a number of years, in such a way that the quantitative guarantees will be reduced in fixed amounts for the first five years. Thus the guaranteed quantity of butter will be reduced by the same percentage each year, and the guaranteed quantity of cheese will be reduced to 90 per cent, 80 per cent, 60 per cent, 40 per cent and 20 per cent in 1973, 1974, 1975, 1976 and 1977 respectively. From 1978 onwards, no further quantitative guarantee will be laid down for cheese.

In 1977 the quantitative guarantee admitted for N.Z. dairy products will be 80 per cent of the quantities guaranteed before the transitional period for butter and 20 per cent for cheese. This represents, expressed as milk equivalents,¹ 71 per cent of the quantities guaranteed under the U.K. quota system, before the commencement of the transitional period.

Although provision has been made for an upward revision of the above figures in 1975; it would seem unlikely that N.Z.

1 A milk equivalent is defined as being that volume of raw milk required to produce a unit weight of product. (e.g. cheese, butter, etc.)

can expect to export any more dairy products to an enlarged European Economic Community (E.E.C.), than laid down by the above guarantees. Consequently N.Z. will have to find new markets for approximately 36,000 tons of butter and 76,000 tons of cheese. (Plus of course for any additional increase in the quantity available for export).¹

Apprehension as to future market availability of milk products is further heightened because of dumping by overseas competitors. Despite the undertaking of the E.E.C. Member Countries not to frustrate the efforts of N.Z. to diversify her dairy products to other markets, there is already evidence to the contrary. At the 1972 Dominion Dairy Conference the chairman of the N.Z. Dairy Board, Mr. F.L. Onion said:

In the first half of this year [1972], under the influence of higher levels of price support, milk production in the EEC has increased and EEC butter stocks have risen to something approaching 100,000 tons above normal levels. The EEC has recently shown a disposition again to seek a solution to their domestic surplus problems by exporting them to our markets.²

The N.Z. dairy industry, confronted with having to procure new markets (and the lower prices associated with these markets - compared with the U.K.) also has problems arising from conditions prevailing within N.Z.

For the years 1966-67 to 1968-69 the proportion of dairy farms earning a net farm income (N.F.I.)³ of less than \$2,000 increased from nine to fifteen per cent as table 1.1 shows.

1 For a more detailed analysis see: R.W. Cartwright, Projections of Requirements for New Dairy Export Outlets 1970/71 - 1977/78, Commodity Report No. 1 Market Research Centre, Massey University, Palmerston North: August, 1971.

2 "Mr Onion warns on Post-EEC Trading," Manawatu Evening Standard, (Palmerston North), June 29, 1972, p. 3.

3 Where N.F.I. is defined as: Total farm income less total expenses. (For details see appendix 1 of footnote a, table 1.1).

TABLE 1.1 Percentage of Dairy Farms with Net Farm
Incomes of Less Than \$2,000 per annum ^a

Year	Net Loss	\$0-999	\$1000-1999	Total < \$2000
	%	%	%	%
1966-67	1	1	7	9
1967-68	1	3	8	12
1968-69	1	3	11	15

^a New Zealand Dairy Board, Farm Production Division. A Survey of the Economic Structure of Factory Supply Dairy Farms in N.Z. in 1968-69. Vol. VI, Wellington: August, 1971, p. 31.

Besides there being an increasing proportion of dairy farms returning a N.F.I. of less than \$2,000, for the season 1970-71, the real average net farm income per dairy farm was smaller than at any time since at least 1963-64. This fact is partially a result of the carry over effects of the drought experienced in the 1969-70 season. However, the fact still remains that since 1966-67 the real average net farm income per dairy farm, despite large increases in productivity, have, with the exception of the 1969-70 season, decreased at successively faster rates. (For details see appendix A). The present problem is that the average rate of productivity has not kept pace with present rates of internal inflation and lower market returns. Farm incomes, as a consequence, have dropped at a faster rate than that at which the necessary adjustments can take place. Further evidence of the relatively worse position of dairy farmers compared with a few years ago is shown by the terms of exchange in Table 1.2.

Table 1.2 indicates that prices received for produce have increased at a slower rate than prices paid for farm inputs, and that the terms of exchange, as a consequence, have (with the exception of 1969-70) deteriorated. The resultant

TABLE 1.2

Dairy Farmers' Terms of Exchange^a

(Base 1960-61 = 1,000)

Year	Prices Received	Prices paid	Terms of exchange
1965-66	1,104	1,071	1,031
1966-67	1,119	1,106	1,012
1967-68	1,102	1,149	959
1968-69	1,097	1,170	938
1969-70	1,202*	1,250	962

a Agricultural Production Council, Report on the Economic Position of the Farming Industry.
 Prepared by Economic Working Party, Wellington:
 April, 1971, p. 37.

* Estimated

effect of this cost-price squeeze is even greater than at first appears when allowance is made for the effect of inflation on the farmers' net income. Given persistent inflation it is necessary for the farmer to have a larger net income (in money terms) to represent the same purchasing power and standard of living. To do this in the face of the cost-price squeeze and inflation, he must become more efficient and/or operate on an increasing scale.

To the extent that farm expenditure on improvements is a function of disposable income; then, should present conditions prevail, capital investment in dairying will continue to remain static, or, as in more recent years, decline. See Table 1.3.

Separate data for dairying for 1969-70 in Table 1.3 is not available but the aggregate capital expenditure in N.Z. agriculture for that year was only \$39m.¹ Undoubtedly the drought influenced the capital expenditure in 1969-70 but it is reasonable to suppose that the capital expenditure for dairying alone, in 1969-70 and 1970-71, was below that for the 1968-69

1 "Farmers Attack Minister," Manawatu Evening Standard, February 19, 1971, p. 3.

TABLE 1.3Capital Expenditure on
N.Z. Dairy Farms (\$m.)^a

Year	Capital expenditure (\$m.)
1965-66	38.2
1966-67	38.4
1967-68	38.9
1968-69	32.7

a (Same reference as for table 1.2),
p. 52.

season. Such a shortfall in capital expenditure affects development. This in turn accentuates the effect of adverse seasonal conditions, and the ability to withstand lower market prices for milk products.

Given market uncertainty and the parlous state of the dairy industry in N.Z. (even before the effects of the United Kingdom joining the E.E.C. have been felt), attention naturally focusses on policies that will assist the N.Z. dairy industry to remain a viable and prosperous industry in the future.

The circumstances in recent years have precipitated the Government of the day to implement relief measures, despite large increases in productivity. Mr. Pickering, the then assistant to the Finance Minister, enumerates some of the widely distributed measures of assistance (subsidies), which appear in many different guises, given by the Government to the agricultural industry since 1968.¹ Some of the more recent and important of these measures were:-

(1) A uniform fertilizer subsidy of \$5.0 per ton on all fertilisers (1970). In 1971 this was amended to \$7.50 per ton.

¹ K.B. Cumberland, J.G. Pryde and H.L. Pickering, "Government Aid For Farming," Proc. of the Ruakura Farmers' Conference Week, (Hamilton, N.Z., June 1971) p. 159.

(ii) Special agricultural assistance fund of \$10.0m. (1970).

(iii) A dairy industry diversification scheme for beef.
Operational as from 1st June, 1969. Terminated 30th June, 1972.

(iv) An addition of \$5.0m. to the State Advances Corporation in marginal loans to assist the restructuring of agriculture by way of amalgamation. (1970).

(v) \$30.0m. for stock retention scheme. (1972).

(vi) \$3.8m. for drought relief. (1970).

In 1970 the total assistance rendered to agriculture was estimated to be over \$90.0m.

According to Wright¹ the benefits accruing to the farmer from (i) above are extremely limited. In (ii) above, the funds were allocated virtually on a 'first come, first served' basis. No stipulation was laid down as to what the money was to be spent on. The relatively small amount of finance allocated to (iv) above and the short term nature of measures (iii), (v), and (vi) above, which were adopted by Government authorities, suggests that none of these schemes have been co-ordinated in purpose or in timeliness. For the most part the above measures were formulated and administered under pressure with all the unsatisfactory details only to be expected from ad hoc legislation. They have been stop-gap measures to tide the industry over a particular crisis, but which have done little to rectify the basic structure of N.Z. agriculture. They have been 'across the board' measures, rather than measures aimed specifically to help those who are in most need of adjusting to the conditions prevailing in the seventies.

The experiences of the United Kingdom, Australia and member countries of the E.E.C. illustrate all too clearly that subsidies merely prolong the hardships suffered by marginally

¹ A. Wright, "Subsidy on Fertilizer Has Limited Appeal," New Zealand Farmer, August 26, 1965, p. 86.

profitable farmers and postpones the need for structural¹ adjustments to the industry.

It is generally considered inevitable that there will be more large farms and fewer farmers in N.Z.,² therefore any improvement to the structure of agriculture is a positive adjustment; benefiting the individual farmer and the nation, in the short and long term. Furthermore it would have seemed expedient to have developed an overall agricultural policy, in which the existing agricultural structure, could be modified as the factors below exert greater pressure:

(i) The adjustment required in N.Z., when the U.K., Ireland and Denmark join the E.E.C.

(ii) The certainty that at some future date prices will fall and existing markets for our primary products will diminish.

(iii) The continuing increase in farm size, reduced number of farmers and the required structural adjustments implied in this inevitability.

(iv) The internal cost-price squeeze will continue to demand increasing productivity from the agricultural sector.

Even if these events do not continue to make themselves strongly felt in the agricultural sector, a structure based on sound, economically viable units, is one of the necessary pre-requisites to increasing productivity.

It is in the light of the above situation that this study was undertaken.

1 'Structural' is defined here to mean the arrangement of farms one to another so as to form economically viable units, the components (farms) of which are able to support themselves without intermittent Government assistance.

2 G. McLauchlan, "Mr. Webb Looks at Future of N.Z. Farming," (D.N.R. Webb - former Director-General of N.Z. Agriculture), N.Z. J. of Agriculture, June, 1968, p. 28.

See also: A.R. Frampton, "Farm Subsidies - Help or Hindrance?" Dairyfarming Annual, 1969, Massey University, Palmerston North: October, 1969.

1.2 SCOPE OF THE STUDY

The N.Z. dairy industry is faced with major re-adjustments arising from the loss of the United Kingdom as the major traditional market. This, together with continuing cost inflation and the worsening of the disparity between farm and non-farm income,¹ will influence the future structure of dairy farming.

This study has as its principal objective, the review of the past structure and changes that are most likely to occur in the future. The study proceeds from the national farm scene, to the dairy industry and finally to a sub-section of suppliers supplying a single dairy company.

Chapters one and two provide the background information, whilst chapter three opens the way for more specific analysis of the problems that are likely to continue to confront dairy farmers and the industry in the years to come. Projections of the likely number of total owner-operators and dairy owner-operators that are likely to exist in the future are made.

Chapter four considers a given area within the Manawatu. In recent years the Manawatu Co-operative Dairy Company, in common with other dairy company's has been concerned at the net outflow of dairy suppliers from the Company. Owing to the fact that in recent years the dairy industry has invested large sums in new capital equipment, the effect of this drift on future milk production is important. This long term and highly specialised form of capital investment is a vote of confidence in the future of the dairy industry. Specialised dairy plant, can, however, only be used for producing dairy products. In order to produce low cost dairy products; it is imperative that dairy factories be supplied with sufficient raw milk so as to fully utilize manufacturing capacity. Despite this requirement it is

¹ Agricultural Production Council, Report on the Economic Position of the Farming Industry. Prepared by Economic Working Party, Wellington: May, 1970, p. 44.

likely that in the years to come there will be a further decline in the number of dairy farmers. To estimate the likely extent and effect of this phenomenon occurring, in a small area of the Manawatu, a survey of factory supply farms was undertaken.¹ From this survey the major physical inputs and outputs were obtained for each of the 98 survey farms. Each category of input and output was summed over the 98 farms.

The survey was designed so as to show (amongst other things) the likelihood of each survey farm continuing in dairy production for the next ten years. No one can accurately predict social trends nor future product prices and to this extent there are hazards in this exercise. Nevertheless there are very definite 'indicators' which are likely to determine whether an existing dairy unit will be in existence, per se, in ten years time (i.e. 1980-81) or not. On the basis of these 'indicators' the structure likely to exist in the given area, is estimated. The implications, especially with regards to future milk supply, resulting from this structure, are discussed.

The next stage of the analysis assumes (unlike the estimation of the structure likely to be in existence in 1980-81) that external influence is exerted to bring about a 'rationalized structure'. The rationalized structure assumes that none of the land used by the original 98 farms is lost to dairying. The 'rationalized structure' consists of synthetic firms. Chapter five describes the selection of eight well organized farms, the average characteristics of which form the average well organized farm (or synthetic firm).

The acreage of the synthetic firm was used to divide the total land used by the original 98 farms into firms, each of which assumed the characteristics of the average well organized farm or synthetic firm. i.e. the marginal productivities of the variable resources for each firm, constituting the 'rationalized structure', are equal.

¹ The study should therefore be looked upon as a pilot study for a larger problem area.

The outcome in terms of total inputs and outputs of this 'rationalized structure' are compared with the total inputs and outputs obtained for the original 98 farms. Such a comparison is the basis for rejecting or accepting the hypothesis:¹

That there existed in the survey area (in the 1968-69 structure) an imbalance in resource use amongst dairy farms.

The comparison further shows the magnitude and direction of changes that occur in individual resources and production when the industry is hypothetically rationalized. These changes in inputs are related to those which are occurring nationally, and which are discussed in Chapter Two.

Thus for the limited area under study, the dairy industry will obtain an indication of the changes, given present trends, likely to occur over the next ten years. Secondly, it will indicate the need for policies that are likely to be required to bring about a more acceptable outcome.

The advantages of, and suggested policies to bring about a rationalized dairy industry, are discussed.

1.3 REVIEW OF LITERATURE PERTAINING TO THE STRUCTURE OF N.Z. DAIRY FARMING

In the last twelve years; despite numerous isolated references, to the observation that generally, dairy farm numbers have been decreasing and that herd size and cow numbers have been increasing; there appears to have been no comprehensive paper written to analyse and interpret this data. Any policy to restructure any part of the dairy industry must take cognisance of the facts buried in this data.

Recognition was given to the existence of, and to the

¹ For details see Chapter Five.

problems of, low income dairy farmers when in 1962 the then Minister of Agriculture, Mr. B.E. Talboys was concerned that some of Northlands farms were not economic and that the Government might have to consider amalgamating some Northland farms to obtain economic production. This was considered not only to be a problem in Northland but elsewhere in New Zealand also.¹

At that time from a survey of 62 Northland dairy farms producing more than 10,000 pounds of butterfat half of them showed a net return of less than \$2,000, 35 per cent of dwellings and 42 per cent of cowsheds were considered substandard. Indebtedness was high.

Ward² considered that the problem of low income dairy farmers probably existed in all other dairying districts on those farms where total butterfat production was less than 12,000 pounds of butterfat. He further pointed out that whilst increased production for these individuals would be to their benefit; this would not necessarily be so from the national viewpoint and thus implying the question: "what is best to produce?". This in turn implied that:

Until we have an agricultural policy based on careful and thorough assessment of the future prospects for various commodities, and providing incentives and encouraging production of those products with the best prospects, it is impossible to formulate a rational and lasting solution for the future development of North Auckland [and all low income farmers].

It was considered by Candler,³ that if a welfare subsidy was to be paid to low income farmers; then it should be received only by those that need it and should be paid in such a way, that

-
- 1 A.B. Ward, The Low-Income Dairy Farm. No. 1. "How Bad are Things in Northland?" (See also the editorial), New Zealand Farmer, May 24, 1962, p. 6.
 - 2 A.B. Ward, The Low-Income Dairy Farm. No. 2. "First Step: Decide on a Policy for our Agriculture," New Zealand Farmer, June 7, 1962, p. 4.
 - 3 W. Candler, "What's Bad About A Farm Subsidy?" New Zealand Farmer, June 21, 1962, p. 4.

subsequently the recipients cease to require the subsidy.

(i) By permitting the farmer to expand production above 8,000 pounds of butterfat.

(ii) By moving him out of dairying into a better job, if an increase in production of the required order was not obtainable economically.

The position of the small dairy farmer was again looked at in a survey carried out by the Department of Agriculture on fifty farms in Inglewood County, Taranaki.¹ It was shown that 28 per cent of farms produced under 15,000 pounds of butterfat, and that the average production per cow per year was less from those herds, which on average, produced a smaller total production of butterfat per year than from those herds which on average produced a larger total production of butterfat per year.

Only 32 per cent of farmers exceeded 200 pounds of butterfat per acre and none exceeded 300 pounds. There seemed therefore scope for increased output from most of the farms. The survey also showed that average net income was a function of total butterfat production, i.e. the higher the total production, the higher the average net income. Total butterfat production was also shown to be a function of average total area, i.e. the higher the total butterfat production the larger the average total acreage. Therefore, as one might expect, high average net incomes were associated with high average total acreages.

In 1963, Onion² noted that cow numbers, at just under 2.0 million, were no greater than they had been some ten years previously. The number of suppliers nationally was

1 A.L. Kearton, H.G. Turnbull, and R.H. Scott, "Inglewood County Dairy Farm Survey" (1960-61 Season), N.Z. Dept. of Agriculture.

2 F.L. Onion, Chairman's Address, Annual General Meeting N.Z. Co-Operative Dairy Company Limited, August 21, 1963.

consistently falling, but herd sizes were increasing. With the realization that there was going to be insufficient overseas exchange for the growing secondary industry he said "... we must have an immediate and authoritative appraisal of our dairy industry". The 'appraisal' never seems to have come to fruition.

The report on the economic position of the farming industry of June, 1963 reported that despite the "... steady increases in production and productivity, net farming income declined between 1957-58 and 1961-62 while the income of other sections of the community generally continued to rise". The same report said: "... the rate of capital investment in farming has slowed down and that as a result the rate of increase in livestock numbers is not as high as previously". This report, as much as anything else, was probably responsible for the convening of the all embracing Agricultural Development Conference (A.D.C.) in 1964.

The A.D.C. of 1964 appears to be the first official attempt to look at farm structure when it formed, amongst others, 'the scale of farming working party'.¹ The basic question of the relationship between farm size and profitability was considered (but never, it seems, satisfactorily resolved). The minimum size of dairy farm compatible with an economically viable and productive agriculture, whilst not seen to be fixed owing to a number of environmental factors, was thought to require an output of 17-18,000 pounds of butterfat for a one man unit. Such a unit was considered to be no less efficient than a unit producing a larger production, but that the former unit would be more vulnerable to a decreased profit margin and to the vagaries of nature.

Since the level of indebtedness can be a major factor in the residual income and because it varies substantially between farms of the same productive capacities it was thought impossible to lay down a general definition as to which farm size

1 Report. Agricultural Development Conference 1963-64.
Wellington: N.Z. Government Printer, February, 1966.

became too small to yield an 'adequate' income. It was also pointed out that the criterion of a management reward in addition to a return on capital invested was not always valid, because buyers willingly paid higher prices for farms and knowingly accepted a lower return.

However, the working party considered that an 'adequate' income should be used to decide at what point an individual farm did become uneconomic. As an indication of its thinking on an 'adequate' income the working party considered that total farm family income, after meeting expenses, interest on debt, taxes and debt repayment, could have been for example, \$2,000 a year.

The problem of uneconomic farms was seen, as being a regional one and consequently more severe owing to limited outside employment. In such instances Government action was seen to be justified where it was proven that in any district 20 per cent, say, of farms fell into the uneconomic class, as defined above. The report further stated that:

A positive effort to eliminate the uneconomic farm is justified on social grounds if New Zealand is to avoid the existence of "rural slums", and while the likely impact on production of the regrouping of uneconomic farms into bigger units may not be great, regrouping would make for better use of the labour force at present employed on these properties, with benefit to the farming industry. From the social aspect it would represent a positive approach to what one submission described as a main reason for concern - "the feeling that the children are likely to be brought up in an under-privileged environment".

Hodgson,¹ saw the trend towards bigger farms fitting into the historical pattern of the past fifty years and that there was no indication that it would lead ultimately to large aggregation of land controlled by corporations.

In this respect the work party looked at current legislation restricting land aggregation as laid down in the Land Settlement Promotion Act of 1952. Part II of the Act

¹ In: G. McLauchlan, "The Economics of Large Dairy Farms," N.Z. J. of Agriculture, September, 1965, p. 21.

deals with the control of sales or leases of farmland to prevent undue aggregation. The work party found numerous reasons for strongly advocating the repeal to the provisions of Part II of the Act, if only because the legislation was ineffective.

It was the belief of a Wairarapa dairy farmer¹ that in 1967 the revenue from approximately 100 cows was necessary to keep a family and to pay mortgages. Therefore from past trends an economic unit would soon become too big for one man to handle (especially as the farmer aged). At the same time over capitalization in a high cost structure of farming and the revolution occurring in agriculture the world over was seen by Webb² as a challenge to N.Z. agriculture to become more efficient, and as units got bigger and bigger, fewer men on the land was seen as being inevitable.

There appears to be only little quantitative analysis as to the extent of, and likelihood of, the seriousness of the low income farm problem, if only because of the paucity of statistical information designed to gauge the extent and distribution of low farm incomes. Philpott³ in 1969 speaking at the Ruakura Farm Conference said:

... we don't know the extent of the low income problem and establishing this is perhaps the first thing to be done. The Dairy Board economic survey indicates (at least on the basis of averages) that the low incomes (below \$2,000) are to be found as the smaller farms (below 50 acres). Significantly these are also the farms where fat per acre is highest at 257 lb. compared with the New Zealand average of 167 lb. On larger farms there appears to be scope for much greater fat per acre, approaching closer to the feasible levels proposed by Ruakura, and there is no doubt, if one judges by the Dairy Board published figures (which are averages), that net

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- 1 H.R. Grossman, "One Man Units - Its Passing Is a Good Thing in Everyway," N.Z. Dairy Exporter, January, 1967, p. 5.
 - 2 McLauchlan, loc. cit.
 - 3 B.P. Philpott, "Agricultural Implications of the National Development Conference," Proc. of the Ruakura Farmers' Conference Week, (Hamilton, N.Z., June, 1969), p. 110.

income per acre rises very sharply with fat per acre.

I feel that on the larger farms there will automatically occur greater intensification, higher fat per acre, and higher incomes without the need for subsidies.

See Table 1.4.

TABLE 1.4 Average Net Farm Incomes For Factory
Supply Farms With Differing Acreages.^a

	Up to 50 acres	51 to 100 acres	101 to 150 acres	All Farms
No. of farms	30	459	484	1,608
Av. Herd size	41	68	89	88
Butterfat per farm (lb)	11,490	20,520	26,790	26,340
Butterfat per acre (lb)	257	250	215	167
Av. farm size (acres)	45	82	125	158
Av. N.F.I. (\$)	2,113	3,731	4,410	4,176

a New Zealand Dairy Board Farm Production Division,
A Survey of the Economic Structure of Factory
Supply Dairy Farms in N.Z. in 1965-66. Vol. III,
Wellington: May, 1968, p. 43.

However the report of the Agricultural Production Council (May, 1970)¹ showed some empirical evidence of the extent of low incomes and equities (centred on the 1967-68 season), when, in the summary; it made the following observation with regards to dairy farms:

... there would be around 1,000 (5 per cent) dairy farms ... with low farm income earning power and equities of less than 40 per cent. (Low income earning power refers to dairy farms of less than 20,000 lb. butterfat ...). ... Tables referring to the income distribution of dairy farms ... show that 10 - 15 per cent ... of farms

1 Agricultural Production Council, Op. cit., May, 1970, p. 43.

return net incomes of less than \$2,000. In absolute terms this would amount to around 2,500 dairy farms ... that generate net incomes of less than \$2,000....

The latest report of the Agricultural Production Council (April, 1971)¹ shows that over the period 1968-69 to 1970-71 the percentage of dairy farms with net incomes of less than \$4,000 had increased from 55 per cent to an estimated² 60 per cent.

A study of the farms falling in the low income group in the 1968-69 financial year revealed that 80 per cent of those farms were below average in herd size, and significantly, most of those farms showed a lower than average milkfat yield per cow. Net worth tended to be low and the resultant high debt service contributed largely to the above average level of expenditure in relation to the gross income generated.

Concern for restructuring has been widely quoted. Ross³ in particular, in discussing needed adjustments in farming said:

The farming industry is in need of some adjustments, and these can be made more quickly with Government assistance. Farm amalgamations are not a panacea for all of the industrys' problems, but they have their place, particularly in regard to the prevention of rural poverty problems. Amalgamations have been taking place at a relatively rapid pace in recent years,⁴ but the Government could still assist by making money more freely available for this purpose. If money made available is not taken up, especially in areas with large numbers of barely economic units, consideration should be given to further amalgamation assistance. This could take the form of a scheme suggested for Australia, under which the farmer who is expanding his

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- 1 Agricultural Production Council, op. cit., April, 1971.
 - 2 Ibid., (Estimated by the Agricultural Production Council for the year 1970-71), p. 50.
 - 3 B.J. Ross, "Farming: An Industry in Need of Adjustment?" Proc. of the 21st Lincoln College Farmers' Conference, (Lincoln, New Zealand, 1971) p. 22.
 - 4 The extent of some current amalgamations are shown in the report of the Agricultural Production Council, op. cit., April, 1971, pp. 53-59.

holding buys only the land. Houses and other buildings which duplicate what he already has, and are thus redundant, are written off and paid for by the Government. Under the scheme the vendor is likely to get a better price for his farm, and is therefore more likely to sell, while the purchaser has to pay only for fully productive assets.

1.3.1 A Compendium of Statistics Relating to Trends in New Zealand Dairy Farming

The following is a resumé of the available and most important statistical information relating to N.Z. dairy farm production.

Figure 1.1 (a) shows the evidence for the four most recent years, for which information is available, of the decrease in the percentage number of holdings of < 100 acres which are principally in dairying. The opposite trend can be seen for those farms over 150 acres. There is little change in the percentage number of holdings in the 100-149 acre range. Figure 1.1 (b) shows, for the years 1951, 1961 and 1969 the decline in the percentage number of holdings milking small herds (< 100 cows), whilst the swing to the percentage number of holdings with large herds (> 100 cows) is shown at the other extreme. For instance, between 1960-61 and 1968-69 the percentage number of holdings with herds of < 50 cows decreased from 42.6 per cent to 16.8 per cent of total herds with ≥ 10 cows, whilst the percentage number of holdings with herds of > 100 cows increased from 10.7 per cent to 37.6 per cent. The total number of holdings milking ≥ 10 cows decreased by 21 per cent over the same period.¹

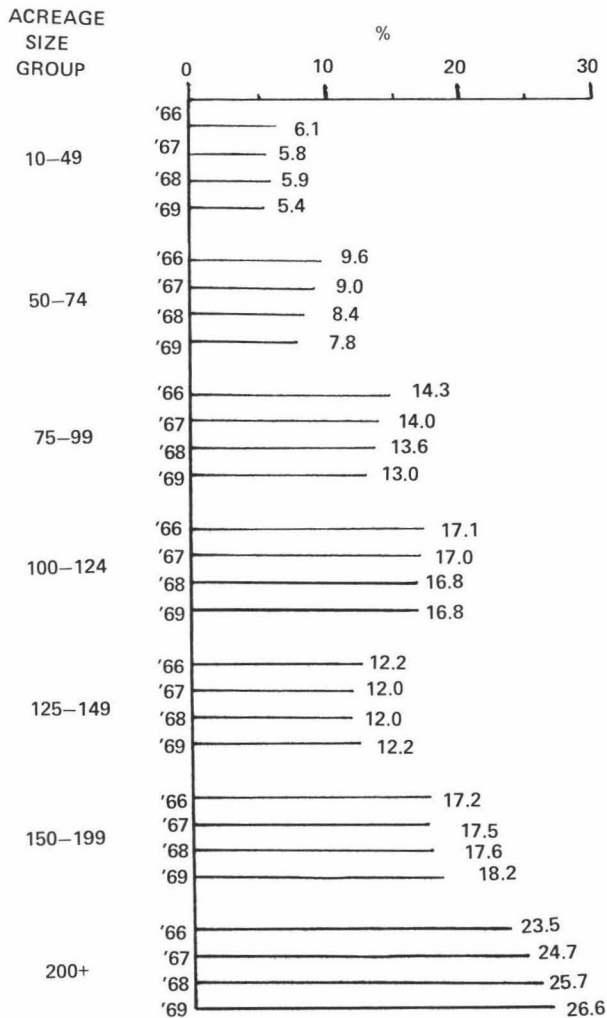
Table 1.5 summarises the relevant data from which figures 1.2 and 1.3 are constructed.

In figure 1.2 average herd size has increased at an ever increasing rate, whilst the total number of suppliers and

¹ N.Z. Farm Production for the Season 1968-69. Dept. of Statistics, Wellington, 1971.

Fig. 1.1(a)

PERCENTAGE NO. OF HOLDINGS PRINCIPALLY IN DAIRYING
BY ACREAGE SIZE GROUPS FOR YEARS: 1966, 1967, 1968
and 1969.

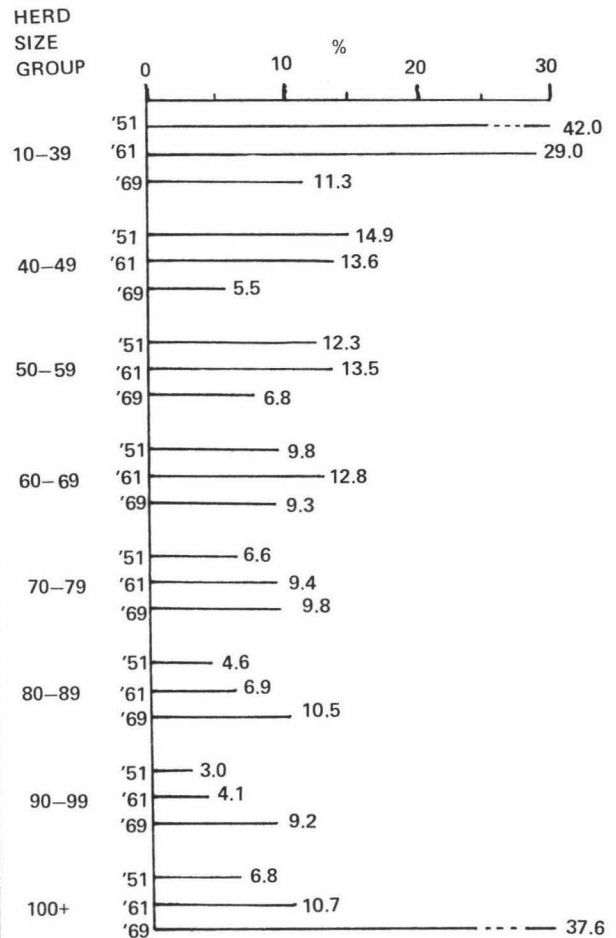


Total No. of holdings ≥ 10
acres principally in dairying.

1966	22,949
1967	22,614
1968	22,398
1969	22,532

Fig. 1.1(b)

PERCENTAGE NO. OF HOLDINGS MILKING HERDS WITH
10 OR MORE COWS ON JAN. 31, IN 1951, 1961 AND 1969.



Total No. of Herds ≥ 10 cows.

1951	36,067
1961	31,151
1969	24,603

Source: Reports on farm production statistics. (Various volumes) Dept. of Statistics.

TABLE 1.5

Data Pertaining to the N.Z. Dairy Industry: 1950 - 1970

Year	No. of cows in milk 31st Jan. ^a ('000's)	Total butterfat prodn. "at the pail" (million lb.) ^d	Av. butterfat "at the pail" per cow (lb.) ^a	No. of herds with ≥ 10 cows ('00's) ^a	Av. herd size for herds ≥ 10 cows ^a	Total No. of suppliers to dairy Companies ^f
1950-51	1,898	494	256	361	50	51,200
1951-52	1,906	501	259	357	52	
1952-53	1,962	535	269	355*	53	
1953-54	1,999	497	245	362*	53	
1954-55	1,995	507	250	361*	53	
1955-56	1,996*	530	261	355*	55	45,200
1956-57	1,998	524	258	349	56	
1957-58	1,967	558	279	337*	56	
1958-59	1,931	557	284	325*	57	
1959-60	1,887	547	284	318*	57	
1960-61	1,929	549	283	312	59	36,700
1961-62	1,968	547	276	305*	62	
1962-63	1,997	559	279	295*	65	
1963-64	2,011	586	290	289	67	31,700
1964-65	2,032	622	305	275	70	29,700
1965-66	2,088	645	308	264	76	27,900
1966-67	2,131	653	305	253	80	26,300
1967-68	2,232	638	285	248	86	25,700
1968-69	2,304	663	287	246	92	25,000
1969-70	2,321 ^b	613	264 ^b	237 ^g	98 ^e	23,700 ^e
1970-71	2,239 ^c	615 ^c	274 ^c	223 ^g	100 ^g	N/A

* Estimated.

References a,b,c,d,e,f,g overleaf.

TABLE 1.5 References

- a New Zealand Dairy Board, 46th Farm Production Report, 1969-70 Season, Wellington: p. 67.
- b Monthly Abstract of Statistics, Dept. of Statistics, Wellington, N.Z.: April, 1972, p. 3.
- c Ibid., (provisional).
- d 1950-51 to 1959-60. N.Z. Dairy Board, 37th Annual Report and Statement of Accounts Year Ended 31st July, 1961, Wellington: p. 22.
 1960-61 to 1968-69. Agricultural Production Council, Op. cit., April, 1971, p. 22.
 1969-70 to 1970-71. Monthly Abstract of Statistics, Op. cit., January, 1972, p. 3.
- e Provisional.
- f N.Z. Dairy Board, 46th Farm Production Report, 1969-70 Season, Wellington: p. 69.
 Factory Supply Herds with One or More cows taken from dairy Company annual accounts.
- g Unpublished Dairy Board Data and Town Milk, August, 1971, p. 19.

number of herds with $\gg$ 10 cows have continued to decline. The decreasing divergency between these latter two series is an indication that only herds containing $\gg$ 10 cows are supplying factories. Previously there were numerous suppliers milking $<$ 10 cows.

Figure 1.3 shows the effect of the drought in 1967-68 and 1969-70 on total butterfat production, and this in face of the highest number of milking cows ever recorded in N.Z. The average production per cow was also similarly affected. Since 1969-70 there is expected to have been a reduction of 82,000 milking cows. Due possibly to the introduction of the dairy industry diversification scheme for beef in June, 1969 and the two droughts.

Since 1965-66 total butterfat production has remained approximately constant or even declined. Restructuring the dairy industry would not only eliminate any existing low dairy farm income problem but would also prevent possible accentuation of the low income problem. Furthermore the industry would be better prepared to withstand any future market crisis, and, by the nature of its competitiveness, would be able to capture any expected increase in demand from markets where countries were not self-sufficient in dairy products.¹

1 The Food and Agriculture Organization (F.A.O.) estimates that: "World Milk Production is projected to increase less than demand at constant prices, with a statistical 'deficit' of 20 million tons whole milk equivalent in 1980". See: Agricultural Commodity Projections, 1970-1980. Vol. 1. Food and Agriculture Organization of the United Nations. Rome: 1971, p. 119.

Fig. 1.2 TOTAL NO. OF SUPPLIERS, HERDS WITH ≥ 10 COWS
AND AVERAGE HERD SIZE: 1950/51 - 1970/71.

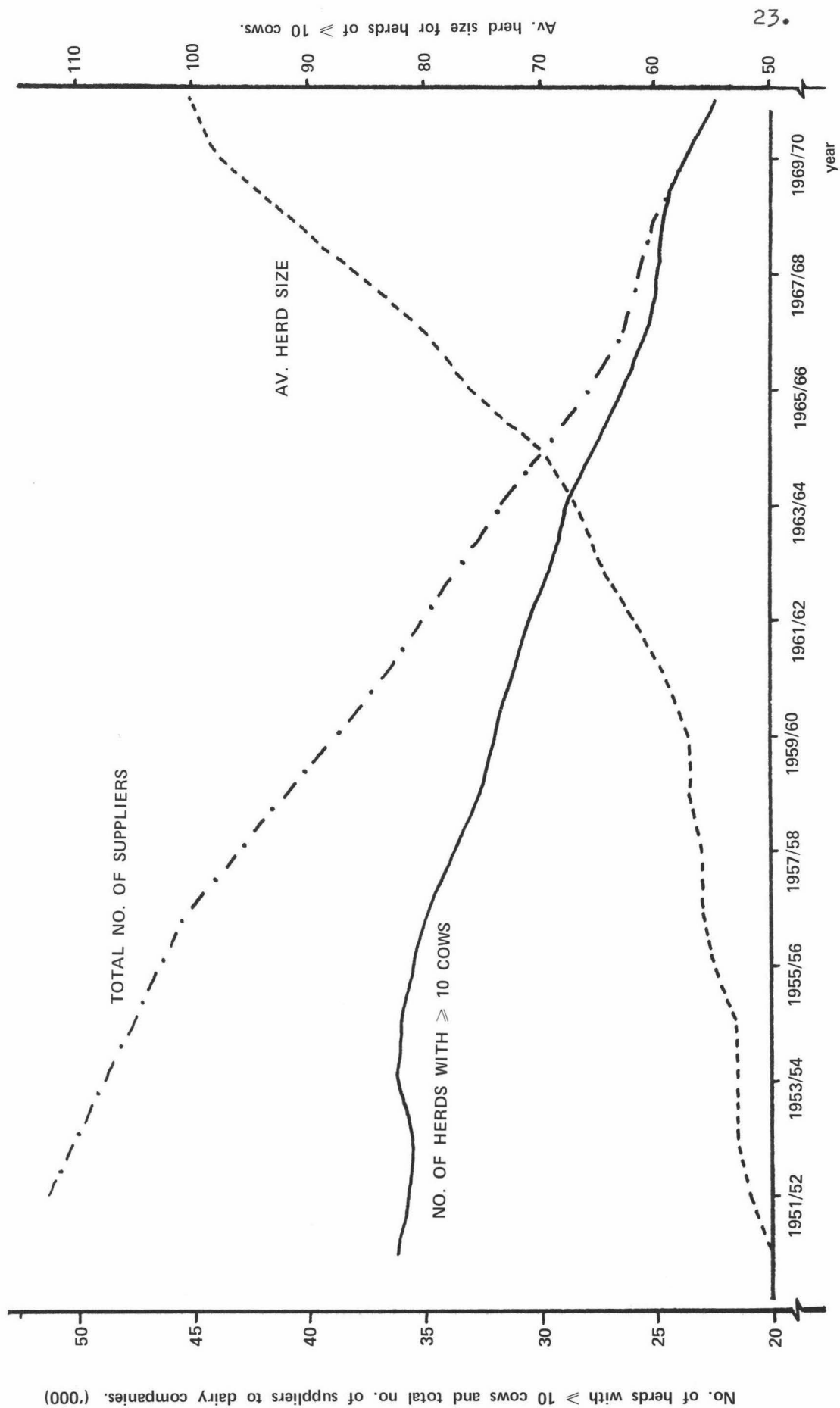
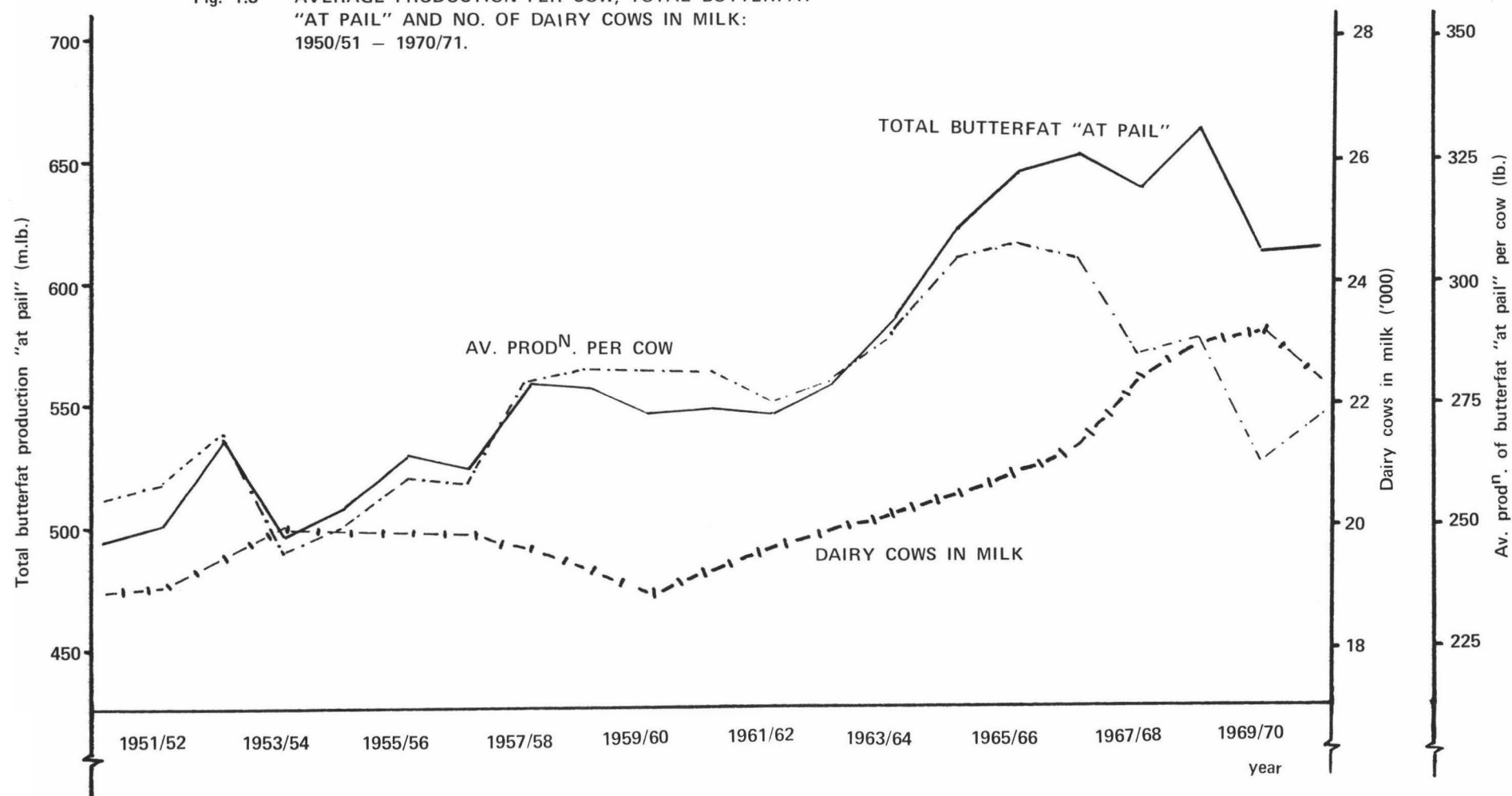


Fig. 1.3 AVERAGE PRODUCTION PER COW, TOTAL BUTTERFAT
"AT PAIL" AND NO. OF DAIRY COWS IN MILK:
1950/51 - 1970/71.



1.4 OVERSEAS REVIEW OF STRUCTURAL CHANGES AFFECTING DAIRYING

1.4.1 Introduction

The economic health of N.Z. dairy farmers largely depends on what changes are occurring in other countries. There are two aspects to be considered:

(i) The need to ensure that N.Z. remains as efficient as possible relative to foreign competitors and producers.

(ii) To monitor trends developing in those foreign countries so that N.Z. agriculture can adapt itself to take advantage of those trends.

For these reasons a necessarily cursory review will be made of the dairying structures of England and Wales, the countries belonging to the European Economic Community (E.E.C.) and the United States of America (U.S.A.).

1.4.2 England and Wales

British food production is unable to satisfy the domestic demand, and therefore food is imported. To enable the British farmer to compete the British Government affords protection principally by:

(i) Limiting imports of foodstuffs. Failure to do so would result in foreign supplies, combined with domestic production, lowering the domestic price to the detriment of the British producer.

(ii) Subsidising domestic production, (Price and cost subsidies). Recently however, with Britain aligning its agricultural policy to be sympathetic to that of the E.E.C., she is now changing from indirect support (i.e. via subsidies etc. [which in turn come from taxes]) to an import-levy system whereby the consumer in Britain will pay for dearer food directly - at

the retail level. The change is colloquially called, moving from a cheap to a dear food policy.

These protective measures are largely responsible for ensuring that the low income problems in British agriculture are not accentuated.

Though Britain has, and is, losing people out of agriculture, in order to maintain income parity with the non-agriculture sector, the loss is not fast enough. To counteract the forces (technological and managerial), which are increasing productivity per man hour and per acre, Thomas¹ sees an accelerated rate of withdrawal of resources out of agriculture as being necessary if a permanent solution to the low income problem in agriculture is to be found.

More recently Britain has put more emphasis on restructuring agriculture. With the inauguration of the farm amalgamation and boundary adjustment scheme² it can confidently be expected that the trend to bigger and fewer units will continue into the seventies. Indeed McCrone³ has previously agreed that:

A redistribution of the total (yearly subsidy of £320-350m.) sum giving more emphasis to measures designed to help investment in viable enterprises might pay off handsomely in the long run by reducing the industry's dependence on support and enabling it to adapt to the conditions facing it.

To illustrate the number of small dairy units existing in England and Wales, Table 1.6 shows the comparison of the

1 W.J. Thomas, "Price Support Systems for Agriculture," Report and Proc. of the Twenty-third Oxford Farming Conference, (Oxford, January, 1969) p. 23.

2 For details and a case study see: E.A. Currie, "Successful Farm Amalgamation," Agriculture in Northern Ireland, (Her Majesty's Stationary Office) Belfast: February, 1969, p. 332.

3 G. McCrone, "The Case for Structural Improvement in British Agriculture," Scottish J. of Political Economy, June, 1965.

number of holdings in each herd size group, compared with that for N.Z.

England and Wales with only 16.9 per cent more cows than N.Z., has 208 per cent more herds of ≥ 10 cows. Table 1.6 shows the greater proportion of smaller herds in England and Wales compared with N.Z., which has a much higher proportion in the larger herds. The reasons for this disparity are many - historical, price structure, and environmental to name only a few.

TABLE 1.6 Number of Holdings in Each Herd Size
Group in England and Wales and New Zealand

Herd Size Group (cows)	10-39	40-49	50-69	70-99	100-199	200+	Total holdings milking ≥ 10 cows	Total No. of cows in milk ^c (m.)
England & Wales ^a	54,174	7,588	8,073	3,992	1,784	199	75,810	2.695
% of total	71.5	10.0	10.5	5.3	2.4	0.3	100	
N.Z. ^b	2,779	1,365	3,965	7,251	8,359	884	24,603	2.304
% of total	11.3	5.5	16.1	29.5	34.0	3.6	100	

NOTE: England and Wales - June, 1968
New Zealand - January, 1969.

- a Ministry of Agriculture, Fisheries and Food, Agricultural Statistics, 1968-69, England and Wales, (Her Majesty's Stationery Office) London: 1971, p. 80.
- b Report on Farm Production Statistics for the Season 1968-69. Dept. of Statistics, Wellington, N.Z.
- c Data for England and Wales includes dairy-type cows, heifers in milk and cows in calf, but not in milk. N.Z. data is cows in milk.

However, the important feature of dairying in England and Wales has been the decrease in the number of milk producers (as opposed to the number of holdings milking ≥ 10 cows). In 1960 there were 123,137 milk producers, in 1965, 100,449 and in

1970, 80,141 or a decrease of 34.9 per cent from 1960 to 1970. Between April, 1969 and March 1970, 77 per cent of those giving up production of milk for sale had ≤ 30 cows in the herd.¹

Over the same period (1960-70) breeding cow numbers increased from 2,595,000 to 2,760,000 or an increase of 6.4 per cent whilst milk sales off farms rose from 1,951 m. gallons (in 1960-61) to 2,205 m. gallons (in 1969-70); an increase brought about by increasing cow numbers and increasing per cow production. Cow numbers have been increasing fairly steadily since 1964 but came to a halt and turned downwards, ending the year in March, 1970 with a total number of dairy cows 14,000 below the previous March; but still 125,000 above March, 1964.²

The rationalization described above is likely to continue into the future. In 1969 it was estimated that by 1978, 32 per cent of dairy cows would be in herds of 100 cows, with 50 herds at least of over 1,000 cows and the number of dairy enterprises further reduced to 55,000.³

1.4.3 European Economic Community (E.E.C.)

As continental Europe strives to take its agriculture from the peasant state into the modern era, great changes will occur. Continental Europe already more than self-sufficient in many food commodities (including milk and milk products) is now, under the guidance of Dr. Sicco Mansholt, making great efforts to reorganize and restructure its agriculture.

1 All data from: Report of the Breeding and Production Organisation 1969-70. Milk Marketing Board. Thames Ditton, England. pp. 13, 75.

2 Ibid., p. 11.

3 C.A.C. De Boinville, (one time Managing Director of British Oil and Cake Mills). Report and proc. of the Twenty-third Oxford Farming Conference, (Oxford, January, 1969) p. 11.

The Mansholt plan (as it has come to be known) in its entirety is an ambitious scheme. A few statistics will suffice to show the enormity of the problem.¹ Table 1.7 shows the slow rate of progress being made over time in the attempt to increase the size of holdings. This is emphasised again in a recent report² that states:

... efforts to increase the size of farms in the Six have not made much progress over the past decade - the average size of farm holdings only reached 12.7 hectares in 1970, compared with 10.4 ten years before.

Table 1.8 shows the relatively high percentage of people employed in agriculture compared with the total number employed. The average (1965) for the E.E.C. is 15.8 per cent, for the U.K. 3.6 per cent, United States of America 5.8 per cent, and New Zealand (a predominantly primary producing country), 12.3 per cent.

Other illustrative statistics relating to European agriculture are as follows:

(i) Between 1958 and 1965, 4.5 m. people moved out of agriculture (i.e. 28 per cent of the 1955 total) of which one result has been the rising productivity of labour per person employed in agriculture of nearly 7 per cent per year.

(ii) Average size of farms in the community was about eleven hectares.

(iii) In the whole community, only 470,000 farms had more than fifty hectares of farm land (i.e. 3 per cent of all farms with greater than one hectare).

1 Data refers to 1967 unless otherwise stated. All data from: Memorandum on the reform of agriculture in the E.E.C. Com. (68) 1000 Part A. Agriculture 1980.

2 "Farmers not to blame for soaring food prices," The Financial Times, September 15, 1972, p. 39.

TABLE 1.7

Farms of One Hectare and Over, Number and Average Size^a

Size Group	Germany			France			Italy	Netherlands			Belgium			Luxembourg		
	1960	1967	1960 = 100	1960	1963	1960 = 100	1961	1959	1966	1959 = 100	1959	1966	1959 = 100	1960	1966	1960 = 100
1 - < 5 ha	617,4	487,2	79	527,0	453,9	86	1787,8	87,7	70,5	80	96,3	59,2	61	3,3	2,0	61
5 - < 10 ha	343,0	271,8	79	406,0	364,0	90	541,6	62,2	49,2	79	52,7	41,6	79	1,9	1,3	68
10 - < 20 ha	286,5	288,6	101	504,0	485,0	96	277,2	53,9	55,4	103	35,2	35,4	101	2,7	2,1	78
20 - < 50 ha	122,0	141,0	116	388,0	393,9	116	109,9	24,5	25,9	106	12,3	15,0	122	2,3	2,5	109
50 - < 100 ha	13,7	14,6	107	81,2	84,9	105	25,0	1,9	2,0	105	1,9	2,0	105	0,2	0,2	100
100ha and over	2,6	2,8	108	22,3	23,5	105	14,8	0,2	0,2	100	0,3	0,3	100	0	0	100
Total	1.385	1.206	87	1.928	1.805	94	2.756	230	203	88	199	154	77	10	8	80
Average size of farm (ha)	10,1	10,6	105	16,7	17,8	107	6,8	9,9	11,0	111	8,2	10,2	124	13,4	16,6	124

a Memorandum on the reform of agriculture in the E.E.C. Com. (68) 1000
Part A. Agriculture 1980.

TABLE 1.8

Share of Persons Employed in Agriculture as
Percentage of Total^a Numbers in Employment

Country	Total numbers in employment				Numbers employed in agriculture							
	'000				'000				(as % of total numbers in employment)			
	1950	1955	1960	1965	1950	1955	1960	1965	1950	1955	1960	1965
Germany ^b	20.376	23.230	26.247	27.091	5.020	4.285	3.623	2.980	24,66	18,45	13,80	11,-
France	19.222	19.355	19.481	19.776	5.438	4.847	4.029	3.370	28,29	25,04	20,68	17,04
Italy	16.930	17.810	19.070	19.850	6.945	6.425	5.870	4.900	41,02	36,08	30,78	24,69
Netherlands	3.785	3.996	4.144	4.498	533	489	429	356	14,08	12,24	10,35	7,91
Belgium	3.253	3.365	3.352	3.531	368	310	257	215	11,31	9,21	7,67	6,09
Luxembourg	134,4	132,7	133,7	138,5	32,2	26,8	21,9	18,7	23,96	20,20	16,38	13,50
E.E.C.	63.700,4	67.888,7	72.427,7	74.884,5	18.336,2	16.382,8	14.229,9	11.839,7	28,79	24,13	19,65	15,81

a See corresponding footnote for table 1.7

b 1950 and 1955: incl. Saar, excl. Berlin. 1960 and 1965: incl. Saar and Berlin.

(iv) Two-thirds of all farm holdings had less than ten hectares of farmland and nineteen per cent of them have between ten to twenty hectares.

(v) More than four-fifths of the persons employed in agriculture work on farms which together account for less than half the farmland in the community.

(vi) More than eighty per cent of dairy farmers own at the most ten cows. Out of four million dairy farmers only 75,000 keep more than twenty cows.

(vii) The cost of improving agricultural structure alone in 1967 was 1,900 m.u.a.

A wide variety of methods to remove land, cows and farmers from agricultural production have been evolved.

Many methods involving some form of subsidy or compensation have been devised to encourage amalgamation of farms into modern 'production units' (P.u's). For example, it is envisaged that a dairy 'production unit' would have at least 80 - 120 hectares and would keep 40 - 60 cows. The memorandum goes on to say:

If living standards of farmers are to rise enough within ten years to make good the present leeway; then the rate of decrease in the agricultural population must be greatly accelerated. Despite the fall occurring in the number of farmers, the problem of their standard of life and living conditions are becoming more and more serious from day to day. The situation is all the more serious as even now the size of some of the new farms being set up is far below what is required by the technological progress and economic requirements of today. The problem of the structure of European agriculture is not that there are so many small farms but that in consequence of the general trend, more farm enterprises are becoming marginal.

The first Mansholt Plan produced few results because it was never adopted as a plan. Instead, problems have been tackled on a short-term basis at the market place, instead of on the farm, by means of market intervention, support prices and domestic and

foreign food aid to lower stocks of surplus items. As a result only limited improvements to farmers' incomes has resulted.

The revised Mansholt Plan (May, 1970) is, like the first version, based on restructuring European Agriculture so that farmers can achieve an equitable standard of living in the community. Unlike the first E.E.C.-wide version however, it stresses agricultural reform at the national level and has a decentralised approach.¹

Webb (1968)² warned that Mansholt's plans were towards the reconstruction of agriculture, searching for the type of production for 20, 30 or 40 years ahead, not towards increased subsidies to help the struggling farmer. Further, despite the productivity increases, the cost of investment and the necessary capital were still too high in relation to the size of holdings. Mansholt, he said, envisaged farms with a capacity of 400 cows only to be viable in the future. "We [N.Z.] are more productive than many of our competitors but we cannot ignore the quiet revolutions in world agriculture".

The inevitable accession of Britain, Ireland, Norway and Denmark to the E.E.C. in January, 1973 has important implications for N.Z. For not only will N.Z.'s dairy exports to Britain be phased down to an agreed minimum by 1978, but also, if the proposed restructuring and organization of European agriculture is successful; then any increase in internal demand for dairy products will be satisfied by an enlarged E.E.C.

1 W. Roenigk, "A European Essay: The Revised Mansholt Plan," Foreign Agriculture U.S. Dept. of Agriculture: August 3, 1970.

2 D.N.R. Webb, "Future of Large Scale Farming in N.Z.," Proc. of the 18th Lincoln College Farmers' Conference, (Lincoln, N.Z., 1968) p. 6.

1.4.4 United States of America (U.S.A.)

To the extent that present exports of N.Z. dairy products to the U.S.A. are small,¹ the trends occurring in the dairy industry in that country are not particularly important to N.Z. However, insofar that in the U.S.A. developments originate which are sometimes taken up overseas - albeit, with a considerable time lag - American developments are of interest to N.Z. dairy farming.

Despite the modernization of American agriculture since 1946 there still remains a low agriculture income problem. There has been a major restructuring of the industry involving consolidation of farms, elimination of small farms and expansion in the number of large farms.²

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- 1 For instance in 1969 provisional figures show that the U.S.A. imported 7,498 tons of N.Z. cheese (0.08 per cent of total cheese exported from N.Z.). Only 189 tons of N.Z. butter was imported into the U.S.A. in 1969.

Source: New Zealand Dairy Board. Ninth Annual Report and Statement of Accounts for the year ended 31st May, 1970. Wellington: p. 105 & 53.

- 2 Readers interested in following this theme up with regards to American Agriculture should consult:

(i) U. Papi and C. Nunn (eds.), Economic Problems of Agriculture in Industrial Societies (London: International Economic Association, 1969) p. 234.

(ii) U.S. Dept. of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1970, 91st Annual Edition.

(iii) U.S. Dept. of Agriculture. Report D.S. -327. September, 1969.

(iv) U.S. Dept. of Agriculture. Report D.S. -338. November, 1971.

1.4.5 Summary

The structural adjustments as proposed by Mansholt for European agriculture are essentially the same adjustments that Britain and the U.S.A. have, and continue to have to make, in order to prevent the disparity between farm and non-farm incomes increasing.

The adjustments briefly noted above are as relevant to New Zealand in that such rationalization is output increasing and cost reducing, hence threatening market availability.

CHAPTER II

NEW ZEALAND'S AGRICULTURAL INPUTS AND OUTPUTS. AN HISTORICAL REVIEW

2.1 INTRODUCTION

Economic growth in N.Z. has been predominantly dependent on the earnings of overseas funds from agricultural exports, to enable the importation of manufactured goods for consumption and raw materials for secondary industry. This reliance on agricultural exports is likely to continue into the future, therefore agricultural productivity and resource use is of great importance to the future well-being of N.Z.

In this chapter aggregative inputs¹ into N.Z. agriculture will be reviewed to see if there have been any discernable trends in the past.

2.2 AGGREGATIVE GROSS FARM INCOME

The most common measurement of total farm output is gross farm income (G.F.I.) which is an estimate of aggregate receipts from sales of farm produce valued at the farm gate. It affords an indication of the return available to farmers as a whole to meet current expenses of farm operation, interest payments, other costs, and to provide an income for themselves and their employees.

¹ Input data (other than for labour) for different sectors within agriculture is unfortunately aggregated and therefore past trends for any one sector cannot be analysed.

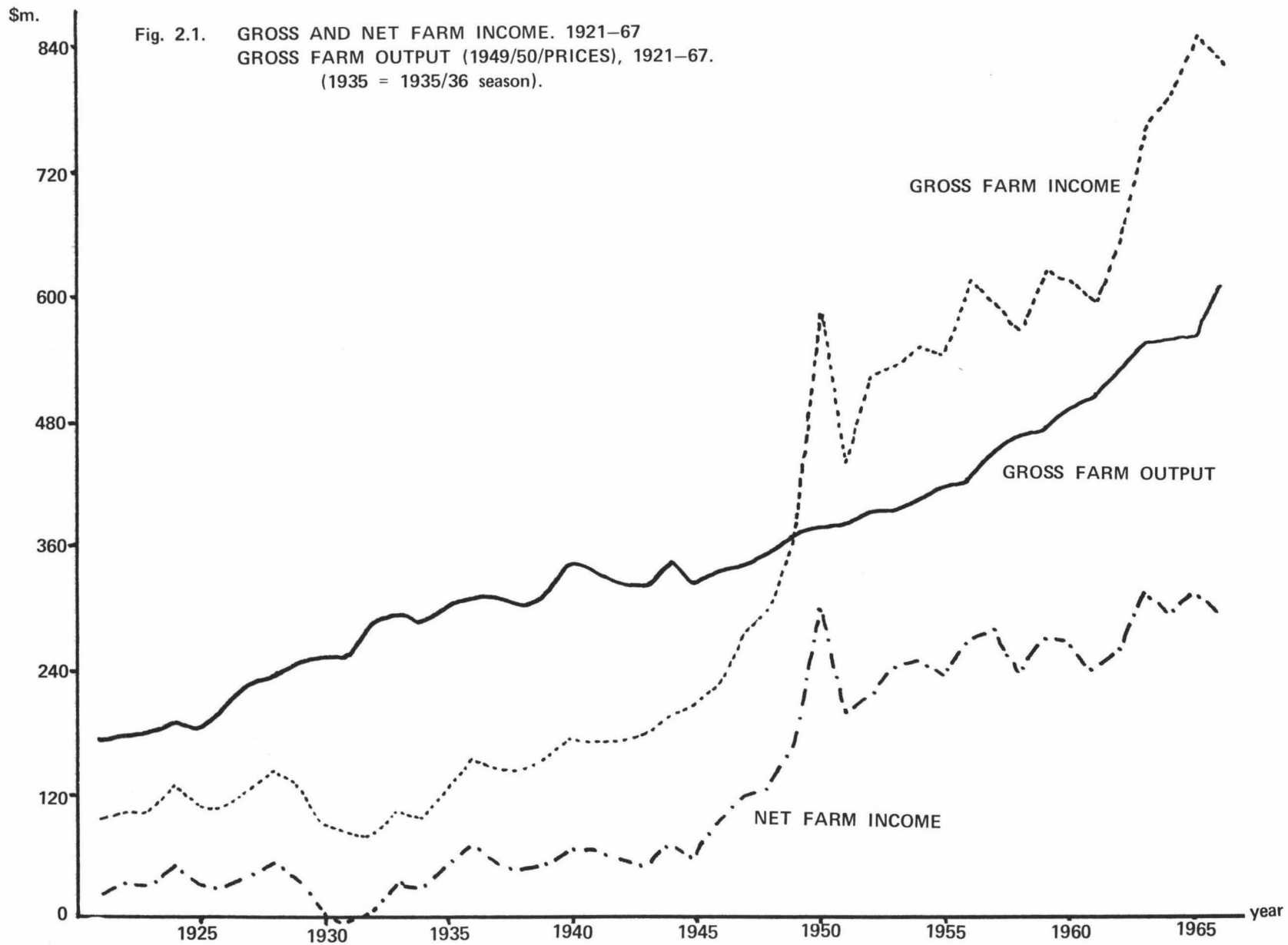
Figure 2.1¹ shows how gross farm income remained approximately constant during the period 1921-1940, but showed a rapid increase in the value and volume of output from 1945 onwards. Net farm income (N.F.I.) follows the pattern of gross farm income, but tends to be an increasing proportion of gross farm income in the three latter decades. However, much of the growth in gross farm income and net farm income has been due to inflation and/or high prices and a better indicator of growth is shown in real terms (1949-50 prices) by gross farm output (G.F.O.), which has been rising steadily over the period. Gross farm output is in effect a measure of the volume of production measured in 1949-50 prices and so indicates that the relatively constant gross farm income between 1921-40 was a result of low prices. Volume production was in fact growing throughout this period.

2.3 GROSS PRODUCTIVITY

This increased volume of output is a result of increased resource use and increased productivity i.e. a greater output is achieved for a given quantity of input or put another way; the same output is produced with less input. Productivity studies show that the increased use of inputs (e.g. capital and labour) do not entirely account for the growth in output. This is because technological advances must also be considered as an input when the above definition of productivity is used.

1 All Data From: D.D. Hussey and B.P. Philpott, "Productivity and Income of New Zealand Agriculture 1921-67," Agricultural Economics Research Unit, (A.E.R.U.) Lincoln College. Research Report No. 59. July, 1969.

NOTE: The A.E.R.U. has not updated the data appearing in research report No. 59. The New Zealand Institute of Economic Research (Inc.) has prepared some estimates for three-year averages, the last of these being for 1969-71, which will update A.E.R.U. Report No. 59. However, at the time of writing the estimates are not complete and any that are remain confidential. Private communication.



Gross output per unit of aggregate input (or gross productivity) has changed over the period 1921/22 - 1966/67 as is shown in Figure 2.2.¹ The components making up gross output are combined into a volume index of gross farm production.

Aggregate inputs consist of land, capital, labour and real working expenses used in agriculture. The annual input of capital is measured at five per cent of the value of real capital, plus five per cent of the real unimproved value of land. The real unimproved value of all agricultural land in counties in 1949-50 was \$329.9 million and represents the unchanging physical input of unimproved land. All men occupied in agriculture were valued at the standard wage for 1949-50 i.e. \$700 per man per year. Real working expenses are the sum of the non-factor inputs.

Figure 2.2 indicates that the data, on the basis of gross output, can be divided reasonably conveniently into three distinct periods:

- (i) 1921/22 - 1938/39 shows a fluctuating growth trend.
- (ii) 1939/40 - 1945/46 reveals a relatively constant gross output.
- (iii) 1946/47 - 1966/67 depicts a smooth and rapid rate of increase in gross output.

Any reasons put forward to explain the shape of the gross output curve must be subjective but undoubtedly the widespread use of aerial topdressing, more fertilizer, new and more intensive management techniques and increased mechanisation must account for at least part of the increased rate of gross output since 1950.

Prior to the war the aggregate inputs curve is characterised by a smooth, slightly inclined curve, whilst during the war years and particularly in the post-war period, inputs fluctuated over an overall upwards trend. Increased gross

¹ Ibid., p. 33. Data has been adapted so that data for each year is presented as a per centage of 1921-22.

productivity as well as increased inputs has contributed to output growth as is shown in Table 2.1.

TABLE 2.1 Annual Average Compound Growth Rates.
Per Cent Per Year.^a

Time Period	Aggregate Inputs	Gross Productivity	Gross Output
1921/22 - 1966/67	1.66	1.39	3.04
1921/22 - 1938/39	1.26	1.68	2.97
1939/40 - 1945/46	0.21	0.94	1.11
1946/47 - 1966/67	2.53	1.29	3.53

a Calculated from: D.D. Hussey and B.P. Philpott,
A.E.R.U. Research report No. 59. July, 1969, p. 33.

Over the whole period 1921/22 - 1966/67 aggregate inputs have contributed more to the growth in gross output than has gross productivity. This is also the case for the period 1946/47 - 1966/67. However for the pre-war and war periods gross productivity contributed more to the growth of gross output than did aggregate inputs. The reason for this disparity could be due to the fact that in the pre-war and war periods prices for produce were low (compare G.F.I. with G.F.O. in Figure 2.1) which may have caused farmers to utilize existing resources more fully. The disparity could also be due to the 'running down' of capital during the depression and war years and then being made good as inputs became available in the post-war period.

index no.'s
of 1921/22

Fig. 2.2. GROSS OUTPUT, AGGREGATE INPUTS AND GROSS PRODUCTIVITY
1921 - 67.

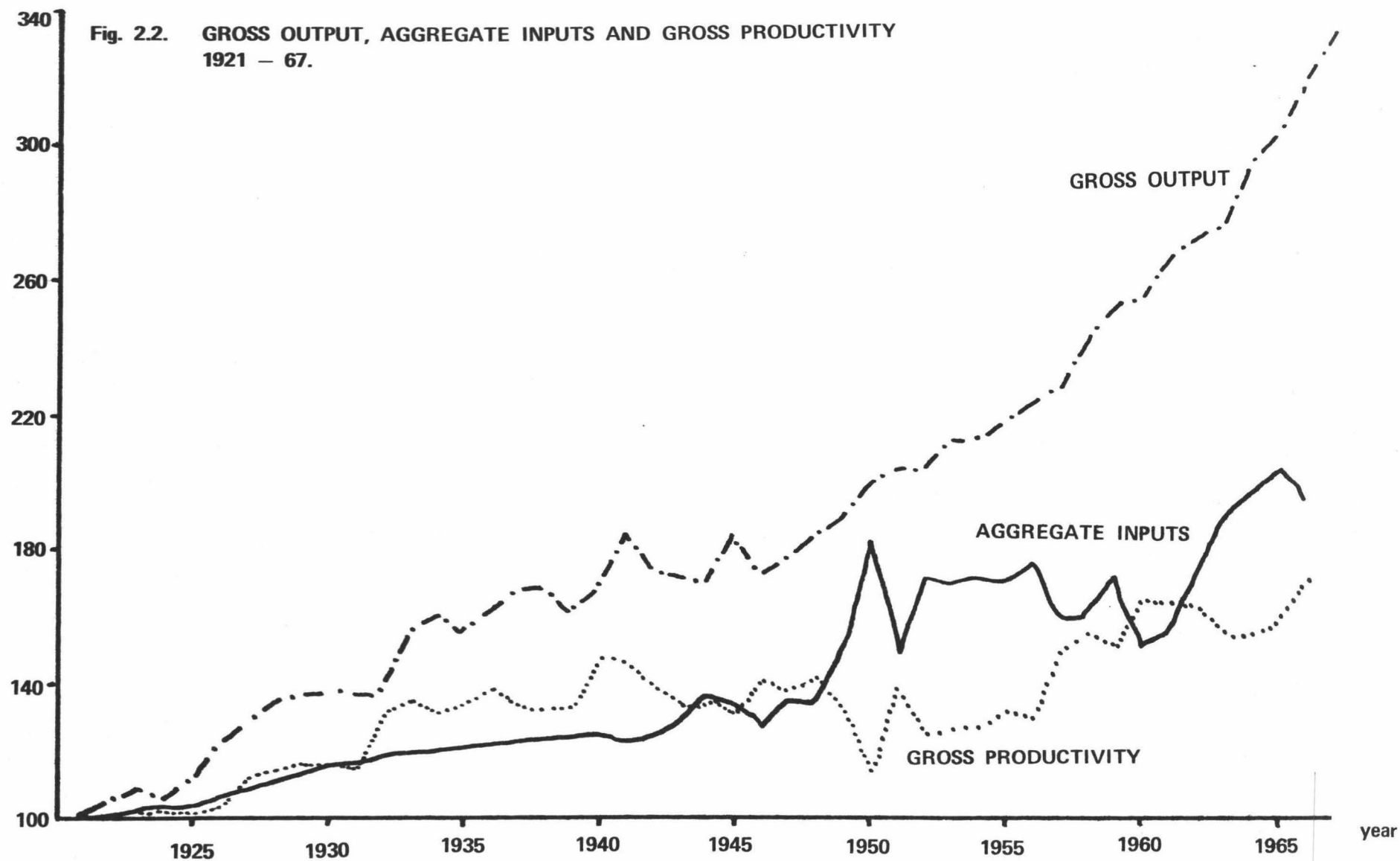
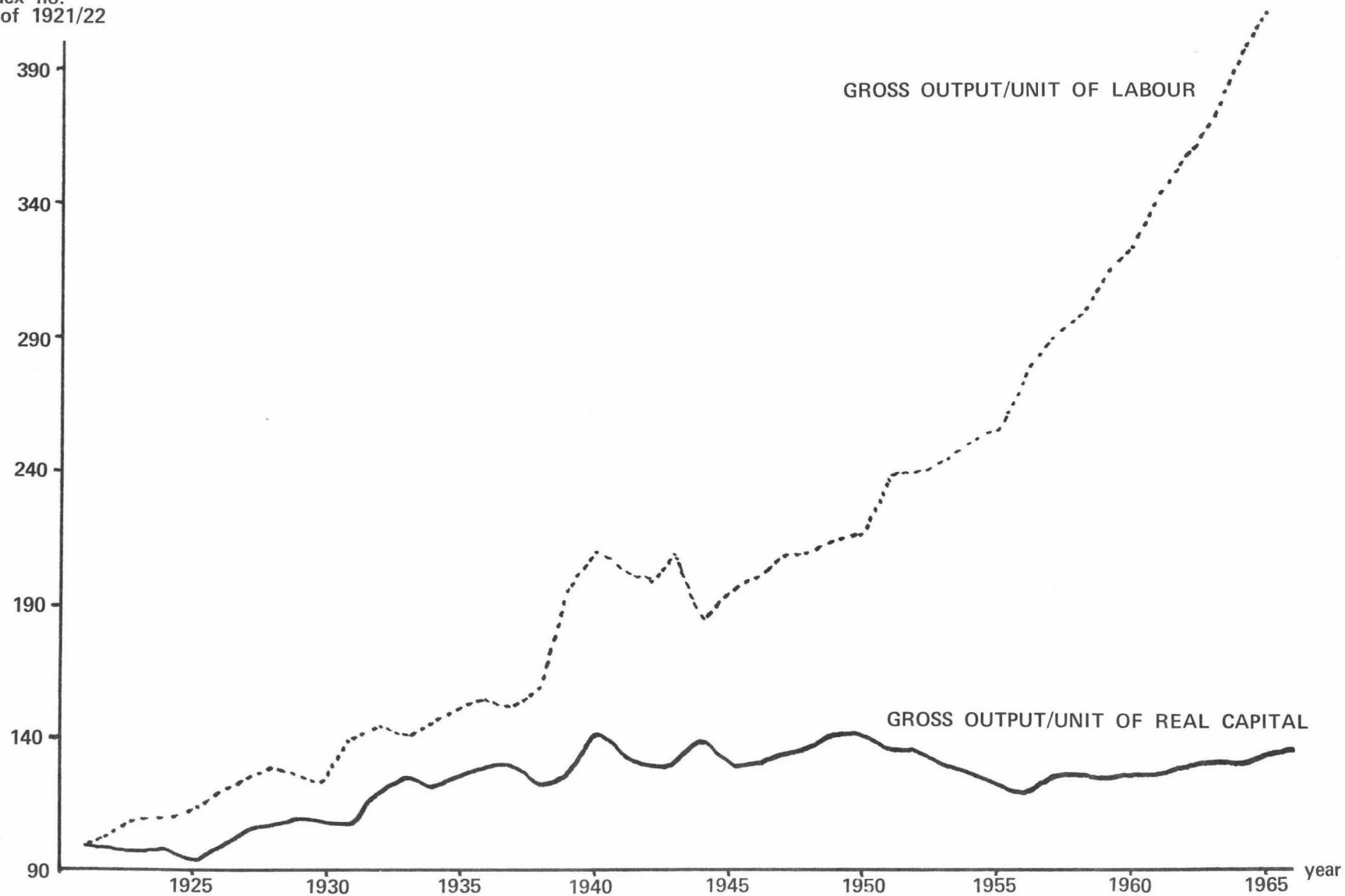


Fig. 2.3. PARTIAL PRODUCTIVITY RATIOS. 1921 — 67.

Index no.'s
% of 1921/22



2.4 PARTIAL PRODUCTIVITY TRENDS

Over the period being considered it is of interest to note the productivity trends of individual inputs. Partial productivity ratios for capital and labour are shown in Figure 2.3.¹ The large increase in labour productivity is a consequence of the labour force declining since 1935 and because of the large increase in real capital (see Figure 2.5) which has substituted the outgoing labour and meant in effect that each remaining labour unit now has a much larger increment of capital with which to work. This is indicative of the change in size that has occurred over the years and illustrates the extra capital that is required for one man to be fully and efficiently employed in farming. It may also justify the observation made by Philpott² that: "... New Zealand has always ranked highest in the world for output per man but nearly always lowest for output per acre". For the period 1921/22 - 1966/67 the rate of increase in the gross output per unit of real capital has remained substantially the same although the average for the last five years of the period is 31.8 per cent higher than in 1921-22.

2.5 MAJOR INPUTS

It was stated earlier that the large growth in gross output was partially a result of 'more fertilizer' and 'increased mechanisation'. Figure 2.4³ shows the upwards trend in real

1 Ibid., Gross output data (row 14), p. 24; Labour data (Column 2), p. 43; and Capital (Columns 1 + 2 + 3 + a constant land value of \$329.9 m.). All data has been adapted so that data for each year is presented as a per cent of 1921-22.

2 M.J. Moriarty (ed.), N.Z. Farm Production and Marketing (Wellington; N.Z. Institute of Public Administration, 1963) p. 16.

3 Hussey and Philpott, op. cit., (row 3 + 4 and 6), p. 24.

growth of machinery, fertilizer and lime. Increased mechanisation (Y) is taken to be a function of fuel (x_1), oil (x_2) and grease (x_3)

$$\text{i.e.} \quad Y = f(x_1, x_2, x_3)$$

The trend in real growth of mechanisation is shown to be a sigmoid curve with the fastest rate of growth occurring between about 1949 and 1957.

The two inputs depicted in Figure 2.4 are of course only part of the aggregate input parcel. Total inputs may be categorised into three groups:

- (i) Non-factor inputs¹ (of which fertilizer and fuel etc. are part).
- (ii) Capital² (here taken to be livestock, land improvements, plant and machinery).
- (iii) Labour.³

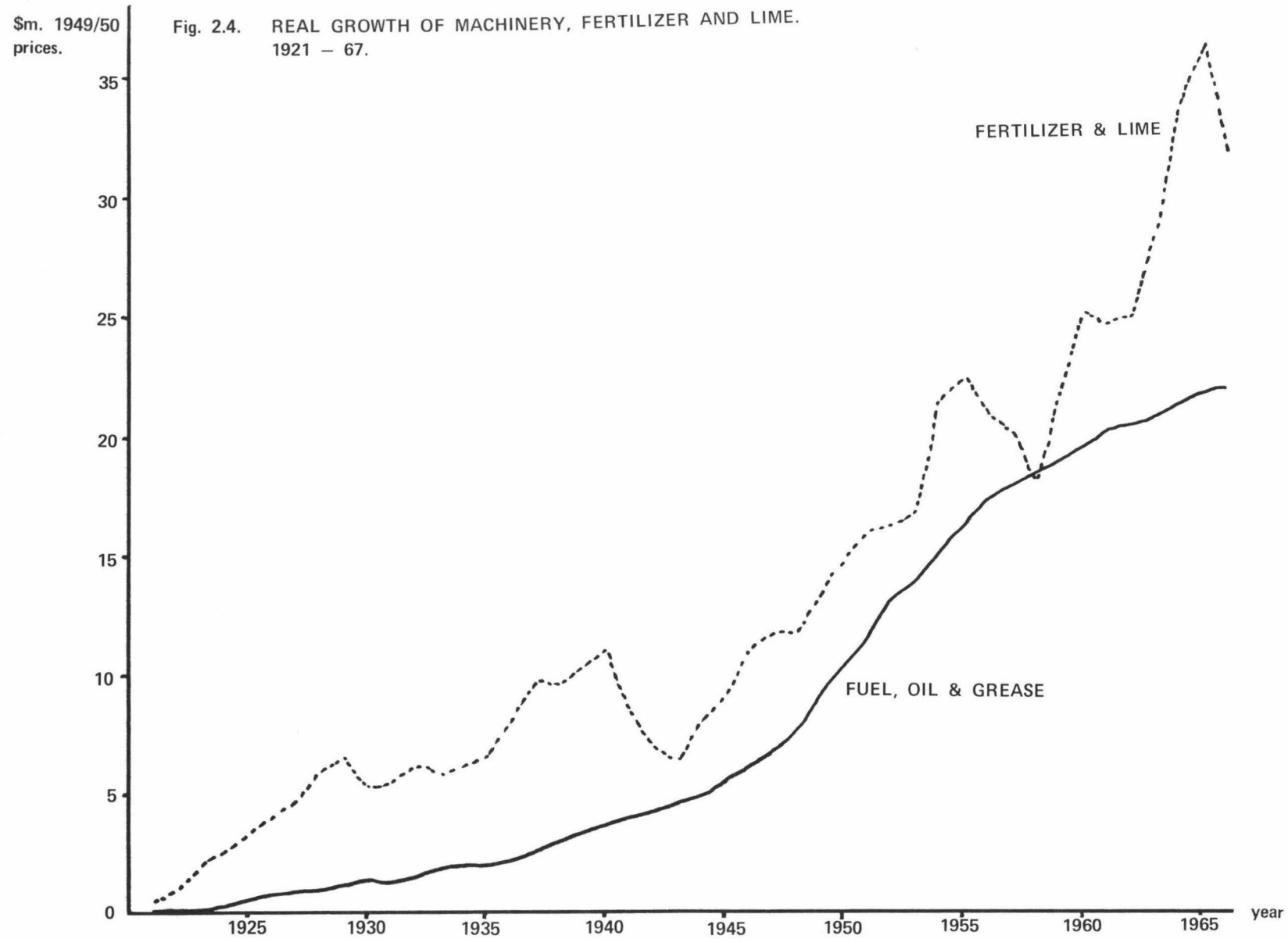
The impossibility in arranging a convenient scale for the three above input categories in absolute real terms, requires that they be shown in Figure 2.5 as percentages of their 1921-22 levels.

The large fluctuations in total non-factor inputs in the post-war period compared with the comparatively smooth curves of real capital and labour inputs over this time, shows that non-factor inputs were largely responsible for the fluctuation appearing in aggregate inputs and thus in gross productivity (see Figure 2.2). Since expenditure on non-factor inputs is closely related to gross farm income and to the extent that gross farm income in the post-war period fluctuates; then varying gross farm income will account for at least a portion of the variation in the purchase of non-factor inputs.

1 Hussey and Philpott, op. cit., (row 12), p. 24.

2 Hussey and Philpott, op. cit., (column 4 + \$329.9 m. to each row in that column), p. 31.

3 Hussey and Philpott, op. cit., (column 2), p. 43.



To show how the composition of individual real inputs¹ (making up total non-factor inputs) has changed over time; the average percentage of each input to the total of non-factor inputs is computed. This has been done for three different, three year periods: 1921, '22, '23; 1946, '47, '48; and 1964, '65, '66. The results are shown in Table 2.2.

TABLE 2.2 The Changing Composition of Real Inputs
Making Up Total Non-factor Inputs.
Averages For 1921-23, 1946-48
and 1964-66.

Category of non-factor input	Average % for Three years of Total Non-factor Inputs		
	1921-23	1946-48	1964-66
Farm Requisites	8.54	5.42	6.02
Fertilizer	1.95	9.48	15.88
Lime	0.66 } 2.61	1.52 } 11.00	0.92 } 16.80
Seeds	1.60	0.72	0.13
Fuel, oil, grease	0.33	6.41	10.70
Power	1.95	2.11	1.50
R. & M.			
(i) Buildings	11.83	8.44	10.27
(ii) Plant and Machinery	4.56	7.70	7.57
Rail & Cartage	5.39	4.88	4.40
Depreciation			
(i) Buildings	6.96	4.96	6.04
(ii) Plant and Machinery	3.32	7.50	7.84
Other Inputs	52.88	40.82	28.70
TOTAL	99.97	99.96	99.97

1 Hussey and Philpott, op. cit., p. 24.

The increase in fertilizer and lime usage, and fuel, oil, and grease compared with the absence of any marked percentage increase over the forty-six year period of other inputs lends support to the fact that along with capital (and that includes machinery), increased fertilizers have been largely responsible for an increased output from the agricultural sector.

Growth in real capital inputs (see Figure 2.5) has experienced a steady and smooth upwards trend but from 1950 increased at a very much faster rate. The initiation of this increased investment at this time can undoubtedly be linked to the rising price of wool in that year (see Figure 2.1). Of the components making up real capital, plant and machinery showed by far the biggest expansion followed by improvements and then livestock. Real land value remained a constant \$329.9 m.

Labour input decreased slightly between 1921-26 and then peaked at 163,000 man years in 1935. Since wheat, other than for one short sporadic rise, the labour force in agriculture has continued to decline to an all time low of 113,100 man years in 1966. This decline is likely to continue.

The relationship between increasing real capital and a declining agricultural labour force - especially since 1950, suggests that over this period capital has been substituting for labour.

Since nominal wages have increased more rapidly than prices of farm inputs; it suggests that over time capital will continue to substitute for labour. Indexes of nominal award wages and prices paid for farm inputs are shown in Table 2.3.

The nominal award weekly wage rates for adult males assumes that farm workers obtain at least this wage overall. Wage rates, being an index of nominal wage rates, are more restrained than if the index was constructed of actual ruling rates. The table illustrates, that wages increased more rapidly than capital inputs into agriculture. Capital is likely to continue to substitute for labour as its relative price falls.

Index no.'s
% of 1921/22

Fig. 2.5. TOTAL NON-FACTOR INPUTS, REAL CAPITAL AND LABOUR
1921 - 67.

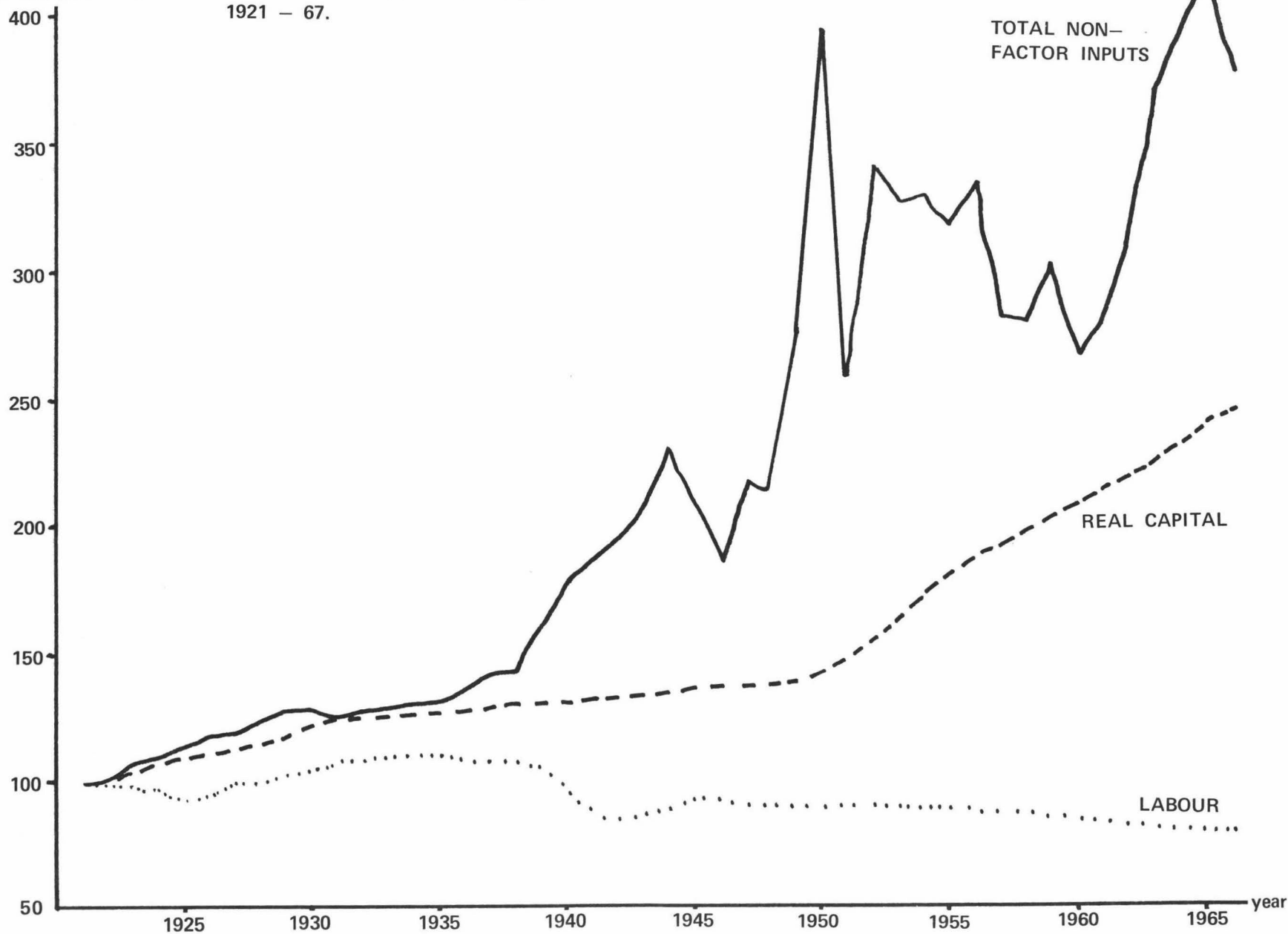


TABLE 2.3 Index Numbers of Costs and of Nominal
Award Adult Male Wage Rates. (1960 = 1000)^a

Year	Prices paid for commodities used by farming	Nominal award weekly wage rates adult male
1967	1,213	1,265
1968	1,104	1,313
1969	1,169	1,391
1970	1,263	1,559*

a Agricultural Production Council, op. cit.,
 April 1971, p. 39.

* Provisional.

2.6 SUMMARY

Analysis of aggregate data for N.Z. agriculture shows that over the period 1921-67 gross farm output increased as a result of increased real capital, increased real non-factor inputs (especially fertilizer) and increased gross productivity.

New technologies have enabled labour productivity to increase (especially since 1950). This increase in labour productivity has been simultaneously accompanied by large increases in real capital inputs (again, especially since 1950). It is reasonable to postulate therefore that capital has been a partial substitute for labour over this period. Increased machinery and improvements constituted the greatest proportion of the increased total real capital.

Given that additional aggregate inputs are a function of aggregate farm investment, and that since 1965/66 - 1969/70 additional aggregate farm investment has fallen successively from \$136.8 m. to \$39.0 m;¹ then the annual average compound growth

¹ Agricultural Production Council, op. cit., April 1971, p. 52.
 See also: "Farmers Attack Minister," Manawatu Evening Standard, (Palmerston North) February 19, 1971, p. 3.

rate for aggregate inputs, over these years, is likely to have declined. Consequently the targets set by the National Development Conference (N.D.C.) for agricultural exports have not been met.¹ If the decline in recent years, in the growth rate of aggregate inputs is to be compensated for; then the necessary rate of growth in gross output will only be achieved by increasing the growth rate of gross productivity.

For gross productivity to increase in the future requires that more output be achieved with the same or less inputs or that current output be achieved with less inputs. Translated into practical terms this means that each labour unit must milk more cows etc. Capital inputs must be more efficiently utilized. As Webb (1968)² said:

There is a lot of over capitalization in this [N.Z.] high cost structure of farming today. If you have two 60 cow farms along side each other you have two dairy sheds, two tractors, two sets of milking machines, two vats, two of everything. And the whole lot can be wrapped up by one man

A needed rationalization of resources, used in agriculture, is thus implied as being a requirement to increase gross productivity. Restructuring of economically non-viable farm units is one way of partially attaining this rationalization of resources.

NOTE: Initial input and output data is heterogeneous in nature. In order to aggregate such data into workable groups involves using a system of index numbers. A technique not without its problems because of a changing input-mix, inflation, and changes in the relative prices of inputs over time. The data is used with an awareness of the above-mentioned weaknesses.

1 Agricultural Committee, Report to the Second Plenary Session - May, 1969. The National Development Conference, Wellington: N.Z. Government Printer, 1969, p. 10.

2 McLauchlan, op. cit., N.Z. J. of Agriculture, June 1968, p. 28.

CHAPTER III

NEW ZEALAND AGRICULTURAL LABOUR SITUATION. PAST AND PROJECTED

In Chapter Two labour was considered as an homogeneous input. In this Chapter the N.Z. agricultural labour force will be examined in more detail.

3.1 PRIMARY AND TOTAL LABOUR FORCE

The contribution of the primary industry¹ labour force relative to the total national labour force over time is shown in Table 3.1. Column one shows that breadwinners as a percentage of total population has remained approximately constant over the period 1896-1966. A slight decrease being discernable from 1946-1966 relative to 1896-1936. Column two shows that primary producers as a percentage of breadwinners has shown a continuous decline (with the exception of 1936); being in 1896, 36.0 per cent of breadwinners and in 1966 only 13.7 per cent. Column three indicates that the percentage of total population in primary industry has continuously decreased from 15.1 to 5.2 per cent over the period. Extracting the total agricultural labour force component from the primary labour force we note that an absolute decrease in the agricultural labour force from about 1935 has also been occurring (see Figure 2.5).

1 Primary rather than agricultural should here be noted. Primary includes all those in mining, fisheries, forestry and agriculture. The increase in primary producers as a percentage of breadwinners in 1936 is probably partially explained by the increase in labour used in forestry during the time of the depression. Agricultural labour is by far the biggest component of the primary labour force.

TABLE 3.1 Primary Producers as a Percentage
of Breadwinners and of Total Population.^a

	(1)	(2)	(3)
Date of Census	Breadwinners as a % of total population	Primary producers as a % of breadwinners	% of total population in primary industry
1896	41.7	36.0	15.1
1906	44.9	31.0	13.3
1916	41.4	30.4	12.1
1926	41.6	23.9	10.6
1936	43.2	27.2	11.7
1946	39.6	21.3	8.4
1956	37.6	17.1	6.4
1966	38.3	13.7	5.2

a Reports of the Census, N.Z. Quinquennial Censuses, Statistics Dept., Wellington. Various Volume numbers. Titles of volumes usually "Occupations of the People" or "Industries and Occupations".

3.2 ESTIMATION OF THE TOTAL AGRICULTURAL LABOUR FORCE

It was noted in Chapter Two that the estimate of the total agricultural labour force was that calculated by Hussey and Philpott. Estimating the total N.Z. agricultural labour force is not without its problems.

3.2.1 Problems of Definition

The 1966 N.Z. census shows that the number of persons engaged in farming occupations does not coincide exactly with the number employed in the farming industry. A number of persons

engaged in farming occupations are employed in other industries, but on the other hand a number of persons in non-farming occupations would be employed in the farming industry. For example, gardeners are included under farm occupations but a number are employed in parks and gardens. They will be included in the labour force of the non-farm sector. Examples of people in non-farming occupations who may be employed in the farming industry are accountants, cooks, and pilots of topdressing planes. For 1966 therefore under the 'occupations' heading there would be 126,200 persons in agricultural and livestock production, whilst under the 'industries' heading there are 125,100 persons in agricultural and livestock production. A difference of 1,100.

For industries other than farming, fishing, hunting and trapping, the N.Z. Labour Department has half yearly returns from employers. Consequently the Department's estimate of the farm labour force, is the residual remaining, after persons known to be in employment in other industries are subtracted from a postulated figure for the total of all persons thought to be in employment. The residual is adjusted in accordance with the latest quinquennial census, which, in respect of farming, is the only reasonably accurate record of the total agricultural labour force.

Table 3.2 shows decennial data broken down into Maori and European components as per 'farming industry'. Philpott's estimates for these years is given for comparison.

The following points are relevant to Table 3.2:

- (i) The relatively small contribution that European females and total Maoris make to the census total.
- (ii) The decrease since 1935 of the total agricultural labour force.
- (iii) In the 1926 Census there was an error in the classification of the number shown to be engaged in agriculture.

As a result of this, the number indicated is too low.¹ The recession that followed the prices of 1919-20 is known to have reduced the number of agricultural employees, employers and those working on their own account. Philpott's estimate therefore may be more accurate than that from the census of 1926.

TABLE 3.2 Total Agricultural Labour Force
1926 - 1966. ('000's).

Year	No. of Europeans employed in agricultural & pastoral pursuits			No. of Maoris employed in agricultural & pastoral pursuits			Census Total ^a	Philpott's estimated
	Male	Female	Total	Male	Female	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(3 + 6)	
1926	117.0	3.4	120.3	6.9	1.5	8.4	128.8	137.0
1936	144.5	6.4	150.8	8.5	1.5	10.0	160.8	163.0
1945	107.8	10.8	118.5	8.1	1.0	9.1	127.6	130.0
1956	108.0	8.0	116.0	8.8	.9	9.7	125.7	130.2
1966	103.4	13.1	116.5	7.3	1.4	8.7	125.1	118.8

a Components may not sum to total because of rounding.

b Mussey and Philpott, op. cit., p. 43.

(iv) The 1936 census total is distorted by the effects of the depression as unemployed persons were included in the industry in which they were normally engaged and hence the total is probably somewhat overstated.

(v) At the time of the 1945 census demobilization was not completed and therefore soon after 1945 the census total would have been greater than 127,600.

¹ Private communication between author and Statistics Dept.

(vi) The census totals for 1956 and 1966 are shown to be approximately the same. The 1961 census showed the total agricultural labour force to be 121,641. The increase from 1961 to 1966 is accounted for by an 'apparent' increase in females engaged in agriculture because of the introduction of tax legislation in the intervening period which made special provision for family labour employed on farms. Therefore the 1966 census total to be consistent with past censuses should be more like 119,000.

Thus the five yearly census is the most reliable indication we have of the total labour force engaged in agriculture. In the absence of more accurate information, the estimations of Philpott is the most acceptable, given the evidence available.

3.3 ESTIMATES OF FUTURE MANPOWER REQUIRED IN AGRICULTURE AS MADE BY THE AGRICULTURAL DEVELOPMENT CONFERENCE (1964) AND THE NATIONAL DEVELOPMENT CONFERENCE (1968).

In the light of the observation and evidence presented that labour in agriculture is decreasing both relatively and in absolute terms; it is convenient at this point to look at the future labour requirements, as determined by the Agricultural Development Conference (A.D.C.) 1964 and the National Development Conference (N.D.C.) 1968.

On the basis of varying productivity rates of labour (defined to be the number of ewe equivalents (E.E.) per member of the farm labour force) the A.D.C. calculated five different estimates of the farm labour force that would be required if the target of 111 m. E.E. (as set down by the targets committee) was to be reached by 1972. See Table 3.3. Between 1952-62, labour productivity was estimated to have increased by 37 per cent. If the same increase in productivity continued for the ten years 1962-72 and if by 1972 there were 111 m. E.E. then 122,800 labour units would be required. In view of the trend of an absolute

decrease in farm labour as discussed above, one would have to postulate two possibilities:

Either (i) the target of 111 m. E.E. by 1972 would not be reached,

and/or (ii) labour productivity (as defined) would fall below its 1952-62 level.

TABLE 3.3

A.D.C. Estimates of Labour
Requirements 1972.^a

Labour productivity increase 1962-72	Labour Force Required by 1972
30%	129,800
34%	126,000
37% (same as 1952-62)	122,800
40%	120,700
44%	117,200

a Report. Agricultural Development Conference
1963-64. Wellington: N.Z. Government Printer,
February, 1966, p. 185.

In actual fact it is estimated that for 1969/70 - 1970/71 total E.E.'s stood at 101.6 m.¹ If we assume the total agricultural labour force to have been 116,000 in 1970-71; then the ratio of E.E.'s per labour unit equalled 876. This gave an increase in labour productivity between 1962-71 of 33.1 per cent, which was 3.9 per cent lower than for the period 1952-62.

The continuing decline in farm labour would further call into serious doubt the adequacy of the estimates of manpower requirements, as expressed by the Agricultural Committee of the 1968 N.D.C., that will be required by 1973 and 1979. Their estimates are shown in Table 3.4.

¹ Agricultural Production Council, op. cit., April 1971, p. 12.

TABLE 3.4 Estimates of Manpower Requirements
for Farming (including Farm Contracting).^a

1968	1973	1979	1968-73		1973-79	
			Increases		Increases	
			No.	%	No.	%
125,000	127,000	130,000	2000	1.6	3000	2.3

^a Labour Committee, Report to the Second Plenary Session - May, 1969. The National Development Conference, Wellington: N.Z. Government Printer, 1969, p. 24.

NOTE: People employed in farm contracting services ARE taken into account in deriving the census estimate of the total farm labour force.

Since the agricultural labour force is unlikely to increase and since the 1972 target of 111 m. E.E. has not been reached; then productivity of the existing labour force must be improved still further by the more intensive dissemination and application (by consulting officers) of technical knowledge. Cronin and Candler¹ in a study of factors hindering increased production on the Rangitaikai Plains, found that 36 per cent of the less progressive dairy farmers, who were interested in developmental work, lacked technical knowledge and confidence to develop. An increasing amount of capital to substitute for declining labour (see Chapter II) and greater utilization of profitable non-factor inputs will also be required.

3.4 COMPOSITION OF THE AGRICULTURAL LABOUR FORCE - WITH EMPHASIS ON OWNER-OPERATORS

The decrease in the number of people engaged in

¹ M. Cronin and W. Candler, Factors Hindering Increased Production on the Rangitaikai Plains and in Galatea, Massey University, Palmerston North: March, 1968.

agriculture since 1935 has been documented above. It is important to note the changing composition of this labour force in terms of age, and the relative proportions of employees to owner-operators over time. The composition of the labour force will, to a large extent, determine the future economic structure of N.Z. agriculture.

Owner-operators are of interest because their number and age patterns can provide an insight into the past, present and future structure of agriculture, with regards to the size of holdings, the rural population and its needs (e.g. schools, hospitals, roads and communications, etc.). Insight into the amount of capital required to finance a farm in the future, the resources that prospective owner-operators will be required to manage and the adequacy of the rural population will also be obtained.

3.4.1 Source of Data

The data of the two populations, total owner-operators (T-O-O) and dairy owner-operators (D-O-O), has been obtained entirely from the national quinquennial census. However, since age intervals are divided into ten year age groups it is most convenient to report and project the population by time intervals of ten years. Consequently data by age groups is given for 1896, 1906, 1916, ..., 1966.

3.4.2 Accuracy of Age Reporting

A general statement as to the accuracy of the data in the two populations is here relevant even though the following remarks are made with respect to the experience of American findings on age reporting. No similar work for N.Z. data is known of.

One common human error is to round figures even though

precise results may be desired or requested. This is particularly evident in census returns where the age in integral years is sought. Particularly does this arise for ages ending with the digit 9, and to a lesser extent frequently with digits, 2, 5 and 8. In the U.S.A. women are less accurate in reporting age than men, though little difference is found in Australia, Canada and the United Kingdom. Reporting in the latter countries would appear to be more accurate than in the U.S.A.¹ Inaccurate age reporting is not thought to be a significant problem in New Zealand.

3.4.3 Layout of Data for total owner-operators and dairy-owner-operators

The relationship between the total number of owner-operators and the replacement of an older generation of owner-operators by a younger generation is important.² The relationship is a dynamic one as is shown by Tables 3.5 and 3.12 (pages 61 and 80 respectively). In these tables original data is used up to and including 1966. The data is presented so that each column reports the age groups as shown by the respective census e.g. in Table 3.5 under 1916 the column shows there were 2,100 (< 25 years of age), 11,700 (25 - 34), 15,700 (35 - 44), 12,700 (45 - 54), 8,200 (55 - 64) and 5,600 (≥ 65).

Each column is off-set against the previous one so that the lines going across the tables represent cohorts. Where a cohort is defined as a population group (e.g. farm owner-operators) that enter on some stage of the life cycle simultaneously (here a cohort is characterized by the census year in which the farmers are less than twenty-five years of age), and hence may be looked upon as a group of people travelling through time together. Some

1 R.J. Myers, "Accuracy of Age Reporting in the 1950 United States Census," American Statistical Assoc. J., 49, 268, 826. December, 1954.

2 D. Kanel, "Age Components of Decrease in Numbers of Farmers, North Central States, 1890-1954," J. Farm Economics, 43, 2, 247. May, 1961.

members of the group die or retire from the population whilst others enter. Among those who survive to each age there will emerge a typical pattern of behaviour that may be taken to characterize the group. This typical pattern may be used to project the characteristics of a population group. For example, take the 1916 cohort. In 1916 there were 2,100 (<25) owner-operators, 10 years later (i.e. 1926) this group (which had now become the 25 - 34 age group) had increased to 11,200; by 1936 this group had increased to 15,000 (35 - 44), but by 1946 had decreased to 15,100 (45 - 54) and by 1956 had decreased to 10,500 (55 - 64) and by 1966 had finally diminished to 3,800 (≥ 65). It must be emphasized that these increases and decreases are net changes. That is, entries minus withdrawals. Entry is made by farm purchase, inheritance or some form of tenancy. Withdrawals are due to retirement, forced sale, death and out migration to non-agricultural employment. Generally net entries exceed net withdrawals up to the age group 35 - 44 but thereafter net withdrawals exceed net entries.

3.5 TOTAL EUROPEAN OWNER-OPERATORS (T-O-O)

In collecting the data, because of the nature in which age groups are reported from census to census, adjustments to the data had to be made. Changes in definitions, omissions and poor instructions on the census form made the systematic and consistent collection of data difficult. The precise method in which adjustments were made is shown for one census year in Appendix B.

Up to and including the 1945 census, Maoris were enumerated separately at each census. The information pertaining to Maoris was insufficient to categorise them into owner-operators by age groups in these years; consequently they were completely omitted from the series. In 1936 it was estimated that there were probably less than 3,000 Maori owner-operators, and in 1966 approximately 2,000 or 3 per cent of the total European owner-operators. Their numbers are therefore relatively insignificant.

Maoris were included in the 1956 and 1966 censuses,

TABLE 3.5 **Total European Owner-Operators.** Original Data Up to and Including 1966 ('000)
All Data Rounded to Nearest 100.

Cohort	1896	1906	1916	1926	1936	1946	1956	1966	1976	1986	1996	2006
2006												1.9 (.5)
1996											2.1 (1.0)	8.6 (4.1)
1986										2.3 (1.5)	9.4 (6.2)	11.7 (7.6)
1976									2.5 (2.0)	10.3 (8.2)	12.7 (10.2)	11.0 (8.8)
1966								2.7	11.1 (11.1)	13.7 (13.7)	11.8 (11.8)	7.5 (7.5)
1956							2.9	11.9	14.7 (14.7)	12.7 (12.7)	8.0 (8.0)	2.9 (2.9)
1946						2.2	13.7	17.0	14.7 (14.7)	9.3 (9.3)	3.3 (3.3)	
1936					2.5	10.5	19.6	16.9	10.8 (10.8)	3.9 (3.9)		
1926				2.0	11.1	16.2	16.7	10.6	3.8 (3.8)			
1916			2.1	11.2	15.0	15.1	10.5	3.8				
1906		10.6	11.7	16.6	17.7	13.0	6.1					
1896	2.0	6.7	15.7	15.5	14.3	7.1						
1886	} 14.3	9.8	12.7	9.4	7.6							
1876		} 11.7	8.2	5.2								
1866			5.6									
1856	} 13.4	4.3										
1846												
Total	32.7	43.1	56.0	59.9	68.2	64.1	69.5	62.9	57.6 (57.1)	52.2 (49.3)	47.3 (40.5)	43.6 (31.4)

therefore it was necessary to establish the number of Maori owner-operators separately from the Maori census volumes and deduct respective age groups from the combined European and Maori total. This was also done when establishing the number of European dairy owner-operators by age groups.

Where censuses enumerated owner-operators as being unspecified with regards to their age groups within a particular occupation class they have been distributed proportionately to age groups.

Data for 1946 has been adjusted from the 1945 census.

3.5.1 Reliability of Total European Owner-Operator Data

To check the reliability of the data expressed in Table 3.5 it was hypothesised that the number of holdings greater than or equal to eleven acres would most nearly equal the number of total owner-operators for any given census year. Table 3.6 compares these two sets of data.

The reasons for the large discrepancies between total owner-operators and the number of holdings in 1926 and 1946 will be apparent from points (iii) and (v) on pages 53 and 54 respectively. Throughout the series the number of holdings are greater than the total number of owner-operators. This is not unexpected since a proportion of holdings, designated as such may be run as separate entities or as one farm, but still owned by the same owner. This situation has also proved a problem in reconciling the number of farmers with the number of holdings existing in England and Wales.¹

A further difficulty in attempting to correlate the number of holdings with the total number of owner-operators is the definition of what acreage constitutes a full time living to its proprietor. There is nothing to say that a farm of < 11 acres could not provide a full time living to its owner if he, for

¹ B.E. Cracknell and H. Palea, "Farm Size and Farm Business," Agriculture, Ministry of Agriculture, Fisheries and Food. 65, 12, 593. March, 1959.

TABLE 3.6

Comparison of Total Owner-Operators
and the Number of Holdings ≥ 11 acres.

Date of Census	No. of European owner operators (1)	No. of Maori owner operat- ors (2)	Total (1+2) (3)	Total No. of holdings $\geq$ 11 acres ^a (4)	Difference (4 - 3) (5)
1896	32,700	N/A	-	36,140	-
1906	43,100	N/A	-	49,020	-
1916	56,000	N/A	-	61,770	-
1926	59,900	2,760	62,660	70,490	7,830
1936	68,200	2,930	71,130	72,970	1,840
1946	64,100	3,200	67,300	74,170	6,870
1956	69,500	2,740	72,240	72,840	600
1966	62,900	1,960	64,860	65,700	840

a N.Z. Department of Statistics, N.Z. Official Yearbooks:
(Wellington: Government Printing Office, Various Volumes).

From 1896 - 1926 acreage groupings were given for 1 - 10, 11 - 50 acres etc. In 1936 the group range was changed from 1 - 9, 10 - 49 acres etc., therefore the series has been adjusted to comply with the former group ranges. The number of holdings given for 1896 and 1906 are inclusive of holdings ≥ 1 acre inside boroughs. 1916 - 1966 are exclusive. Because farm production statistics give the number of holdings ≥ 1 acre outside borough boundaries for 1896 and 1906 an adjustment was made. All data is therefore shown on an adjusted ≥ 11 acres, outside borough boundaries, basis. 1966 data - private communication.

instance, farmed pigs or poultry intensively. Further there is no guarantee that a farm of 30 acres need be a full time living for its owner. Therefore relating the number of holdings < 11 acres to the number of total owner-operators tends to be somewhat arbitrary.

The method adopted above does however provide a guide line, especially when, in the 1906 census; it is stated that "The actual number of persons described in the census schedules as

having occupations necessitating their occupying holdings of land was 43,438". Even allowing for a few Maori owner-operators this figure correlates extremely well with the estimate of total owner-operators for that year.

Further evidence that the data presented in Table 3.5 is reasonably reliable and consistent are the similar proportions within age groups over time. (see Table 3.7). This Table and Figure 3.1 show the relative stability and regularity of change, between age groups and from census to census. The 1896 and 1916 cohorts depicted in Figure 3.1, and which terminated in 1946 and 1966 respectively indicates that the number of older farmers existing in recent periods are largely determined by the size of the older cohorts. Both cohorts show rapid increases in the number of owner-operators up to 33 - 44 years of age. The 1896 cohort then levels off but falls rapidly between the 55 - 64 to $\geq$ 65 age groups. The 1916 cohort starts to fall rapidly at the 45 - 54 age groups and finally to a lower terminating level than the 1896 cohort. This is indicative of the low $\geq$ 65 age group reported in 1966, which is itself the terminating cell for the 1916 cohort.

3.5.2 Discussion of Trends Shown in the Data

From 1896 - 1956 (with the exception of 1946) the number of owner-operators increased from 32,700 to 69,500. In 1966 the number dropped to 62,900 and the evidence is that this trend will continue. Over the period 1896 - 1966 age groups between census years showed very little significant proportional changes. The < 25 group remained practically constant from 1916 onwards. The censuses 1916, 1926, 1956 and 1966 had a higher proportion of 25 - 34 and 35 - 44 than did other years. The years 1936 and 1946 had a higher proportion of older age groups than other years due to the depression (farmers who normally would have retired, didn't) and the war years.

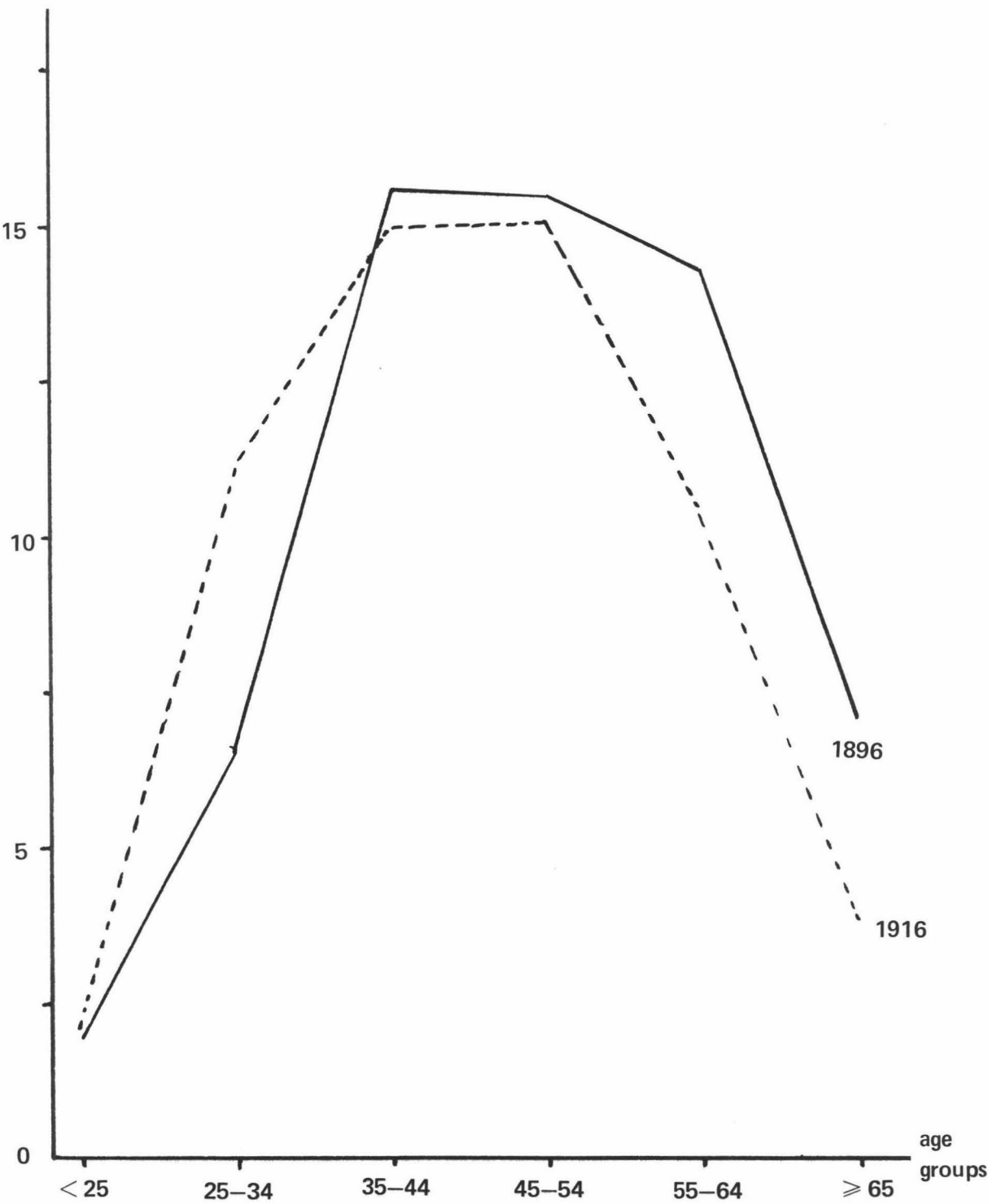
TABLE 3.7

Proportions of Total European Owner-Operators by Age Groups

Cohort	1896	1906	1916	1926	1936	1946	1956	1966	1976	1986	1996	2006
2006												4.4 (1.6)
1996											4.4 (2.5)	19.8 (13.1)
1986										4.4 (3.0)	19.9 (15.2)	26.8 (24.3)
1976									4.4 (3.5)	19.7 (16.7)	26.8((25.1)	25.2 (27.9)
1966								4.3	19.2 (19.4)	26.3 (27.8)	24.9 (29.1)	17.2 (23.8)
1956							4.2	18.8	25.6 (25.8)	24.3 (25.7)	16.9 (19.8)	6.6 (9.3)
1946						3.4	19.7	27.1	25.5 (25.7)	17.9 (18.9)	7.1 (8.3)	
1936					3.7	16.4	28.2	26.9	18.7 (18.9)	7.4 (7.9)		
1926				3.4	16.3	25.3	23.9	16.8	6.6 (6.7)			
1916			3.7	18.7	22.0	23.6	15.3	6.1				
1906		24.6	20.8	27.7	25.8	20.2	8.7					
1896	6.3	15.6	28.3	25.9	20.9	11.1						
1886	} 43.5	22.7	22.7	15.7	11.3							
1876		} 27.2	14.6	8.6								
1866	} 40.9		9.9									
1856		9.9										
1846	9.3											
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0(100.0)	100.0(100.0)	100.0(100.0)	100.0(100.0)

no. of
operators.
(‘000)

Fig. 3.1. NO. OF EUROPEAN OWNER-OPERATORS.
1896 AND 1916 COHORTS.



The fall in the number of owner-operators between 1956 and 1966 was due to a difference of 4,600 under the age of 44 years, (2,600 of these being from 35 - 44 age group). The 45 - 64 age group increased overall marginally by 300 and there was a difference in the ≥ 65 age category of 2,300. Therefore of the decrease in owner-operators between 1956 and 1966 those under 44 years of age, when expressed as a percentage of the 1956 total, comprised 6.6 per cent of the difference and those 45 years and older comprised 2.8 per cent of the difference, i.e. an overall decrease of 9.4 per cent. This is indicative of the fact that more young people who were leaving or not entering agriculture found more opportunities and/or higher remuneration from non-agricultural employment.

In one way this is serious for the industry because a lot of potentially energetic young people are being lost to the industry. However, on the other hand the census does show that whilst those owner-operators employing labour between 1956 and 1966 increased slightly those owner-operators on own account (not employing labour) decreased markedly. Presumably, for the most part, these owner-operators have left farming for alternative employment and in the main are from farms that are, in themselves, no longer viable units. However much one may sympathise with these people, it does indicate that the industry is undergoing competitive rationalization.

The high price of land despite the relatively low returns made from investment in purely non-speculative land, would seem to indicate that there is no shortage of prospective owner-operators.

3.5.3 Changes in the Total Number of Owner-Operators. Entries and Withdrawals

Cohort analysis only shows net changes. It is therefore not possible to accurately determine if the decrease in owner-operators between 1956 - 66 was due to a decline in the rate of entry or in the increased rate of withdrawal, or both. A historic look at the net rates of entries and of withdrawals allows a

'guestimate' to be made of the probable main causes of this decrease. These rates are shown in Table 3.8.

TABLE 3.8 Per Cent Net Rates of Entry And
Withdrawal Between Decennial Censuses.
1916 - 1966

Decennial Period	Change in Total Number of Owner Operators	Net Rate of Entry	Net Rate of Withdrawal.
	%	%	%
1916-1926	+ 6.9	28.5	21.6
1926-1936	+13.9	27.5	13.6
1936-1946	- 6.0	22.5	28.5
1946-1956	+ 8.4	37.4	29.0
1956-1966	- 9.4	21.6	31.0

The difference between the net rate of withdrawal and the net rate of entry equals the change in the total number of farmers. It can also be seen that between 1956-66 the net rate of entry and of withdrawal were the lowest and highest respectively. The combined effect of these two counter opposing movements gave rise to a decrease in the total number of owner-operators of 9.4 per cent. The low net rate of entry is an indication of the fewer opportunities existing in agriculture for ownership and also the higher remuneration obtainable from the non-agricultural sector. The latter factor also influences the rate of withdrawal.

The aggregate nature of the data prevents any statement of regional differences for age groups within or between censuses.

3.6 PROJECTIONS: A GENERAL COMMENT

This section and subsequent subsections of 3.6 discuss some of the possible alternative methods of projecting age data.

Numerous methods have been developed by which to project a given population forward in time. Whilst there can be no certainty in estimates of future population trends (by use of any of the projection methods), they can serve a useful practical purpose by indicating the approximate numbers that appear most likely to be attained, in view of the information available. The possibility of catastrophic events, such as war or natural calamity, or the sudden appearance of important new factors without parallel in the current situation or past experience, has to be neglected. It must always be recognised that such possibilities exist and that the trend of population growth may consequently be very different from anything which could have been foreseen. Within the framework of present and past experience; it is desirable to calculate upper and lower limits in such a way that the future trends will more probably lie between these limits than outside them. The limits may be revised from time to time in the light of changes being observed in the current situation.

Consistent trends of change can reasonably be expected in populations with fairly regular age composition and where the social and economic environment exerts a steady or only gradually changing influence. The two populations being considered here, fulfil these requirements. (See Tables 3.7 and 3.15).

3.6.1 Projection by use of Markov Chain Analysis

An attempt was made to analyse the data of T-O-O's and D-O-O's for projection purposes using first order Markov processes. However, after investigation this proved not to be possible for the following reasons:

(i) The data in its present form is not detailed enough. Only net movements are recorded.

(ii) The probability of moving from one state to another state (i.e. from one age group to another) is one, which, in terms of constructing a transition matrix is meaningless.

A more detailed account of Markov chain analysis, as applied to age cohort data, appears in appendix C.

3.6.2 Projections By Use of Cohort Analysis

Another possible method of projecting the number of owner-operators by age groups is by use of cohort analysis. With the exception of those owner-operators under twenty five years of age the remaining age groups in any census are determined by the numbers of existing owner-operators in the cohorts comprising the data in that census. Economic and social factors ruling between the last enumerated census and the next will also have a direct influence on the number of owner-operators that will exist at the time of the next census.

Clawson¹ used the proportional changes between age groups by averaging these changes between three consecutive cohorts and applying them to the latest census data to project the series. He assumed that because of the stability shown in the downward trend from peak numbers in earlier cohorts that more recent cohorts (which would dominate the total number of owner-operators in the immediate future) would decline in the same way. He used other proportions for cohorts rising to a peak and an educated guess for the <25 group. Since the total number of owner-operators in the U.S.A. has been declining since 1920 his method assured that total owner-operators would go on declining throughout the projection period.

In Table 3.5 the number of owner-operators can be seen to have been rising until 1956, from then until the present time the number have been declining and as evidenced; shows every indication of declining into the foreseeable future. The downturn in the curve representing the total number of owner-operators has only just been reached. Thus the taking of proportional changes between

¹ M. Clawson, "Aging Farmers and Agricultural Policy," J. Farm Economics, 45, 1, 13. February, 1963.

consecutive age groups for any individually completed cohort (i.e. 1896, 1906 and 1966) or combinational averages of these, when applied to the 1966 census data produces projections which indicate an increasing number of owner-operators. This is clearly contrary to the evidence given above.

A weighted average of proportional changes between age groups could be used, but since there is no a priori evidence for assigning weights; this would only complicate the projections.

3.7 PROJECTIONS OF TOTAL OWNER-OPERATORS: 1966 - 2006

The projections for 1966 - 2006 (Table 3.5 outside the brackets) were made using the proportional changes between age groups as shown by the 1956 and 1966 census, and applying them to the appropriate 1966 data. Rounding off of data was done after the application of these proportions. Only the < 25 age group cannot be imputed in this way; accordingly a figure approximating the percentages of < 25 making up the total for 1956 and 1966 censuses is used. This is a best guess estimate only, but since in 1976 it only accounts for about 4 per cent of the total owner-operators is not considered important. Its initial impact is not significant until it has influenced the 35 - 44 age group in 1996 which then makes up 26.8 per cent of the total. To see the significance of imputing fewer owner-operators under twenty five years of age, a low projection was estimated (see bracketed figures Table 3.5). The effect of smaller < 25 age groups on the totals does not become significant until 1996. Table 3.7 shows that over the projected period the high proportion shows very little change with regard to the relative proportions in the lower and higher age groups. However, in the low projection there is a slight downswing in the proportion in the lower age groups and a slight upswing in the higher age groups.

The projection is thus made on the simple assumption that the proportional changes occurring between 1956 - 66 will be the same in the future. Implied in this simplifying assumption is the

fact that economic and social changes will have the same relative effect in the future as they had in the period 1956 - 66.

With regard to the above assumptions the high and low projections give a range within which the total number of owner-operators is likely to fall. See Table 3.10 and Figure 3.2.

3.7.1 Projections of Total Owner-Operators Using Regression Time-Series Trends

The age group data was also projected in aggregate form by fitting least squares regression curves. Three multiple regression equations were formulated using quadratic equations of the type:

$$Y = \alpha + \beta_1 t + \beta_2 t^2$$

where Y = The number of total owner-operators (excluding Maoris). In thousands.

t = Time, where t takes on the values -7, -5, -3, ..., 7 for the years 1896, 1906, ..., 1966 respectively.

Results are shown in Table 3.9.

Equation A in Table 3.9 was calculated using the complete total owner-operator data (i.e. 1896 - 1966 inclusive), whilst equation B was calculated omitting the actual 1946 data. The third equation, C, was estimated by forcing the function through the observed 1966 data i.e. 62,900 and omitting the actual 1946 data. This was done to explore the outcome, from what, in effect amounts to 'weighting' the most recent data available. The method by which equation C was formulated is shown in appendix D.

The Durbin - Watson 'd' statistic is here reported only for academic interest since its significance is difficult to assess owing to there not being enough degrees of freedom to test for

TABLE 3.9 **Results of Three Multiple Regression**
Equations of Total Owner-Operators on Time.
(Students T shown in brackets)

Equation	No. of obs.	Constant	β_1	β_2	$\bar{R}^2$	d
A	8	64.323437	2.244940 (10.54068)	-.335342 (6.29814)	.95506	3.7199
B	7	65.403191	2.333083 (13.27773)	-.357378 (8.13544)	.97428	2.7914
C	7	65.500753	2.252139 (15.98837)	-.374974 (9.79152)	.96629	2.2180

serial correlation in the errors.¹ The best indicator of fit is the coefficient of multiple correlation $\bar{R}^2$, (Corrected for degrees of freedom). This coefficient (corrected for degrees of freedom) shows the proportion of the total sum of squares explained by regression and as such, partially justifies the omission of the observed 1946 data in equation B, since equation B has a higher $\bar{R}^2$ than equation A.

Forcing the curve through the last observed data (i.e. 1966) and omitting the actual 1946 data gave a lower $\bar{R}^2$ than that obtained for equation B. When equation C is used to project the future number of total owner-operators for the years 1967 - 2006 a curve lower than that obtained from using equation B is obtained.

The projected number of total owner-operators using equation B and C are given in table 3.10, whilst the observed data and the Curve obtained by fitting equation B is shown in figure 3.2.

¹ J. Durbin and G.S. Watson, "Testing for Serial Correlation in Least Squares Regression. II," Biometrika, Vol. 38, parts 1 and 2, p. 159. June, 1951.

3.7.2 Summary of Projections

Table 3.10 summarises the most important of the projection estimates.

TABLE 3.10 Summary of Projections

Projections	1966	1976	1986	1996	2006
High	62,900	57,600	52,200	47,300	43,600
Low	62,900	57,100	49,300	40,500	31,400
Equation B	64,200	57,500	47,800	35,300	20,000
Equation C	62,900	55,400	44,900	31,400	14,900

Whilst the high projection estimate tends to flatten out the low estimate decreases more rapidly, especially after 1986. The line for estimate C goes approximately through the point for 1970 that is the most recent estimate of the number of owner-operators available (59,700).¹ Doubt must be cast on the projection as prescribed by equation C after 1986 because of the time span involved. Equations B and C add considerable weight to selecting the low projection as being the most realistic estimate of the future number of owner-operators, that are likely to exist at any given time in the future.

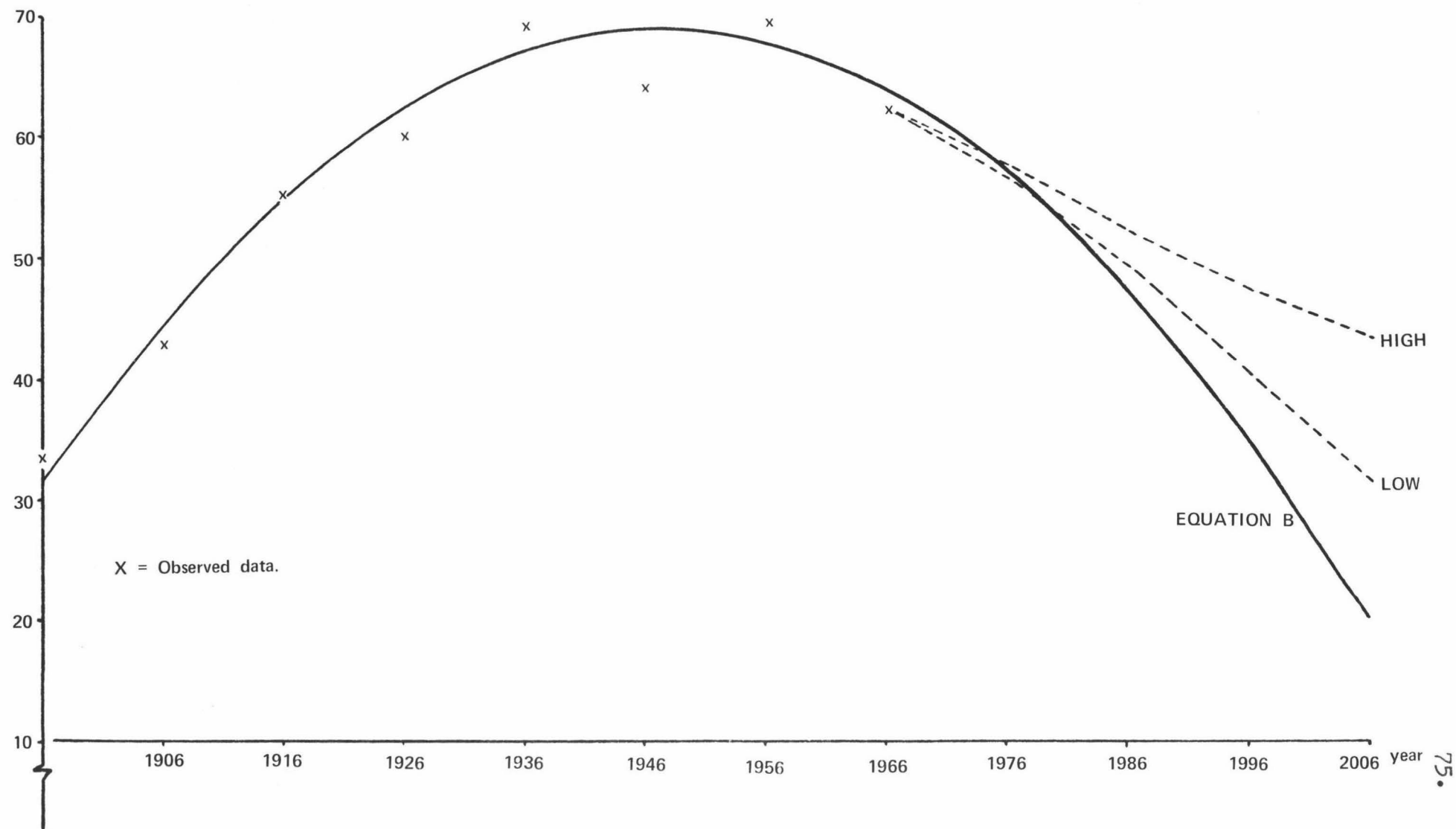
Using the low projection estimate by the year 2006 there will be half as many owner-operators as there were in 1966. The rate of decrease, in the total number of owner-operators, is likely to diminish through time.

In terms of the kinds of factors mentioned in section 3.4 (p. 58) the projections above are seen as being of paramount importance in future long term planning.

¹ Monthly Abstract of Statistics, "Survey of Farm Employment - June, 1970," Wellington N.Z. Supplement - August, 1971.

no. of
operators.
('000).

Fig. 3.2. TOTAL NUMBER OF OWNER-OPERATORS (EXCLUDING MAORIS).
ACTUAL DATA AND VARIOUS PROJECTIONS. ('000).



3.8 RELATIONSHIP BETWEEN THE TOTAL NUMBER OF OWNER-OPERATORS AND EMPLOYEES

Whilst the number employed in agriculture has decreased since 1935 the number of owner-operators has only started decreasing since 1956. In actual fact, but for the war, it is probable that the number of owner-operators would have started decreasing from about 1946. Therefore there seems to be a lag between decreasing employees and decreasing owner-operators of about ten years. But for the war there would also undoubtedly have been more employees during the war period but the downturn in the number of employees had already occurred prior to the war starting.

The effect of the war makes it difficult to conclude when owner-operators actually would have become more numerous than the number of employees. However it is likely to be very little different from the actual 'cross over' point of 1944. There are three factors largely responsible for this phenomena:

(i) The large number of single man units created by the Government under the land resettlement scheme to rehabilitate returned soldiers.

(ii) Improved communications and opportunities in the non-agricultural sector enabling the farm population to find more remunerative employment off the farm.

(iii) The start of aerial topdressing, mechanisation and improved management techniques that enabled gross production per labour unit employed in agriculture to improve from this time on (see Figure 2.3), so that farm labour could be released from agriculture.

The ratio of employees to owner-operators has declined over time as is shown in Table 3.11, column (4). Column (2) and (3) are depicted in Figure 3.3.

The effect of there being no Maoris in the earlier data

TABLE 3.11

Ratio of Employees to Total
Owner-Operators 1896 - 1966

Census Year	(1)	(2)	(3)	(4)
	Philpotts est. of total labour in agric.	My est. of O-O European and Maori	Employees (1 - 2)	Ratio (3 - 2)
1896 ^a	83,300	32,700	50,600	1.55
1906 ^a	97,000	43,100	53,900	1.25
1916 ^a	117,400	56,000	61,400	1.09
1926	137,000 ^b	62,660	74,340	1.18
1936	163,000 ^b	71,130	91,870	1.29
1946	130,000 ^b	67,300	62,700	0.93
1956	130,200 ^b	72,240	57,960	0.80
1966	118,800 ^b	64,860	53,940	0.83

a Reports of the Census, N.Z. Quinquennial Censuses.
Op. cit., Excludes Maoris.

b Mussey and Philpott, op. cit., p. 43.

would make very little difference to the ratio. If anything one would suspect that there would have been relatively more Maori employees than Maori owner-operators, so making the ratio bigger. Up to 1936 the number of employees was higher and very approximately parallel with the number of owner-operators. This is because up to 1946, beside the converse of points (ii) and (iii) above being true, land was still being broken in which required a high labour input.

It is not at all clear that the trend which has been apparent since 1944 will continue into the future. It may well be that there will be a reversal of this trend, as there is a limit to the extent of labour intensification. Since 1944 owner-operators have been gearing their units so as to become less reliant on employed labour. This itself has been a result of scarcity of labour, economic pressure to reduce costs and the technical know-how by which to remedy the former two exigencies.

In macro terms this amounts to a substitution of capital for labour and how long this can continue remains a matter for speculation. At the limit there comes a physical barrier as to the area one man can work efficiently. At this juncture when this size is reached, and no longer able to generate enough gross income, or fully utilize 'lumpy inputs' efficiently, more land and/or labour may be acquired. Under these circumstances, assuming land to be a fixed quantity, one can predict that the number of owner-operators would decrease more rapidly than the number of employees. On the other hand however new labour saving technologies may increase the amount of land an owner-operator is able to manage. Thus maintaining the employee/owner-operator ratio below unity. This possibility with respect to dairy farming is elaborated on in Chapter VI, Section 6.5.4.

3.9 DAIRY FARMER OWNER-OPERATORS

Dairy owner-operators (D-O-O's) are a component of the total European owner-operators going to make up Table 3.5. In Table 3.12 total European dairy owner-operators are enumerated separately in exactly the same way. The bottom line of Table 3.12 shows D-O-O's as a percentage of T-O-O's through time and indicates that in the twenties and thirties D-O-O's made up over 50 per cent of all owner-operators (as defined in appendix B) existing in N.Z. at that time. In 1966 D-O-O's made up only about 40 per cent of the T-O-O's existing in N.Z. at that time.

3.9.1 The Number and Size of Dairy Herds

Table 3.12 includes all D-O-O's who, via the quinquennial census, have listed their occupation as being principally concerned with farming dairy cows. Thus in the late nineteenth and early twentieth centuries there were very few farms where dairying was the principal enterprise, largely because of the undeveloped

Fig. 3.3 THE NO. OF OWNER-OPERATORS AND EMPLOYEES. 1896-1966.

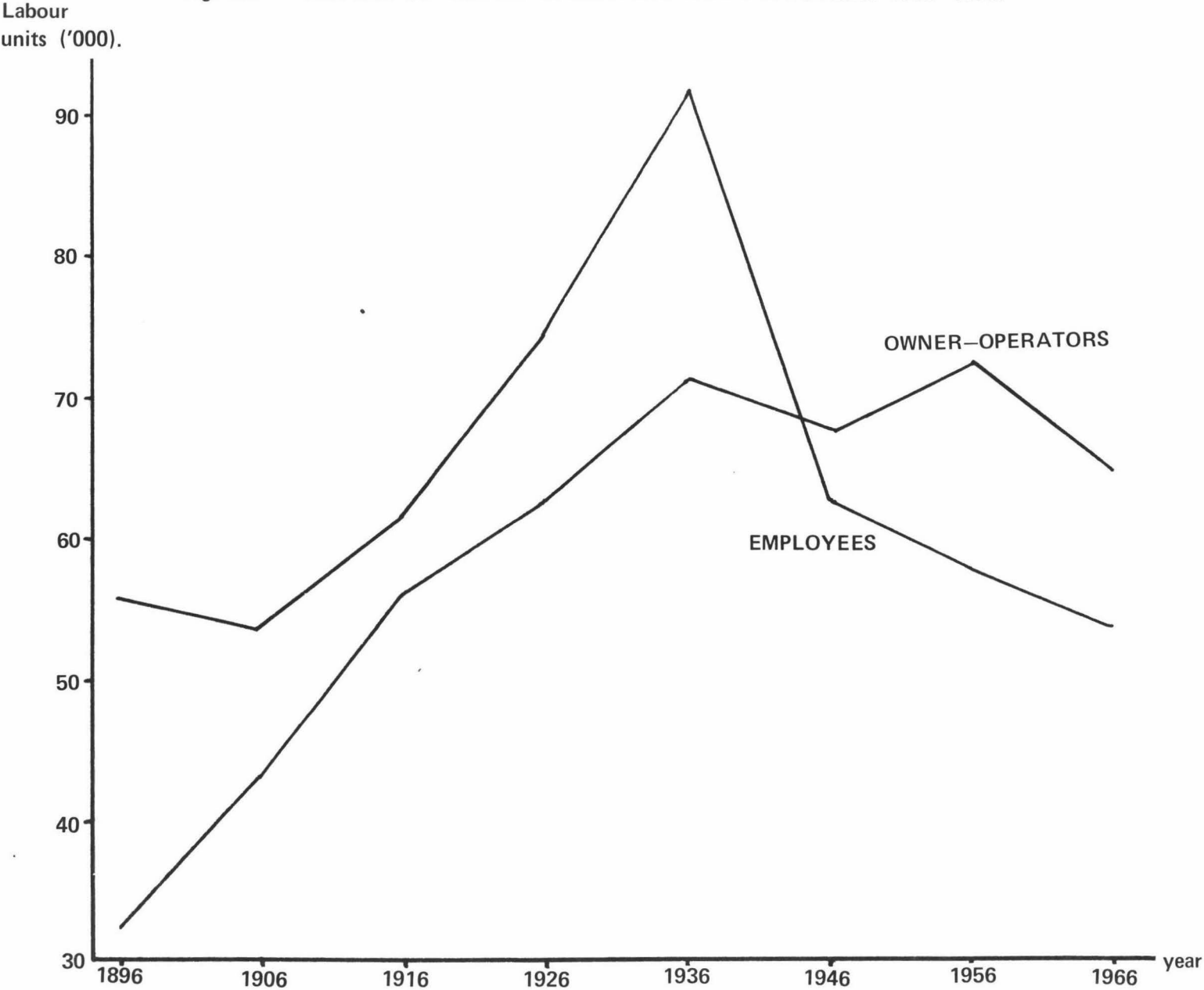


TABLE 3.12

Total European Dairy Owner-Operators. Actual Data Up To and Including 1966.

(Numbers) All Data Rounded to Nearest Ten.

Cohort	1896	1906	1916	1926	1936	1946	1956	1966	1976	1986	1996	2006
2006												1200 (300)
1996											1300 (600)	5220 (2410)
1986										1400 (900)	5620 (3610)	5800 (3730)
1976									1500 (1200)	6020 (4810)	6220 (4970)	4270 (3410)
1966								1640	6580 (6580)	6800 (6800)	4660 (4660)	2170 (2170)
1956							1420	5670	5860 (5860)	4020 (4020)	1870 (1870)	440 (440)
1946						930	6940	7170	4920 (4920)	2290 (2290)	540 (540)	
1936					1420	5340	9180	6300	2930 (2930)	690 (690)		
1926				1460	6750	7950	7260	3380	790 (790)			
1916			1380	7030	8680	6960	4130	970				
1906		370	5100	10670	10220	5630	2100					
1896	20	1540	7020	9100	7760	2490						
1886	70	2120	5030	5190	3810							
1876	100	1660	2700	2550								
1866	100	890	1810									
1856	50	570										
1846	30											
Total	370	7150	23040	36000	38640	29300	31030	25130	22580(22280)	21220(19510)	20210(16250)	19100(12460)
D-0-0 as a % of T-0-0	1.1	16.6	41.1	60.1	56.6	45.7	44.6	39.9	39.2 (39.0)	40.6 (39.5)	42.7 (40.1)	43.8 (39.6)

nature of the land. Dairy cows were kept predominantly to satisfy farm requirements. The years 1906 - 1926 saw a dramatic rise in the number of farms where dairying was the principal enterprise. However the majority of the herds were extremely small, and as Table 3.13 shows, even twenty five years ago, the number of herds with < 10 cows supplying dairy factories was still significant. The decline in the number of D-O-O's since 1936 is very largely due to the decline in the number of D-O-O's with small herds. This is illustrated in Table 3.13 where the decreasing divergency between the number of herds with ≥ 10 cows and the number of suppliers to dairy companies can be seen, until in 1968-69 there were very few herds with < 10 cows supplying dairy companies.

In 1956-57 there were 34,900 herds with ≥ 10 cows and only 31,030 D-O-O's. This apparent discrepancy is an indication that there were 3,870 herds ($34,900 - 31,030$) of ≥ 10 cows where dairying did not comprise the main enterprise and therefore the owner-operators did not classify themselves as being dairy farmers in the census returns. A similar situation can be seen to have existed in 1966-67 but to a lesser extent; giving evidence that dairying has become more and more associated with specialised, large units.

3.9.2 Reliability of Total European Dairy Owner-Operator Data

For reasons already stated Maoris are excluded from the data presented in Table 3.12. In 1966 there were 2,178 Maoris classified as being in agriculture and livestock production under 'employer of labour' or 'on own account'. Not all of these would have been in dairying. Indeed it is thought that there are relatively fewer Maori dairy farmers relative to other forms of farming. Their omission is therefore not considered significant in this analysis.

The 1926 data again caused problems. From the 1921 census the writer estimates that there were 32,770 D-O-O's in

TABLE 3.13 A Comparison Between Number of Herds
With Ten or More Cows and the Total Number
of Suppliers to Dairy Companies.^a ('000).

Year	47-48	51-52	56-57	60-61	63-64	64-65	66-67	68-69
(a) Total No. of factory supply herds with ≥ 1 cow supplying dairy co's.	53.8	51.2	45.2	36.7	31.7	29.7	26.3	25.0
(b) No. of herds with $\geq$ ten cows (NZ)	34.0	35.7	34.9	31.2	28.9	27.5	25.3	24.6
(c) No. of herds with $<$ ten cows(a-b)	19.8	15.5	10.3	5.5	2.8	2.2	1.0	0.4

a New Zealand Dairy Board, 46th Farm Production Report, op. cit., p. 69.

NOTE: The divergency is in fact worse than indicated since the No. of herds with ≥ 10 cows includes town supply herds whereas the total No. of suppliers to dairy companies includes only factory supply herds. Few town supply herds have ever existed with ≤ 10 cows. Further inaccuracies occur because some herds are 'mixed'. All figures rounded to nearest 100.

1921, but that in 1926 this figure had fallen to 18,000. It is known that there was difficulty in identifying the different types of farming from the census returns; probably as a result of the omission from the 1926 census schedule of any instructions to lessen the use of general terms such as farmer, mixed farmer etc. It is significant that those categorised as being in mixed farming in 1926 shows a huge upsurge compared with 1921 and 1936. It is thought that 36,000 represents a reasonably accurate estimate of the D-O-O's in 1926.¹

1 Private Communication between Author and Statistics Dept.

For details as to how data in Table 3.12 was arrived at for one census, see appendix K.

Since average herd size is known to have increased over time (see Figure 1.2) verification of the consistency of the data in Table 3.12 can be obtained from Table 3.14. Column two is

TABLE 3.14 Two Estimates of Herd Size Average

(1)	(2)	(3)	(4)	(5)	(6)
Year	Author's est. of European D-O-O	No. of cows in Milk ('000) ^a	Av. herd Size (3 - 2)	Herds of ≥ 10 cows	
				No. of herds	Av. herd size
1896	370	N/A			
1906	7150	N/A			
1916	23040	732.9	32		
1926	36000	1303.8	36		
1936	38640	1951.5	50		
1946	29300	1661.9	56		
1956	51030	1994.7	64	35500 ^c	56 ^c
1966	25130	2087.8	83	26400 ^c	80 ^c
1970	23710 ^b	2320.6	98	23746 ^d	98

a New Zealand Official Year Book, op. cit., various volumes.

b Monthly Abstract of Statistics, op. cit., "Survey of Farm Employment - June, 1970," Supplement - August, 1971.

c New Zealand Dairy Board, 46th Farm Production Report, op. cit., p. 67.

d Unpublished dairy Board data. Includes 21707 Factory Supply Farms with Herd Av. of 96.9 cows, and 2039 town supply farms with their cows making overall herd av. approx. 93 cows.

the estimate of the number of D-O-O's as per Table 3.12. Column three is the number of cows in milk not in boroughs and not on holdings not covered by the Government Statisticians census.

Since the average herd size in Column four is obtained by dividing the number of cows by the estimated number of D-O-O's; then in so far as the estimate of D-O-O's only includes dairy farms where dairying is the principal enterprise, the average herd size in Column four is somewhat inflated, especially in earlier years. However, as shown in Table 3.13 nearly all herds of ≥ 10 cows are now operated by full time D-O-O's. Consequently the two different estimates of the average herd size for 1970 agree, thus showing the estimate of the number of D-O-O's to be consistent and reasonably accurate.

3.9.3 Discussion of Trends Shown in D-O-O Data

Table 3.12 shows that dairy owner-operators increased up to at least 1936, since when there has been a steady decline. This is in distinct contrast to the number of total owner-operators which have only declined since 1956.

The pattern of cohorts is similar to those of total owner-operators and in Figure 3.4 each successively more modern cohort is seen to become generally lower than the last as the number of dairy owner-operators decline. However, there is little diminuation in the numbers in the < 25 and 25-34 age groups for these cohorts. The number < 25 in 1956 had not been higher since 1926 and in 1966 there were more < 25 than in any previous year. The decline in the number of dairy owner-operators has been the result of rapid withdrawal from older age groups. The balance in favour of the younger portends well for the present and future of the industry and is an indication that though in total, there are fewer opportunities, young people do exist that are able to get into dairying on their own account and that older people are sufficiently mobile to move out of dairying for one reason or another.

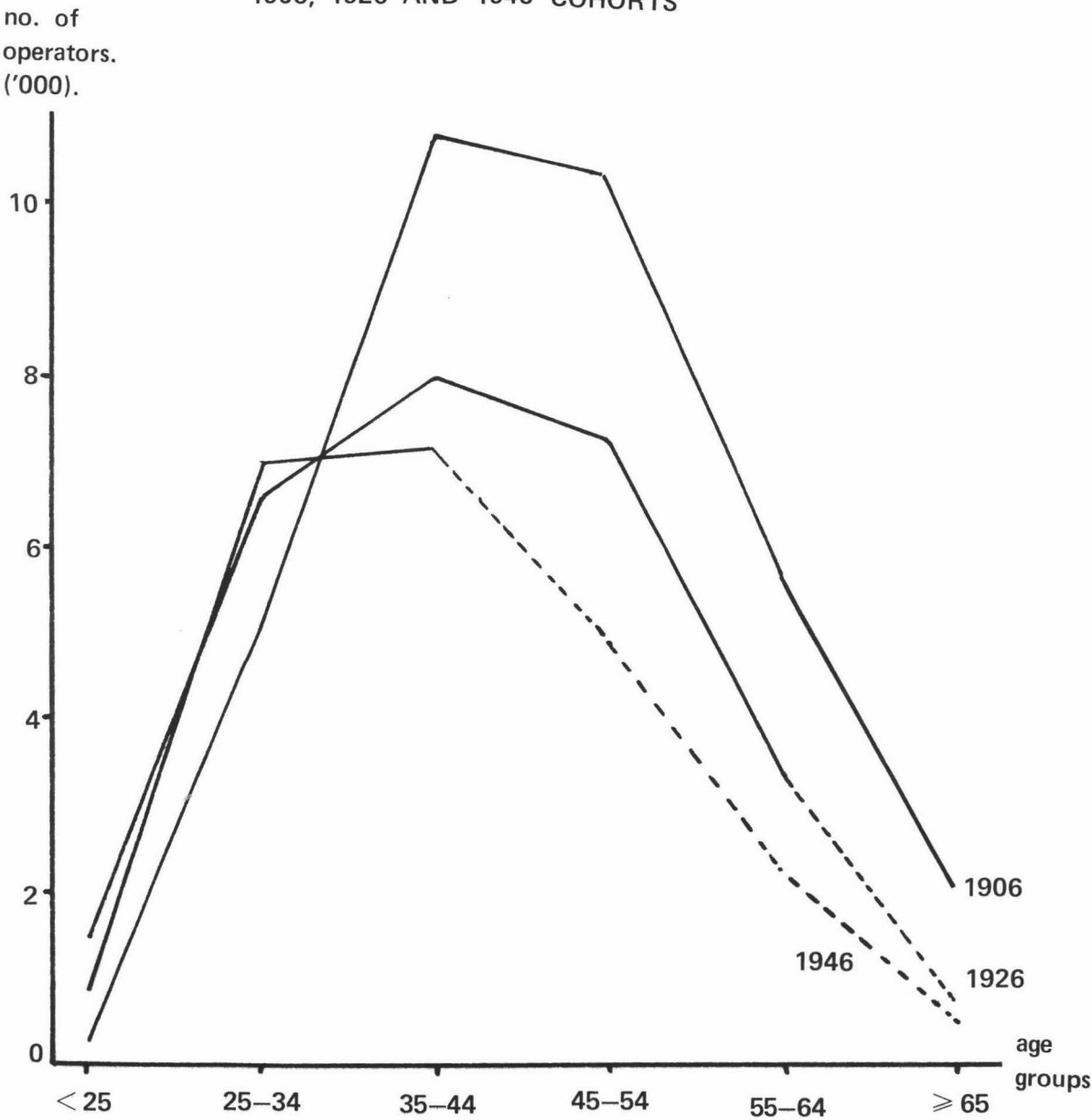
The percentage composition within any age group (Table 3.15) for any census year show remarkable stability and as one

TABLE 3.15

Proportions of Total European Dairy Owner-Operators, By Age Groups

Cohort	1896	1906	1916	1926	1936	1946	1956	1966	1976	1986	1996	2006
2006												6.3 (2.4)
1996											6.4 (3.7)	27.3 (19.3)
1986										6.6 (4.6)	27.8 (22.3)	30.4 (29.9)
1976									6.6 (5.4)	28.4 (24.7)	30.7 (30.6)	22.4 (27.4)
1966								6.5	29.1 (29.5)	32.0 (34.8)	23.1 (28.6)	11.4 (17.5)
1956							4.6	22.6	25.9 (26.3)	18.9 (20.7)	9.3 (11.5)	2.2 (3.5)
1946						3.2	22.4	28.5	22.0 (22.1)	10.8 (11.7)	2.7 (3.3)	
1936					3.6	18.2	29.6	25.1	12.9 (13.2)	3.3 (3.5)		
1926				4.1	17.5	27.1	23.4	13.5	3.5 (3.5)			
1916			5.9	19.5	22.5	23.7	13.3	3.8				
1906		5.2	22.1	29.6	26.4	19.3	6.7					
1896	5.4	21.5	30.6	25.4	20.1	8.5						
1886	18.9	29.7	21.8	14.4	9.9							
1876	27.0	23.3	11.7	7.0								
1866	27.1	12.4	7.9									
1856	13.5	7.9										
1846	8.1											
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0(100.0)	100.0(100.0)	100.0(100.0)	100.0(100.0)

Fig. 3.4. NO. OF DAIRY OWNER-OPERATORS.
1906, 1926 AND 1946 COHORTS



would expect, similarity with total owner-operators (Table 3.7). Table 3.15 does however show more of a trend towards increased proportions existing in the younger age groups and less in the older age groups. This no doubt is a function of the smaller amount of capital required to get into dairy farming and the availability of sharemilking.

Between 1956-66 the number of D-O-O's declined by 19.0 per cent. Age group for age group those ≤ 44 accounted for 9.8 per cent of the decline whilst those ≥ 45 accounted for 9.2 per cent of the decline. Respective figures for T-O-O's between 1956-66 were - 9.6 per cent, - 2.6 per cent and - 6.6 per cent. Therefore the rate of decrease of D-O-O's was almost twice as great as that from T-O-O's. This is a result of technological and economic pressures forcing dairy farmers to become bigger and more productive if he is to stay in the industry. Further evidence of this is provided by the decrease in the number of D-O-O's operating on own account. Since 1951 the number of male D-O-O's employing labour has remained approximately constant whilst those males on own account have fallen from approximately 20,000 in 1951 to approximately 13,000 in 1966.

3.10 PROJECTIONS OF DAIRY OWNER-OPERATORS 1966-2006

The proportional changes between consecutive age groups between 1956-66 were used to project the data. The number in the < 25 age group was again chosen arbitrarily, but it will be seen from Table 3.15 that it remained approximately the same proportion of the total for any projected ten year period as in 1966, namely about 6.5 per cent. This projection represents the high estimate and is shown outside the brackets in Table 3.12. The low projection (inside the brackets) is computed in exactly the same way as that for the high projection; the only difference being due to the smaller < 25 age group. In 1966 D-O-O's < 25 represented 60.0 per cent of T-O-O's < 25 years of age. Therefore since the low estimate of T-O-O's < 25 years in 1976 was 2,000 then 60.0 per

cent of 2,000 equals exactly 1,200, (the low, ≤ 25 estimate for D-O-O's in 1976). Each low estimate of ≤ 25 for D-O-O's was estimated in this way. Consequently the difference between the high and low estimate in 1976 is a result of imputing different numbers for the ≤ 25 age group. It is only in 1996 that the difference works its way through the cohorts to make a marked difference between the low and high 1966 total estimates.

Under the above assumptions, the percentage change in the total number of D-O-O's for any of the projected periods, (other than for the 1996 - 2006 low estimate) are less than that for 1956-66. This is because of a higher net rate of entry and a slightly lower net rate of withdrawal than occurred in 1956-66. See Table 3.16.

The decrease in the rate of D-O-O's leaving dairy farming (See Figure 3.5) is a direct consequence of the high numbers in the ≤ 25 and 25 - 34 age groups in 1966. For instance for the high estimate, in 1976 these two age groups will effect 55.0 per cent of the total D-O-O's that are likely to exist in 1976. Therefore between 1966 - 76 should there be an unprecedented withdrawal from these age groups without replenishment; then the decrease in total D-O-O's may well be greater than that shown by the high estimate.

3.10.1 Projection of D-O-O's Using Regression Time-Series Trends

In order to verify which prediction (high or low) was most likely to represent what would happen in the future; using the original data, various least squares regression equations were calculated. The results are shown in Table 3.17.

The Durbin - Watson 'd' statistic is again reported but only for academic interest as there are insufficient degrees of freedom to test for serial correlation in the errors.

Equations D and E are quadratic equations of the type:

TABLE 3.16 Components of the Percentage Change in
the Total Number of Dairy Owner-Operators
Between Two Successive Decennial Censuses.

Decennial census	% change in total No. of D-O-O's %	Net rate of entry %	Net rate of withdrawal %
1956 - 66	- 19.0	19.7	33.7
On basis of projections:			
1966 - 76 H	- 10.0	26.4	36.6
L	- 11.4	25.2	36.6
1976 - 86 H	- 6.0	27.2	33.2
L	- 12.4	21.2	33.6
1986 - 96 H	- 4.7	26.9	31.6
L	- 16.7	17.7	34.4
1996 - H	- 5.5	26.2	31.7
2006 L	- 23.3	13.7	37.0

TABLE 3.17 Results of Four Multiple Regression
Equations of Dairy Owner-Operators (excluding Maoris)
on Time (Students T shown in brackets).

Equation	No. of obs.	Constant	β_1	β_2	β_3	$\bar{R}_2$	d
D	7	36.165710	2.259285 (2.63671)	-2.247856 (4.54382)		.81011	1.9397
E	6	38.916562	2.603142 (5.81755)	-2.591712 (9.58595)		.95856	2.4192
F	6	39.057048	.954997 (.81123)	-3.264411 (7.89582)	-5.790581 (4.39541)	.98959	3.5002
G	6	39.237505	1.090126 (.51837)	-3.240923 (4.78908)	-4.518270 (7.25582)	.98552	3.5577

$$Y = \alpha + \beta_1 t + \beta_2 t^2$$

where Y = The number of dairy owner-operators
(excluding Maoris). In thousands.

t = Time, where t takes on the values -3,
-2, -1, ..., 3 for the years 1906, 1916,
..., 1966 respectively.

The 1896 data was omitted from equations D, E, F and G since at that time dairy farms were generally not well enough developed to distinguish them from farms whose owner-operators have been classified under total owner-operators.

The 1896 and 1946 data was omitted in the estimation of equation E (this is also the case for the estimation of equations F and G). The justification for omitting the 1946 data in equation E is seen from the higher $\bar{R}^2$ value compared with that obtained for equation D.

In equations F and G a quadratic was grafted to a linear function. The only difference between F and G was the point of graft. In F 1946 was the point of graft and in G, 1936 was the point of graft. Using equation G as an example the way in which two functions are grafted and the properties of the resultant function are described in appendix F.

As can be seen from the $\bar{R}^2$ (corrected for degrees of freedom) values in Table 3.17, equations F and G account for a high proportion of the total sum of squares, being .989 and .985 respectively.

Use of equation F predicts a number of dairy owner-operators some .03647 above the observed value, whilst that of equation G is some .55269 above the observed value. In terms of real units the two functions can be seen to pass extremely close to the observed 1966 value. Equations F and G are sufficiently better than equation E not to use equation E to project future numbers of dairy owner-operators.

The linear portion of equation F diminishes at a faster rate than that for the same portion in equation G, as can be seen in

Table 3.17 (coefficient β_3). Figure 3.5 depicts the observed data and the curve drawn from equation G.

When both linear portions of equations F and G are projected to the year 2006 it is observed that both predict a number of dairy owner-operators lower than that predicted by the previous lowest estimate (see Table 3.18). The estimates of projections obtained from equation F are considered to be too low.

3.10.2 Summary of Projections

The three projection estimates are summarised in Table 3.18.

TABLE 3.18 Summary of Projections

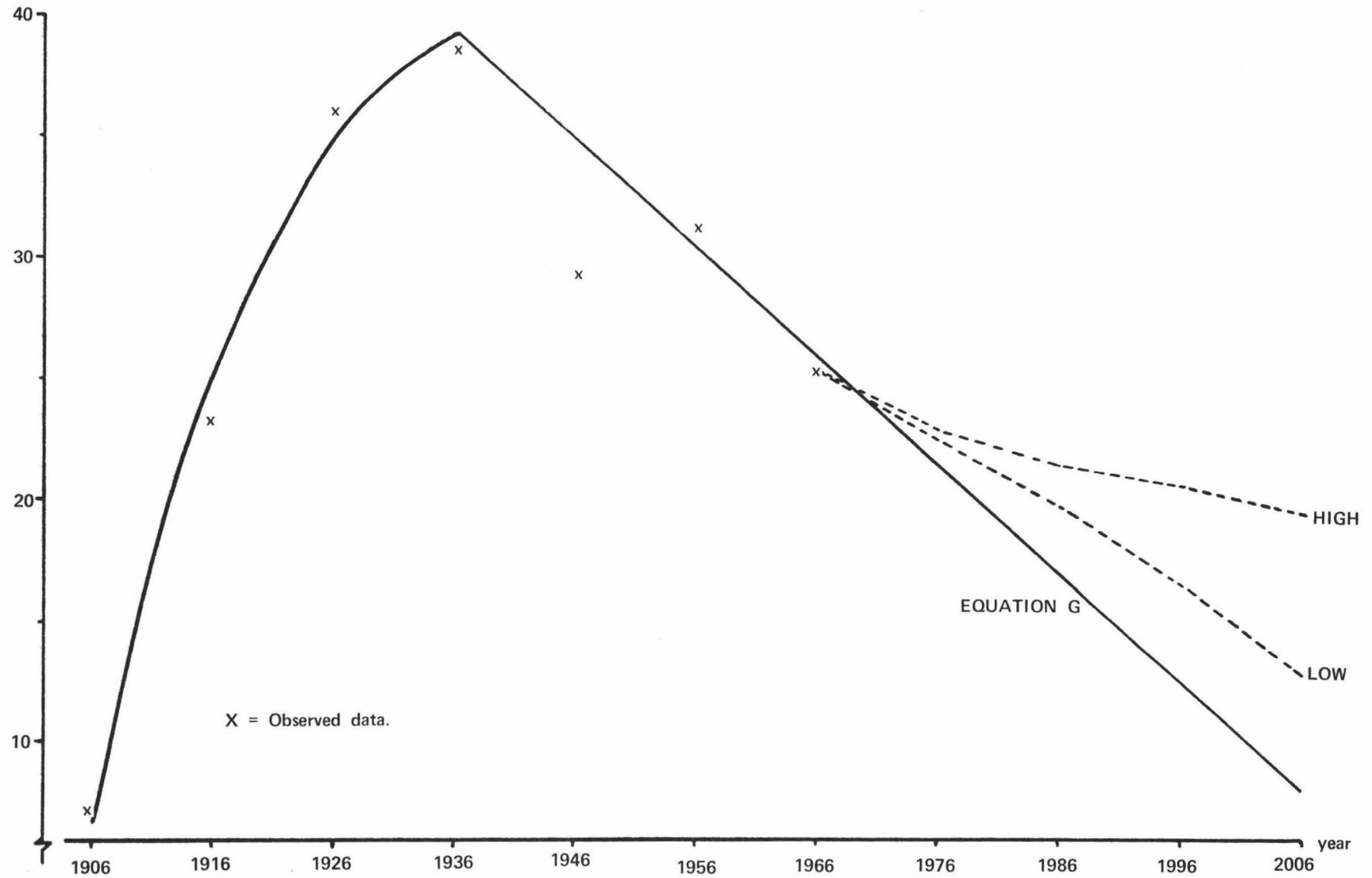
Projection	1966	1976	1986	1996	2006
High	25,130	22,580	21,220	20,210	19,100
Low	25,130	22,280	19,510	16,250	12,460
Equation F	25,170	19,380	13,580	7,790	2,000
Equation G	25,680	21,170	16,650	12,130	7,610

In 1970-71 there were 20,305 factory supply herds with ten or more cows and 1,958 town supply herds making a total of 22,263 herds. Assuming all of these fall into the category of D-O-O it can be seen already, that the number of D-O-O's has fallen below the low estimate for 1976. The estimate from equation G of 21,170 would therefore seem to be about correct.

Assuming that the number of town supply farms will remain approximately constant; then in 1970-71 there were still 5,245 herds (26.0 per cent of factory supply herds) with ≤ 70 cows. If there are to be no dairy farms existing by 1986 with herds containing ≤ 70 cows and if we assume that 22,263 - 21,170

no. of
operators.
('000).

Fig. 3.5. TOTAL NUMBER OF DAIRY OWNER-OPERATORS (EXCLUDING
MAORIS). ACTUAL DATA AND VARIOUS PROJECTIONS. ('000).



= 1,093 of these herds with < 70 cows will have gone out of dairying by 1976; then $5,245 - 1,093 = 4,152$ dairy farms with herds < 70 cows remain to go by 1986. This leaves $21,170 - 4,152 = 17,018$ dairy farms with herds ≥ 70 cows by 1986. This is some 370 more than predicted by equation G. It is naive however to suppose that there will be no herds with < 70 cows existing by 1986. However, the number of herds between 70 - 100 cows is also declining (approximately an average of 400 per year in the last three years), whilst those herds with ≥ 100 cows increased by 652 between 1968/69 - 1969/70 and by 82 between 1969/70 - 1970/71. Roughly speaking, therefore, the estimate of the number of D-O-O's for 1986, derived from equation G, will only be out by the number of herds with < 70 cows remaining in the industry by 1986. Other things being equal, projection estimates would indicate that from 1986 - 2006 the most likely number of D-O-O's likely to exist at any given time in this period, would fall between the range predicted by the low and the estimates as predicted from equation G. These estimates indicate the likely number of D-O-O's that can be expected to be displaced from dairy farming in the years to come. Furthermore the estimates indicate the growth in herd sizes that is going to be required from the remaining D-O-O's if existing levels of total production are to be maintained or increased.

The number of herds existing at any one time must not be confused with the total output of milkfat. For instance in 1970-71 whilst herds of < 100 cows comprised 54.9 per cent of total factory supply herds, they only made up 36.0 per cent of the total milkfat supplied by factory supply herds. This factor is elaborated on more fully in Chapter VII, p.174.

In the long run it is impossible to be too dogmatic as to the number of D-O-O's that there will be owing to changing technology, changing markets, profitability of other enterprises and social acceptability.

CHAPTER IV

A REGIONAL STUDY IN THE MANAWATU

4.1 INTRODUCTION

As outlined in Section 1.2 the Manawatu Co-operative Dairy Company is concerned to safeguard future milk supplies. This fact, together with the proximity of the area to Massey University made it a logical area for empirical study.

4.2 DESCRIPTION OF THE SURVEY AREA, AND COMPARISON WITH OTHER DAIRYING DISTRICTS OF NEW ZEALAND

The area in which the study was undertaken is shown in Figure 4.1. Drawn on this map are the boundaries demarcating the four major soil series. The approximate location of each survey farm is also shown by a cross. West of the Orua River is Manawatu County and East of the river is Kairanga County. Only 30 per cent of the survey farms were in Kairanga County.

4.2.1 Soils of the Survey Area

The survey farms differ as to the soil series they are on; but since this is a structural study, as opposed to an inter-farm study of management techniques, the varying soils can be ignored. The soils, once drained are approximately similar in their productive capacities and are equally or more naturally fertile than other soils of the country where dairying is the principal land use. (For details of the four major soil series found in the survey area see appendix G).



4.2.2 Climate of the Survey Area

Table 4.1 shows the 'normal' climate experienced in the survey area as recorded at Ohakea.¹ A comparison with actual weather data at Ohakea for June, 1968 - May, 1969 is made as well as a comparison of the 'norms' for other major dairying districts in the North Island.

In 1968 - 69, the year for which the survey was conducted, the area described had an average monthly temperature of 0.8°F less than the 'norm' and a rainfall of only 1.85 inches higher than the 'normal' yearly total of 35.83 inches. In 1968 - 69 the survey area received sixty hours (or 3 per cent) more sunshine than the 'normal' yearly total of 2,030 hours. In other words, climatically, in 1968 - 69 the surveyed area experienced, in total and in seasonal distribution, a close to 'normal' year.

The 'normal' monthly temperatures do not vary significantly between dairying districts, however considerable variation does occur between districts with regards to rainfall and the number of hours of sunshine. The survey area having approximately ten inches less total rain per year than the next lowest total. This factor alone may account for the relatively minor role that dairying plays in the Manawatu Plains.² It should also be noted that the lower rainfall combined with flat land gives the Manawatu Plains arable potential lacking in other dairying areas of New Zealand.

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- 1 Ohakea is seven miles north-west of Rongotea and whose 'normal' temperature is 2.0°F above that of Palmerston North Aerodrome. 'Normal' rainfall is the same at both localities.
 - 2 Heavy, non-free draining soils, topographic suitability to other forms of production, longer winters and slightly lower temperatures may be other reasons for dairying not being so popular as in more northern districts.

TABLE 4.1

Normal Temperature ($^{\circ}$ F), Rainfall (inches) and Sunshine (Hours).

	J	J	A	S	O	N	D	J	F	M	A	M		Av. Mthly Temp.
<u>Normal Temperature^a</u>														
Ruakura	47.7	46.6	48.6	51.2	54.6	57.6	60.8	62.2	64.0	61.4	56.8	51.8		55.3
Whakatane	49.3	48.6	50.0	50.9	56.5	60.0	63.7	65.4	66.2	63.4	58.8	54.0		57.2
New Plymouth	50.4	48.9	50.0	50.8	54.6	59.4	60.5	62.4	63.3	61.6	58.4	53.9		56.2
Ohakea	48.2	47.0	48.6	51.7	54.6	57.8	60.9	63.3	63.6	61.3	57.0	52.2		55.5
Ohakea 1968-69	49.7	46.0	49.4	50.0	52.9	55.8	59.8	62.8	62.0	61.3	55.4	51.8		54.7
<u>Normal Rainfall^a</u>														
													Total Rainfall	Av. Mthly Rainfall
Ruakura	4.88	4.56	4.09	3.70	4.29	3.70	2.86	3.32	3.18	2.90	4.02	4.27	45.77	3.81
Whakatane	5.23	4.74	5.18	3.66	4.00	3.41	3.37	3.64	4.27	3.11	4.29	4.98	49.88	4.15
New Plymouth ^b	6.44	5.59	5.94	3.60	5.75	4.53	4.76	4.73	4.10	3.67	5.01	5.31	59.43	4.95
Ohakea	3.49	2.78	3.17	2.72	3.40	2.82	2.95	3.00	2.91	2.29	2.96	3.34	35.83	2.98
Ohakea 1968-69	5.96	1.84	2.35	3.51	5.32	1.63	4.78	3.52	1.87	0.59	2.36	3.95	37.68	3.14
<u>Normal Sunshine</u>														
													Total Sunshine	Av. Mthly Sunshine
Ruakura ^c	109	121	143	162	175	203	213	228	187	165	149	127	1982	165.1
Whakatane ^c	156	163	172	192	189	228	220	259	200	193	220	161	2353	196.1
New Plymouth ^d	116	135	154	168	175	201	216	245	194	196	165	145	2110	175.8
Ohakea	113	113	142	173	191	195	223	247	191	177	150	115	2030	169.2
Ohakea 1968-69	82	131	166	156	166	238	203	236	209	221	166	116	2090	174.2

Continued over ...

- a N.Z. Meteorological Service, "Climatological Table - Summary of the Records of Temperature, rainfall and sunshine." Extracts from N.Z. Gazette.
- b There is considerable variation within Taranaki.
- c J.C. Gerlach, "Climatographs Part 1: Warm Zone of N.Z." Dept. of Agriculture, August, 1970.
- d J.C. Gerlach, "Climatographs Part 11: Cool Zone of the North Island." Dept. of Agriculture, November, 1971.

4.2.3 The Number of Cows and Number of Herds by Herd Size in Specified Districts

The decline in the number of dairy herds in the survey area between 1950/51 - 1968/69 is shown in Table 4.2.

In the whole of the North Island the number of dairy herds decreased from 45,935 in 1950-51 to 21,698 in 1968-69 (a 53 per cent decrease). In the Wellington land district (of which Manawatu and Kairanga counties are part), the number of herds in the same period decreased by 72 per cent. The percentage decreases in the Manawatu and Kairanga for the same period were 43 and 56 per cent respectively. Whilst these decreases were typical of the Wellington land district; in more firmly entrenched dairying areas, such as South Auckland - Bay of Plenty, dairy herd numbers only decreased by 32 per cent between 1950/51 - 1968/69. The above decreases are of course net decreases.

The biggest decrease in the number of herds were those containing less than fifty cows. However, accompanying the decrease in the total number of herds has been the increase in the total number of cows in the North Island. See Table 4.3. Between 1950/51 - 1960/61 the average rate of growth in the total number of cows was 0.45 per cent per year and between 1960/61 - 1968/69, 2.4 per cent per year. The number of cows in South Auckland and Bay of Plenty has increased in absolute and proportional terms, whilst the number of cows in Manawatu County increased in absolute terms, but diminished as a percentage of the total number of cows in the North Island. The same applies with respect to Northland.

Also counteracting to some extent the decrease in the number of smaller herds was the upsurge in the number of herds with 100 or more cows. The relative comparative advantage and specialization in dairying enjoyed by South Auckland and the Bay of Plenty is reflected by Matamata County, having, in 1968-69, 66.5 per cent of total herds in the County with 100 or more cows, or 51.0 per cent for the combined two land districts. The increased number and proportion of cows in these land districts, also reflects the above

TABLE 4.2 **Number of Herds by Herd Size, 1950-51,^a**
1960-61^b and 1968-69^c, Selected Districts.

Herd Size	10-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Northland									
1950-51	3452	804	648	477	290	199	125	230	6225
1960-61	1278	735	746	606	389	268	133	276	4431
1968-69	380	182	249	354	408	387	318	1016	3294
% of 68-69	11.5	5.6	7.6	10.7	12.4	11.7	9.7	30.8	100.0
Matamata County									
1950-51	338	104	141	176	139	104	85	213	1300
1960-61	60	61	88	127	148	127	100	340	1051
1968-69	20	15	20	44	57	90	105	695	1046
% of 68-69	1.9	1.4	1.9	4.3	5.4	8.6	10.0	66.5	100.0
S. Auckland S. of P.									
1950-51	5436	1539	1543	1517	1116	830	546	1347	13874
1960-61	1653	1122	1333	1659	1427	1084	633	1927	10838
1968-69	418	269	389	674	808	1053	1012	4815	9438
% of 68-69	4.4	2.9	4.1	7.1	8.6	11.2	10.7	51.0	100.0
Manawatu County									
1950-51	333	88	75	74	46	20	24	26	686
1960-61	102	63	79	81	46	38	23	41	473
1968-69	27	15	24	46	50	47	30	150	389
% of 68-69	6.9	3.9	6.2	11.8	12.8	12.1	7.7	38.6	100.0
Kairanga County									
1950-51	355	82	75	44	25	16	3	14	614
1960-61	113	52	67	53	45	11	14	22	377
1968-69	31	23	22	35	37	25	22	78	273
% of 68-69	11.4	8.4	8.1	12.8	13.6	9.2	8.0	28.5	100.0
Wellington									
1950-51	6202	793	554	399	239	140	94	181	8602
1960-61	1140	577	529	405	265	164	114	233	3427
1968-69	273	178	207	268	269	229	191	763	2378
% of 68-69	11.5	7.5	8.7	11.3	11.3	9.6	8.0	32.1	100.0
North Isl.									
1950-51	26369	4711	4079	3371	2295	1636	1067	2407	45935
1960-61	6272	3664	3835	3790	2831	2090	1261	3305	27048
1968-69	1650	975	1351	1958	2179	2439	2143	9003	21698
% of 68-69	7.6	4.6	6.3	9.1	10.0	11.2	9.9	41.3	100.0

a Report on the agricultural and pastoral statistics of N.Z. for the season 1950-51. Dept. of Statistics. Wellington, 1953.

b Report on the farm production statistics of N.Z. for the season 1960-61. Dept. of Statistics. Wellington, 1962.

c N.Z. Farm Production for the Season 1968-69. Dept. of Statistics, Wellington, 1971.

advantages. The Wellington land district in contrast had only 32.1 per cent, and Manawatu and Kairanga Counties only 38.6 per cent and 28.5 per cent of herds respectively, in the 100 or more cows category. Further more the Wellington land district has had, since 1950 - 51 a decreasing proportion of the number of milking cows in the North Island.

TABLE 4.3 The Number and Percentage of Milking Cows
By Selected Districts as at 31st January.

District	1950-51 ^a		1960-61 ^b		1968-69 ^c	
	Cow No's.	% of total cows in NI.	Cow No's.	% of total cows in NI.	Cow No's.	% of total cows in NI.
Northland	237,851	14.1	246,295	13.9	284,317	13.3
Matamata C.	81,622	4.8	95,902	5.4	133,650	6.2
S. Auckland- B. of P.	707,023	41.9	806,129	46.7	1,031,798	48.2
Manawatu C.	29,178	1.7	29,649	1.6	35,833	1.6
Kairanga C.	21,665	1.3	20,865	1.2	23,410	1.1
Wellington	217,286	12.8	190,359	10.8	209,043	9.7
North Island	1,685,384		1,760,940		2,139,527	

a,b,c; See corresponding footnotes for Table 4.2.

In 1968-69 the distribution of the number of herds by herd size between Manawatu County and the whole of the North Island is seen to be very similar. Therefore whilst there are areas of reasonably well structured dairy units, there still remain, on the basis of herd size, a large number of marginal units. Marginal in the sense that their continued viability as dairy farms over the next ten years is in doubt.

4.3 FORMATION OF THE MANAWATU CO-OPERATIVE DAIRY COMPANY LIMITED

The merging of twelve previously independent dairy companies over a number of years culminated in the present company being established in June, 1960. This had the effect of extending the companies' collection area from as far north as Raetihi and south to a point equidistant between Levin and Shannon. As a result of amalgamations the Company reached the highest number of suppliers (1,061 in 1968-69) in its history. In 1971-72 this number had fallen to 805 milk and cream suppliers. In 1968-69 the Company received 24.429 m. pounds of milkfat and in 1971-72 an estimated 23.751 m. pounds of milkfat. Both were good dairy seasons. Other than for town supply herds the only other processors of milk within this area are the Glaxo Company, Bunnythorpe, which has approximately 200 suppliers and the Oroua Downs Casein Factory with approximately 60 suppliers. Some of the suppliers to these latter two factories are interspersed with those in the area surveyed - especially in the north east.

4.4 SELECTION OF SURVEY FARMS

The large and contrasting area from which the Manawatu Dairy Company collects its milk, made it necessary to study a given area within the Companies' supply area, in detail. Limited finance and time, prohibited the undertaking of a statistical cross section of dairy farms throughout the supply area. The study can therefore be considered a pilot study for a possibly more comprehensive study involving all factory supply areas in N.Z.

The Manawatu Dairy Company listed all its supply farms in the survey area. For purposes of the survey, those producing more than 10,000 pound of milkfat, were selected. Those supplying less than 10,000 pound of milkfat were considered not to be obtaining the bulk of their gross farm income from dairying. For instance in 1968-69 the average N.F.I. for a farm producing 10,120 pounds of

milkfat was \$1,597.¹ Table 3.12 (p. 80) would indicate that these small herds can be expected to cease production at their present level before too long. Therefore their continued role as suppliers of milk to the Company is insignificant.

4.4.1 Exclusions

Of the 129 dairy suppliers to the Manawatu Dairy Co-operative known to be within the confines of the survey area, 18 were producing less than 10,000 pounds of milkfat. Of the remaining 111 farms, nine were known to have serious complications, e.g. town supply and factory supply combined, unusually high labour inputs because of contracting businesses, two successive share-milkers in two years with the owner overseas and one farm with two sharemilkers, etc. The remaining 102 farmers were included in the final survey, of which 98 were included in the final analysis.

4.5 SELECTION OF THE SURVEY PERIOD

The survey was carried out in May - June, 1971 for the season June 1968 - May 1969. The season 1968-69 was selected to avoid the effect of the very severe drought of 1969-70. Also there were severe carry over effects into 1970-71 and accounts would not be generally available at the time the survey was carried out. As shown in Section 4.2.2 the climatic conditions in 1968-69 approximated the 'normal' for the survey area.

¹ New Zealand Dairy Board, Farm Production Division. A survey of the economic structure of Factory Supply Dairy Farms in N.Z. in 1968-69. Vol. VI, p. 36: Wellington, August, 1971.

4.6 THE QUESTIONNAIRE - GENERAL BACKGROUND

The amount and depth of information required about each farm and its owner-operator necessitated a personal interview being conducted, using a pre-formulated and pre-tested questionnaire.

The literature abounds with papers written on aspects of survey work such as the selection of the method to collect data, the construction of a questionnaire and interviewing techniques.

Gallup¹ discusses the different methods of collecting data and the advantages and disadvantages of each. The detailed construction of a questionnaire is covered by Payne² and Festinger and Katz.³ The latter also provide principles to interviewing, but a more comprehensive and useful guide to interviewing is given by Monroe⁴ and a bulletin prepared by the United States Department of Agriculture.⁵

4.6.1 Objectives of the Questionnaire

The questionnaire related to the past, present (the time at which the interview was carried out, May-June, 1971) and future and had as its two main objectives:

(1) To ascertain, in detail, the resources used and the production obtained, solely from dairying and enterprises closely

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- 1 G. Gallup, Methods of Collecting Data: Evaluation in Extension, ed. D. Byrn (Washington: Division of Extension Research and Training, U.S.D.A. 1959), p. 57.
 - 2 S.L. Payne, The art of asking questions, (Princeton: Princeton University Press, 1951).
 - 3 L. Festinger and D. Katz (eds.), Research Methods in the Behavioral Sciences (New York: Holt, Rinehart and Winston, 1953).
 - 4 V.V. Monroe, Mimeographed Interviewers Manual, (Washington: U.S.D.A.)
 - 5 University of Michigan Survey Research Centre, Manual for Interviewers on Sample Surveys for the U.S.D.A., mimeographed (Washington: Bureau of Agricultural Economics, U.S.D.A., 1946).

related to dairying, by the survey farms in 1968-69.

(ii) To determine how the present farm structure was achieved. Current information as to the kind of management (partnerships, sharemilker, etc.), age, attitudes and future aspirations with regards to the owners own future in dairying. Questions were also asked as to production systems likely to be adopted in the future.

4.6.2 Pre-Testing the Questionnaire

A pilot study was conducted on four farms to ensure that the questionnaire was unambiguous and clearly understood. To test the adequacy of the questionnaire and to ensure the collection of accurate data; farms were also selected where the structural make-up and management were complex.

As a result of the pilot study minor amendments were made before the final questionnaire was put to the final group of 102 respondents. So as to be able to determine the authenticity and accuracy of answers given to the questions asked; four 'straight' and one 'cross' check 'test' questions were incorporated into the questionnaire. (On the basis of these questions and on the interview itself one respondent's questionnaire was excluded). The test questions suggested that the information collected was not inaccurate and inconsistent.

For purposes of the structural study (see objective (1) page 104) each farm was considered to have only one owner-operator; even where farmed in partnership.

4.6.3 Method of Analysis and Data Preparation

The questionnaire consisted mainly of closed questions and was therefore amenable to computer analysis.

Certain closed questions were designed specifically to fulfil the first objective, namely to determine the resources used and the production obtained, solely from dairying and enterprises closely related to dairying, in the 1968-69 season. The following remarks are pertinent to these questions:

(i) Definition of total acreage

Is that area of land owned or leased for dairying purposes without any deductions such as for 'waste area' etc. being made. It includes the area of runoffs.

(ii) Definition of 'waste area'

In questions relating to the area owned the 'waste area' was deemed to be that area of fenced off woodlots and lakes etc., that were totally unproductive. Buildings, tracks, hedges, etc. did not come into this category since very few farmers accurately know the acreage 'consumed' by these items. The 'effective acreage' was found by deducting the 'waste acreage' from the 'total acreage'.

(iii) The Capital Value of Land and Improvements

The latest farm values at the time of interviewing, for Kairanga and Manawatu counties, (other than for recently purchased land) were set in November, 1966. Since all values in the survey area were made at the same time and since any change in value from farm to farm would have changed differentially, no adjustment was made to up-date these values to 1968-69. Therefore, in so far as the study determines the amount and value of resources used by the 98 final respondents in 1968-69, the value of resources is somewhat underestimated, but is consistent.

In the case of land being leased out, the capital value of the block of land was proportionately decreased by the amount of land in the block being leased out.

The value of improvements and unimproved value refer in each case to the total acreage of the particular block of land actually farmed by the owner-operator himself.

(iv) Definition of total corrected acreage (T.C.A.)

The area owned referred to in (ii) above was by no means,

in all instances, fully utilized. An adjustment to the 'home farm', 'run off' and 'other land' acreage and capital value was accordingly made. Firstly any 'waste area' was deducted and the unimproved value proportionately adjusted to give the new adjusted capital value. Then, for the 'run off' and 'other land', the breed, class and number of stock in each such class was recorded. The number of months each class and number of stock was grazed on these areas of land was also recorded. Using a conversion factor (see appendix H) for different breeds (Freisian F and Jersey J) stock was converted to dairy cow equivalents (D.C.E.) and on the arbitrary basis of one D.C.E. per acre the fully utilized acreage was calculated. The acreage used for hay and silage was adjusted on the basis of the length of time the paddock(s) were not able to directly support any livestock. In all cases the acreage but aside for hay or silage was known. This adjusted acreage was added to the acreage fully utilized by the livestock, which when added to the effective acreage of the 'home farm' gave the number of total corrected acres. (T.C.A.). The total capital value of 'run offs' and of 'other land' was accordingly adjusted proportionately since livestock were considered to have benefited from the improvements. This adjustment to the capital value and any made to the capital value of the 'home farm' gave the total capital value of the T.C.A.'s.

In some instances run offs as large as 80 acres were hardly used at all and therefore accrediting 80 acres and its capital value to the total resource pool would have unduly increased the respective totals. However, even though there were 27 farms with run offs, (which had an average area of 55.6 acres with a range of from 4 to 134 acres) the difference between the total acreage (12,173) - owned or leased - and the total corrected acreage (11,875) of 298 acres was, in this study, not great.

(v) Estimation procedure for calculating the gross farm income

In estimating the gross farm income any hay or root crops sold were credited to the value of crops sold outside the farm. Income derived from pigs was not taken into account. This was done so as to comply with objective (i) on page 104. The value of any grain grown and either fed to pigs on the farm or sold

off the farm was not credited. The acreage of any such grown grain was deducted in the operations of (iv) above. If a grain and/or root crop was grown for the livestock (other than pigs) on the farm, the acreage so grown was credited to the total acreage in (iv) above. However the value of such feeds was not credited to the gross farm income.

The value of livestock and livestock products sold and purchased was taken directly from the accounts. The change in the value of stock inventory was calculated by recording the number of stock by class and breed at the beginning and end of season. In the case of a herd having some cross breeding (F. x J.) then half the number involved were allocated to the respective class type under F. and J. This tended to lower the standard value and D.C.E. totals somewhat. However, only 30 per cent of farms had any cross bred stock at all and only 22 per cent had 50 per cent or more of cross bred stock.

A computer programme was written to calculate the change in the inventory stock value which was the difference in value between the total value of stock at the beginning and end of season. Each class of stock by breed was also converted to a D.C.E. basis for the stock on hand at the beginning and end of season. The stock class values for each breed and the D.C.E. ratios for each breed are shown in appendix H.

If 'grazing out' was practiced, the actual cost of agistment was included under the 'value of purchased feeds'. Likewise, if stock was 'grazed in', the revenue so made was added under 'value of livestock and livestock products sold'.

For purposes of the feed inventory hay was taken as being worth 65 cents per bale and dairy ration at \$75. per ton.

The value of milkfat was estimated by multiplying the total milkfat supplied to the Dairy Company by the final payout for milk supply. (32.076 cents per pound milkfat). The figure used as being the amount of milkfat supplied to Longburn was that supplied by the Company.

Actual details of the calculation of G.F.I. are shown on pages 114 and 116.

(vi) Definition of labour unit (L.U.)

One labour unit or man year was taken to be any person milking two times per day throughout the season with or without doing any other work between milkings. Any person milking once per day equalled half a labour unit. The rationale for these standards is that the owner-operator would have to employ a man fulltime to milk two times per day if he did any work in between milkings or not. For purposes of estimating fractions of a man year, one man year was also considered equivalent to 2,288 hours or \$2,340.¹

4.7 CONDUCTING THE SURVEY

The author being the sole interviewer permitted the consistent interpretation to any questions the respondents were not too clear about and ensured that information collected from the accounts was consistent. The respondents were interested and communicative, which is essential when answering open-ended questions.

The interviews were all carried out within as short a period of time as possible (May - June) so that the answers to questions relating to the managements future aspirations were all made subject to the same socio-economic climate.

At the time the interviews were made the E.E.C. negotiations were still in progress. Further gloom was accentuated by spiralling costs, relatively low returns for milkfat and the set back of the drought experienced that year. Temporary respite, at least, was seen to exist in the expected higher milkfat prices for the 1971-72 season.

¹ This is unrealistic from an owner-operators point of view as he often works seven days a week, but to an employee a 5½ day week or 2,288 hours per year is a more realistic total on which to take a proportion.

4.8 RESULTS OF THE SURVEY.CHARACTERISTICS OF THE 98 SURVEYED FARMS: 1968-69

The physical inputs used and the production obtained between 1968 - 1969 will first be described. The socio-economic structure of the 98 farms will then be described and discussed.

4.8.1 The Physical Inputs Used and the Production Obtained Between June, 1968 - May, 1969

The ninety eight farms owned or leased a total acreage (x_2), of:

$$x_2 = \sum_{i=1}^{98} x_{1,2} = 12,173 \text{ acres.}$$

$$\bar{x}_2^1 = 124.1 \text{ acres. Range } 50 - 427 \text{ acres.}$$

The distribution of these 98 farms, by the number of total acres owned or leased according to acre size groups is shown in Figure 4.2. Despite $\bar{x}_2$ equalling 124.1 acres there were 27 farms with ≤ 80 acres in total owned or leased and 47 farms with ≤ 100 acres. This is approximately 47 per cent of the farms. If total corrected acreage is used as a measure of size distribution there are exactly 49 farms or 50 per cent with ≤ 100 T.C.A.'s from which to obtain income from dairying.

The total acreage owned or leased by these farmers had a total capital value x_3 , of:

$$x_3 = \sum_{i=1}^{98} x_{1,3} = \$3,936,860$$

which was made up as follows:

1 Where $\bar{x}_1$ denotes the mean value of the variable.

Value of Improvements X_4 , \$2,718,187
 and Unimproved Value X_5 , \$1,218,673.
 $\bar{X}_3 = \$40,172$. Range \$16,620 - \$100,600.

As one would have expected there was a strong positive correlation between the total number of acres owned or leased and their capital value. Capital values besides reflecting quality differences and size differences also gave another measure of land input.

If the amount of waste area and area not fully utilized is discounted i.e. leaving that area from which dairy production was obtained, then the total corrected acreage (T.C.A.) X_6 , was:

$$X_6 = \sum_{i=1}^{98} x_{i,6} = 11,875 \text{ acres}$$

$$\bar{X}_6 = 121.2 \text{ acres. Range } 50 - 427 \text{ acres.}$$

The Total capital value X_7 , associated with the T.C.A. (X_6) was:

$$X_7 = \sum_{i=1}^{98} x_{i,7} = \$3,896,381$$

$$\bar{X}_7 = \$39,758. \text{ Range } \$16,620 - \$100,600.$$

Because run offs were utilized to a far greater extent than had been anticipated and because of the absence of large woodlots and areas of bush etc. the difference, as already mentioned, between the actual total acreage owned or leased and the total corrected acreage was very small. Therefore in this study the existing structure will be rationalized in terms of the actual total acreage, X_2 .

Another measure of 'size' is the number of cows milked X_8 , as at 31 January, 1969:

$$X_8 = \sum_{i=1}^{98} x_{i,8} = 8,699 \text{ cows.}$$

$$\bar{X}_8 = 88.76 \text{ cows. Range } 43 - 294.$$

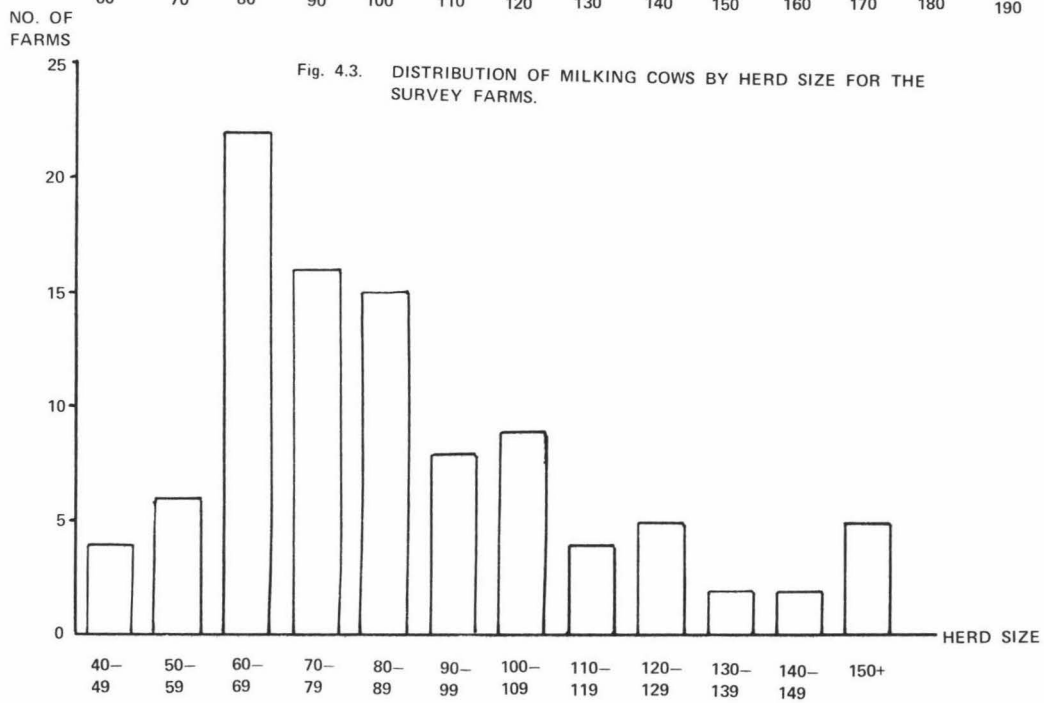
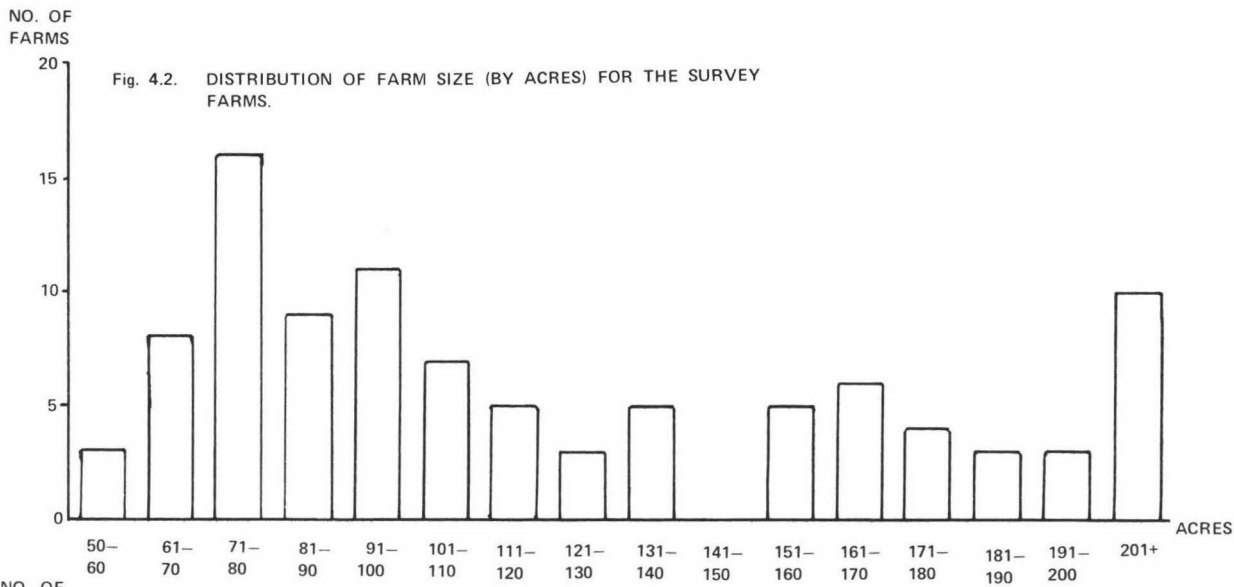


Figure 4.3 shows the distribution of milking cows by herd size groups. On the assumption that 120 or more cows warrants a second fulltime labour unit; then the figure also shows that there are only 14 farms where two or more fulltime labour units are warranted. A comparison of herd size distributions is made between the North Island, Kairanga and Manawatu Counties and that existing in the survey area; in Table 4.4.

TABLE 4.4 Comparison of Herd Size Distributions:
1968-69.^a (%)

Herd Size	40-49	50-59	60-69	70-79	80-89	90-99	100+
N.I.	4.8	6.9	9.7	10.8	12.2	10.7	44.9
Manawatu C.	4.2	6.6	12.7	13.8	12.9	8.3	41.5
Kairanga C.	9.5	9.1	14.5	15.3	10.3	9.1	32.2
Survey Area	4.1	6.1	22.4	16.3	15.3	8.2	27.6

a Derived from Table 4.2 and Figure 4.3.

Whilst the herd size distributions for the North Island and Manawatu County are very similar, the distribution of herds by size groups in the survey area is atypical with respect to the North Island, Manawatu County and Kairanga County for the 1968-69 season. The survey area having a similar proportion of herds in the 40-49 and 50-59 cow groups, but a very much higher proportion in the 60-69, 70-79, and 80-89 cow groups; resulting in there being a smaller proportion of large herds in the survey area compared with any of the other three areas. The reason for the larger proportions in the 60-89 cow herd groups in the survey area is a likely result of there being many returned soldiers being settled on rehabilitation blocks after World War II.

The data in Table 4.4 supports the earlier contention in this Chapter (p. 102) that because of the difficulty in making inferences to other dairying areas in N.Z., the results obtained are

only applicable for the survey area, and as such, the study should be considered a pilot study for a larger undertaking incorporating all factory supply dairy farms in N.Z.

Gross Farm Income (G.F.I.) X_9 , was comprised of four component parts such that X_9 was a function of:

$$X_9 = f\left(\sum_{i=1}^{21} x_{1,10} ; \sum_{i=1}^{98} x_{1,11} ; \sum_{i=1}^{73} x_{1,12} ; \sum_{i=1}^{98} x_{1,13}\right)$$

$$\text{Such that } X_9 = (X_{10} + X_{11} - X_{12} + X_{13})$$

and where:

X_{10} , value of crops sold off the farm = \$11,961

$$\bar{X}_{10} = \$569. \text{ Range } \$20-\$2,501.$$

X_{11} , value of livestock and livestock products (other than milkfat) sold, minus livestock purchases $\pm$ inventory changes:

$$= \$227,645$$

$$\bar{X}_{11} = \$2,322. \text{ Range } \$499-\$8,625.$$

X_{12} , value of opening feed inventory plus the value of purchased feeds minus the value of the closing feed inventory:

$$= \$-32,968$$

$$\bar{X}_{12} = \$-451. \text{ Range } \$-4,141 \text{ to } \$1,300.$$

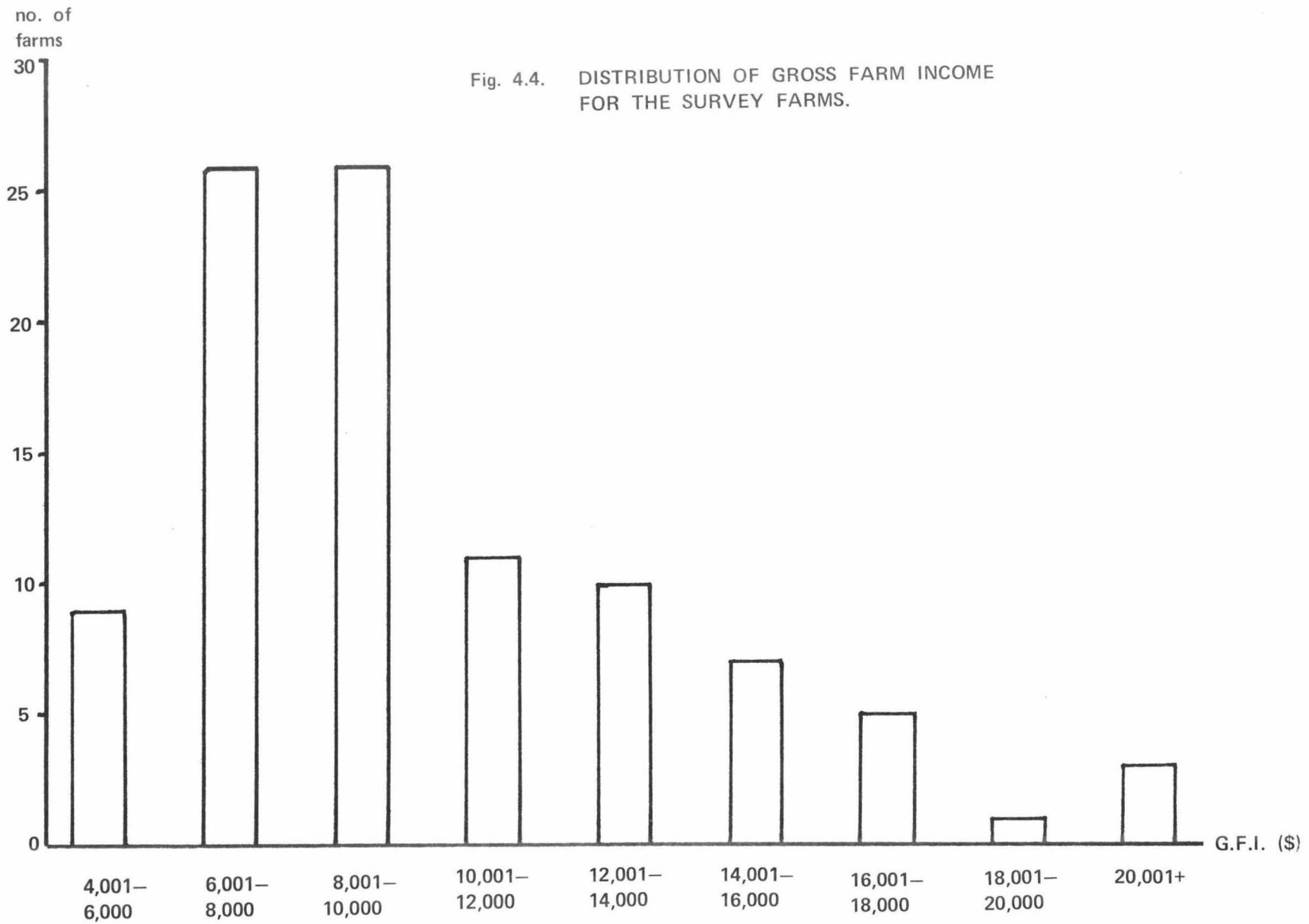
X_{13} , value of milkfat: = \$805,876

$$X_{13} = \$8,223. \text{ Range } \$3,031-\$27,909.$$

X_9 , Gross farm income = \$11,961 + 227,645 - 32,968 + 805,876
= \$1,012,514

$$\bar{X}_9 = \$10,332. \text{ Range } \$4,098-\$33,019.$$

The distribution of G.F.I. (X_9) is shown in Figure 4.4 to be heavily skewed to the left, consequently the average value of X_9 (10,332) is misleading. The median value is \$9,200.



Approximately 61 per cent of the farms had a G.F.I. of $\leq \$10,000$ and of these 27 per cent had ≤ 80 T.C.A.'s and 42 per cent had ≤ 95 T.C.A.'s.

Only nine farmers had alternative sources of farm incomes from other enterprises not taken into consideration in estimating the above G.F.I., (X_9). Eight kept pigs and one ran sheep as a minor sideline to their dairying operations.

In all cases milkfat was by far the most important product going to make up G.F.I. There was a high positive correlation ($r = 0.99$) between the value of butterfat produced and the G.F.I. for individual farms.

The total milkfat supplied to Longburn X_{14} , was:

$$X_{14} = \sum_{i=1}^{98} x_{i,14} = 2,512,503 \text{ lb}$$

$$\bar{X}_{14} = 25,637 \text{ lb. Range } 9,449 - 87,012 \text{ lb.}$$

The distribution ratios of milkfat per cow, milkfat per T.C.A., milking cows per T.C.A. and milking cows per labour unit are shown in Figure 4.5. The average milkfat per cow (milkfat supplied to the factory divided by the number of milking cows) from the factory supply industry for N.Z. in 1968-69 was 284 pounds per cow. In the survey area there were 50 farms with an average milkfat per cow ratio (calculated in the same way as for the N.Z. industry) lower than the national average.

Milkfat per T.C.A. showed considerable variations; the range being 66 - 428 pounds per T.C.A. and an average of 224 pounds per T.C.A. Milkfat per T.C.A. was positively correlated ($r = 0.93$), with the number of dairy cow equivalents at the start of the season per T.C.A. This is not to say that a high stocking rate is the only factor responsible in achieving a high output of milkfat per acre.

The distribution of milking cows per T.C.A. had a range of 0.28 - 1.40 and a mean of 0.78. (The average number of D.C.E.'s at the start of the season per T.C.A. was 1.14. Only 38

NO. OF
FARMS

Fig. 4.5(a). DISTRIBUTION OF MILKFAT/COW RATIOS.

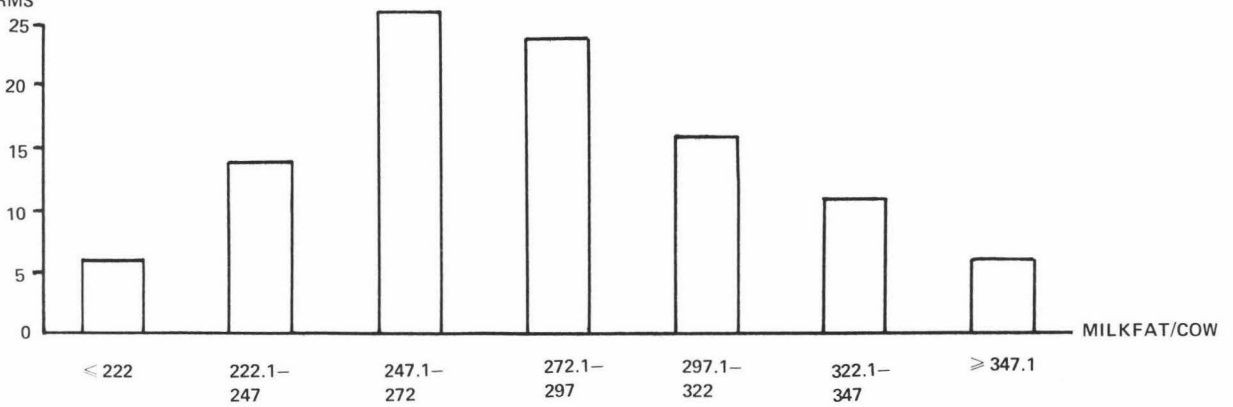
NO. OF
FARMS

Fig. 4.5(b). DISTRIBUTION OF MILKFAT/T.C.A. RATIOS.

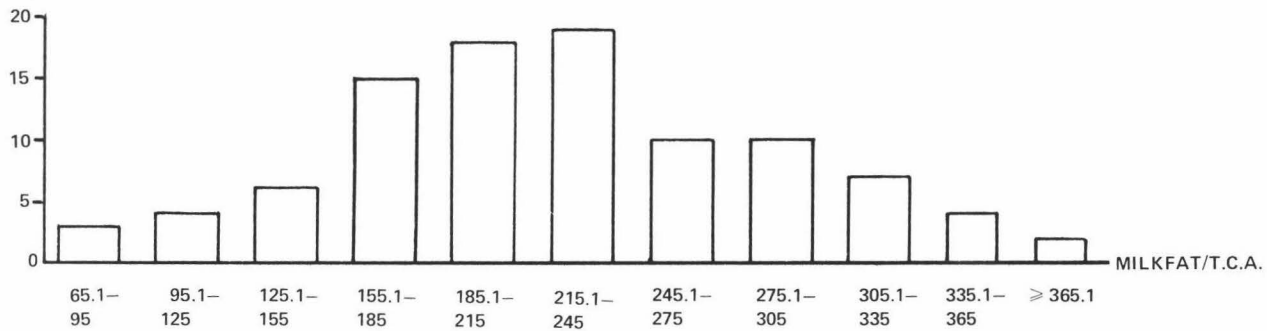
NO. OF
FARMS

Fig. 4.5(c). DISTRIBUTION OF COWS/T.C.A. RATIOS

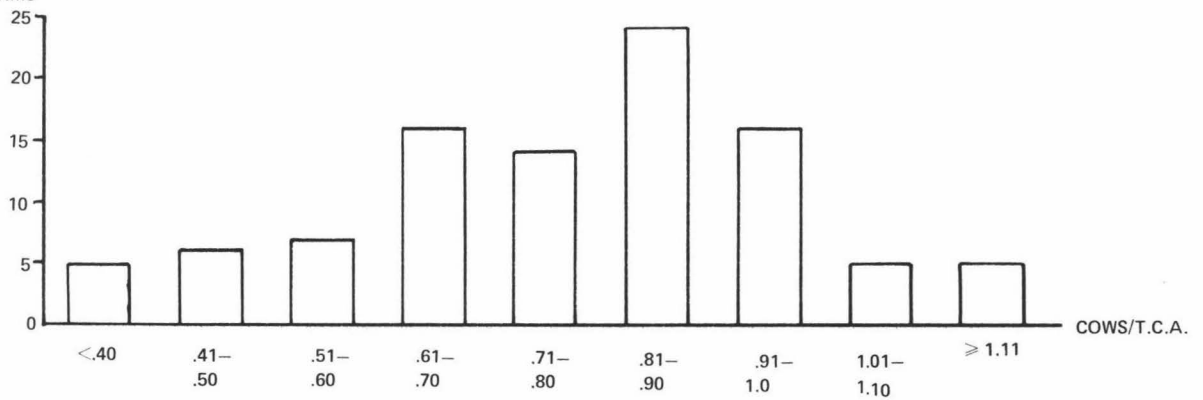
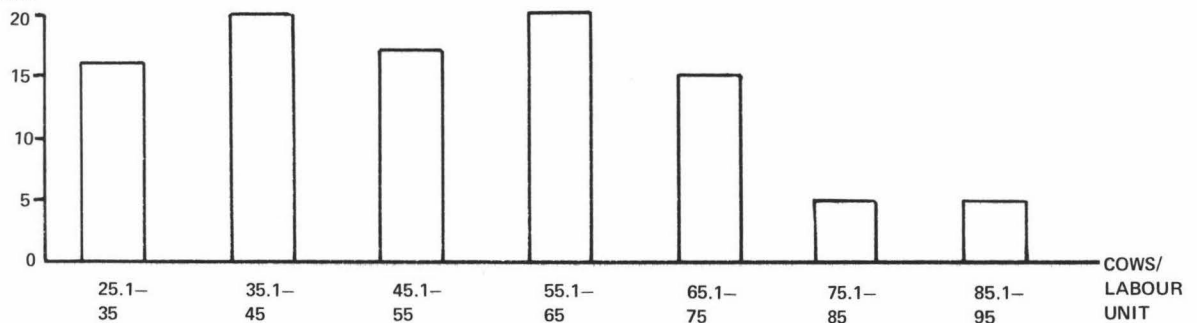
NO. OF
FARMS

Fig. 4.5(d). DISTRIBUTION OF COWS/LABOUR UNIT RATIOS.



farms had a D.C.E. at the start of the season per T.C.A. of ≤ 1.0 , whereas 88 farms had a milking cow per T.C.A. ratio of ≤ 1.0 . This is indicative of the fact that the vast majority of farmers reared their own replacements on their own or leased property. Only eight farmers grazed any stock out at all.)

Since exact measurement of the number of labour units associated with dairying and closely related production is extremely difficult to establish; the ratio of the number of cows milked per labour unit is implicitly subject to some error. For instance where only a small herd (say 60 cows) is milked, the husband and wife may milk two times per day throughout the season. Sometimes the husband will admit to not being able to cope without the help of the wife, whilst in other instances, the help of the wife, whilst appreciated, was not absolutely necessary. In the latter case the wife helped only because she thoroughly enjoyed doing so, but was, to all intents and purposes counted as being a labour unit. The distribution illustrated in Figure 4.5 (d) does however give an indication of the situation. On 53 farms, ≤ 53 cows were milked per L.U., whilst on 73 farms there were ≤ 65 cows milked per L.U. The highest number of cows milked per L.U. was 95 and the lowest 26, with an average of 54. The national average for 1968-69 was 68 cows per L.U.

The 98 farms had a total labour force, X_{15} of:

$$X_{15} = \sum_{i=1}^{98} x_{i,15} = 168 \text{ labour units}$$

$$\bar{X}_{15} = 1.7. \quad \text{Range } 1.0-3.30 \text{ labour units.}$$

Since each owner-operator was one L.U. this left 70 L.U.'s, the vast majority of which consisted of contract and family labour (especially that of the wife). There were 12 double partnerships (but only some of these were working partners) and outside of these partnerships there were 5 married men and 12 single men who were employed full time (some of the single and married men were sons of farmers in the survey).

The total value of the plant (book value), X_{16} was

TABLE 4.5

Summary of Results

Notation	Resources, products and ratios	Unit	$\sum_{i=1}^n x_{i,j}$ where $j=1...20$	'Av. per farm'	Range
X_1	No. of farms	farm	98		
X_2	Total acres owned or leased	acre	12,173	124.1	50-427
X_3	Total capital value of X_2	\$	3,936,860	40,172	16,620-100,600
X_4	Value of improvements	\$	2,718,187		
X_5	Unimproved value	\$	1,218,673		
	} = X_3				
X_6	T.C.A.	acre	11,875	121.2	50-427
X_7	Total capital value of X_6	\$	3,896,381	39,758	16,620-100,600
X_8	No. of cows milked	cow	8,699	89	43-294
X_9	G.F.I.	\$	1,012,514	10,332	4098-33,019
X_{10}	Value of crops sold off the farm	\$	11,961	569	20-2501
X_{11}	Value of livestock sales etc.	\$	227,645	2,322	499-8,625
X_{12}	Value of net feed inventory	\$	-32,968	-451	-4141 to +1300
X_{13}	Value of milkfat	\$	805,876	8,223	3031-27,909
X_{14}	Total milkfat supplied	lb	2,512,503	25,637	9,449-87,012
X_{15}	Total labour units	L.U.	168	1.7	1.0 - 3.30
X_{16}	Book value of plant	\$	185,707	1,914	140 - 6753
X_{17}	Value of fertilizer and lime	\$	35,192	382	13 - 1,490
X_{18}	Cows per labour unit			54	26 - 95
X_{19}	Milkfat per cow			286	178 - 511
X_{20}	Milkfat per T.C.A.			225	66 - 428

The 'average per farm' data represents the average characteristics of a dairy farm in the survey area.

\$185,707 with an average of \$1,914 and range of \$140 - \$6,753.

The average value of fertilizer and lime X_{17} , used per year between 1967-70 was \$382.00 with a range \$13-\$1,490.

A summary of the main resource and production characteristics are shown in Table 4.5.

4.9 SOCIO-ECONOMIC ASPECTS OF THE SURVEY FARMS

The questions in the questionnaire dealing with the non-physical aspects of the survey were designed so that the answer to one question could be followed up in an appropriate manner by related questions. All possible outcomes implied in the original question were subsequently and sequentially followed up by further questions to a logical conclusion. The construction of a 'decision tree' incorporating these sequential questions enabled the number of individuals in a particular set of circumstances to be recorded. (A simplified 'decision tree' appears as appendix I).

4.9.1 Type of Management and Time Spent in Dairy Farming

Of the 98 farms, 74 were run by the owner, 12 as partnerships and 12 by sharemilkers, operating a 50/50 share agreement. These groups represented the kind of management in existence amongst the 98 farms.

Of the 86 farmers designated as being owners and in partnerships, 7 had been in dairy farming between 6-10 years, 10 between 11-15 years, 16 between 16-20 years, 10 between 21-25 years and 19 between 26-30 years. Twenty four had been in dairying for more than or equal to 31 years. Seventy nine of these farmers had had over ten years of experience in dairy farming. The average length of experience was twenty six years. Despite the length of time most of these farmers had been in dairy farming

the majority had only become owner-operators in the last twenty five years. Twelve having become owner-operators in the last 0-5 years, 17 in the last 6-10 years, 19 in the last 11-15 years, 13 in the last 16-20 years, 15 in the last 21-25 years and 10 in the last 26 years or more. On average they had been owner-operators for fifteen years. There was a positive correlation between the time spent in dairy farming with the time spent as an owner-operator. On the average it took between ten to eleven and a half years to attain the status of an owner-operator. Consequently there was little difference in the average length of time to attain the status of full owner-operator, between those that considered that they had had considerable family help and those that considered they hadn't.

4.9.2 Age Distribution Amongst Survey Owner-Operators

Compared with the national age distribution of dairy owner-operators in 1966 (see Ch. 3, p. 85) there were, in the survey area, approximately 7 per cent less and 14 per cent more persons in the 25-34 and 45-54 age groups respectively. See Table 4.6.

TABLE 4.6 Age Distribution of the 98 Farmers

Age Group (years)	< 25	25-34	35-44	45-54	55-64	≥ 65
Number	2	15	26	39	12	4
Percentage	2.0	15.3	26.6	39.8	12.3	4.0

Typically in the national age groups a net decrease in the number of dairy owner-operators occurs between 45-65 years of age. If this were to occur for owner-operators in the survey a high number of present owner-operators could be expected to leave dairying within the next ten years. The net result will depend on the number of new entrants to each age group and the numbers leaving each age group.

4.9.3 The Number of Current Dairying Units Likely to be Lost to the Industry in the Next Ten Years

An indication of the number of present owner-operators in the survey likely to leave dairying and the number of units likely to be lost to non-dairying production in the next ten years, is given below.

Excluding share-milkers, of the remaining eighty six owner-operators, three did not intend staying on their present farms until they retired. Two of these intended leaving dairy farming altogether within four years to take up jobs in town. Both had units of less than 100 acres each. The third farmer was going dairying in the Waikato, within the next three years. His present unit had considerably less than 100 acres in total. All three of these owner-operators seemed almost certain that when the time came, their units would be sold and amalgamated with units that were currently not in dairying. Providing none of these enlarged units turn to dairying within the next ten years, three units currently producing a total of 57,383 pounds of milkfat per year (on the basis of 1968-69 production) from a total of 231 acres will, in the next four years, be lost to the dairying industry.

Eighty three owner-operators said they would manage their present holding (providing general economic conditions were no worse than they were at the time of the survey) until they retired. (Only three were uncertain to the extent that they answered "don't know"). Of these eighty three owner-operators, six declared that they had no intentions of carrying on dairying for longer than ten years. Three of these had already started to change completely into alternative enterprises. Of the others, one intended changing in 5-6 years and two in 7-10 years time. Thus within the next ten years, six of the eighty six owner-operators presently producing milkfat are likely to have ceased doing so. The total acreage owned or leased and the total milkfat production lost to the dairying industry, on the basis of 1968-69 production, as a result of these owner-operators changing over to other forms of production; will be 762 acres (range 50-227 acres) and 155,580 pounds of milkfat per year.

In total therefore it appears highly likely that between 1970/71 - 1980/81, nine dairy owner-operators, a total of 993 acres and a realised milkfat potential of at least 212,963 pounds of milkfat per year will be lost to the dairy industry. (At least for the remainder of the working-life of present owners).

The remaining seventy seven (86-9) owner-operators were asked when they envisaged retiring. Six said in 1-2 years time, but all but one had units in excess of 150 total acres, as did the one farmer who intended retiring in 3-4 years time. Eight owner-operators intended retiring in 5-6 years time and five of these had units of less than or equal to 100 total acres. A further eight owner-operators intended retiring in 7-10 years time and six of these had units of less than or equal to 100 total acres.

Therefore of the 86 owner-operators there is every possibility that within the next ten years, 32 will not be in dairy farming. In terms of these 32 owner-operators and forgetting the above 9 owner-operators, there are 12 owner-operators out of the remaining 23 that have less than or equal to 100 total acres each. The owners of these units considered that they were not large enough under present day conditions for a new owner to take over and make a reasonable living for himself and family, as well as repaying the mortgage. The units were unlikely to be able to generate an acceptable net farm income from dairying or from other forms of production other than from intensive horticultural production.

Of the twelve owner-operators owning units with less than or equal to 100 total acres and who intended retiring within ten years; five had sons whom they thought showed an interest in taking over and seven either didn't have a son, or if they did, the son showed no interest in taking over the farm. With respect to those owner-operators with less than or equal to 100 acres and who had sons interested in managing the farm; all five farms had conventional milking sheds in relatively poor states of repair, and which more than likely would, in their opinion, require extensive rebuilding at costs approximating \$5-6,000 each. Within the next ten years therefore a decision has to be made whether to make this

investment on a relatively small acreage, obtain more land (if land and credit are available at an acceptable cost), or sell out. For one or all of the above reasons it seems unlikely that the sons will take over the present farms per se.

It is of interest to note that of the eleven owner-operators intending to retire within ten years and who owned more than 100 acres in total (in fact all except two owned over 150 acres), ten had sons who were either working on the farm or who showed a definite interest in taking over the management of the farm within the next ten years. (i.e. either before or at the time the father is due to retire). From the structural point of view these units offer the next generation anyway, a sound viable unit from which to utilise and benefit from modern technological development and from which to generate a considerable and adequate G.F.I.

With respect to the twelve farms with less than or equal to 100 total acres and whose owner-operators are retiring within the next ten years it seems to the author that whether the present owner-operator has sons to go on the farm or not; within the next ten years these farms will either absorb or be absorbed by other existing units. If the assumption is made that these twelve units will not remain unaltered with respect to acreage; then the two following propositions state the extreme, diametrically opposite outcomes, of possible combinational outcomes to events that could occur to these twelve farms.¹

(i) All twelve units could be amalgamated with other units which are currently in dairying. In which case no land would be lost to the industry and providing present production obtained from those units being amalgamated was maintained; there would be no decrease in total production. The number of owner-operators as

¹ Amalgamation of land ownership can be complex. e.g. land lost to agriculture, increasing and decreasing farm area, consolidation or fragmentation of ownership. See: G.E. Jones and A.J. Simmons, "Towards an Interpretation of Change in Farm Structure: A Nottinghamshire Case Study," The Farm Economist, University of Oxford Agricultural Economics Research Institute, 10, 8, 332.

such, would decline by twelve. All twelve units have at least one immediate neighbour that is producing factory supply milk. Therefore, providing credit could be arranged and providing neighbours wanted to amalgamate, there is no reason why land or production need be lost to the industry.

(ii) This proposition assumes that all twelve farms could be amalgamated with other units which are currently not in dairying (and which have no intention of going into dairying within the next ten years). If this alternative were to occur 934 acres and 214,764 pounds of milkfat per year, on the basis of 1968/69 production, would be lost to the dairy industry. In so far as technology (other things being equal) is enabling more milkfat to be produced from the same acreage; the above loss in milkfat over estimates the loss of production likely to be incurred by the industry. The number of owner-operators would decline by twelve.

These two extreme possibilities are elaborated on in section 4.9.5 (see p. 126).

4.9.4 Future of Properties Operating a 50/50 Share Agreement

As mentioned previously there were twelve properties being managed by sharemilkers. Two of these sharemilkers intended withdrawing from dairy farming altogether within ten years. The remainder expected to stay in dairying but not necessarily in the Manawatu. However, because ultimately it is the owner of the property and not the sharemilker who makes the decision as to what will happen to the land; it was found in all instances that the owner was content with the present land use. Either by virtue of obtaining enough income from his 50 per cent of the milk cheque and/or because of his having a private income. It was notable that all but two properties with sharemilkers on them had in excess of 120 acres. Therefore even in the event of the present owners dying it is likely that the properties when sold, would be retained as dairying units.

4.9.5 Summary of Possible Outcomes as a Result of Dairy Units Being Lost to the Industry

For purposes of summarising the above results three hypotheses have been made which anticipate three possible dairying structures that could exist in the survey area by 1980-81.

The three hypotheses are as follows:¹

(H₁) That the nine properties (see p.123) do in fact all change production from dairying to non-dairying enterprises.

(H₂) Ditto, H₁, and that the first alternative of the extreme outcomes (p.124) does in fact eventuate.

(H₃) Ditto, H₁, and that the second alternative of the extreme outcomes (p.125) does in fact eventuate.

The structure predicted under H₁ for 1980-81 has a high probability of occurring, even though there may be some changes, represented at their extreme by H₂ and H₃, superimposed on this structure. Support for the latter statement is substantiated by the evidence presented in subsection 4.9.6.

The outcomes of the three hypotheses above are summarised in Table 4.7 subject to the following assumptions:

(i) That units of less than or equal to 100 acres amalgamate with units that are already more than 100 acres.

From the point of view of obtaining credit this assumption seems reasonably realistic. If the assumption should be proved correct; then, under H₂ and H₃ thirty units with less than or equal to 100 acres will remain by 1980-81. The present owner-operators of which intend farming them as dairy units for at least the next ten years. The only economic events likely to alter this situation are:

1 None of these hypotheses take into account the eighteen suppliers in the survey area producing less than 10,000 pounds of milkfat. See page 103. These may or may not be supplying milk to the Company by 1980-81.

TABLE 4.7 Summary of Three Possible Dairy Structures That Could Exist in the Survey Area by
1980 - 81.

Criterion	Year	No. of units ≤ 100 acres	No. of units > 100 acres	No. of D-O-O or No. of total units	Decrease in total No. of units as a % of 1968-69	Total No. of acres devot- ed to dairy- ing.	Decrease in total acre- age as % of 1968-69.	Total Milk fat prod- uction (lb)	Decrease in total milk fat as % of 1968-69.
As per 1968-69 survey data	1968-69	47	51	98	0	12,173	0	2,512,503	0
H ₁	1980-81	42	47	89	9.2	11,180	8.2	2,299,540	8.5
H ₂	1980-81	30	47	77	21.4	11,180	8.2	2,299,540	8.5
H ₃	1980-81	30	47	77	21.4	10,246	15.8	2,084,776	17.0

(a) If the profitability of dairying relative to other forms of production declines. (However, in the opinion of the Department of Agriculture under present (June, 1972) circumstances the price of milkfat would generally have to fall to twenty-five cents per pound of milkfat before diversification into other types of production would be as profitable as that from dairying).

(b) If costs increase to such an extent that the farmer is unable to generate a large enough G.F.I. from conventional methods of production. Since these thirty owner-operators are all established farmers; it seems improbable that they will leave dairying within the next decade. The indications are, that some of them at least, will be endeavouring to purchase more land with which to expand output.¹

(ii) That no further amalgamations or purchasing of land occurs (other than that permitted under respective hypotheses) before 1980-81.

Other than the amalgamations allowed for under each respective hypothesis; it is difficult to know to what extent likely additional amalgamations will take place between 1971-81. Some idea may be obtained however from what has occurred in the previous ten years. In the period 1961-71, 13 of the 98 respondents had purchased 927 acres of additional land (average 71.3, range 11 - 134 acres), none of which adjoined the home farm, but which was used in conjunction with the home farm. An additional 1,463 acres adjoining the home farm were purchased by 16 respondents.² The mean acreage so bought being 66.5 acres.

A further nine respondents leased a total of 516 acres adjoining the home farm (average 57.3, range 15 - 131 acres) and seven of these persons intended, if possible, buying this land

1 Two thirds of the thirty owner-operators answered "yes" to the question - "If your neighbours or other land very close became available now would you buy this land given your present conditions and those existing in the financing world?"

2 Four of these respondents had also purchased land not adjoining the home farm.

within the next decade. Twelve persons leased a total of 751 acres not adjoining the home farm, half of whom intended, if possible, purchasing within the next decade.

In the ten years 1961-71 therefore, 2,390 additional acres were purchased and 1,267 more leased. Much of this land was simply a transfer of ownership from one dairy owner-operator to another. Therefore, though amalgamations will continue (as anticipated under H_2 and H_3) there is likely to be little or no increase in the land available for dairying. (See also assumption (vi)).

(iii) That, (other than the cows milked from the properties taken into allowance in H_1 and H_3), there is no change in the number of cows milked.

This assumption implies that there will be no further substitution of other enterprises for cows (other than for the farms considered under H_1 and H_3). As to whether this assumption will or will not be correct is difficult to say because of the uncertainty of future market prices, changing technology and changing social attitudes. However to gauge the attitude of farmers to diversification the 98 respondents were asked questions concerning dairy beef.

In the last five years, 63 respondents had not diversified into dairy beef and 49 of these had no intention of doing so within the next decade. Of the 14 that did intend diversifying within the next decade 13 said they would diversify into dairy beef.¹ Of these 13, four said they would diversify without milking less cows, one was at the expense of 6-10 cows, two at the loss of 16-20 cows, one at the loss of 26-50 cows and five at the expense of the whole herd. (These five are included under the first hypothesis (H_1)).

Of the 35 respondents who had produced dairy beef in the last five years, 18 were producing it before and 17 after, the

¹ Despite the termination of the dairy beef incentive scheme.

dairy beef incentive scheme was announced.¹ Eight of these 17 considered that it was the \$10. subsidy per beast that was the deciding factor making them go into dairy beef. However, seven of these persons did not reduce the number of cows milked and only one person milked between 1-5 cows less as a result of rearing dairy beef. Nine owner-operators who entered into dairy beef production after the announcement of the incentive scheme said they had planned to do so anyway, and did so without reducing the number of cows milked. Therefore, in the survey area the dairy beef incentive scheme as such, failed to significantly reduce the number of cows milked.

It would appear from the evidence of the last five years that cow numbers will not decrease significantly as a result of diversification into dairy beef. This does not preclude, however, diversification into enterprises, other than dairy beef, at the expense of milking less cows. (The likelihood of this happening however, is not very probable, as explained on p. 128).

Whilst there may not be a reduction; there may well be an increase in the number of cows milked. New technology and management techniques will permit more cows to be kept per unit area of land.

(iv) That in 1980-81 the amalgamated units together produce

1 Of the 13 farmers who had not produced dairy beef in the last five years, but who intended to in the next decade, only four had < 115 acres and most had an acreage considerably in excess of this figure. Likewise of the 35 respondents who had produced dairy beef in the last five years only 12 had < 115 acres. Using the Chi-square (χ^2) test of significance to test the hypothesis: H_0 (The number of owner-operators who keep or intend keeping dairy beef with < 115 acres equals those owner-operators who keep or intend keeping dairy beef with ≥ 115 acres). It was found at the 0.05 level of significance and using Yates Correction for 1 d.f. that the test was significant i.e. the hypothesis was rejected. Therefore there is a less than 1 in 20 chance that the prediction that more farmers with ≥ 115 acres keep or intend keeping dairy beef than do farmers with < 115 acres, will be wrong. The possible significance of this finding is evaluated in Chapter 7.

in total, the same milkfat (as for the 1968-69 season) as did the two units separately.

So long as the average per acre production of milkfat does not fall below the existing average, any increase in stocking rate will, other things being equal, increase the total milkfat production from the survey area, over and above that amount predicted by respective hypotheses. Should this be the case this assumption will not hold and the total amount of milkfat predicted under each hypothesis will be a minimum amount.

(v) That units, whether involved in amalgamation or not, that are still in dairying by 1980-81 do not increase production of milkfat above their 1968-69 level.

See assumption (iv).

(vi) That there are no new entries into dairying.

It has been the experience of the Manawatu Co-operative Dairy Company that each year, in the whole of its supply region, there are usually very few entirely new suppliers of milk. Any new entry in the survey area is therefore likely to be insignificant, unless the relative profitability of dairying improves dramatically.

4.9.6 Reasons and Consequences of Dairy Farmers Leaving Dairying

A telephone survey, encompassing fifteen former factory supply dairy owner-operators, who had given up dairy farming between 1967/68 - 1970/71 within the confines of the survey area, was undertaken.

The age of leaving dairying was not readily obtainable from an impersonal telephone call from all respondents. However, it was clear that by no means all left dairying as a consequence of reaching retirement age. It would appear that quite a proportion

left in their late fourties and early fifties for alternative employment.

The largest of the fifteen farms with respect to acreage was 140 acres, whilst the smallest had only 32 acres. The total acreage used by the fifteen farms was 1,294 acres with an average of 86.3 acres. All but five farms had $\leq$ 100 acres. A total number of milking cows of 1,002 produced 280,379 pounds of milkfat. Therefore on average, each farm had 66.8 cows which produced 18,692 pounds of milkfat.¹

At least for the remainder of the working life of present owners, 556 acres (or 42.9% of the total acreage owned or leased by the fifteen dairy farmers) have been lost to the dairy factory supply industry. Only 110 acres of this has gone into cropping or town supply milk; the remainder has been retained or leased by the present owners for running dry stock. The remaining 738 acres (1,294-556) has either been sold or leased to other factory supply dairy farmers by way of amalgamations.

In four instances farmers had kept their original acreage for running dry stock on. None had outside employment. One of these thought that when he retired the son (who was sharemilking on another property) would carry on milking on the home farm. In four other instances three of the owners had leased and one had sold some of the original farm, whilst still retaining the house and a few surrounding acres (range 3 - 43 acres). Two of these owners had full-time jobs in town labouring and one was a stock agent. The fourth owner was 65 and retired. It would seem that the retention of the home and a few acres is a satisfactory solution for both parties involved.² The tenants were able to lease an

1 In so far that these figures relate to the last complete season before the owners gave up dairying, they are probably somewhat under-estimated, since stock numbers may have been reduced prior to the final year of operation. The effects of the drought in 1969-70 will also have effected output.

2 Nationally this may not be satisfactory if the few acres retained are not intensively farmed. Land ownership is further fragmented.

increased acreage without having to lease unwanted houses, and one neighbour was able to purchase more land without having to buy an unwanted house. Two owners whilst working full-time in town also had a secondary source of income from leasing land. One ex-farmer whilst working full-time had the capital value of the acres sold and the retired owner had a source of revenue from leasing 67 acres. All four owners were able to continue living in the country.

In six other instances the owner or tenant was no longer living on the property but was working full-time in town. Only in one instance had the owner sold the farm and retired, because of old age, to town.

Excluding the four owners who were still living on their properties running dry stock but without outside employment, of the remaining eleven farmers all considered their units to be uneconomic under present day conditions. Six respondents said it was finally financial reasons why they gave up dairying, though one of these was due to retire anyway. In some cases the 1969-70 drought was the final deciding factor. Three considered ill health to be the main reason for leaving dairying though one of these was sixty five years of age. One farmer besides milking cows also had outside employment, but as he had been milking for fifty two years decided to go into outside employment full-time. One farmer left dairying on grounds of religion.

Three respondents specifically mentioned that even if they had wanted to go on milking cows, doing so would have involved satisfying the authorities as to cowshed hygiene and to the disposal of effluent. To rectify these deficiencies would have required sums of capital out of all proportion to the size of the farms.

It is pertinent to note that all those who had previously been dairy farming and who now had jobs in town expressed the fact "that they had never been so well off financially." It should be remembered that whilst the farmers in the survey area were within striking distance of alternative non-farming employment, many dairying areas of N.Z. are not. Therefore alternative sources of employment for displaced dairy owner-operators may not be so easily resolved in other areas of the country.

Much of the evidence from the telephone survey bears out some of the subjective contentions of earlier subsections in this chapter. It further supports the statement that the structure in the survey area by 1980-81 will probably fall somewhere between H_2 and H_3 . (See page 126).

4.9.7 Summary and Conclusions

Compared with the 1966 age distribution for D-O-O's the survey area contained a disproportionate number of D-O-O's in the 45 - 54 age group. This has been a major contributing factor in discerning the likely decrease in the number of D-O-O's that will exist by 1980-81, as hypothesised in the second and third hypotheses.

The age distribution also reflects the small proportion (relative to the 1966 national proportion) of those ≤ 34 years of age. With regards to the number of D-O-O's likely to exist in years to come this factor only reinforces the contention as prescribed by the three hypotheses, that there will continue to be a decline in the number of D-O-O's in the survey area.

The information also shows the use to which age groupings on a regional, county and/or occupational basis could be put to in formulating future plans.

By 1980-81 it is likely that there will only be seventy seven D-O-O's (a reduction of 21.4 per cent). Thirty of these are still likely to own ≤ 100 acres. Compared with that acreage used for dairying in 1968-69, the total acreage devoted to dairying is likely to decrease by between 8.2 - 15.8 per cent and total milk-fat production by between 8.5 - 17.0 per cent. In actual fact it is probable that new technology and management techniques will ensure that total milk production in 1980-81 will remain approximately at the same level as that produced by the survey farms in 1968-69; despite the likely decrease in the number of D-O-O's and acreage available to dairying. An increase in the total amount of milkfat produced in the survey area by 1980-81 is

not anticipated.

With regards to making inferences to the whole of the Manawatu Co-operative Dairy Company's supply area, Table 4.8 shows the average payouts per pound of milkfat for milk suppliers at the farm gate, total milkfat production, the number of suppliers and the average milkfat (supplied to the factory) per supplier for the period 1964/65 - 1971/72.

TABLE 4.8 Production Statistics for the Manawatu
Co-operative Dairy Company. 1964/65 - 1971/72.^a

Season	Price (cents per pound milkfat).	Total milkfat production. (m. lb.)	No. of suppliers.	Milkfat per supplier.
1964-65	35.266	14.862	747	19,895
1965-66	36.633	18.403	870	21,152
1966-67	36.184	18.781	898	20,914
1967-68	34.180	16.856	859	21,951
1968-69	32.076	24.429	1061	23,024
1969-70	32.440	20.839	998	20,880
1970-71	37.442	21.592	893	24,179
1971-72	49.000	23.751 ^b	805 ^c	29,504

a Manawatu Co-operative Dairy Company Limited. Annual Report and Accompanying Accounts: Palmerston North. Various years.

b Estimated as being 10 per cent greater than the 1970-71 total.

c Private communication.

The high total milkfat production credited to 1968-69 was a direct result of a good dairying season (production wise) and a large number of suppliers resulting from the amalgamation of two former dairy companies.

The 1971-72 season was also a good dairying season (production and price wise) and it seems probable at the time of

writing, that the total production will approach that reached in 1968-69, but with 256 fewer suppliers. It is therefore probable that if the conclusions reached for the survey farms (namely that fewer D-O-O's will produce approximately the same total milkfat in 1980-81 as was produced in 1968-69) also holds for the whole company supply area; then the Manawatu Co-operative Dairy Company can NOT expect an increase in milkfat production from the present suppliers in toto.

The one major event that could alter the situation, so far as the Manawatu Dairy Company is concerned, is the merging of interests with an existing local dairy company. The author is of the opinion that such a merger is the surest way of assuring sufficient milk supplies to fully utilise manufacturing capacity of the Longburn Complex.¹ Such a merger(s) will also ensure maximum payouts to dairy farmers, in an area where the total number of milking cows is decreasing, or at the best, static.

¹ Longburn, (four miles from Palmerston North) is the administrative and manufacturing headquarters of the Manawatu Co-operative Dairy Company.

CHAPTER V

SYNTHESIS AND CHARACTERISTICS OF THE AVERAGE WELL ORGANIZED FARM

5.1 INTRODUCTION

Section and subsections of 4.9 described what is likely to be the actual future structure of dairy farms in the survey area by 1980-81. In this, and the succeeding chapter, the results obtained from hypothetically rationalizing existing dairy units in the survey area, without loss of land, into average well-organized farms, is described.

5.2 THE HYPOTHESIS

Kaldor,¹ describing the conditions necessary for an efficient farm industry, says:

A well-balanced (efficient) farm industry will exhibit three important characteristics: (i) The output of each product will be produced at the lowest possible resource cost. (ii) The composition of farm output - the product mix - will be meshed with the pattern of demand for farm products. (iii) The total output of the industry will be geared to the total demand for farm products.

Since the survey farms were basically producing one product and because the total output of the survey farms was small relative to the total N.Z. production of milk products, (ii) and (iii) above were of little concern to the writer.

¹ D. Kaldor, et al., Comparison of Resource Returns of Well-Organised Iowa Farms With Selected Nonfarm Opportunities, Research Bulletin 491. Agr. and Home Eco. Exp. Station, Iowa State University of Science and Technology; March, 1961.

Resulting from (i) above however; it was hypothesised that dairy farms in the survey area contained an imbalance in resource use. Such an imbalance means that there are opportunities in the industry to: (i) Increase total output without increasing total resource input. Or, (ii) Produce the same total output with less total input. Or, (iii) Increase total output and at the same time reduce total input.

In order to test the hypothesis:

That there existed in the survey area (in the 1968-69 structure), an imbalance in resource use amongst dairy farms.

The following four procedural steps were required:

- (i) The selection of well organized farms from the survey area.
- (ii) The synthesis of an average well organized farm. (A.W.O.F.)
- (iii) Using the acreage of the average well organized farm to divide into the total land area of the survey farms, to give farms each with the characteristics of the average well organized farm; such farms representing the rationalized structure.
- (iv) Comparison of the total resources and products of the rationalized structure with those of the 1968-69 structure.

The latter step will show:

- (i) If an increase in total output without increasing total resource input is possible.
- Or, (ii) if total output can be maintained with less total input.
- Or, (iii) if total output can be increased whilst at the same time reducing total inputs.

On the basis of one of these possibilities the original hypothesis will be rejected or accepted.

The method of synthesising and the characteristics of

this average well organized farm are described in Chapter V. In Chapter VI the resources and production characteristics of this average well organized farm are used to divide the total land area in the survey area into farms, each with the characteristics of the average well organized farm. These farms represent the rationalized dairy farm structure in the survey area. The total resources and production characteristics of the rationalized structure are calculated and compared with those totals found to be in existence for the 98 farms in 1968-69.

5.3 IDENTIFICATION OF WELL ORGANIZED FARMS

In order to rationalize the dairy farm structure found to be in existence in the survey area in 1968-69, well organized farms in that structure were selected. The inputs and outputs of these well organized farms were then averaged, to construct a hypothetical average well organized farm.

A farm was deemed to be well organized on the basis of the following criteria:

- (i) The farm area had to exceed 120 acres.

In justifying the selection of 120 acres as the cut off point it was felt that at least this acreage would be required in the future: (a) To be financially viable. (b) To be able to repay mortgages and still leave an acceptable level of disposable income. (c) To be able to utilize more fully technological¹ and managerial innovations. (d) To enable owners of such blocks to better meet any exigencies, such as lower milkfat prices, without having to elicit Government aid.

¹ It is probable that, within the near future, with the advent of the rotary milking shed, automatic cup removal and automatic udder stimulators one man will be able to milk between 150 - 200 cows as a matter of course. Unless there are similar associated developments to enable more cows per acre to be milked, at least 120 acres will be required to utilize efficiently the above innovations.

Furthermore, the trend historically has been to bigger farms (more acres) and the evidence presented in chapters two and three indicates that there is no reason for supposing that this trend will not continue.

(11) The farm had to support not less than 100 milking cows and replacements.

In 1968-69 the N.Z.¹ average net farm income per cow was \$39.14. To obtain this average net farm income per cow required an average gross farm income of \$112.39 per cow.² Table 5.1 shows the average total net farm income for different levels of average total gross farm income³ derived from varying herd sizes.

TABLE 5.1 The Average Total Net Farm Income Derived
From Average Total G.F.I. for Different Herd Sizes.

Herd Size (cows)	Av. G.F.I. (\$)	Av. total net farm income (\$)
1	112.39	39.14
75	8,429.25	2,935.50
175	19,668.25	6,849.50

It can be seen that under 1968-69 conditions a well organized farm, milking in excess of 100 cows, was assured of

1 Factory Supply dairy farms only.

2 New Zealand Dairy Board, Farm Production Division. A survey of the Economic Structure of Factory Supply Dairy Farms in N.Z. in 1968-69, op. cit., p. 47.

3 G.F.I. included \$1.55 per cow from pigs. Otherwise G.F.I. was calculated in virtually the same way as for the authors survey farm.

obtaining, on average, a minimum total net farm income of \$3,914,¹ from which had to be met, taxation,² living expenses, debt repayments and capital expenditure.

(iii) The total milkfat production had to be higher than the average total milkfat production from the 98 farms (i.e. $> 25,637$ pounds). This criterion excluded those farms which had over 120 acres but which had very low milkfat production per acre.

(iv) The number of cows milked per labour unit had to be more than sixty.

This ensured that labour productivity was of a reasonably high standard.

(v) Present managerial ability had to be above average.

The author, on the basis of the data collected and on the basis of the interviews selected ten farms meeting in his view the above criteria. Two consulting officers were then asked independently to select those farms which in their opinion met with the above criteria. The first consulting officer was not conversant with all the farms but selected seven, all of which were amongst the ten the author had selected. The second consulting officer had worked in the survey area for 14 years and had made contact with 95 per cent of those in the survey. He endorsed nine of the original ten farms and added another as being possibly suitable.

The opinions of the consulting officers were particularly valuable in clarifying the fifth criterion above.

As a result of these deliberations eight farms were selected as best meeting the above criteria and consequently represented well organized farms. It should be emphasised, that the selection of these farms was a subjective evaluation, based on experience with the farms, farm owners and empirical data collected

1 Any borrowed money is not taken into account in this figure.

2 Allowing \$1,810 of exemptions, tax on \$3,914 in 1968-69 alone was \$643.

from the survey. Basically we were seeking farms in which the quantity and combination of land, capital and other inputs were combined in such a way as to give a high output at low cost.

5.4 CHARACTERISTICS OF THE AVERAGE WELL ORGANIZED FARM

The hypothetical average well organized farm was synthesised by taking the mean characteristics of the eight selected well organized farms. Consequently, the structure is rationalized to the point where the marginal productivities of the variable resources are equal for each unit (A.W.O.F.) comprising the rationalized structure.

The mean characteristics of the eight well organized farms were as follows: (Where the subscripts on the Z's represent the same resource, product or ratio as those appearing on the X's in Table 4.5 (p. 119)).

5.5 THE CHARACTERISTICS OF THE AVERAGE WELL ORGANIZED FARM COMPARED WITH THE 'AVERAGE FARM' OBTAINED FROM THE SURVEY FARMS

The average well organized farm had a land base of 181.4 acres (+ 57.3 acres, + 46.2 per cent) and an associated total capital value of \$54,856 (+ \$14,684, + 36.5 per cent). Where the figures in brackets represent the absolute difference, and the percentage increase respectively, between the average farm formed from the 98 farms, and the average well organized farm.

The number of cows milked on the average well organized farm was also correspondingly higher; being 161 cows as opposed to the average for the 98 farms of 89 cows, (+ 72 cows, + 80.1 per cent). The number of cows milked per labour unit was also higher for the average well organized farm; being 73 cows per labour

TABLE 5.2 Specifications of the 'Average Well
Organized Farm'.

Notation	Resources, products & ratios	Unit	Av. well organized farm	Range of values comprising the average.
Z ₂	Total acres owned or leased	acre	181.4	121 - 302
Z ₃	Total capital value of Z ₂	\$	54,856	38,440-89,340
Z ₄	Value of Unimprovement	\$	38,650	27,220-64,000
Z ₅	Unimproved value		16,206	10,940-25,340
Z ₆	T.C.A.	acre	178	121 - 284
Z ₇	Total capital value of Z ₆	\$	54,267	38,440-85,504
Z ₈	No. of cows milked	cow	161	103 - 294
Z ₉	G.F.I.	\$	18,313	10,006-31,939
Z ₁₀	Value of crop sold off the farm	\$	-	—
Z ₁₁	Value of livestock sales etc.	\$	3,353	644 - 6,534
Z ₁₂	Value of net feed inventory	\$	-1,248	-4,141 to 0
Z ₁₃	Value of milkfat	\$	15,495	8,836-27,909
Z ₁₄	Total milkfat supplied	lb	48,309	27,550-87,012
Z ₁₅	Total labour units	L.U.	2.1	1.1 - 3.3
Z ₁₆	Book Value of plant	\$	3,679	1,759-6,753
Z ₁₇	Value of fertilizer and lime	\$	662	300 - 1,113
Z ₁₈	Cows per labour unit		73	62 - 95
Z ₁₉	Milkfat per cow.		301	225 - 511
Z ₂₀	Milkfat per T.C.A.		275	217 - 428

unit, (+ 19 cows per L.U., + 35.2 per cent). Total labour requirements on the average well organized farm was 2.1 L.U.'s, compared with 1.7 L.U.'s on the average of the 98 farms.

The book value of plant was higher in an absolute sense for the average well organized farm; being \$3,679 (+ \$1,765, + 92.2 per cent) and also on a per acre basis, being \$20.3 per acre and \$15.4 per acre respectively. Likewise, the total value of fertilizer per average well organized farm was \$662 (+\$280, + 73.3 per cent) and, on a per acre basis, \$3.6 per acre and \$3.1 per acre, respectively.

The total milkfat supplied from the average well organized farm was 48,309 pounds (+ 22,672 pounds, + 88.4 per cent). This gave rise to a gross revenue from milkfat alone on the average well organized farm of \$15,495, compared with only \$8,223 from the average of the 98 farms.

Table 5.3 summarises the more important characteristics of the average well organized farm and the average per farm characteristics obtained from the 98 farms.

5.6 SUMMARY

A glance at table 5.3 indicates the very much more intensive nature of production on the A.W.O.F. compared with that of the average farm, formed from the original 98 survey farms. Despite this, the average well organized farm is still very much a family concern.

The gross farm income of the average well organized farm was \$18,313 (+ \$7,981, + 77.3 per cent). On an average N.Z. milk supply (factory) farm it required an average G.F.I. of \$112.39 per cow to obtain an average net farm income of \$39.14 per cow in 1968-69. Dividing \$112.39 into \$18,313 gives 163 cows (2 cows more than actually existed on the A.W.O.F.). Thus, 163 multiplied

TABLE 5.3 Percentage Increase in Respective
Characteristics of the Average per Farm Characteristics
Formed From the 98 Farms, Compared with the Characteristics
of the Average Well Organized Farm. (A.W.O.F.)

Resources, products and ratios	Unit	Av. per farm.	A.W.O.F.	% Increase
Total acres owned or leased	acre	124.1	181.4	46.2
Total capital value	\$	40,172	54,856	36.5
No. of cows milked	cow	89	161	80.1
G.F.I.	\$	10,332	18,313	77.3
Total milkfat supplied	lb	25,637	48,309	88.4
Total labour unit	L.U.	1.7	2.1	23.5
Cows per labour unit		54	73	35.2
Milkfat per cow		286	301	5.2
Milkfat per T.C.A.		225	275	22.2

by \$39.14 gives an average total net farm income of \$6,380 from which to meet taxes, living expenses, principal repayments and capital expenditure.

Using the number of cows actually supported on the average well organized farm gives an average total net farm income for this farm of \$6,302 (161 x \$39.14).¹ On the basis of the N.Z. average it would therefore seem, that from the practical point of view, the

¹ On this basis the average net farm income from the average farm formed from the 98 farms is \$3,483 (89 x \$39.14), which is \$2,819 less than the average net farm income obtained from the A.W.O.F. The A.W.O.F. is therefore not only deemed to probably possess greater non-pecuniary advantages such as security, more leisure time etc. than the 'average farm' obtained from the survey farms, but also very real pecuniary advantages.

hypothetical farm is feasible. Jackson¹ has shown that economies of size on dairy farms do exist, but unfortunately the calculation of the total net farm income above implies the existence of a linear relationship between average G.F.I. and the number of cows. The resulting error, however, would appear not to be too important, since the Dairy Board publishes data, relating to the 1968-69 season, for income and expenditure per farm (milk supply) by herd size.² This data showed that herds containing between 150 - 199 cows had an average herd size of 169 cows, producing on average 49,580 pounds of milkfat and generating on average a G.F.I. of \$18,875. This gave an average total net farm income of \$5,931.³ The figures pertaining to the number of cows, total milkfat production and G.F.I. will be seen to relate very closely to those obtained for the average well organized farm.

The work done by Jackson would indicate that the characteristics of the average well organized farm, that is, a farm with a G.F.I. of \$18,000, milking 161 cows and with two labour units, are not those of an optimum (minimum cost) unit. His work would appear to indicate that under certain conditions, the optimum two man dairy unit (with milkfat at 33 cents per pound), would milk approximately 240 cows. The G.F.I. so generated was approximately \$28,000 which yielded a net farm income of approximately \$18,000. If we accept these figures as representing the minimum cost (most profitable) two man dairy unit; then it is clear that using the synthesised average well organized farm, will only give rise to a sub-optimal rationalized structure. To this extent it is a non-normative exercise.

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- 1 R.G. Jackson, A Study of the Economics of Size in N.Z. Dairy Farming, Unpublished Masterate Thesis, Massey University, Palmerston North, 2 Vols; 1971.
 - 2 New Zealand Dairy Board, Farm Production Division. A Survey of the Economic Structure of Factory Supply Dairy Farms in N.Z. in 1968-69, op. cit., p. 36.
 - 3 Ibid., p. 36. Similarly, herds with between 80-99 cows had an average of 89 cows (equal to the 'average per farm' figure in the author's survey), produced on average 25,250 pounds of milkfat and generated a G.F.I. of \$9,988 which gave a N.F.I. of \$3,687.

Using the characteristics of the minimum cost, two man dairy farm, would yield the optimum rationalized structure. The reasons for only restructuring the dairy farms in the survey area sub-optimally are given in Chapter VI.

CHAPTER VI

CHARACTERISTICS OF THE RATIONALIZED STRUCTURE AND A COMPARISON OF THIS STRUCTURE WITH THAT DAIRY STRUCTURE OBSERVED TO BE IN EXISTENCE IN THE SURVEY AREA IN 1968-69.

6.1 INTRODUCTION

Having derived the characteristics of the average well organized farm it is now possible to construct the hypothetical rationalized structure.

6.2 ASSUMPTIONS IN CONSTRUCTING THE HYPOTHETICAL RATIONALIZED STRUCTURE

To estimate the characteristics of the rationalized structure required the following assumptions:

(i) That the total acreage used by the 98 farms (12,173 acres) was all available for use in the rationalized structure.

(ii) That land transfers could be arranged to conform to the acreage of the average well organized farm (i.e. 181.4 acres).

(iii) That owner-operators of the average well organized farms ('new' farms) had the managerial ability to produce at least as much production (with the given resources) as stipulated in Table 5.2, page 143.

(iv) That the necessary restructuring of farm size would be achieved without affecting land prices.

(v) That labour and capital would be available at current prices.

6.3 BASIS FOR RE-ORGANIZATION

To construct the rationalized structure (and to calculate the total production produced and the resources used by it) required that the land base (12,173 acres) be re-organized into farms each having the characteristics of the average well organized farm.

Since the number of 'new' farms is a constant multiplier in assessing the total production obtained, and the total resources used by the rationalized structure; the basis for calculating the number of new farms is important. For this reason two methods of calculating the number of 'new' farms that would exist in the rationalized structure, within the survey area, were considered.

(i) One method was to divide the total acreage used by the original ninety eight farms by the acreage of the average well organized farm.

(ii) Assuming the capital value reflects to some degree the quality of the land; then the number of 'new' farms can be calculated by dividing the total capital value (C.V.) of the 98 farms (X_3) by the C.V. of the average well organized farm (Z_3). To some extent this method would negate the effects of varying soil quality encountered in the survey area.

The latter method though used previously¹ is not considered by this author to be satisfactory for use in this study on two basic accounts:

(a) The C.V. not only takes into account soil quality, but also location, value of improvements and original vegetative cover, etc. All of which may conceal any variation in C.V. due to inherent soil quality differences, amongst the well organized farms.

¹ Technical Committee, Efficient Organization of the Farm Industry in the North Central Region of the United States in 1959 and 1980, Research Bulletin 560. Agr. and Home Economics Exp., Station, Iowa State University of Science and Technology; Ames. Iowa. March, 1968.

(b) The total C.V. of all the 'new' farms in the rationalized structure is constrained to that total C.V. which was relevant only to the original 98 survey farms. There are no a priori grounds for believing that the total C.V. should be so constrained. In fact there is every reason to suspect, that despite the constant land base; because of the fewer farms in the rationalized structure, duplication of milking sheds, houses and implement sheds would be avoided, thus decreasing the total C.V.

6.4 CHARACTERISTICS OF THE RATIONALIZED STRUCTURE

For these reasons the first method of calculating the number of 'new' farms existing in the rationalized structure was used. The number of 'new' farms so derived was designated Y_1 ,

$$\text{where } Y_1 = \frac{X_2}{Z_2} = 67 \text{ farms}$$

The total C.V. of these 67 farms was calculated by multiplying the number of 'new' farms by the C.V. of the average well organized farm. This variable was Y_3 :

$$Y_3 = (Y_1) (Z_3) = \$3,675,352.$$

This was 6.6 per cent lower than the total C.V. for the 98 farms.

The number of cows milked under the rationalized structure was calculated by multiplying the number of 'new' farms by the number of cows per average well organized farm (Z_8). This variable was Y_8 :

$$Y_8 = (Y_1) (Z_8) = 10,787 \text{ cows.}$$

This was 2,088 more cows or an increase of 24.0 per cent over and above that number milked in total by the 98 farms. More cows in larger herds, are thus milked on fewer farms. This result supports the trends, shown to be occurring nationally in Chapter 1. More

cows in total and higher milkfat per acre on the 'new' farms ensured that total milkfat supplied (Y_{14}) by the rationalized structure produced in total, a milkfat supply 28.8 per cent in excess of that total supplied by the original 98 farms.

$$Y_{14} = (Y_1) (Z_{14}) = 3,236,703 \text{ lb. milkfat.}$$

The extra milkfat so produced was largely responsible for increasing the G.F.I. (Y_9) from the rationalized structure.¹

$$Y_9 = (Y_1) (Z_9) = \$1,226,971.$$

In order to obtain the above G.F.I. the 'new' farms comprising the rationalized structure produced no crops for sale off the farm. The total value of livestock sales etc., (Y_{11}) remained virtually unchanged:

$$Y_{11} = (Y_1) (Z_{11}) = \$224,651.$$

Since stock sold is a function of herd size it might have been expected that the 'total value of livestock sales etc.' from the rationalized structure would have been greater than from the original structure. This however, was not the case since the well organized farms (whose average characteristics formed the A.W.O.F.) were building up cow numbers and thus had a lower culling rate and consequently fewer cows to sell. Some of these farmers were also purchasing stock to build up numbers. Also in so far that 'total value of livestock sales etc.' includes revenue from 'grazing in' (in the original structure) this too is not included (in the rationalized structure), since none of the well organized farms 'grazed in' any stock.

To the extent that the A.W.O.F. consists of eight farms - not all of which are in equilibrium with regards to livestock - then the G.F.I. is probably somewhat understated. Using the stock reconciliation records from farms containing approximately 161 cows

¹ Components of G.F.I. do not equal this G.F.I. figure as working with averages. The components of the G.F.I., calculated for the 98 farms, do sum to the total G.F.I.

would have overcome this problem, but very few such herds existed in the survey area that were in the equilibrium state.

The value of net feed inventory (Y_{12}) increased considerably:

$$Y_{12} = (Y_1) (Z_{12}) = -\$83,616.$$

That is to say \$50,648 worth of feed more was purchased by the 'new' farms, than by the original 98 farms. This extra feed took the form mainly of bought in hay and the 'grazing out' of replacement stock. Such stock was invariably carried on sheep farms, therefore though the 'new' farms comprising the rationalized structure use more 'bought in' feed; it is likely that this grazing would be available.

The total value of milkfat (Y_{13}) supplied to the Dairy Company was:

$$Y_{13} = (Y_1) (Z_{13}) = \$1,038,165.$$

The total number of labour units (Y_{15}) used by the rationalized structure was:

$$Y_{15} = (Y_1) (Z_{15}) = 140.7 \text{ L.U.'s.}$$

This was marginally lower (27.3 L.U.) than the total for the 98 farms. Not only is the decrease in the total labour force important, but so also are the changes in the composition of the remaining labour force. For instance the number of owner-operators under the reorganized structure requires that there be only 67 owner-operators as opposed to 98 under the original structure. Further details of these changes will be looked at in the next section.

The book value of plant (Y_{16}) used in the rationalized structure was:

$$Y_{16} = (Y_1) (Z_{16}) = \$246,423$$

and the value of fertilizer and lime (Y_{17}) used by the rationalized structure was:

$$Y_{17} = (Y_1) (Z_{17}) = \$44,354.$$

6.5 COMPARISON AND SOME CONSEQUENCES IN MOVING FROM THE OBSERVED 1968-69 STRUCTURE TO THE RATIONALIZED STRUCTURE

Table 6.1 summarises the total production and resource characteristics of the original 1968-69 structure and the rationalized structure, represented by the 67 average well organized farms.

TABLE 6.1 Comparison of the Original and
Rationalized Structure

X & Z Sub- scripts	Resource or product	Unit	Original structure	Rationalized structure	% change from original structure
(1)	No. of farms	farm	98	67	- 31.6
(2)	Total acres owned or leased	acre	12,173	12,173	-
(3)	Total C.V. of (2)	\$	3,936,860	3,675,352	- 6.6
(4)	Value of improvements	\$	2,718,187	2,589,550	- 4.7
(5)	Unimproved value	\$	1,218,673	1,085,802	- 10.9
(8)	No. of cows milked	cow	8,699	10,787	24.0
(9)	G.F.I.	\$	1,012,514	1,226,971	21.2
(10)	Value of Crops sold off the farm	\$	11,961	zero	-100.0
(11)	Value of livestock, sales, etc.	\$	227,645	224,651	- 1.3
(12)	Value of net feed inventory	\$	- 32,968	-83,616	153.6
(13)	Value of milkfat	\$	805,876	1,038,165	28.8
(14)	Total milkfat supplied	lb	2,512,503	3,236,703	28.8
(15)	Total labour unit	L.U.	168	140.7	- 16.3
(16)	Book value of plant	\$	185,707	246,426	32.7
(17)	Value of fertili- zer and lime	\$	35,192	44,354	26.0

6.5.1 The Number of Farms and Their Capital Value

The first thing to note in changing from the original structure to the rationalized structure is that the number of farms, though still occupying the same total area, have declined in number by 31.6 per cent. In terms of individuals, the dairy industry and the nation, this has important repercussions which are looked at in more detail in Chapter VII.

The total capital value, in declining by 6.6 per cent, is indicative that the saving in duplication of milking sheds, implement sheds and houses etc. was in fact greater than the extra cost of new milking facilities incurred on the 'new farms'. The rate of transition in moving from the existing structure to the rationalized structure is important, since the decline in C.V. of 6.6 per cent is not an immediate capital saving. In the long run however, in so far as these 'extra' houses etc. won't have to be replaced; then there is a capital saving of 6.6 per cent in moving from the existing to the rationalized structure.

Individual owner-operators in moving from a smaller farm to a larger farm (as envisaged in the rationalized structure) would have to find more capital. It does not necessarily follow that because of this, individuals would find it harder to obtain their own dairy farm.¹ From the interviews conducted at the time of the survey it was subjectively clear that lending institutions were more prepared to lend money on larger units, irrespective of the equity held in a small farm. Undoubtedly this is partially because of the extra security procured on larger farms and because of the long term viability of such properties, payability is more assured. Whilst lending institutions tend to cut their risks in respect of the above factors; there is however much more capital concentrated in the hands of one manager. The managerial expertise required to efficiently manage such large amounts of capital increases as the

1 Even under existing conditions evidence from the survey indicates that there was no significant difference in the length of time to become the sole owner-operator of a dairy farm whether it be small (< 100 acres) or large (> 100 acres).

capital input increases. Therefore, whilst lending institutions prefer for security and profit¹ reasons to lend on larger farms, they do, and will continue to require, certain prerequisite managerial standards to be met. Such standards (formal qualifications and experience) can only become more formal and necessary, as the amount of capital involved increases.

6.5.2 The Number of Cows Milked

The number of cows milked increased by 24 per cent relative to the original structure, owing to a higher stocking rate of milking cows per acre. This also implies that the managerial competence of the owner-operators on the sixty seven farms in the rationalized structure, was better than that in the original structure. In fact this was one of the assumptions made in formulating the rationalized structure (see Chapter VI, p. 148, assumption (iii)).

The fact that cow numbers and subsequent production increased under the conditions of the rationalized structure is not altogether unrealistic. The rationalized structure, as already proved, is only comprised of farms representing the national average for herds containing between 159 - 199 cows. Further, as already stated, to obtain finance from lending institutions for these larger units requires proven managerial competence to produce a high, profitable production. Also, there now only being 67 farms instead of 98; the servicing sectors of the dairy industry (e.g. advisory specialists) would be in a position to give a more individualistic and intensive service.

1 Lending institutions would prefer to lend to fewer, bigger clients so as to minimise administrative expenditure, so long as these clients offer no more risk than the risks involved in lending to a lot of smaller clients.

6.5.3 Gross Farm Income

Under the rationalized structure G.F.I. increased 21.2 per cent as an indirect result of the higher total milkfat supplied (+ 28.8 per cent); which in turn was due to:

- (i) The greater number of cows being milked.
- (ii) The higher production of milkfat/acre.

The fact that no feed was sold off the farms is indicative of the value owner-operators of the well organized farms attached to converting all the possible feed grown on the farm into milkfat - even at the relatively low milkfat prices ruling in 1968-69. This again was exemplified by the fact that the 'value of net feed inventory' increased; that is to say, more feed was purchased. Most of the extra feed purchased was in the form of 'grazing out'. Six out of the eight well organized farms grazed replacement heifers and any dairy beef stock out, so as to be able to milk more cows. It being profitable usually to milk more cows, despite the expense of grazing young stock out.

6.5.4 Labour

The total labour units used in the rationalized structure decreased by 27.3 (or 16.3 per cent).

Table 6.2 shows the breakdown of the composition of labour that existed on the 98 farms and the likely composition of the labour force under the rationalized structure.

Despite the number of L.U.'s per farm under the rationalized structure being 2.1; (as opposed to 1.7 labour units per farm, under the original structure), the total number of labour units declined from 168 to 140.7 (a decrease of 16.3 per cent).

TABLE 6.2 Composition of the Labour Force Under
the Two Structures. (Labour Units)

Class of labour	Original structure 1968-69		Rationalized structure	
	No.	% of total	No.	% of total
Av. L.U.'s per farm	1.7		2.1	
<u>Full-time labour</u>				
Owner-operator	98	58.3	67	47.6
Married employee	6	3.6		
Single employee	26	15.5	67	47.6
Wife	27	16.1		
	59	93.5		95.2
<u>Part-time labour</u>				
Wife	2.6	1.5		
Children	3.1	1.8	6.7	4.8
Casual	5.3	3.2		
	11	6.5		4.8
Total	168.0	100.0 100.0	140.7	100.0 100.0
Employee per owner-operator	0.7		1.1	

The rationalized farms having 2.1 L.U.'s per farm, have two main components:

(i) the owner-operator

and (ii) another full-time worker which could consist of either a married employee, single employee or wife of the owner-operator.

Of the 29.6 L.U.'s comprising that of wives, 27 were full-time. However their full-time help was not necessarily absolutely imperative to the milking of the cows. They milked largely because they enjoyed doing so and not because of necessity. It is thus a matter of conjecture as to whether these wives would in fact help with the greater work load involved in milking 160 cows under the rationalized structure. Therefore although under the rationalized structure 67 L.U.'s have been allocated as being

filled by married employees, single employees or full-time wives; it seems likely that more L.U.'s would have to be forthcoming from the two former classes of labour, than was the case under the original structure.

This being so it is reasonable to suggest that the extra demand for such labour could be filled by displaced owner-operators. Displaced owner-operators have the advantage of being trained in dairy farming and being familiar with the practical operations of a dairy farm. It should be noted that not counting owner-operators, the number of full-time employees is increased by eight L.U.'s under the rationalized structure. Casual and part-time labour requirements under the rationalized structure would remain much the same as under the original structure.¹

If displaced owner-operators did not become employees on dairy farms; then training schemes along the lines of the present cadet scheme would have to be increased in capacity to fill the expected increased demand for married or single employees.

The above remarks concerning labour availability and training are only relevant should each of the average well organized farms require 2.1 L.U.'s. Under existing technology this number of L.U.'s may be required, but it is already becoming apparent that within the very near future, with the perfecting of the rotary milker, automatic udder stimulator and cup removal devices, one man (the owner-operator) will, as a matter of course, be able to milk at least 160 cows by himself.² Such major technological breakthroughs presumably also have profound significance when discussing the economics of size of dairy farms. The optimum size³ of one, two, three,

1 Casual labour used by the original farms was very much involved with the annual hay making operations.

2 A.R. Frampton, "Successful Dairy Farming in the '70's," Massey Dairyfarmers' Meeting, June 7, 1972. (Unpublished). See also: B. Gooding, "New Cup Removal System for Rotary Milker," New Zealand Farmer, December 9, 1971, p. 8.

3 Jackson used varying sizes of herringbone milking sheds for a given labour input to obtain the optimum size unit under any set of given conditions.

four and five man dairy farms as mooted by Jackson¹ may as a result, change within the very near future.

Referring back to the rationalized structure, under 1968-69 levels of technology it will be seen in Table 6.2 that the employee/owner-operator ratio increases as we move from the original structure to the rationalized structure. That is, for every one owner-operator there are 0.7 employees in the original structure and 1.1 employees to every one owner-operator in the rationalized structure, i.e. positions are reversed and employees (including wives) become more numerous than owner-operators under the rationalized structure. However if new technology were to enable the owner-operator to virtually manage and run the average well organized farm by himself; then owner-operators would once again become more numerous than employees.

6.5.5 The Value of Plant and Fertilizer

The total book value of plant increased by 32.7 per cent in moving from the original to the rationalized structure. On a per acre basis the investment in plant was approximately \$5 more under the rationalized than under the original structure. It is easier to reconcile the use of more machinery on a larger farm than on a smaller dairy farm, where efficient utilization is more difficult to achieve. Such an increase in capital expenditure, means that much extra capital must be found for the agricultural industry under the rationalized structure. In effect it is the continuation of substituting capital for labour that was shown to be occurring nationally in Chapter II.

Likewise, the total value of fertilizer and lime increased 26 per cent under the rationalized structure. This is evidence of the significance the owner-operators of well organized farms attached to fertilizer for increased profitability. Under the rationalized structure the value of fertilizer averaged \$3.6 per

¹ Jackson, Loc. cit.

acre or taking fertilizer at \$25 per ton, carted and spread, was equivalent to 2.9 cwt. per acre as opposed to 2.3 cwt. per acre under the original structure.

6.6 REJECTION OR ACCEPTANCE OF HYPOTHESIS?

In changing from the original to the rationalized structure two basic 'size' increases can be seen to have occurred:

(i) The Extensive kind

e.g. The addition of land. Historically this has been occurring because of the extra land required to efficiently utilize 'lumpy' inputs, such as tractors and labour. (Witness the number of cows one man can now milk through a rotary milker compared with the walkthrough parlour).

(ii) The intensive kind

e.g. The addition of more fertilizer to increase grass production so that more cows can be milked, thus increasing output (without increasing the acreage).

Extensive and intensive inputs should be looked upon as being complementary to each other. Thus in the rationalized structure we have farms with larger acreages, larger inputs of machinery, fertilizer and cows. Higher ratios of cows per L.U., milkfat per cow, and milkfat per acre. Smaller inputs of labour and larger G.F.I.'s (and N.F.I.'s).

To decide whether or not to accept the hypothesis that there existed in the survey area (in the 1968-69 structure, an imbalance in resource use amongst dairy farmers, requires that one or more of the following possibilities be accepted:

(i) That total output is increased without increasing total input.

(ii) That total output is maintained with fewer total inputs.

(iii) That total output is increased whilst at the same time reducing total inputs.

Taking capital inputs for the two structures we obtain the value comparison shown in Table 6.3.

TABLE 6.3 Differences in Inputs as Between the
Original and Rationalized Structures.

Inputs	Absolute change in moving from the original to the rationalized structure (\$)	
	+	-
Land and improvements		261,508
Value of livestock ^a	164,430	
Plant and machinery	60,719	
Total	225,149	261,508
Net Effect	- 36,359	

^a This value should not be confused with the 'Total value of livestock sales etc.' discussed earlier. The value of livestock here, is the added capital value of extra livestock present in the rationalized structure.

Table 6.3 shows that a once and for all net cost saving from inputs of \$36,359 is achieved in moving from the original, to the rationalized structure. Such cost savings are associated with an added annual G.F.I. of \$214,457. Using the N.F.I./G.F.I. ratio of \$39.14/\$112.39 (see p. 145) we obtain a coefficient of 0.348. Therefore of the \$214,457 added G.F.I., \$74,631 is N.F.I., which, when capitalized at different rates of interest gives capital increases shown in Table 6.4.

The capitalised N.F.I., at five per cent interest rate, say, represents a significant capital increment. Furthermore not only is there a decrease in the number of Labour Units (27.3) required to generate this N.F.I., but also there would be a considerably increased profit obtained from the rationalization; this would make the

TABLE 6.4 Values of Added N.F.I. (\$74,631) when
Capitalized in Perpetuity at Different
Rates of Interest (\$m.)

Rate of Interest (%)	2.5	5.0	7.5	10.0
Capitalized value of N.F.I. (\$m.)	2.98	1.49	0.99	0.75

continuance of Government assistance difficult to justify.

As a consequence the third possibility above (p. 161) is realized and the original hypothesis is accepted: i.e. there was an imbalance in resource use amongst dairy farms in the survey area in 1968-69.

In rationalizing the 1968-69 structure the net savings in capital input are small. However it should be remembered that in terms of the management techniques and the technology existing in 1968-69 that it is likely that the rationalization was not carried out optimally.

6.7 REASONS FOR RATIONALIZING SUB-OPTIMALLY

Methods exist by which the optimum farm size (based on the value of output, acreage and number of labour units etc.) can be calculated.¹ Consequently a normative restructuring could be carried out in much the same way as was done in this study. All these methods however have their own idiosyncrasies and are dependent upon certain assumptions. For instance the optimum farm so calculated

¹ See for instance: E.O. Heady, "Optimal Sizes of Farms under Varying Tenure Forms, Including Renting, Ownership, State and Collective Structures," American J. of Agricultural Economics, 53, 1, 17. February, 1971.

is only optimum given a assumed level of managerial ability and level of technology.

From the point of view of this study, the most serious of the objections associated with the optimum farm size, are listed below:

(i) With respect to management:

The importance of good management in obtaining high production is a relationship that has long been recognized.

If restructuring was to be on the basis of using optimum farms; then the rationalized structure would theoretically be feasible. Practically however it is extremely dubious as to whether the management input required by such a structure would exist. Restructuring on the basis of the optimum unit 'size' would therefore amount to an academic exercise in calculating the magnitude and direction of resource use imbalance, without having any real relevance to possible implementation.

(ii) With respect to technology:

The optimum farm 'size' is only optimum for any given level of technology. Thus in previous sections it was indicated that according to Jackson's¹ work, a farm with two labour units, 180 acres and 160 cows was not an optimum 2 man unit under 1968-69 conditions. However, this does not preclude the possibility in the near future of 180 acres and 160 cows being approximately equal to the optimum dairy farm unit with one labour unit, given for instance, a rotary milker and other complementary devices to go with it.

(iii) Variability of inputs:

If restructuring were to be carried out using the concept of the optimum farm; it would assume that all inputs were homo-

1 Jackson, loc. cit.

geneous. This assumption is not true either in respect to fixed inputs, such as soil, topography, farm layout and climate¹ or to variable inputs - especially with regards to employed labour.

6.8 SUMMARY

The most important points are that under 1968-69 conditions a resource use imbalance was found to have existed amongst the surveyed dairy farms. In so far that the original structure has been hypothetically restructured (sub-optimally) on the basis of an average well organized farm in this study, the new structure is not only theoretically feasible but also practically feasible. The sub-optimal approach is intended to suggest what is likely, rather than what is remotely possible.

Restructuring on the basis of the average management that is found nationally for herds of between 180-199 cows, is, to a considerable extent, satisfying the requirements placed by the 'managerial ability' constraint.

Though the cost savings achieved from the rationalized structure are relatively small, the author considers that equally or more important than this factor is the fact that the units comprising the rationalized structure will have: the prospect of being viable businesses into the foreseeable future, without further price or cost support measures from the Government of the day.

In considering the synthesis of the rationalized structure it is important to consider the macro nature of the problem, the purpose for which the data was collected and the underlying assumptions.

Further advantages of the rationalized structure are discussed in Chapter VII.

¹ Even in a small area such as the survey district.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The Luxembourg Agreement makes it clear that Western European Market integration and agricultural rationalization¹ will result in traditional N.Z. outlets for dairy products gradually disappearing. The finding of new, equally remunerative markets, to replace some of the dwindling U.K. market combined with lower incomes of dairy farmers in recent years (relative to the secondary and tertiary sectors) are considered to be the major problems facing the N.Z. dairy industry.

This study attempts to analyse the extent of likely changes, and their consequences, that can be expected to occur in a given area of the industry under such conditions. Major trends were looked at on a national scale, whilst more specific changes were looked at on a very much more limited scale.

Nationally, the number of persons engaged in agricultural pursuits was shown to be declining both in total and as a percentage of the total work force. This trend is expected to continue. In doing so the composition of the agricultural work force was also shown to be changing both in respect of age and status (i.e. whether on own account, employer of labour, or an employee etc.) In analysing the total number of owner-operators (excluding Maoris) by age groups, over time, projections of the most likely number of owner-operators up to the year 2006 were made. Implied in these

1 If the Mansholt plan is successful in rationalizing European agriculture; it is likely that besides improving resource use, that production will increase still further unless simultaneous restraining measures are taken to equate supply with demand. For American work on this topic see: Technical Committee, Efficient Organizations of the Farm Industry in the North Central Region of the United States in 1959 and 1980, op. cit.

projections was the magnitude and direction of policies that are going to be required in planning the long term future of N.Z. agriculture. This is particularly so with regards to the structural changes that will be required.

In order to reduce the task of analysing these anticipated structural changes into a manageable study, the field of interest was narrowed as follows:

- (i) By analysing D-O-O's by age groups (on a national scale).
- (ii) By predicting the probable structure of dairy farms in a given area, likely to be in existence, by 1980-81.
- (iii) Rationalizing the existing structure of dairy farms in that area mentioned in (ii) above.

Analysis of dairy owner-operators by age groups provided a method of projecting the probable future national number of dairy farms, that could be expected to exist at any given time in the future. The projection showed that a continuing decline in the number of D-O-O's could be expected. It is considered that the analysis of structural changes that could confidently be predicted to accompany the continuing decline in the number of owner-operators, could best be confined to a pilot study. No previous study of this type has been undertaken in New Zealand.

The data collected from the survey farms, showed the very real use that age and associative data could be put to, in predicting the most likely structure that would exist by 1980-81. Such data is seen by the author as being of particular use in low income dairying areas and where the continuation of present, or increased levels of production of milk supplies are not assured. These supplies are essential to keep per unit costs of manufacture low and to ensure reasonable profitability. The current position of the Manawatu Co-operative Dairy Company falls into the latter category.

In using such data to predict the most likely future structure and the production forthcoming from that structure, certain assumptions had to be made. The results obtained, are thus only

valid, providing the assumptions do in fact hold. Any departure from the assumptions will result in an error in the predicted outcome. However; it would appear that up to 1980-81 the Manawatu Co-operative Dairy Company cannot look forward to a greatly increased supply of milk (if in fact any), from the farms surveyed.¹ This prediction can only be made for dairy farms in the survey area, as they were not representative (on the basis of herd size)² of all the herds supplying the Manawatu Co-operative Dairy Company.

Whilst nationally the number of herds has decreased without a corresponding decline in the total output of milkfat;³ this relationship is in doubt for the survey area. In Chapter IV p. 134; it was suggested that despite the decline in the number of D-O-O's expected before 1980-81, that the total production of milkfat from the survey area would probably not fall. This; it was argued, was because the remaining D-O-O's by milking more cows and producing more milkfat per acre, due to new technology and managerial techniques would maintain output. However, in Chapter IV p. 130 (footnote one) there was found to be a significant difference between those dairy farmers who had, or who intended, to keep dairy beef with those owning < 115 acres and those owning ≥ 115 acres. Significantly more dairy farmers who had, or intended to keep, dairy beef in the next decade owned ≥ 115 acres. The survey further showed that dairy beef was being kept on these larger farms in addition to, and not in place of cows being milked. (On the basis of the number of cows being milked before and after starting to keep dairy beef stock).

It would appear that if any further diversification is going to occur, it will be to an enterprise that complements the

1 This does not take into account any milk (produced in the survey area) that is, or will be, surplus to the requirements of the town milk industry. Any such surplus milk would be used for manufacturing purposes.

2 Even if they were representative on the basis of herd size a meaningful prediction still could not be made because of the differences in the (physical and socio-economic) environment of the total supply area. (In a large study, embracing varied areas, stratified sampling techniques could be used).

3 See: Figures 1.2 and 1.3.

dairying operation. Those farmers on small acreages (here considered to be ≤ 115 acres) usually find that their labour (including family labour) is sufficient to run their unit. Their major problem is one of maintaining an adequate G.F.I. from a limited acreage. Specializing in dairying has allowed this aim to be achieved. However, on larger units (≥ 115 acres) where the owner-operator's labour is often extended, he looks for alternative enterprises, with a low labour requirement, to complement his dairying activities. Dairy beef is such an alternative enterprise.

Therefore so long as the owner of a small unit can generate a larger G.F.I. from dairying alone, he will not normally diversify. However, where labour is a limiting factor and land is not fully utilized by milking cows; then dairy beef is a profitable extension to the farming system.

It was the subjective impression of the author that though the acreage owned in many cases would have permitted more cows to have been milked, doing so would have required employing more labour. Farmers admitted that even where the number of extra cows could be kept to warrant the employing of a man, doing so was unacceptable to the majority of them on socio-economic grounds.

Consequently the increase in milkfat production that might have been expected as a result of more cows being milked, by the remaining farmers, will be reduced to the extent that non-family labour is required. This statement however is qualified by adding that new technologies will undoubtedly enable those owner-operators with larger acreages to handle more cows, without employing additional labour. For example, when the full potential of the rotary milking shed is exploited with the development and perfecting of complementary devices (e.g. automatic udder stimulator and cup remover) one man is expected to be able to milk 150-200 cows, thus avoiding the necessity of employing an extra man. These advances however will take time to be assimilated and implemented by existing operators.

In moving from the expected to the hypothetical situation, the results obtained, again, only hold so long as the assumptions

underlying the hypothesis are valid. The results are only valid for the area under discussion and for the farms surveyed. As such, the study should be looked upon as a pilot study for a more fully representative study.¹ The author suggests that studies of this type be undertaken in other dairying areas in the immediate future in order to ascertain the presence and magnitude of gains from rationalization.

A return to the prices prevailing for milkfat in 1968-69 together with the steady erosion of profits through cost inflation since then, will make many more dairy farms marginal. Marginal in the sense that their continued viability as dairy farms is in doubt.

The author considers that in the event of milkfat prices falling to their 1968-69 level it would be helpful to know the extent of the low income problem on a district basis. In the event of prices falling to such levels, long term policies to overcome these problems should also be formulated in advance. The consequences, in terms of inputs and outputs, of these policies being put into practice should also be estimated. The cost of the necessary research should be looked upon as an insurance and as an investment in the future prosperity of the New Zealand dairy industry. Such policies (see below, p. 177) should be implemented before such low income farms pose an intractable problem. Implementation of such policies should be viewed as increasing the long term viability of the dairy industry, as well as eliminating the need for intermittent Government subsidies.

Rationalizing the dairy farms in the survey area to produce a more viable structure had the effect of increasing total output whilst at the same time reducing, overall, the amount of capital inputs required to obtain this total output.

The direction of the absolute changes in individual

1 Were this study ever to be done on a national scale; it may well be that rationalization would have to be based on the total corrected acreage (T.C.A.) This is because the survey area may not have been typical in its land utilization compared with other dairying districts.

inputs and outputs, in moving from the original (1968-69) structure, to the rationalized structure, were such as to increase the G.F.I. and N.F.I. Likewise, gross productivity and gross output per unit of labour increased. Inputs of fertilizer, stock, plant and machinery also increased. The amount of capital in land and buildings however, decreased. Rationalization of buildings and other improvements is seen, in the long run, as being an important source of cost saving. Unless some policy is implemented however, whereby the purchaser is able to buy a property, for the purposes of amalgamation, without having to buy a second (and unwanted) milking shed, etc., this potential cost saving will not be realized and will only act as an impediment to amalgamation. The vendor naturally expects to be paid the approximate market value of the improvements.¹

7.1 IS RATIONALIZATION OF THE PRESENT STRUCTURE WORTH WHILE?

Before any reconstruction (as opposed to adjustments)² are made to any part of the New Zealand dairy industry the need for reconstruction must be seen:

- (i) to be needed
- (ii) to be economically and socially justifiable.

With reference to (i) evidence for the need of reconstruction has been presented in Chapter I. Evidence to justify (ii) is given below.

The magnitude in cost savings and increased output from the rationalized structure have been estimated. The cost

1 The Australian Dairy Farm Reconstruction Scheme incorporates means by which this policy can be adopted.

2 Evidence given in Chapters I, II, and III, should dispel any doubt as to N.Z. agriculture not adjusting. Reconstruction however, under auspices of Government control, implies the controlled movement of resources so as to fulfil some policy objective.

savings were not great but the increased output anticipated was enough to raise average net farm income per farm from \$3,483 to \$6,302 (on the 'average per farm' and 'average well organized farm' respectively [see p. 145]). An increase of \$2,819 or 81.0 per cent. Other reasons for advocating a policy of reconstruction for selected areas are as follows:

A. National Advantages Resulting From Rationalization

(i) The national advantage of rationalization would be the elimination of Government assistance.

(ii) Scarce resources would be more efficiently utilized. (Smaller input resulting in greater output).

(iii) Government lending institutions would be dealing with fewer 'problem' farmers and therefore be in a position to devote more time and resources to progressive dairy farmers.

(iv) Were rationalization to follow a co-ordinated plan the Government would be in a better position to undertake rural-social planning. Planning here implies a cost saving. For instance in a rural area where there are many small dairy units, the number of children now present, may warrant the addition of new classrooms. Should the Government have a plan to rationalize the dairy structure in that locality however; it may well be economically advisable to make alternative arrangements for teaching the children, rather than building a permanent asset that is likely to have no use after the rationalization of units occurs.

(v) Source of labour for other industries. Displaced farm labour however would require retraining. In so far as the rationalized industry requires less man-power than would otherwise be the case, recruitment of labour into the industry would be lower (as would prospects of farm ownership).

(vi) Better utilization of scarce Government and private advisory personnel, by improving the F.A.O./farmer ratio.

B. Advantages Accruing to the Dairy Industry, as a Result of Rationalization

(i) Fewer suppliers of milk would mean:

- (a) less farm dairy tanks and refrigerators,
- (b) fewer tankers required to collect milk,
- (c) better quality control over the raw product.

Dairy Companies could afford to install more sophisticated equipment on the farm as there would be a larger throughput.

(ii) Dairy factories would be in a better position to monitor trends in supply and to produce a higher quality raw product.

(iii) In so far that farm rationalization would increase milk output (see p.153), factory capacity could be more fully utilized, thereby lowering per unit costs of manufacture with resulting benefits to the nation, industry and individuals.

C. Advantages of Rationalization for the Individual

(i) Providing the individual owner-operator had the right credentials he would probably find credit easier to obtain.¹ Fewer owner-operators requiring capital and the smaller total amounts of capital required for land and improvements, would make more capital available, even though each individual would require more of it.

(ii) Greater potential returns for a given set of conditions.

(iii) More security in the knowledge that the unit should be a viable business into the foreseeable future.

(iv) Better able to arrange time off if two men are available,

1 The establishment of a Rural development bank has been mooted by several agriculturalists as possessing potential advantages over the present system, to allocate credit. For instance see: A.B. Ward, A.R. Frampton and J.W.M. Gardener, "Submission to the Committee of Inquiry into Lending to Farmers," Massey University, September 27, 1971. (unpublished).

or, if still only one man, better able to afford temporary 'stand in' labour. Less risk due to poor health. This is of increasing relevance as working conditions and benefits rise in the non-farm sector.

(v) Better able to utilize and apply new methods of technology. Adoption of new research findings - especially those embedded in larger and discrete capital inputs.

The statement made by the A.D.C. (1964) that:

... while the likely impact on production of the regrouping of uneconomic farms into bigger units may not be great ...¹

is not in accordance with the above findings.

7.2 FUTURE PROSPECTS OF THE SMALL HERD

It may be (and often is) argued that small dairy farms (in terms of acreage and total output) are viable businesses. In so far that many owner-operators of such properties have a high equity, low costs of production and high production per acre, they are viable - so long as the present owner-operator remains on the farm. However, being small has inherent disadvantages. One of the more important being the inability to overcome the effects of rising costs, inflation and any shortfall in milkfat prices. This inability to generate an adequate G.F.I., and to adjust to exogenous changes is considered by this author to be one of the major defects of a small farm. As previously noted, because many small farms are already producing intensively, the only way to increase revenue (other than by purchasing inputs of the extensive kind) is to cut costs and then only so long as in doing so, revenue is not cut back disproportionately.

As seen in Chapter IV the problem for small farms comes

¹ See: Section 1.3, p. 14.

when the present owner-operator wishes to retire. Usually the farm, is too small for anyone to take over per se, so it can either be purchased by an existing dairy farmer, and dairy production obtained from it, or else it can be completely lost to dairying. The significance or other wise of the latter assumption is looked at in more detail immediately below.

Supposing, in the unlikely event of all factory supply farms in New Zealand, with herds of less than fifty cows and the resources associated with these herds, being lost to the dairy industry; then in 1970-71 2,618 herds of 13.0 per cent of the total number of factory supply herds in New Zealand would have disappeared. But, the total butterfat supplied would only have declined by 4.0 per cent, i.e. in terms of total output the loss of these herds would not be great. However, if all herds with less than 100 cows and the resources associated with these herds were lost to the industry; then in 1970-71 11,120, or 54.9 per cent of the total number of factory supply herds in New Zealand would have disappeared and the total output of milkfat would have decreased by 36.0 per cent.

Table 7.1 shows the total milkfat produced for the years 1968-69, 1969-70 and 1970-71. The per cent and number of herds with less than 100 cows and greater than or equal to 100 cows is also shown together with the percentage milkfat that these two groups of herds supply.

From Table 7.1; it is apparent that for these years the number of factory supply herds in N.Z. with < 100 cows has been declining absolutely and proportionately. The reverse situation has been occurring for herds with ≥ 100 cows.

The percentage of total milkfat produced by herds with < 100 cows has been declining by over 3.0 per cent per year, whilst the percentage of total milkfat produced by herds with ≥ 100 cows has been increasing by over 3.0 per cent per year. The herds with ≥ 100 cows are providing an increasing proportion of the total milkfat.

TABLE 7.1 Proportion of Milkfat Supplied by Herds with $\leq$ 100 Cows and Those with $\geq$ 100 Cows
for Three Seasons, 1968-69, 1969-70 and 1970-71.^a

			1968-69	1969-70	Change from 1968- 69 to 1969-70	1970-71	Change from 1969- 70 to 1970-71
A	Total milkfat (m.lb.)		571.1	524.4	- 46.7	523.4	- 1.0
B	Herds with $\leq$ 100 cows	No.	14,138	12,604	- 1,534	11,120	- 1,484
		% of total	66.3	58.1	- 8.2	54.9	- 3.2
C	Total milkfat pro- duced by herds with $\leq$ 100 cows	Total m.lb	245.9	205.6	- 40.3	188.6	- 17.0
		% of total	43.0	39.2	- 3.8	36.1	- 3.1
D	Herds with $\geq$ 100 cows	No.	8,451	9,103	+ 652	10,587	+ 1,484
		% of total	33.7	41.9	+ 8.2	45.1	+ 3.2
E	Total milkfat pro- duced by herds with $\geq$ 100 cows	Total m.lb	325.1	318.8	- 6.3	334.7	+ 15.9
		% of total	57.0	60.8	+ 3.8	63.9	+ 3.1

^a Private communication. Adapted from unpublished N.Z. Dairy Board data.
All data rounded.

The evidence in Table 7.1 is by no means conclusive because of the short period for which data are available for comparison.¹ However, for the two seasons, 1969-70 and 1970-71, the total outputs of milkfat were virtually equal. Despite this the output for herds with < 100 cows between these two seasons, dropped by 17 m. pounds whilst output from herds with ≥ 100 cows increased by only 15.9 m. pounds. In other words the decrease in production of herds with < 100 cows was not offset by the increased production in the herds with ≥ 100 cows. If this trend were to continue total milkfat production would decline. As it is, the evidence presented in Table 7.1 and Section 1.3.1, suggests that total production will remain approximately static.

If the loss of resources currently being lost to the dairy industry, from the outgoing of herds with < 100 cows could be halted, total production could be increased. A policy designed to specifically restructure the smaller existing dairy farms, without reducing the area available for dairying, could well be profitable nationally. (See page 162).

Any formal policy to rationalize parts of the existing dairying structure (along the lines of Chapter V and VI) would result in advantages to the nation, dairy industry and individuals within that industry.

It is not the purpose of this study to formulate policy decisions required to implement the results of this analysis. The principal objective of the study was to measure the effects of rationalizing dairy farms in a given area. From the results obtained from this pilot study the author finds that application of policies along the lines of the Australian Dairy Farms Reconstruction Scheme² could be of benefit to the nation, the dairy industry and to individuals comprising that industry.

1 The analysis that follows is further complicated because of the effects of the severe drought in 1969-70.

2 R.G. Mauldon and H.P. Schapper, "Policy and Programs for Rural Reconstruction," Farm Policy, Nedlands, W.A.: University of Western Australia Press. 10, 3, 75. December, 1970.

Wetherhall,¹ Currie² and Madden³ describe policies that could be used as ideas to formulate suitable policies with which to rationalize selected portions of the N.Z. dairy industry. Such policies as are selected, if adopted now, may well be cheaper (or even profitable) than letting the low income problem develop to the extent that an 'ad hoc' rescue operation is precipitated.

McCrone,⁴ is left to have the final word:

The importance of farm structure as a determinant of agricultural productivity and efficiency is obvious even from purely a priori reasoning....

Natural conditions may limit the application of innovations. But for the greatest part of agriculture it is institutional rather than natural factors which inhibit flexibility in farm structure and prevent the full advantage of innovations from being realised. Once land has been laid out in farms, the pattern is difficult to alter and both laws of inheritance and systems of land tenure play an important part.

The effect of insufficient structural adjustment is to prevent costs per unit of output in real terms from being as low as might otherwise be possible.

... more emphasis to measures designed to help investment in viable enterprises might pay off handsomely in the long run by reducing the industries' dependence on support and enabling it to adapt to the conditions facing it.

- 1 H. Wetherall, "Farm rationalization with special regard to Structural changes: Experiences from Activities in Sweden," J. of Agricultural Economics, 15, 2, 189. December, 1962.
- 2 Currie, loc. cit.
- 3 M. Madden, "New Farm Improvement and Structure Schemes," Agriculture, Ministry of Agriculture, Fisheries and Food: 75, 3, 99. March, 1968.
- 4 McCrone, loc. cit.

APPENDIX A.

In the dairy farm sector, despite the number of herds containing ten or more cows decreasing from 31,200¹ in 1960-61 to 22,300² in 1970-71 (a decrease of 28.5 per cent) and the number of cows milked over the same period increasing from 1,929,000¹ to 2,239,000³, (an increase of 16.1 per cent), real average net dairy farm income in 1970-71 was less than at any time since 1963-64.

The real average net farm income of dairy farmers was calculated by taking the consumer price index (for all groups) from twenty five centres combined, and with a base year, 1965 = 1000; this index was then applied to the appropriate average net farm income per dairy farm. See Table A.

TABLE A: Average Net and Average Real Net Farm Income
Per Dairy Farm 1960-61 to 1970-71

Year	Average Net Farm Income per Dairy Farm (\$) ^a	Index (1965 = 1000) ^b	Real average net farm income per dairy farm (\$)
1960-61	3,070	877	3500.6
1961-62	2,640	893	2956.3
1962-63	2,700	916	2947.6
1963-64	2,746	935	2936.8
1964-65	3,696	967	3822.1
1965-66	4,176	1,000	4176.0
1966-67	4,676	1,028	4548.6
1967-68	4,273	1,090	3920.2
1968-69	4,069	1,137	3578.7
1969-70	4,710	1,193	3948.0
1970-71	3,860	1,271	3036.9

- a 1960-61 to 1962-63 and 1969-70 to 1970-71 estimated by: Agricultural Production Council, op. cit., April, 1971, p. 43.
1963-64 to 1966-67 from: N.Z.D.B., Farm production division A Survey of the Economic Structure of Factory Supply Dairy Farms in N.Z. - 1966-67. Vol. IV. p. 27.
1967-68 to 1968-69. Ditto. Vol. VI. p. 25.

- b New Zealand Official Yearbook, op. cit. 1971. p. 686.

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- 1 New Zealand Dairy Board, 46th Farm Production Report, 1969-70 Season, Wellington: p. 67.
2 Unpublished Dairy Board Data and Town Milk, August, 1971, p. 19.
3 Monthly Abstract of Statistics, Dept. of Statistics, Wellington, N.Z. : January, 1972, p. 3.

After 1965, the average net farm income per dairy farm remained very approximately constant. However, with the rapid rates of inflation experienced since 1966-67 real average net farm incomes, with the exception of the 1969-70 season, have fallen.

For the 1971-72 season average real net farm income for dairy farmers can confidently be expected to take an up turn. However the future thereafter is not so assured. Mr F.L. Onion, Chairman of the Dairy Board, recently said that N.Z. dairy farmers may have to take a "substantial" drop in butter and cheese returns when Britain enters the E.E.C. in February, 1973.

Table A should be interpreted subject to the following constraints:

(i) There are at least two national estimates made of net farm income; one put out by the Department of Statistics and the other (the one used here) issued by the Dairy Board. They both indicate comparable trends but differ in absolute terms, primarily because of differing survey techniques and definitions.²

(ii) There are many consumer price indexes that could have been used but there is generally little difference between them and nothing to say that the one chosen is any less or more meaningful than any of the others.

(iii) In so far that net farm income is not entirely spent on items covered by the consumer price index; the derived real net farm income is lowered or raised depending on whether the rate of inflation has been higher or lower on these items of expenditure, than on those items explicitly covered by the all groups consumer price index. The effect of this is probably to cause less of a divergency between net and real net farm incomes.

(iv) The index is derived for a calendar year but the average net farm incomes are calculated on a 31st March financial year. This discrepancy is not important.

1 "Mr. Onion Joins E.E.C. 'Realists'," The Dominion, Wellington, March, 14, 1972, p. 2.

2 For these differences see: Agricultural Production Council, op. cit., April, 1971, p. 64.

APPENDIX B:Estimation of Total European Owner Operators by Age Groups.

The following detailed description of how age groups, for the total number of European owner-operators, were obtained in Table 3.5 (p. 61) holds only for the year under discussion; namely 1936. This, due to changes in definitions, changing of occupational classes, omissions and other idiosyncrasies found in the censuses were responsible for slight differences in approach from census to census.

Estimate for 1936: From the Dominion of N.Z. Population Census, 1936. Vol. X. Industries and Occupations.

Page 69. Table 9. Occupation Groups and Principal occupations. Occupational status. Males.

Those designated 'employer' and 'own account' under occupational status and who probably own ≥ 11 acres are deemed to be owner-operators.

Under Agricultural and Pastoral Occupations, code numbers 20 to 79, the following occupations were considered to be those representing owner-operators. Their code numbers, occupation and numbers under 'employer' and 'own account' are shown in Table B.1.

TABLE B.1: Occupations Representing Owner-Operators

Code	Agricultural & Pastoral Occupations	Employer	Own Account	Total
20	Wheat or other grain grower, agricultural farmer (so defined)	988	830	1,818
21	Farmer in Mixed Farming	4,379	3,536	7,915
22	Farmer, N.O.D. ^a settler N.O.D.	334	483	817
23	Sheepfarmer, station-owner, runholder	7,895	5,133	13,028
24	Dairy farmer	13,812	20,587	34,399
29	Poultry farmer	134	542	676
31	Orchardist, fruit or nut grower (excluding grapes)	765	899	1,664
37	Market gardener	425	953	1,378
59	Sharemilker	775	795	1,570
		29,507	33,758	63,265

a N.O.D. Not otherwise defined.

Somewhat arbitrarily omitted from the above list as far as males are concerned, are possible would-be owner-operators e.g. (38) Nurseryman, seed-grower, flower-grower, and horticulturalist. They were omitted as for the most part they probably have holdings of < 11 acres and secondly their omission was not significant, there being only 447 in the two occupational status classes in 1936.

Only 14 of total male sharemilkers designated as such, fell outside the above two status classes. Presumably therefore, 29 and 39 per cent sharemilkers are included in the data in Table B.1. It is not immediately obvious that their inclusion as owner-operators is correct, however, throughout the series where sharemilkers have been so enumerated they have been included in the estimate of total owner-operators.

On Page 38 of Volume X occupations by age groups (and marital status) are given. Unfortunately occupations are not reported by age groups for just 'employer' and 'own account' classes. Instead age groups are reported for all occupational status classes, i.e. employer, own account, wages and salary, apprentice, etc., by occupations. Also, besides those occupations selected in Table B.1 as representing owner-operators, page 38 enumerates many more, some of which could possibly represent legitimate owner-operators e.g. (27) stud-stock farmer and breeder. Therefore a new list is drawn up and the numbers under each age group inserted. See Table B.2. Now, from the number in occupations shown in Table B.1 it is clear that not all those listed under the appropriate occupation by age groups in Table B.2 are owner-operators as defined. e.g. Table B.1 lists:

(24) Dairy farmer 34,399

but under Table B.2

(24) Dairy farmer 34,576

The difference of 177 are not from 'employer' and 'own account' classes, but from one of the other status classes. To eliminate these from the age groups in Table B.2, each age group is represented as a percentage of the total in that occupation and then that percentage is taken for the occupation total in Table B.1 giving new adjusted age groups for 'employer' and 'own account' only. See Table B.3. The total in Table B.3 is still greater than that total of 63,265 in Table B.1 because 'employer' and 'own account' categories are only enumerated for the most important (numerically) occupations. Other occupations appearing in Table B.2 but not in Table B.1 cannot be adjusted and in so far that their numbers will include some people who are not owner-operators; then the total in Table B.3 is a little high. Relative to the total, those enumerated under occupations appearing in Table B.2 but not in B.1 are very small (1.2 per cent); therefore not being able to make the necessary adjustment is considered unimportant.

1 Private communication.

TABLE B.2:

Code Number, Occupations and Numbers in Each Age
Group For All Status Classes

Code	Occupation	< 25	25-34	35-44	45-54	55-65	≥ 65	N.S. ^a	Total
20	Wheat or other grain grower	53	304	392	457	381	232	-	1,829
21	Farmer in mixed farming	205	1,107	1,736	2,121	1,815	965	4	7,953
22	Settler, N.O.D. Farmer, N.O.D.	43	117	174	204	205	126	1	870
23	Sheep farmer, station owner etc.	362	2,093	2,944	3,315	2,727	1,621	11	13,073
24	Dairy farmer	1,212	6,102	7,968	9,165	6,818	3,292	12	34,576
25	Cattlefarmer, grazier	6	22	24	68	83	90	-	293
26	Horsebreeder	1	2	1	4	2	2	-	12
27	Stud stock farmer and breeder	1	1	3	10	5	1	-	21
28	Pig farmer	15	23	30	21	17	8	-	114
29	Poultry farmer	93	112	142	170	185	74	2	778
31	Orchardist, fruit or nut grower	98	274	328	426	433	225	-	1,784
32	Grape grower	4	4	5	8	6	2	-	29
33	Hopgrower	4	9	9	10	15	5	-	52
34	Tobacco grower	13	41	26	22	14	5	-	121
35	Tomato grower	9	23	26	35	23	13	-	129
36	Potato grower	1	3	5	5	1	1	-	16
37	Market gardener	210	304	493	462	373	177	4	2,023
59	Sharemilker	185	558	366	310	148	17	-	1,584
		2,515	11,099	14,672	16,813	13,261	6,856	41	65,257

a N.S. Not specified.

TABLE B.3: Code Number, Occupations and Numbers in Each Age Group
For 'Employer' and 'Own Account' Classes for Those
Occupations Listed in Table 3.1. Other Occupations
Same as in Table B.2.

Code	Occupation	< 25	25-34	35-44	45-54	55-65	≥ 65	Total
20	Wheat or other grain grower	51	303	390	454	390	230	1,818
21	Farmer in mixed farming	201	1,104	1,729	2,110	1,809	962	7,915
22	Settler, N.O.D. Farmer, N.O.D.	41	110	164	192	192	118	817
23	Sheep farmer, station owner etc.	352	2,092	2,932	3,312	2,719	1,621	13,028
24	Dairy farmer	1,204	6,072	7,934	9,125	6,787	3,277	34,399
25	Cattlefarmer, grazer	6	22	24	68	83	90	293
26	Horsebreeder	1	2	1	4	2	2	12
27	Stud stock farmer and breeder	1	1	3	10	5	1	21
28	Pig farmer	15	23	30	21	17	8	114
29	Poultry farmer	81	98	124	148	161	64	676
31	Orchardist, fruit or nut grower	92	255	306	397	404	210	1,664
32	Grape grower	4	4	5	8	6	2	29
33	Hopgrower	4	9	9	10	15	5	52
34	Tobacco grower	13	41	26	22	14	5	121
35	Tomato grower	9	23	26	35	23	13	129
36	Potato grower	1	3	5	5	1	1	16
37	Market gardener	142	208	337	316	255	120	1,378
59	Sharesilker	184	553	362	307	147	17	1,570
		2,402	10,923	14,407	16,544	13,030	6,746	64,052

The same procedure is carried out for females. Their adjusted age groups are combined with the appropriate male age group to give the total number of owner-operators for 1936, as being:

	<25	25-34	35-44	45-54	55-64	≥65	N.S.	Total
Male	2,402	10,923	14,407	16,544	13,030	6,746		64,052
Female	58	184	587	1,137	1,298	904	1	4,169
	2,460	11,107	14,994	17,681	14,328	7,650	1	68,221

which, when rounded to the nearest 100 gives:

2,500	11,100	15,000	17,700	14,300	7,600	68,200
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APPENDIX C:

Kemeny¹ defines a Markov Chain Process as being determined by specifying the following information:

There is given a set of states ($s_1, s_2, \dots, s_r$). The process can be in one and only one of these states at a given time and it moves successively from one state to another. Each move is called a step. The probability that the process moves from s_i to s_j depends only on the state s_i that it occupied before the step. The transition probability p_{ij} which gives the probability that the process will move from s_i to s_j is given for every pair of states. Also an initial starting state is specified at which the process is assumed to begin.

The transition probabilities p_{ij} can be represented in the form of a transition matrix so that:

$$\sum_j p_{ij} = 1$$

$$\text{and } p_{ij} \geq 0 \text{ for all } i \text{ and } j$$

Although the age group data of Tables 3.5 and 3.12 fulfil the requirements of being detailed, time-ordered and existing over time; it is not possible to construct a meaningful transition matrix since the probability of moving from state i to state $j = 1$. i.e. The owner-operator can only get older and can only go from one age group to the one immediately following it. Such a matrix would look like the following:

$$P = \begin{matrix} & \begin{matrix} s_1 & s_2 & s_3 & s_4 & s_5 & s_6 \end{matrix} \\ \begin{matrix} s_1 \\ s_2 \\ s_3 \\ s_4 \\ s_5 \\ s_6 \end{matrix} & \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \end{matrix}$$

Where $s_1 = < 25$

$s_2 = 25 - 34$

$s_3 = 35 - 44$

$s_4 = 45 - 54$

$s_5 = 55 - 64$

$s_6 = \geq 65$

1 J.G. Kemeny, et al., Finite Mathematical Structure (London : Prentice Hall International, 1959), p. 148.

Which, when combined with the initial starting state is meaningless with regards to determining say the n th step.

Trouble arises mainly because the census data only reports total net movements. In the absence of detailed information on individual owner-operator movements the Markov process loses the essence of its usefulness as a predicting tool.

APPENDIX D:

The total owner-operator data was fitted in equation C (see p.73) by omitting the 1946 data and forcing the function through the observed data for 1966.

The general model can be stated:

$$(i) \quad Y_i = \alpha + \beta_1 t_i + \beta_2 t_i^2 + \epsilon_i \quad i \neq 1966$$

subject to

$$(ii) \quad Y_{1966} = \alpha + \beta_1 t_{1966} + \beta_2 t_{1966}^2$$

that is to say

$$\hat{Y}_{1966} = Y_{1966}$$

i.e. the estimated regression passes through the observed value for 1966.

Subtracting (ii) from (i)

$$Y_i - Y_{1966} = \beta_1(t_i - t_{1966}) + \beta_2(t_i^2 - t_{1966}^2)$$

(iii) Therefore

$$Y_i^* = \beta_1 t_i^* + \beta_2 t_i^{2*}$$

where Y_i^* equals the difference of each census period from 1966 census data.

$$i.e. \quad Y_i^* = Y_i - Y_{1966}. \quad \text{Using all } Y_i \quad i \neq 1966$$

$$t_i^* = t_i - t_{1966}$$

$$t_i^{2*} = t_i^2 - t_{1966}^2$$

Least square estimates of β_1 and β_2 are thus estimated directly from (iii).

The estimated value of α is obtained by substituting β_1 and β_2 into (ii), giving:

$$\alpha = Y_{1966} - \beta_1 t_{1966} - \beta_2 t_{1966}^2.$$

APPENDIX E:Estimation of Total European Dairy Owner-Operators

Dairy owner-operators by age groups are extracted from the table for total European owner-operators (see Appendix B). For 1936 the relevant data is:

age group	< 25	25-34	35-44	45-54	55-64	≥ 65	total
<u>Male</u>							
dairyfarmer	1,204	6,072	7,934	9,125	6,787	3,277	34,399
sharemilker	184	553	362	307	147	17	1,570
<u>Female</u>							
dairyfarmer	25	116	382	775	817	516	2,631
sharemilker	3	6	6	2	9	-	33
	1,416	6,747	8,684	10,216	7,760	3,810	38,633

Because the age groups have been adjusted (except for female sharemilkers) according to 'employer' and 'own account', the data is considered accurate enough to be rounded to the nearest ten. Consequently, for 1936 the final age groups became:

< 25	25-34	35-44	45-54	55-64	≥ 65	total
1,420	6,750	8,680	10,220	7,760	3,810	38,640

APPENDIX F:

The following is the methodology by which the dairy owner-operator data was fitted by grafting a quadratic to a linear function.

In order to join these functions at the year 1936, as per equation G (see p. 89), required three assumptions to be made:

(i) That the 1906 - 1936 data could be represented by a quadratic function of the type:

$$(a) \quad Y_i = \alpha + \beta_1 t_i + \beta_2 t_i^2 + \epsilon_i \quad i = 1906, \dots, 1936$$

(ii) That the data 1936 - 1966 (omitting 1946 data) could best be fitted to a linear function of the type:

$$(b) \quad Y_i = \gamma + \beta_3 t_i + \epsilon_i \quad i = 1936, 1956, 1966$$

(iii) That the two functions (a) and (b) above would meet and therefore be equal at point t_{1936} in time.

Consequently:

$$(c) \quad \hat{Y}_{1936} = \alpha + \beta_1 t_{1936} + \beta_2 t_{1936}^2 = \gamma + \beta_3 t_{1936}$$

therefore $\gamma = \alpha + \beta_1 t_{1936} + \beta_2 t_{1936}^2 - \beta_3 t_{1936}$

substituting γ in (b)

$$\begin{aligned} \hat{Y}_i &= \alpha + \beta_1 t_{1936} + \beta_2 t_{1936}^2 - \beta_3 t_{1936} + \beta_3 t_i \\ (d) \quad &= \alpha + \beta_1 t_{1936} + \beta_2 t_{1936}^2 + \beta_3 (t_i - t_{1936}) \\ &= K + \beta_3 (t_i - t_{1936}) \end{aligned}$$

where $K = \alpha + \beta_1 t_{1936} + \beta_2 t_{1936}^2$

The least square estimates of α , β_1 , β_2 and β_3 are estimated directly from (d).

The curve represented by (d) above, i.e. equation G, is continuous but does not possess continuous first derivatives at the point of graft of the two equations expressed by (a) and (b) above¹.

¹ In order to obtain continuous first derivatives see:

W.A.Fuller, "Grafted Polynomials as Approximating Functions",
The Australian J. of Agricultural Economics 13, 1, 35, June, 1969.

APPENDIX G:

The survey area depicted in Figure 4.1 (p. 95) is distinguished by four major soil categories which in terms of increasing order of age are:

(i) The area marked by A, are Gley Recent soils consisting of the rapidly accumulating Parewanui Series. This area is still subject to flooding (though less since flood controls have been implemented). Common Parewanui textures are silt loams, fine sandy loams and heavy silt loams.

(ii) The area immediately west and east of the Oroua River (marked B) are also classified as Gley Recent soils formed from alluvium but are the slowly accumulating Kairanga Series of soils; whose textures are silt loams, fine sandy loams, heavy silt loams with small areas of peaty silt loams.

(iii) The area north of Kairanga township (marked C) are Gley soils, formed from alluvium and are the non-accumulating; (that is to say, not subjected to flooding) Te rakura Series of soils; whose textures are silt loams, fine sandy loams and sandy loams.

Topographically the area covered by the three soil series above consists of a series of river flat terraces starting from the Manawatu River in the southeast and rising to 100 ft. a.s.l. to the soil boundary, indicated on the map, in the west. The soil series are related and vary principally in the time of their deposition.

(iv) The area surrounding Rongotea township (marked D) is on a high terrace 100 ft. a.s.l. and consists of yellow grey earth formed from loess, colluvium and alluvium whose Tokomaru Series of soils has the single texture of silt loam. Relative to the other areas above; this area was where the majority of the survey farms were situated.

All four series are renowned for their wetness. However, the causes for this wetness differ. In the soil series (i), (ii) and (iii) above, the wetness is due to a ground water table directly related to the Oroua and Manawatu Rivers. Water percolates up from underneath, and its drainage usually necessitates pumping.

In the Tokomaru soil series (iv), at the lower part of the profile is a compacted fragipan which results in a perched water table causing seasonally wet soil conditions. Extensive artificial drainage is required.

APPENDIX H:

The dairy cow equivalent (D.C.E.) coefficients were those used by the Department of Agriculture and published as an appendix in 'Farming as a business'.

The value of stock was taken to be the same at the beginning and end of season. The difference between the two value totals was therefore a reflection of the change in the number of stock kept. The values used are those used by the Department of Agriculture for 1968-69 in their case history scheme. Standard values are based on conservative market realisations. Table H shows the standard values and D.C.E. for different classes of Friesian and Jersey stock.

TABLE H: Standard Values and Dairy Cow Equivalent Coefficients

Class of stock	Friesian dairy cattle		Jersey dairy cattle	
	Standard values (£)	D.C.E.	Standard values (£)	D.C.E.
Calves	14.00	.4	10.00	.3
R.1 yr. heifers	50.00	.7	40.00	.5
R.2 yr. heifers	90.00	1.3	75.00	1.0
R.3 yr. heifers	100.00	1.3	80.00	1.0
Milking cow ≤ 8 yrs.	100.00	1.3	80.00	1.0
Milking cow > 8 yrs.	70.00	1.3	65.00	1.0
Dry cows any age	65.00	1.3	60.00	1.0
Bulls R.1 yr.	80.00	.7	60.00	.5
Bulls R.2 yr. & over	130.00	.9	90.00	.7
R.1 yr. steers	60.00	.7	45.00	.5
R.2 yr. steers	90.00	.7	65.00	.5
R.3 yr. steers & bullocks	120.00	.7	90.00	.5

APPENDIX I:

86 OWNER-
OPERATORS
WERE ASKED

"DO YOU INTEND MANAGING THIS
FARM UNTIL YOU RETIRE"

NO - 3 - "DO YOU INTEND CARRYING
ON DAIRYING ELSEWHERE?"

NO - 2

Were both leaving dairy
farming within the next 4
years to take up jobs in
town. Both units had less
than 100 acres.

YES - 1

Was going to the Waikato
within the next 3 years and
was not due to retire for
16 or more years. Unit
had less than 100 acres.

RESULT: Loss of 231 acres and 57,383
lb of milkfat per year to
the dairy industry on the
basis of 1968-69 production.

YES - 80) "DO YOU INTEND CARRYING IT ON AS A DAIRY FARM PROVIDING
D/K - 3) THINGS DON'T GET ANY WORSE THAN THEY ARE NOW?"

NO - 6 "WHEN DO YOU ENVISAGE CHANGING OVER
PRODUCTION?"

1-2 5-6 7-10 years?

3 1 2 respondents

RESULT: Loss of 762 acres and 155,582 lb of
milkfat per year to the dairy
industry on the basis of 1968-69
production.

YES - 76)
D/K - 1) "WHEN DO YOU ENVISAGE RETIRING?"

1-2 3-4 5-6 7-10 11-15 16 years

6 1 8 8 24 30 respondents

No. of respondents	1 < 100	1 > 150	5 ≤ 100	6 ≤ 100
with defined	5 > 150		1 = 114	1 = 131
acreage			2 > 150	1 > 150

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