THE ECONOMICS OF HIGH RATES OF FERTILIZER ON SOUTH TARANAKI DAIRY FARMS

by

J.V. Graham

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CHAPTER 1

INTRODUCTION

This thesis reports the findings of a survey conducted to test the hypothesis that the use of increased rates of stock and fertilizer could lead to increased production on dairy farms in South Taranaki.

Increases in stocking rates and fertilizer rates had been taking place on some farms in the South Taranaki area for several seasons preceding the 1961-62 season. Farmers making these increases suggested that other management changes were necessary when increased rates of stock and fertilizer were used. These changes, when taken together, were thought to lead to increases in production.

Thus the specific aim of the survey was to find a well proven management system incorporating increased rates of stock and fertilizer, and to evaluate this system in physical and financial terms.

No attempt was made to find the best management system for increasing production since this attempt would have been defeated by the important differences between farms and between farmers. Rather, the aim was to fully document one management system so that the uncertainty associated with its adoption by farmers would be reduced. Should farmers feel that there are management systems superior to the one evaluated in this study, then it is to be hoped that a demand for further research will arise.

Throughout this study it has been necessary to consider individual farm problems. Resources available for increasing production vary widely from farm to farm. Each farm, for example, has a different locality, different soil characteristics and different herd quality. The capital resources of farmers, and their managerial abilities, vary widely. Thus,

problems arise in the integration of a new technology which are unique to each farm. Six of the farms visited in this survey are discussed in detail in Appendix F to show how these problems arose and how they were overcome.

1.1: Sources of information

It is important to note that there are five groups of farmers who may be referred to in this thesis. Firstly, there is the population of dairyfarmers, that is, 2,002 dairyfarmers in the 1956-57 season and 1,926 dairyfarmers in the 1960-61 season. These farmers supplied 23 dairy companies in South Taranaki, the survey area. Secondly, there are the dairyfarmers supplying 16 of the survey area dairy companies and for whom stock and production records were obtained. These records, obtained for 1,575 suppliers in the 1956-57 season and for 1,555 suppliers in the 1960-61 season, relate to suppliers with herds of ten cows and above.

The third group of 209 farmers are those who responded to a mail questionnaire about fertilizer usage circulated to 1,670 farmers in the survey area. This questionnaire is discussed in Appendix B. The 272 farmers of the fourth group are those for whom farm size data were collected from the Hawera and Waimate West County Councils. Production per acre in the 1960-61 season was estimated for these farmers. This estimate is discussed in Section 3.5,4, Chapter 3.

Finally, there are the forty farmers who were interviewed by the author and who will be referred to collectively as "the survey farmers." Supplementary information obtained from these farmers by means of a mail questionnaire is summarised in Appendix D.

Basic data relating to these groups is lodged with the Department of Agricultural Economics and Farm Management, Massey University of Manawatu, Palmerston North.

1.2: The survey farm groups

Throughout this thesis the survey farms will be referred to in three groups. The first group of 14 farms includes those farms on

which increases in cow numbers were made between the 1956-57 and 1960-61 seasons, but on which fertilizer usage remained constant. This group will be referred to as the "cows increased" group.

The second group of 25 farms includes those farms on which increases in stocking rate and fertilizer rate were made between the 1956-57 and 1960-61 seasons. This group will be referred to as the "cows and fertilizer increased" group.

The third group comprises one farm on which no changes were made in stocking rate and fertilizer rate between the 1956-57 and 1960-61 seasons. This group will be referred to as the "no change" group.

1.3: Definition of terms

In this section terms which will be used extensively throughout this thesis are defined. Production per acre is defined as butterfat supplied to the factory divided by total farm area. Stocking rate is defined as milking cows at 15th January per hundred acres of home farm area.

No allowance is made in the calculation of production per acre and stocking rate for unproductive areas on the home farm, for stock grazed away from the farm or for supplementary feed purchased. Neither is any allowance made for the number of dry stock reared.

Fertilizer rate is defined as tonnage of fertilizer, less nitrogenous fertilizers and mineral mixes, divided by the area to which the farmer said this was applied. Production per cow is defined as pounds of butterfat supplied to the factory in a season divided by the number of cows.

In all tables production per acre will be expressed as pounds of butterfat per acre, stocking rate as milking cows per 100 acres, fertilizer rate as hundredweights per acre and production per cow as pounds of butterfat per cow. Number of cows refers to the number of

milking cows per farm at 15th January and butterfat production the pounds of butterfat supplied per farm to the factory each season.

Unless otherwise indicated, "change" or "increase" refers to a change or increase between the 1956-57 and 1960-61 seasons. Similarly "the period" refers to the five seasons from 1956-57 to 1960-61 inclusive.

1.4: An outline of the thesis

The farm survey procedure on which the findings reported in this thesis are based is discussed in Chapter 2.

Chapter 3 presents a discussion of the physical features of the South Taranaki area, together with a general discussion of the area's dairy industry. This chapter is for the reader with little knowledge of dairyfarming in South Taranaki.

The selection of farms visited in this survey and the survey procedures used are discussed in Chapter 4. Some descriptive characteristics of the survey farms are presented in Appendix C.

The survey findings are presented in the main body of the thesis, Chapters 5 and 6. Management for increased production is discussed in Chapter 5 supported by six "Case Farm" studies in Appendix F. The scope for increased dairy production in South Taranaki is considered. Financial aspects of dairy farm development in the area are discussed in Chapter 6. Consideration is given to the problems involved in estimating the profitability of farm development plans and an assessment is made of the profitability of increasing production on some of the survey farms.

Chapter 7 summarises the survey findings.

CHAPTER 2

EVALUATING NEW FARM MANAGEMENT TECHNOLOGY

Sources of new farm management technology are briefly reviewed in the first section of this chapter. One of these sources - farmer experiment - is then discussed. Research methods for evaluating technological information from this source are then considered.

2.1: Sources of new farm management technology

New technological information may be provided from experiment stations, small farm experimentation or farmer experiment. These sources of information will now be considered in greater detail.

2.1,1: Experiment stations

Technological information is typically obtained at an experiment station under well controlled conditions. Pasture yield responses to various rates of fertilizer, for example, can be established from plot trials which include controls and replicates. There remains a problem, however, of incorporating this information into a farm management system. Attention must also be given to the known discrepancies between experiment station results and those attained in commercial application.(1)

The farm management research worker can use several approaches in applying and evaluating technological information from an experiment station. Budgeting and linear programming can indicate the likely outcome of adopting a new technology and suggest how management should be changed if the technology is to be adopted with success. Where a complete change in management is suggested a small farm experiment may be necessary to

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(1) See: Davidson, B.R., "Crop Yields in Experiments and on Farms," Nature, 194, 4,827, May 1962, and Swanson, E.R., "Problems of Applying Experimental Results to Commercial Practice," Journal of Farm Economics, 39, 2, May 1957.

evaluate the system before its recommendation to farmers. Alternatively, the research worker may take experiment station findings and use these immediately in a small farm experiment. He can also wait until farmers adopt the new technology. A farm survey can then find how the technology has been incorporated into the management system and if its adoption has been profitable.

2,1.2: Small farm experiments

The use of small farm experiments, such as those conducted at the Ruakura Number 2 Dairy or the Waimate West Demonstration Farm, as a research tool have been discussed by Candler.(2) A further discussion on the role of small farm experiments in a farm management research programme has been presented by the Southern Farm Management Research Committee.(3) This Committee summarises the operation of a small farm as follows : "Farm organizations of the desired types are actually set up and observed in operation over a series of years; changes may be introduced from year to year." Information used in setting up the management system under evaluation may be provided from experiment stations, from budgeting or linear programming studies or from farm surveys.

The main contributions of small farm experiments are likely to be :

(a) In the testing of new farm management systems.
(b) In providing an opportunity for experiment station workers to see the operation of their findings in a farm management system.
(c) In making possible immediate application of experiment station findings into something approaching a farm management system.

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(2) Candler, W.V., "Production Economics and Problems of Animal Production," Proceedings of the New Zealand Society of Animal Production, 22, 1962, pp. 142-158.

(3) Saville, R.J., et al, Limitations and Contributions of Pilot Farms, Management Units, or Experimental Units in an Economic Research Programme, Southern Farm Management Research Committee, March 1954. (Mimeo.)

(d) As demonstrations of the operation and profitability of new management systems.

(e) As a source of information for experiment station workers.

(f) Where there are no farmers in a particular area prepared to adopt an untested management system.

Small farm experimentation is limited by the fact that each small farm is costly and that each small farm experiment provides only one additional set of information about a given management system. As an alternative to small farm experimentation, subsidised (and supervised) farmer experimentation offers an opportunity for a new management system to be studied at lower cost and under a wider range of environmental conditions.(4)

2.1,3: Farmer experiments

Farmer experiments may be based on the ideas of the farmer, on technological information from an experiment station or small farm or on the ideas of other farmers. In general the farmer is confronted with the problem of fitting this information into his existing management system.

Farmer experiments are characterised by the fact that there is no control. The task of the research worker in evaluating the outcome of such an experiment is one of comparing the changed situation incorporating the new technology with the situation existing before changeswere made. A related task is the discovery of common elements, or principles on which the experiment is based. A fundamental requirement in the evaluation of farmer experiments, therefore, is that farmers must be asked about these experiments. This procedure may be termed a farm survey.

.2: Farm surveys

Survey techniques have as their aim the collection of information

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(4) For an example of the use of subsidised farmer experimentation see: Swain, F.G., and Bird, J.G., "Agronomic and Economic Planning of an Improved Farming System in a Sub-Tropical Dairying Area," A.N.Z.A.A.S., 37th Congress, 1964. Paper read to Section K.

from farmers. Warren and Livermore defined the basis of the survey method as follows :(5)

"Agricultural survey work in its various phases, is a recognition of the immense fund of information that has been secured as a result of experience and experiment on farms. It is an attempt to make use of this knowledge and to separate out the truths from the superstitions." "Every farm is an experiment station and every farmer a director thereof."(6)

Because surveys can be conducted with superficially similar objectives two broad groups of farm surveys will now be considered. These groups include "farm record" and "interview" surveys.

2.2,1: Farm record surveys

These surveys have as their aim the collection of records for use in establishing guides or standards for successful farming. Records may be collected either by interview, by mail or by telephone, and may be used for the calculation of farm standards,(7) preparation of two way, "cross sectional" tables or scatter diagrammes to show causal relationships,(8) calculation of farm costs, and for the derivation of production functions.(9)

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(5) Warren, G.F., and Livermore, K.C., An Agricultural Survey, Cornell University Bulletin 295, 1911, p. 386. Warren and Livermore recognised that survey work "has very definite limitations as there are many new subjects in which no such basis of experience exists."

(6) Ibid., p. 385. Many aspects of farm survey work are discussed by Warren in the following bulletin : Warren, G.F., Agricultural Surveys, Cornell Agricultural Experiment Station Bulletin 344, April 1914.

(7) "The Farm As A Business," H.M.S.O., London, 1958.

(8) Ward, A.H., "Level of Superphosphate Topdressing and Production per Acre," Proceedings of the New Zealand Society of Animal Production, 13, 1953, p. 97.

(9) Mason, G., "Resource Productivities from a Sample of Light Plains Farms, Canterbury, New Zealand," Australian Journal of Agricultural Economics, 4, 2, December 1960, pp. 121-129.

Limitations of these research procedures, where farm records are divorced from the context of the farm on which they were collected, have been discussed by Candler,[10] Candler and Sargent,[11] and by Salter.[12]

Some of the limitations of the farm record survey are apparent in a study of fertilizer usage conducted by the New Zealand Dairy Board. Information about butterfat production and fertilizer usage were collected with a questionnaire mailed to dairy farmers in Waikato and Taranaki. The survey data were analysed in a cross sectional fashion. In reporting the results of the study Ward wrote :[13]

> "As over 50% of the farmers in both areas appear to make a practice of applying less than 3½ cwts. of superphosphate per acre it is difficult to find any strong evidence in favour of higher topdressing rates."

Because the survey was restricted to records of fertilizer usage and levels of production a detailed study of the few farms in both areas which used 5½ cwts. per acre or more of fertilizer was impossible. This may have shown in fact, that profits were greater on farms using over 3½ cwts. of fertilizer, despite the fact that over 50% of farms used less than 3½ cwts. per acre.

Ward appeared, however, to be aware of the limitationsof the survey and of the necessity for a more precise investigation.

2.2,2: Interview surveys

The interview survey involves a series of interviews with farmers to gain information about some aspect of management. All interviews will be conducted by the research worker who will be concerned with individual farm problems.

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(10) Candler, W.V., "Production Economics and problems of Animal Production," op cit.

(11) Candler, W.V., and Sargent, D.S., "Farm Standards and the Theory of Production," Journal of Agricultural Economics, 15, 2, December 1962, pp. 282-290.

(12) Salter, L.A., "Cross Sectional and Case Grouping Procedures in Research Analysis," Journal of Farm Economics, 24, 4, 1942, p. 792.

(13) Ward, A.H., "Level of Superphosphate Topdressing and Production per Acre," op cit.

Interview surveys may be conducted with one or more of the following objectives :

(a) To study farmers attitudes, for example, to borrowing or to new technological information.(14)

(b) To find if information about new technologies is reaching farmers and is being adopted by them.(15)

(c) To record the incomes, credit and tenure arrangements of farmers in an area where there is a "felt" low income problem.(16)

(d) To investigate the possibility of introducing a completely new agricultural technology, for example, the growing of sugar beet on mixed farms in South Otago.

(e) To test the hypothesis that adoption of a particular technology is profitable.(17), (18)

(f) To establish the scope for increased production in a particular area. A survey of this kind should follow a survey of type (e).

(g) To study the management processes of farmers.

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(14) Williams, D.B., Parish, R.M., and Bollen, A.G., "Attitudes and Expectations of Wheatgrowers in New South Wales," Review of Marketing and Agricultural Economics, 21, 1, March 1953, pp. 7-72.

(15) Fallding, H.J., Precept and Practice on North Coast Dairy Farms, University of Sydney, Department of Agricultural Economics, Research Bulletin No. 2, 1958.

(16) Bird, J.G., "The Dairy Industry on the Far North Coast of New South Wales," Review of Marketing and Agricultural Economics, 30, 1, March 1962, pp. 13-70.

(17) Candler, W.V., "A Study of the Economics of Bulk Handling of Wheat on Farms," Review of Marketing and Agricultural Economics, 27, 2, June 1959, pp. 81-103.

(18) Wright, A., The Development of Unploughable Hill Country, Unpublished M.Agr.Sc. thesis, Massey University of Manawatu, 1963.

The survey under discussion is a further example of a survey conducted to test the hypothesis that adoption of a new technology is profitable.

2.2,2.1: Surveys conducted to test the hypothesis that adoption of a new technology is profitable

In this type of survey the aim of the research worker will be to find a well proven management system incorporating the new technology and to evaluate this system in physical and financial terms. At this same time the research worker attempts to define exactly what are the pre-conditions necessary for success, and what associated management changes are necessary. Farm selection will be based on purposive criteria to ensure that farmers actually using the technology are visited. Criterion of selection can be used which, as discussed in Chapter 4, Section 4.2,1, allow several aspects of one management system to be studied. Where a technology is being investigated that has not been widely adopted, the only selection problem might be that of finding farmers who have adopted the technology.

Inclusion of a randomly selected group of farmers with which to compare the performance of the purposively selected farmers will depend largely on information available to the research worker about "typical" farm practice.

Between 30 and 60 farmers will usually be visited in the survey. While this sample is substantially smaller than the 500 to 1,000 farmers suggested by Warren[19] the detailed interview which it allows enables the research worker to explain between farm differences and to make some subjective allowance for them rather than hope that these "cancel out" in a large sample, as assumed by Warren.[20]

Where the research worker is confident that survey findings show the technology under investigation to be profitable the survey will be followed by extension activities. Where the validity of the survey findings is questionable, however, small farm experimentation, or subsidised farmer experimentation may be necessary before extension recommendations can be made.

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(19) Warren, G.F., op cit.

(20) Ibid, p. 427.

CHAPTER 3

DAIRY FARMING IN SOUTH TARANAKI

The survey area in South Taranaki covered a region of approximately 510 square miles or 327,500 acres. The 1,926 dairy farmers in this predominantly dairy farming area produced 46% of New Zealand's cheese output in the 1960-61 season. In this chapter the physical features of the survey area are described. Statistics relating to dairy farming are presented and some features of dairy farm management are discussed.

3.1: Location and boundaries of the survey area

Figure 3.1 shows the location of the survey area within the North Island of New Zealand.

3.1.1: Boundaries of the survey area

The survey area is shown in Figure 3.2.

The western boundary of the survey area is fixed by the western extreme of the supply area of the Oaonui Dairy Company. To the north the area is bounded geographically by the lower bush line of the Egmont National Park while the north-eastern boundary is fixed by the northern extremes of the supply areas of the Lowgarth, Cardiff, Ngaere and Eltham Dairy Companies.

Along the eastern boundary, land suitable for dairying adjoins an area of moderately steep to steep hill country more suitable for sheep farming. This boundary, has been derived from Sheet 6 of the General Soil Survey [1] and corresponds approximately to the outer limits of the supply areas of the Eltham, Normanby, Hawera, Ohangai, Mokoia, Alton, Hurleyville and Kakaramea Dairy Companies.

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(1) Department of Scientific and Industrial Research, General Survey of the Soils of the North Island, New Zealand, Soil Bureau Bulletin (N.S.) No. 5, 1954.

FIGURE 3.1 NORTH ISLAND OF NEW ZEALAND SHOWING LOCATION OF THE SURVEY AREA

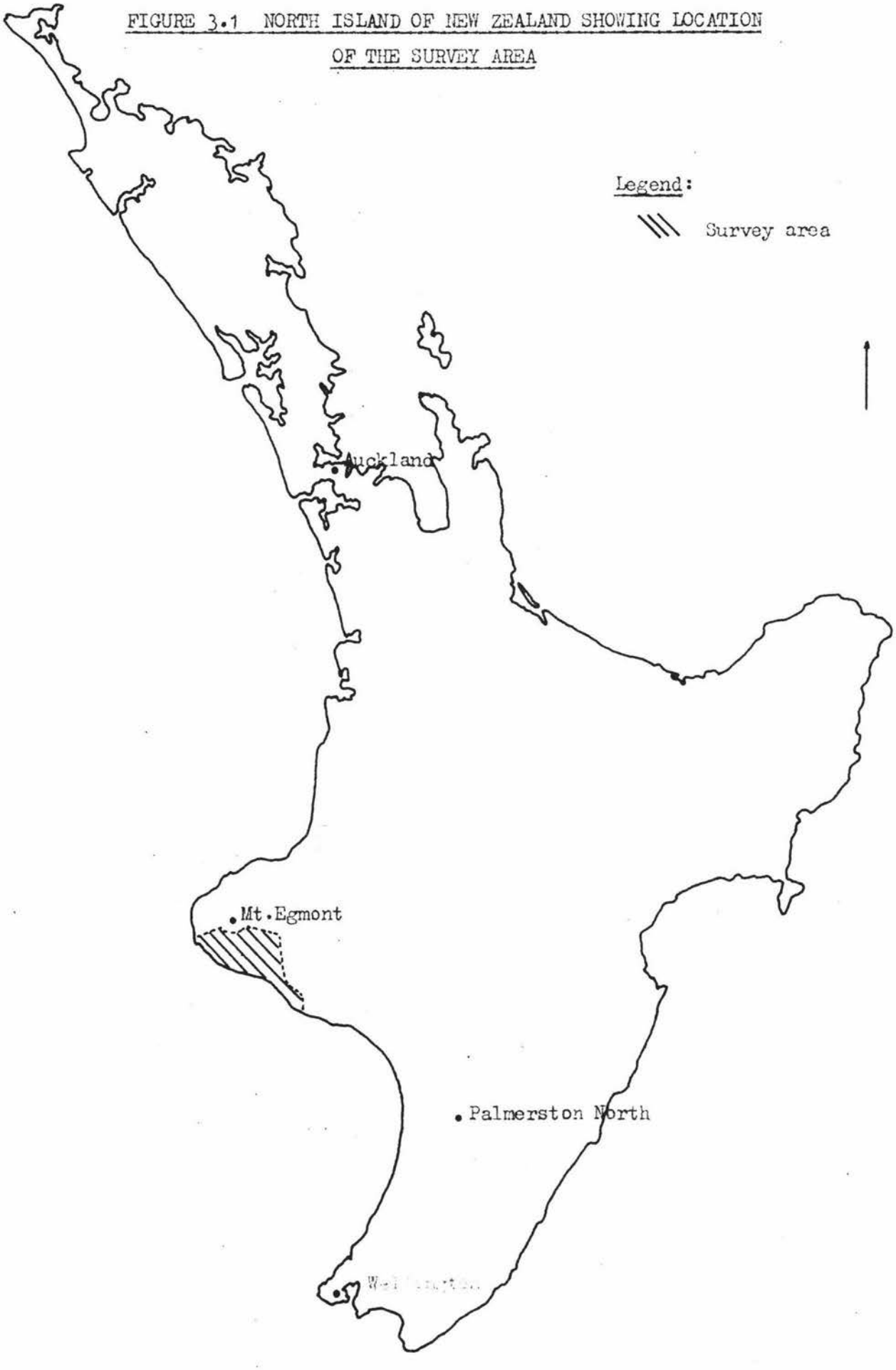
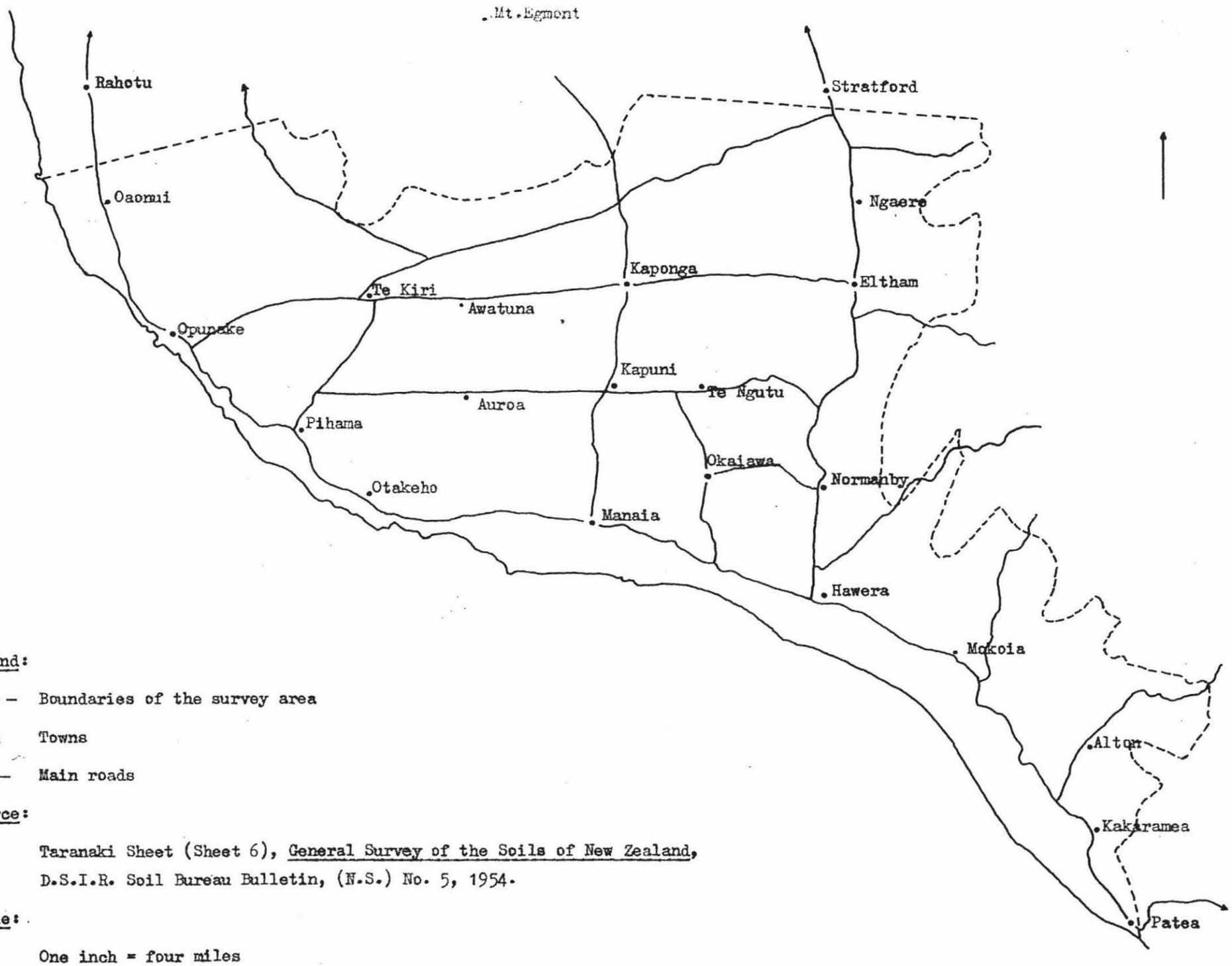


FIGURE 3.2 BOUNDARIES OF THE SURVEY AREA



Legend:

----- Boundaries of the survey area

. Alton Towns

——— Main roads

Source:

Taranaki Sheet (Sheet 6), General Survey of the Soils of New Zealand, D.S.I.R. Soil Bureau Bulletin, (N.S.) No. 5, 1954.

Scale:

One inch = four miles

The south-eastern boundary of the survey area follows the course of the Patea River and is largely fixed by climatic factors. Sheep and beef cattle production are more suited to the lower summer rainfalls experienced south of Patea (see Section 3.4,2). This boundary excludes a pocket of 48 dairy farmers supplying the Whenuakura Co-operative Dairy Company.

The southern boundary of the survey area is fixed by the Tasman coastline.

3.2: Topography and drainage pattern of the survey area

The topography and drainage pattern of the survey area are illustrated in Figure 3.3. The streams which radiate from Mount Egmont provide adequate and reliable supplies of water for farm, factory and town. Topographical features, especially those which have a marked influence on land use, are discussed in the next section.

3.3: Soils of the survey area

3.3,1: Introduction

The yellow brown loam and gley soils, which cover most of the survey area, strongly reflect the environment within which they have been formed. The dominant factors in the genesis of these soils have been, in the case of the yellow brown loams, ash showers from the eruption of Mount Egmont (see Figure 3.4), and in the case of the gley soils, high rainfall and poor natural drainage.

The yellow brown loam and gley soils can thus be included in a broad group of intrazonal soils. The distribution of these soils in the survey area is shown in Figure 3.5.

3.3,2: Characteristics of intrazonal soils

Taylor and Cox [2] define intrazonal soils as :

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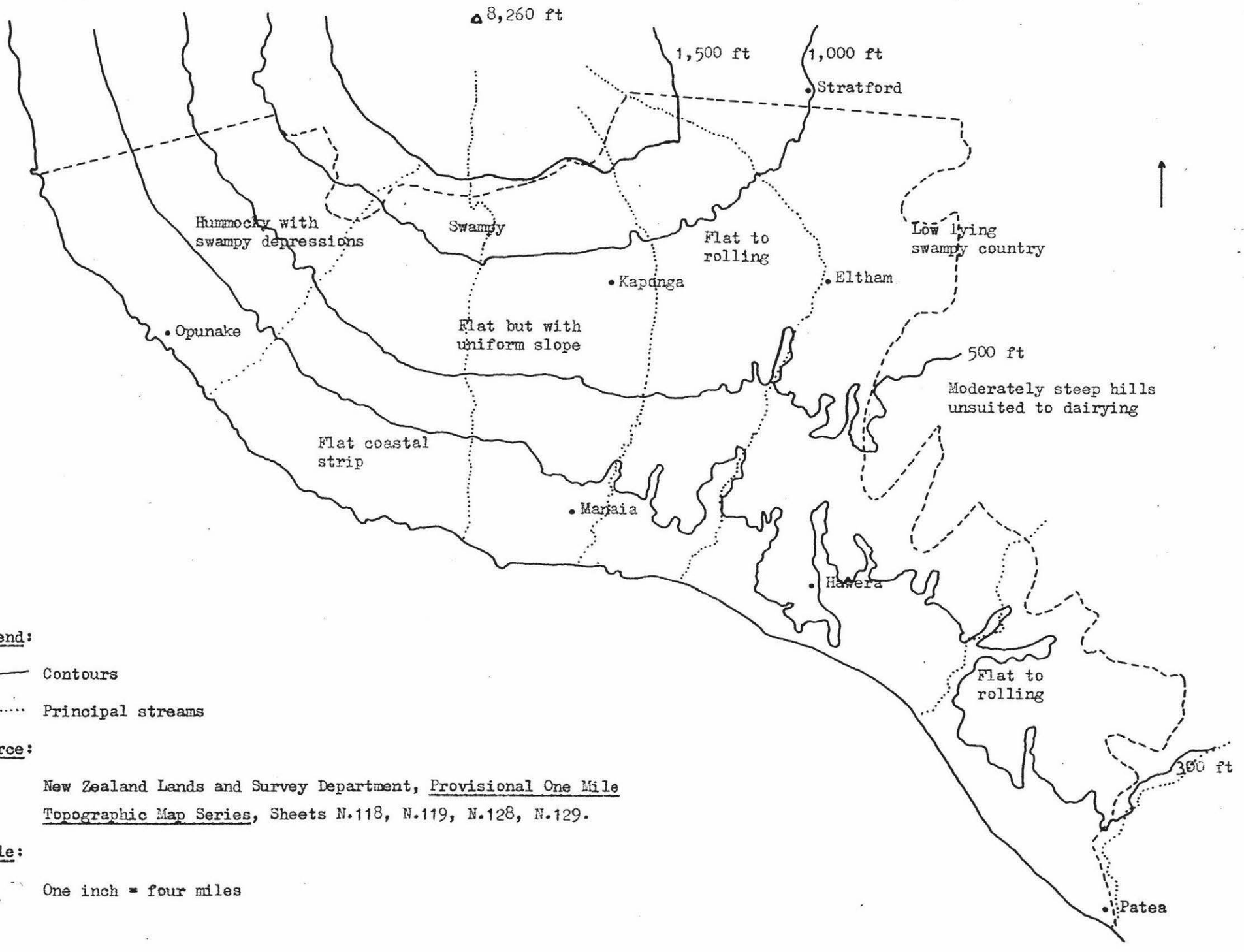
(2) Taylor, N.H., and Cox, J.E., "The Soil Pattern of New Zealand," New Zealand Institute of Agricultural Science Proceedings, 1956.

FIGURE 3.3 TOPOGRAPHY AND DRAINAGE PATTERN OF THE SURVEY AREA



Legend:

——— Contours

..... Principal streams

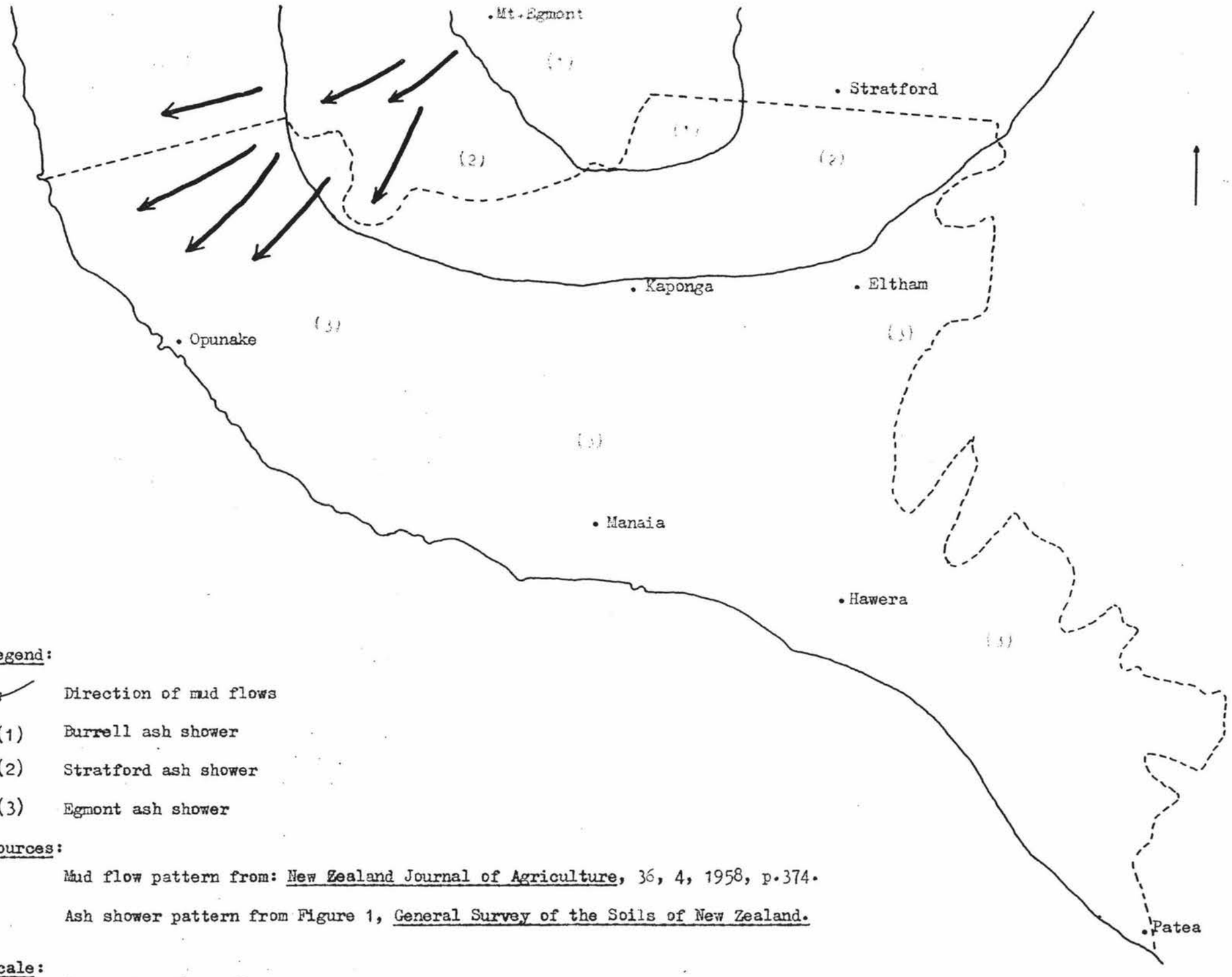
Source:

New Zealand Lands and Survey Department, Provisional One Mile Topographic Map Series, Sheets N.118, N.119, N.128, N.129.

Scale:

One inch = four miles

FIGURE 3.4 SURVEY AREA SHOWING SOIL FORMING ASH SHOWERS



Legend:

↙ Direction of mud flows

(1) Burrell ash shower

(2) Stratford ash shower

(3) Egmont ash shower

Sources:

Mud flow pattern from: New Zealand Journal of Agriculture, 36, 4, 1958, p.374.

Ash shower pattern from Figure 1, General Survey of the Soils of New Zealand.

Scale:

One inch = four miles

"Soils whose main characteristics are due not so much to the climate of the zone in which they are formed as to the strong impress of some local factor such as a particular kind of rock or closeness of the water table to the surface."

The intrazonal soils include the yellow brown loams of Waikato and Taranaki derived from fine volcanic dust and the gley and meadow soils of low lying areas where the soils have been modified by high groundwater. The yellow brown loams have grey or brown, very friable, loamy topsoils and friable free draining subsoils. Pastures respond well to superphosphate topdressing but absorption of soluble phosphate is strong. In these soils the reserve of available potash is low.

The high groundwater level of the gley soils causes the formation of a fairly impermeable gley subsoil commonly mottled with rust colours. Some of these soils in Taranaki are underlain by an impervious ironstone pan which exists at a variable depth. Intensive drainage is necessary if these soils are to support good pastures and high stocking rates. (3)

3.3,3: The soil pattern of the survey area

The General Soil Survey (4) recognizes 13 soil groups, or sets, within the survey area. Differences between some of these sets are small, especially where classification has been based on differences in rainfall and topography, rather than differences in parent material. The author has accordingly regrouped these sets:

3.3,4: Group 1 soils

Include soil sets 66, 66a, 66b, 68.

3.3,5: Group 2 soils

Include soil sets 66c, 67c.

3.3,6: Group 3 soils

Include soil sets 69 and 70.

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(3) Taylor and Cox, op cit.

(4) D.S.I.R., Soil Bureau Bulletin (N.S.) No. 5, op cit.

3.3,7: Group 4 soils

Include soil sets 100, 100a.

3.3,8: Group 5 soils

Include soil sets 100b, 105.

3.3,9: Group 6 soils

Soil set 108.

The pattern of these groups within the survey area is shown in Figure 3.5, which is based on Sheet 6 of the General Soil Survey.(5) The numbered areas in Figure 3.5 refer to the soil groups listed in Section 3.3,3.

The discussion of these soil groups which follows is based on the extended legend of, and the supplementary notes to, the General Soil Survey.(6)

3.3,4: Group 1 soils

Immature yellow brown loam soils of medium fertility formed under a 45 to 90 inch rainfall. Well drained friable soils of flat to rolling topography showing good responses to both phosphates and potash. Pastures are mainly ryegrass, white clover and cocksfoot dominant. The water supply is adequate throughout. These soils tend to dry out in summer in southern parts of the area, especially south of Patea.

Case farms situated on these soils include 3, 6, 7, 8, 22, 23, 24, 25, 26, 30, 34, 35, 36, 37, 38, 39, 40, 41, 44, and parts of farms 1, 2 and 4.

3.3,5: Group 2 soils

Immature yellow brown loam soils of hummocky topography, especially near the mountain where ash showers have fallen on mudflow debris (see Figure 3.4). These are medium fertility soils showing good responses to phosphates and potash, which have been formed under a 50 to 80 inch annual

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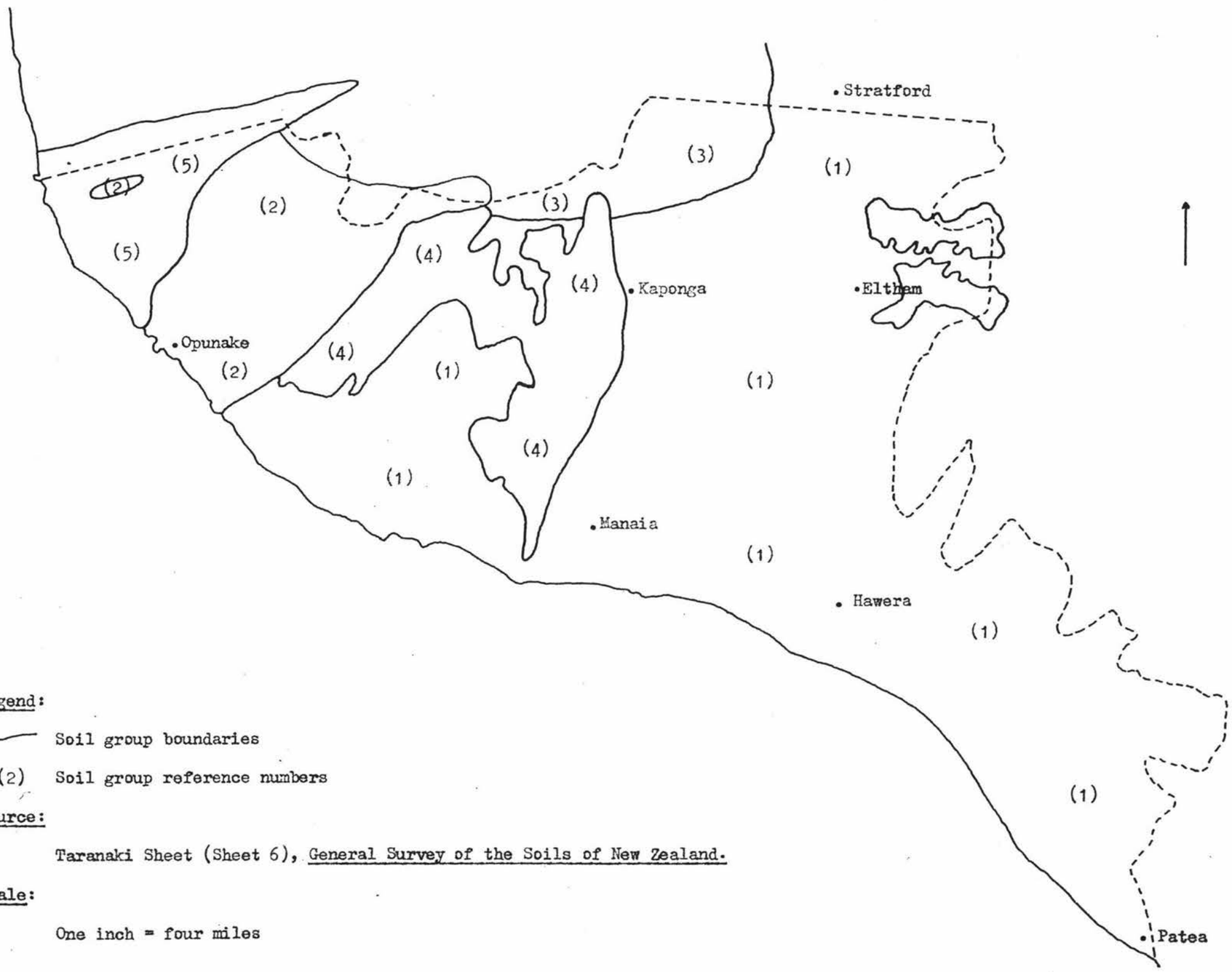
(5) Ibid

(6) Ibid, pages 61 and 219.

FIGURE 3.5 SOIL GROUPS WITHIN THE SURVEY AREA



Legend:

Soil group boundaries

(2) Soil group reference numbers

Source:

Taranaki Sheet (Sheet 6), General Survey of the Soils of New Zealand.

Scale:

One inch = four miles

rainfall. The soil profile includes bouldery hummocks and swampy depressions. These soils are largely undeveloped but are capable of high levels of production when intensively drained and topdressed. Much of the area is covered with boulders making the use of implements difficult, if not impossible. The swampy depressions are accordingly difficult to drain. Pastures are poor, in general, with browntop, sweet vernal, ratstail, blackberry and gorse prominent. Much of the area is covered with stumps and some land nearer the mountain is still uncleared of the original rimu and tawa forest.

Case farms situated on this soil group are 13, 14, and parts of farms 10 and 33.

3.3,6: Group 3 soils

Yellow brown loam soils of flat to rolling topography situated in an 80 to more than a 100 inch rainfall zone. These medium fertility soils show good responses to both phosphates and potash. The area is dissected by many rivers arising on Mount Egmont. Winters are colder and spring growth is correspondingly later than nearer the coast, although higher rates of fertilizer are modifying this pattern of growth. Extreme wetness of the soil, slow winter growth (at low fertility levels) and soil poaching are major management problems on these soils. Much of the area is covered by poor pasture and blackberry.

Case farms situated on this soil group are 9, 16, 18.

3.3,7: Group 4 soils

Meadow or gley soils with poor natural drainage except on some high areas. These soils are of flat to undulating topography and have been formed under a 45 to 75 inch annual rainfall. Towards the mountain the topography becomes hummocky, with swampy depressions. A discontinuous ironstone pan, 18 inches in depth, lies 12 to 24 inches below the surface of much of the lower part of this area. These areas tend to be broken by swampy streams.

The hummocky areas at higher altitudes are also underlain in places

by an ironstone pan and are accordingly difficult to plough. Gorse and blackberry covers much of this higher, largely undeveloped area.

Case farms situated on this soil group are 5, 19, 21, 28, 29, 42, and parts of farms 1, 2, 4 and 33.

3.3,8: Group 5 soils

These are loamy gley soils lying in a 45 to 100 inch rainfall zone. They are flat, are naturally poorly drained, and are wet for most of the year, especially when underlain by an ironstone pan. Extensive drainage is required for the further development of these soils. Stone drains are common and effective. Although largely undeveloped these soils can support good pastures producing at high levels.

Case farms situated on this soil group are 12 and 43.

3.3,9: Group 6 soils

A flat, peaty loam soil in a 50 inch rainfall zone. The topsoil of this medium fertility soil dries out in summer but will hold good pastures if adequately topdressed. Some of these soils are being used for dairyfarming in Taranaki but usually in conjunction with drier country, since they are very wet in winter. No case farms are situated on this soil group.

3.4: Climate of the survey area

Garnier (7) divides New Zealand into nine climatic regions. This classification places the survey area in the Middle New Zealand Region.

3.4,1: Climatic features of the middle New Zealand region

Climatic features of the middle New Zealand region are :(8)

(a) The region is under the dominant influence of westerly winds. This feature is expressed particularly in plentiful and variable rainfall with relatively small mean annual ranges of

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(7) Garnier, B.J., The Climate of New Zealand, Edward Arnold Ltd., London, 1958.

(8) Ibid, p. 51.

temperature.

(b) The region is occasionally affected by external subtropical and/or Antarctic influences.

(c) The region has a moderate diversity of climatic types.

(d) Mean temperatures are moderate.

3.4,2: Rainfall

The mean annual rainfall within the survey area varies from 40 inches on the coast to over 100 inches on the lower slopes of Mount Egmont. Figure 3.6 shows rainfall isohyets for the survey area together with average annual rainfall, and altitude, for five rainfall stations. As shown by Figure 3.6, Mount Egmont has a dominant influence on rainfall distribution. South from Patea, the south-eastern boundary of the survey area, rainfall totals are lower and Garnier shows that in these regions, soil water deficiencies may arise during the late summer months of the year.(9) In the area between Patea and Wanganui dairying is less important, with fat lamb and beef cattle production assuming a greater importance than within the survey area.

Rainfall is evenly spread throughout the year with no pronounced summer minimum or winter maximum. No part of the area normally receives more than 35%, or less than 15% of its annual total in any one season.

The mean annual percentage variability(10) in total rainfall lies between 12 and 14% for most of the survey area, except for the Egmont National Park area where variability ranges from 14 to 16%. Where rainfall is derived principally from westerly winds, as it is over most of the survey area, the mean variability is reduced, since these winds are the most reliable sources of rainfall in the country.(11) Table 3.1 illustrates this effect and compares the rainfall variability at Hawera in the survey

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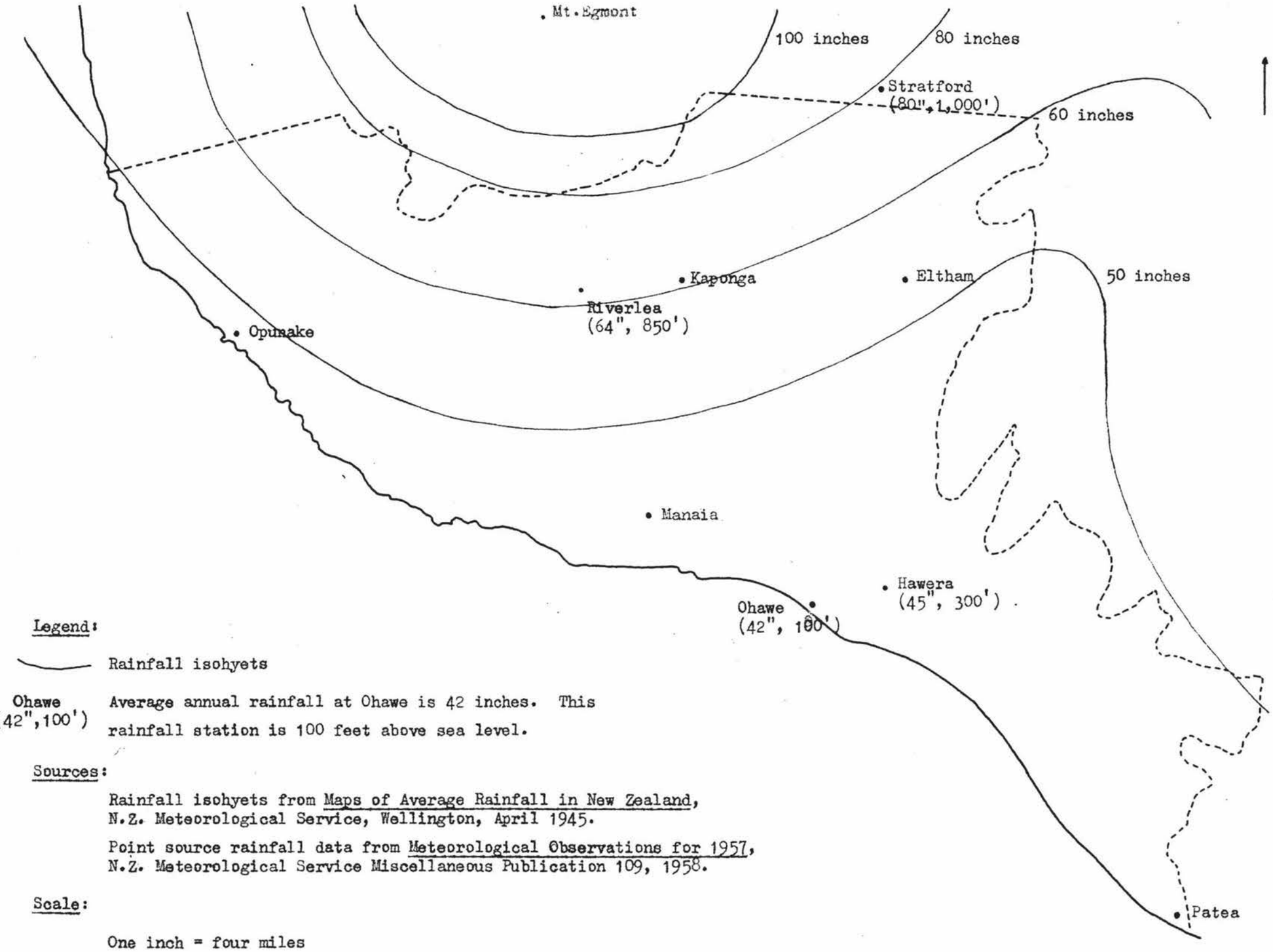
(9) Ibid, p. 60.

(10) The mean annual percentage variability of rainfall is the mean deviation of annual falls expressed as a percentage of the mean. This is a common measure of rainfall variability.

(11) Garnier, op cit, p. 31.

FIGURE 3.6 AVERAGE ANNUAL RAINFALL OVER THE SURVEY AREA



Legend:

Rainfall isohyets

Ohawe (42",100') Average annual rainfall at Ohawe is 42 inches. This rainfall station is 100 feet above sea level.

Sources:

Rainfall isohyets from Maps of Average Rainfall in New Zealand, N.Z. Meteorological Service, Wellington, April 1945.

Point source rainfall data from Meteorological Observations for 1957, N.Z. Meteorological Service Miscellaneous Publication 109, 1958.

Scale:

One inch = four miles

area with 3 other North Island centres.

Table 3.1 Percentage Variability in Annual Average Rainfall

Centre	Percentage variability	Predominant wind
Whangarei	18 - 20	N.E.
Hamilton	12 - 14	W. to N.E.
Hawera	12 - 14	W.
Palmerston North	10 - 12	W.

Source: Garnier, op cit, fig. 10, p. 30.

3.4,3: Temperatures

Mean annual temperatures of above 55°F are a feature of the survey area, together with a mean annual temperature range of under 15°F. Mean winter temperatures fall between 45 and 50°F while mean summer temperatures seldom fall below 60°F.

3.4,4: Sunshine hours of the survey area

Although the area is occasionally subject to prolonged and heavy rains associated with the passage of northwesterly warm fronts sunshine hours are in general above the average for the rest of the country. This is partly explained by the fact that the westerly exposure of the area keeps the air in constant motion, so preventing the build up of dense cloud cover.

3.5: Some survey area dairying statistics

3.5,1: Dairy companies and dairy company suppliers

Twenty three dairy companies were operating in the survey area in the 1960-61 season. These companies had 2,002 suppliers in the 1956-57 season and 1,926 suppliers in the 1960-61 season. One hundred and sixty (8% in the 1960-61 season) of these suppliers milked fewer than 10 cows.

Names and supplier numbers of each company are shown in Appendix A.

3.5,2: Dairy production

Table 3.2 shows the product mix of the survey area dairy companies and expresses the areas' total output of each product as a percentage of total New Zealand output.

Table 3.2 Product mix of the Survey Area Dairy Companies, 1960-61 Season

	Production (tons)			
	Cheese	Butter	Whey butter	Casein
Total tonnage, survey area	45,522	688	1,211	100
Total New Zealand tonnage	98,267	209,505	3,247	30,589
Percentage of New Zealand production	46%	0.35%	37%	0.3%

Source: New Zealand Dairy Production and Marketing Board, Dairy Industry Information Service, pers. comm.

Table 3.2 emphasises the predominance of cheese manufacturing within the survey area.

3.5,3: Farm size, herd size, and levels of total production

Dairy farms in the survey area vary widely in size. This is illustrated for a sample of farms in Table 3.3.

Table 3.3 Distribution of Farm Size

Farm size range (acres)	Percentage of farms
0 - 49	3.9
50 - 99	35.0
100 - 149	36.8
150 - 199	11.2
200 - 249	8.2
250 - 299	3.4
300 - 349	1.5
Total (206 farms)	100.0

Source : Mail fertilizer survey, see Appendix B.

As might be expected from the variation in farm size both herd sizes and levels of butterfat production per farm show a wide range. These ranges are illustrated in Tables 3.4 and 3.5 for the 1956-57 and 1960-61 seasons.(12)

Table 3.4 Distribution of Herd Size

Herd size range (number of cows at 15 January)	Percentage of farms	
	1956-57 season	1960-61 season
10 - 39	12.5	10.3
40 - 59	23.5	19.6
60 - 79	26.3	34.4
80 - 99	21.5	15.4
100 - 119	9.5	13.2
120 - 139	4.8	5.1
140 - 159	1.3	1.6
160 - 179	0.3	0.4
180 - 199	0.3	
Total	100.0	100.0
Number of farms	315	311

Source : A 20% sample drawn from Dairy Company Annual Returns to the New Zealand Dairy Production and Marketing Board, for herds of 10 cows and above.

(12) Lists showing the name, size of milking herd (at 15th January) and butterfat production of each supplier for the 1956-57 and 1960-61 seasons were obtained by the author from 16 of the dairy companies within the survey area. These companies are indicated in Appendix A. Lists were not available from the remaining 7 dairy companies. Suppliers with fewer than 10 cows are excluded from these lists.

Frequency distributions shown in Tables 3.4 and 3.5 have been drawn from these lists which provided records for 1,575 suppliers in the 1956-57 season and 1,555 suppliers in the 1960-61 season.

Table 3.5 Distribution of Butterfat Production Per Farm

Production range (lb.b.f. supplied to the factory)	Percentage of farms	
	1956-57 season	1960-61 season
0 - 4,999	3.8	3.0
5,000 - 9,999	5.6	3.5
10,000 - 14,999	16.6	14.0
15,000 - 19,999	26.6	25.4
20,000 - 24,999	19.5	22.5
25,000 - 29,999	12.8	9.5
30,000 - 34,999	8.5	11.5
35,000 - 39,999	4.1	4.2
40,000 - 44,999	1.0	1.6
45,000 - 49,999	1.0	3.5
50,000 - 54,999	0.5	1.0
55,000 - 59,999		0.3
Total	100.0	100.0
Number of farms	319	311

Source: A 20% sample drawn from Dairy Company Annual Returns to the New Zealand Dairy Production and Marketing Board for herds of ten cows and above.

Tables 3.4 and 3.5 suggest that the distribution of both herd sizes and levels of production per farm have changed between the 1956-57 and 1960-61 seasons. Table 3.6 shows the extent to which cow numbers increased within the survey area over this period, while Table 3.7 shows how butterfat supplied to the survey area dairy companies changed over the same period.

Table 3.6 Number of Milking Cows within the Survey Area

Year	Number of milking cows at 15 January
1957	130,754
1961	137,577
Increase	6,823
Percentage increase	5.2

Source: Dairy Company Annual Returns to the New Zealand Dairy Production and Marketing Board, for herds of 10 cows and above. Dairy Industry Information Service, pers. comm.

Table 3.7 Butterfat Supplied to Dairy Companies within the Survey Area

Season	Butterfat supplied to the factory
1956-57	37,710,473
1960-61	42,729,699
Increase	3,019,226
Percentage increase	7.6

Source: Dairy Company Annual Returns to the New Zealand Dairy Production and Marketing Board, for herds of 10 cows and above. Dairy Industry Information Service, pers. comm.

Tables 3.6 and 3.7 confirm that changes in both cow numbers and butterfat production were made between the 1956-57 and 1960-61 seasons.

3.5.4: Production per acre and changes in production per acre[13]

Changes in cow numbers and butterfat production have been accompanied by an increase in average production per acre between the 1956-57

(13) Production per acre is defined as butterfat supplied to the factory divided by total farm area. No allowance has been made for gullies, plantations or other unusable areas, for the off farm grazing of replacement stock or for the purchase of supplementary feed. Neither has any allowance been made for the number of dry stock reared.

Table 3.8 Changes in Average Production per Acre between 1956-57 and 1960-61 Seasons

Season	Number of farms	Average production per acre (lb. of butterfat)
1956-57	126	197
1960-61	128	217

Source: Mail fertilizer survey, see Appendix B.

Farm size data collected from the Hawera and Waimate West County Councils enabled production per acre to be estimated for 272 suppliers to the Joll, Kaupokonui and Hawera Dairy Companies. Average production per acre on these farms in the 1960-61 season was 220 lb. of butterfat.

The distribution of production per acre on 128 mail fertilizer survey farms in the 1960-61 season is shown in Table B.1, Appendix B.

3.5,5: Stocking rate[14]

Average stocking rate on 128 farms whose owners replied to the mail survey questionnaire was, in the 1960-61 season, 70 cows per 100 acres. The distribution of stocking rate on these farms is shown in Table B.2, Appendix B.

3.5,6: Fertilizer rate[15]

Average fertilizer rate used on 206 farms whose owners replied to the mail survey questionnaire was, in the 1960-61 season, 4.0 cwts. per acre. The distribution of fertilizer rate used on 128 of these farms is shown in Table B.1, Appendix B.

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(14) Stocking rate is defined as milking cows at the 15th January per hundred acres of home farm area. No allowance is made for stock grazed off the farm, supplementary feed purchased or any ungrazable area on the home farm. Neither is any allowance made for the number of dry stock reared.

(15) Fertilizer rate is defined as tonnage of fertilizer, less nitrogenous fertilizers and mineral mixes, divided by the area to which the farmer said this was applied.

3.6: Some dairy farming practices used in the survey area

Data presented in Section 3.5 indicated that production had increased in the survey area since the 1956-57 season.(16)

3.6,1: Management practices contributing to increased production

Technological changes which have been made on farms in the survey area since the 1956-57 season include the use of increased rates of stock and fertilizers, use of D.D.T. fertilizer for the control of grass grub and the use of artificial breeding and herd testing as aids to herd improvement.

Adoption of labour saving practices has contributed to increased production by increasing the number of cows handled per man. These labour saving practices include the use of herringbone cowsheds with round yards, once per day calf feeding, tanker collection of milk, use of shed flushing pumps, calfeteria feeding of calves and the self feeding of silage.

Changes have been made in winter feeding methods to minimize pasture damage from increased stocking rates and to reduce the wastage of conserved feed. McKenzie(17) has evaluated several winter feeding methods used in the survey area. Farmers on wetter soils near the mountain are becoming interested in platform feeding of stock during the winter and some are already using their concrete access races for this purpose.

Some extension personnel are emphasising the value of an "all grass" system of farming, especially where the farm is physically well developed and of high fertility. Reduced rates of hay and silage feeding are also being recommended. Some farmers with stocking rates of over one cow per acre have shown that dairy cows can be wintered with less than 10 bales of hay per cow without supplementary crop or silage. Most farmers, however, still use 30-40 bales of hay per cow for winter feed in addition to several acres of silage.

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(16) For a discussion of the development and present farming pattern of the Taranaki Land District see: Burgess, A.C., "Farming in New Zealand: Taranaki," New Zealand Journal of Agriculture, 36, 4, 1958, p. 369; 36, 5, 1958, p. 454; 36, 6, 1958, p. 531.

(17) McKenzie, S.A., "Winter Feeding Systems," Massey College Dairy-farming Annual, September 1960, p. 65.

3.6,2: General management practices

Calving usually commences in late July - early August and rationed grazing of autumn or winter saved feed is common for four to eight weeks following calving. On many farms subdivision into 20-25 paddocks allows a rotational grazing system to be used over the summer period.

Pastures are predominantly perennial ryegrass - white clover dominant. Prarie grass and cocksfoot are contributing to total production on some coastal farms. Bloat is a problem on many farms although pasture spraying with various oils has proved to be a successful control measure.(18)

Many farmers graze replacement heifers away from their "home" farm for 8-12 months, especially those with stocking rates above three quarters of a milking cow per acre.

3.6,3: Farm development(19)

Development of many farms within the survey area has involved bulldozing, drainage and cultivation, particularly those on soil groups 2, 4 and 5. One survey farmer estimated the cost of fully developing this class of country (scrub clearing, drain digging, tiles, cultivation, fertilizer, grass seed, water supply and subdivision) to be between £45 and £50 per acre.

Development of farms on soil groups 1 and 3 since the 1956-57 season has in many cases only involved intensification of stocking rates and fertilizer rates. These soils, particularly those nearer the Southern coast, were the first to be cleared from bush following settlement of the area in

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(18) Bloat spraying methods and costs are discussed in the following articles: Johns, A.T., "Preventing and Treating Bloat in Dairy Cows," New Zealand Journal of Agriculture, 99, 1, July 1959, pp. 2-5, and, Boyer, M.G., "Pasture Spraying to Prevent Bloat," New Zealand Journal of Agriculture, 107, 4, October 1963, pp. 270-271.

(19) Reports on the development of farms in the survey area have appeared in the New Zealand Dairy Exporter from time to time. These include: Anon, "Big Output from Former Problem Farm," New Zealand Dairy Exporter, 35, 8, February 1960, pp. 6-7, Anon, Butterfat Nearly Doubled in Six Years, New Zealand Dairy Exporter, 35, 8, February 1960, pp. 8-9, Yerex, D.K., Volcanic Debris Built a Farm, New Zealand Dairy Exporter, 36, 4, October 1960, pp. 13-14. The first two reports describe the development of farms situated on Group 2 soils while the third report describes the development of a farm situated on Group 4 soils. Developmental budgets

the late nineteenth century.

3.7: Extension services within the survey area

Extension personnel located in the area include two Department of Agriculture Farm Advisory Officers, a Dairy Board Consulting Officer and a District Pig Council Supervisor. A Farm Improvement Club with two advisors operates in the area.

Two Demonstration Farms are situated within the survey area. The Waimate West Demonstration Farm near Manaia is currently engaged in a long term small farm experiment comparing two rates of stocking and two rates of fertilizer. The layout, management and results of the first two seasons of the trial have been reported by Smith.(20) The second Demonstration Farm is situated near Stratford.

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(20) Smith, B.A.J., "Three Hundred and Eighty Pounds of Butterfat per Acre in a Drought Year," New Zealand Journal of Agriculture, 105, 6, December 1962, pp. 513-515, and "Four Hundred and Ninety-Five Pounds of Butterfat per Acre on Waimate West Demonstration Farm," New Zealand Journal of Agriculture, 107, 6, December 1963, pp. 543-545.

CHAPTER 4

A SOUTH TARANAKI DAIRY FARM SURVEY

This Chapter discusses the objectives of the survey, the selection of farms and the interviewing technique. The location of the farms visited in the survey is shown in Figure 4.1. Major descriptive characteristics of the survey farms are summarised in Appendix C.

4.1: Basis and objectives of the survey[1]

This survey was based on the hypothesis that increased rates of stock and fertilizer can give increased production on dairy farms in South Taranaki.[2] Within the framework of this hypothesis the following detailed objectives of the survey were established :

(a) To test the hypothesis that increases in stocking rate and fertilizer rate could lead to increased production.

(b) To isolate the associated management changes which were necessary if the use of increased rates of stock and fertilizer were to result in increased production.

(c) To look for a fairly well proven development plan (or management system) for increasing production incorporating these management changes.

(d) To evaluate the profitability of using this development plan.

Research work, extension recommendations and farmer experience provided a grounding for the original hypothesis.

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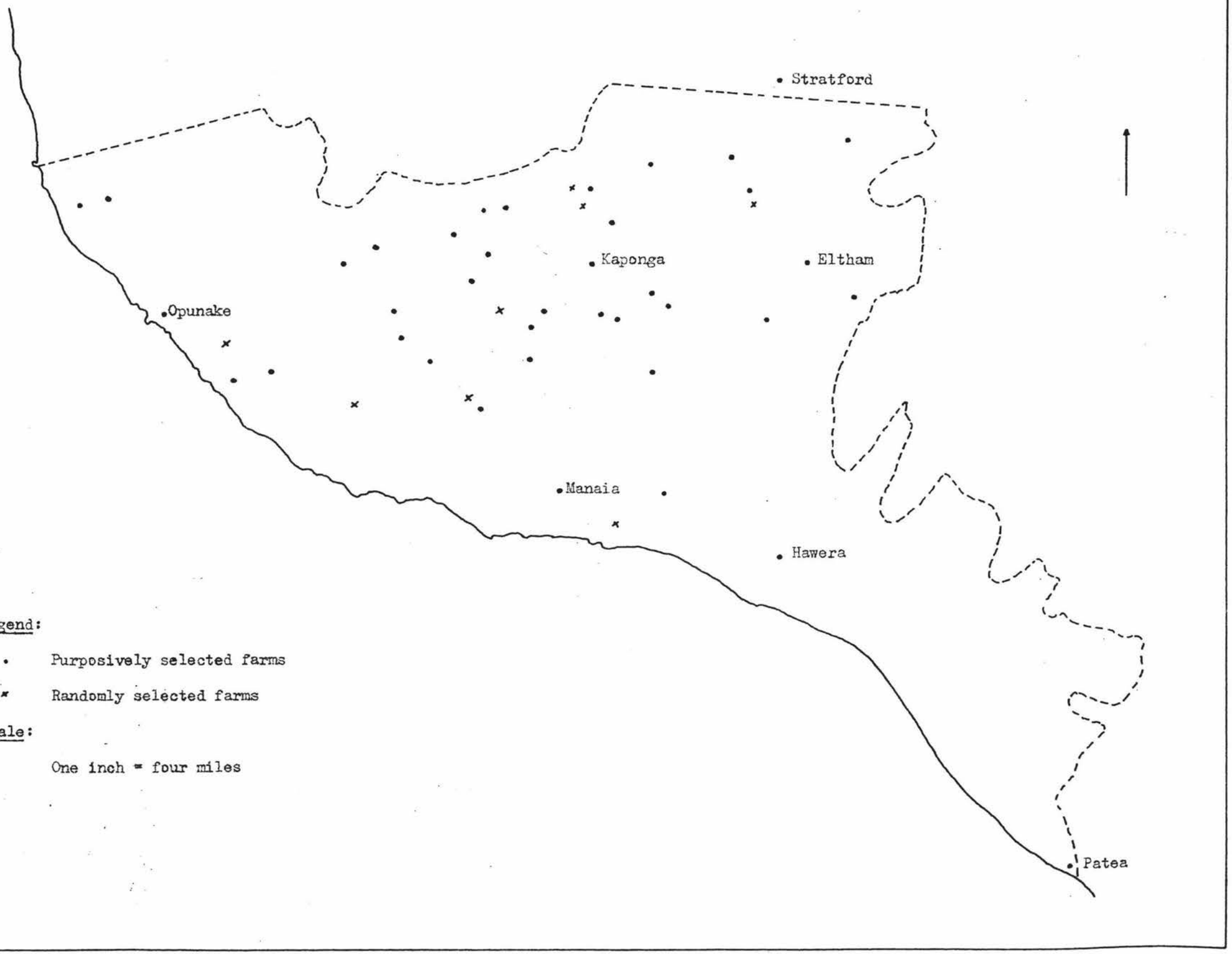
(1) The survey area is defined in Section 3.1 and illustrated in Figures 3.1 and 3.2.

(2) Note that the survey was not based on the hypothesis that "only increased stocking rates and fertilizer rates will lead to increased production on dairy farms in South Taranaki," or that "increases in stocking rate and fertilizer rate invariably lead to increased production."

FIGURE 4.1 LOCATION OF THE SURVEY FARMS



Legend:

- • Purposively selected farms
- x Randomly selected farms

Scale:

One inch = four miles

Small farm experiments at Ruakura Animal Research Station have shown that increased stocking rates can lead to increased production.(3) Associated management practices include the rationing of feed by rotational grazing and the off farm grazing of replacement stock.(4) Although Ruakura experimentation has demonstrated the contribution which increased stocking rates can make to increased production application of this principle on South Taranaki dairy farms has been limited by lack of knowledge about the management changes which would be necessary as stocking rates were increased on dairy farms in the area; and, lack of knowledge as to the financial outcome of using this management system.

Extension personnel in the area had, however, been recommending a management system for several seasons prior to 1962 which included increased stocking rates. Associated management changes which were recommended included the use of D.D.T. for grass grub control and the use of potassic phosphatic fertilizers at rates of up to 8 cwts. per acre. These recommendations were largely based on farmer experience, and in particular, the experience of Mr. R.B. Kidner. Production levels of about 350 lb. of butterfat per acre had consistently been achieved on this farm. High fertilizer rates and high stocking rates were two features of the management of Mr. Kidner's farm.(5)

Several reports of farm development in South Taranaki had also indicated the value of a management system based on increased rates of stock and fertilizer. On three farms production increases of up to 45 per cent in a 6 year period had been obtained. Associated management changes again included the use of D.D.T. for the control of grass grub, feed rationing with rotational grazing, herd improvement, intensification

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(3) Experimental results from the Number 2 Dairy at Ruakura for the 1957-58, 1958-59 and 1959-60 seasons have been summarised by McMeekan. See McMeekan, C.P., "Grazing Management," Proceedings of the Eighth International Grassland Congress, 1960, pp. 21-26.

(4) The author is not aware of any Ruakura studies of the profitability of this system.

(5) For a report of the development and management of this farm see : Tyrer, T.G., "Thirty Year Old Pastures Still Going Strong," New Zealand Dairy Exporter, 34, 10, April 1959, pp. 43-44.

of drainage and pasture renewal.(6)

One of these farms was visited by the author in the winter of 1961, and again later that year.(7) These visits, together with the results of Ruakura experimental work, provided the motivation for the survey.

4.2: The selection of farms

The survey farms were selected on the basis of the following criteria:

(i) A large percentage increase in stock numbers between the 1956-57 and 1960-61 seasons.
(ii) A large percentage increase in fertilizer usage between the 1956-57 and 1960-61 seasons.
(iii) A large percentage increase in butterfat production between the 1956-57 and 1960-61 seasons.
(iv) Recommendation by Mr. S.A. McKenzie, Dairy Production and Marketing Board Consulting Officer, Hawera, as representing "good examples of the management system."
(v) At random.

Eight farms were selected on the basis of each of these criteria, giving a total of 40 farms.

4.2,1: Criteria for the purposively selected farms

The survey hypothesis provided a logical basis for the use of these criteria in the purposive selection of farms. Selection of farms on the basis of increased stock numbers and fertilizer use permitted the selection

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(6) Development and management of these farms has been reported as follows :
Anon, "Big Output from Former Problem Farm," New Zealand Dairy Exporter, op cit.
Anon, "Butterfat Nearly Doubled in Six Years," New Zealand Dairy Exporter, op cit.
Yerex, D.K., New Zealand Dairy Exporter, op cit.

(7) The farm reported under the title of "Butterfat Nearly Doubled in Six Years," New Zealand Dairy Exporter, op cit.

of farmers who had not increased production, and enabled the following questions to be considered :

(a) What happens to production levels when stocking rates and fertilizer rates are increased?
(b) What other management changes are necessary when stocking rates and fertilizer rates are increased?
(c) Is increased production usually associated with increased stocking (fertilizer) rate?

Selection of farms on the basis of increased production enabled similar questions to be considered :

(a) Have increases in stocking rate and fertilizer rate contributed to increased production on these farms and if so, what other management changes have been necessary?
(b) Are there any other management systems which have given major increases in production on dairy farms in South Taranaki?(8)

Similar questions to those outlined for criteria (i), (ii) and (iii) were able to be considered with farms selected on the recommendation of Mr. S.A. McKenzie, the Dairy Board Consulting Officer in the area. Mr. McKenzie based the selection of his group of farms on the following criteria :(9)

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(8) Use of criterion (iii), therefore, threw some light on the hypothesis that "only increased stocking rates and fertilizer rates will lead to increased production on South Taranaki dairy farms." As has been mentioned earlier, however, the author was not concerned to consider the merits, or faults, of other management systems.

(9) Mr. McKenzie was asked to select a group of farms as he had for several years been advocating a management system for South Taranaki dairy farms based on increased rates of stock and fertilizer.

(a) Farms on which large increases in production had been achieved between the 1956-57 and 1960-61 seasons.

(b) Farms which illustrated important aspects of a management system based on increased rates of stock and fertilizer which Mr. McKenzie had found led to increased production.

(c) Farms which in the 1960-61 season were achieving what Mr. McKenzie considered to be good levels of production for the area in which each was situated.

4.2,1.1: Sources of information used for purposive farm selection

The information used in the selection of farms on the basis of criteria (i) and (iii) was obtained from annual returns of Dairy Companies to the New Zealand Dairy Production and Marketing Board. By comparing returns for the 1956-57 and 1960-61 seasons percentage changes in cow numbers and butterfat production were obtained for individual suppliers.

Returns were collected from 16 of the 23 companies within the survey area.(10) These returns provided information about butterfat production and stock numbers for 1,575 suppliers with herds of 10 cows and above in the 1956-57 season, and for 1,555 suppliers in the 1960-61 season. It was then possible to compare stock and production figures in these seasons for about 1,500 suppliers. Efforts were made while selecting farms to collect returns from the remaining 7 companies but these efforts were not successful.

Secretaries of the 7 non co-operating Companies were asked to suggest any suppliers who had made large changes in stock or production between the 1956-57 and 1960-61 seasons. The author then wrote to these suppliers and asked for detailed production records. The Secretary for two Companies failed to co-operate in even this respect. As the author was uhable to check the supply lists himself selection of farms from these 7 Companies must be regarded as unsatisfactory. The fact that the supply areas of all but two of these Companies were within the Hawera-Patea area may explain the absence of survey farms in this part of the survey area (see Figure 4.1).

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(10) Companies supplying records are shown in Appendix A.

Information about fertilizer usage (criterion (ii) was collected from stock and produce firms, extension workers and from discussion with a large number of farmers. This information was checked by mailing a small pro-forma to the farmer asking for his actual fertilizer purchases, and for his farm area. This procedure enabled percentage changes in fertilizer rate to be calculated for individual suppliers.

4.2,3: Criterion (v)

Eight farms, with which to compare the purposively selected farms, were selected at random. These farms, it was hoped, would represent typical South Taranaki dairy farms but as discussed in Appendix C, they are markedly atypical in some respects.(11)

4.2,4: Selection of the purposive sample

Lists of suppliers were prepared on the basis of percentage changes in stock, butterfat production or fertilizer usage. Subsequent eliminations were made from these lists on the basis of the eligibility criteria discussed in Section 4.2,6. Checking the elegibility of farms proved to be the most difficult part of farm selection. Information for the application of eligibility criteria was collected from stock and produce firms, dairy companies, extension personnel, and by discussion with farmers. This information included details of farm ownership and management, changes in labour and farm size and the contribution of butterfat sales to gross farm income.(12) Most farmers could not be approached directly for this information, since the author had based initial selection on butterfat or stock records supplied by the dairy factory, or fertilizer records supplied by the produce firm. This information is confidential, and hence cannot be referred to directly as the reason for selection.

Successive eliminations of farms were made from the above lists until eight farmers satisfying the eligibility criteria were obtained in

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(11) Perhaps not surprising in view of the size of the sample, a 0.41% sample of the 1960-61 population of 1,926 farmers.

(12) Criteria adopted for farm selection did not require farm size data for their application. Twenty-four farms were selected on the basis of percentage changes in either stock, production or fertilizer while farm acreages were not required for the selection of the remaining farms.

each selection category. While these farmers had made the largest percentage changes in stock, production and fertilizer of any farmers known to the author, farm selection was not exhaustive since there may have been other farmers in the survey area who had made larger changes in either herd size, production level or fertilizer usage.(13)

Mr.S.A. McKenzie was asked to select his farms within the basis of the eligibility criteria of Section 4.2, 6.

4.2,5: Selection of the random sample

The random sample was drawn from dairy factory suppliers with herds of 10 cows and above. Supplier numbers were obtained for 19 of the 23 dairy companies in the survey area, from the 1958 Government Register of New Zealand Creameries. This register was the most up-to-date source of information available to the author at the time the random sample was drawn. The dairy companies and numbers of suppliers used in random sampling are shown in Appendix A.

The sample was drawn from 1,636 suppliers, 130 suppliers less than the 1,766 suppliers with herds of 10 cows and above in the survey area in the 1960-61 season. This deficit was attributable to the accidental exclusion of 43 suppliers to the Taungatara branch of the Awatuna Dairy Company in the 1957-58 season, and 90 suppliers to the Hurleyville, Ihia Road, Melrose and Mokoia Dairy Companies in the same season. In view of the small size of the random sample this deficit will have had little effect except that it reduced the chance of selecting farms in the Hawera-Patea area. The Hurleyville, Melrose and Mokoia Dairy Companies are situated in this area.

Supplier numbers obtained from the Creamery Register were listed cumulatively. Fromthis list 12 suppliers were drawn by the use of a

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(13) Two reasons why some suppliers may have been excluded from selection are :
(a) Change in name on the supplier lists, e.g. from a trust to an individual, although the farm couldhave been operated by the same person for the whole time.
(b) Purchasing fertilizer from more than one produce firm.

table of random numbers. These suppliers were identified from factory supply lists or by dairy company secretaries. Seven of these 12 suppliers had to be rejected for various reasons. A further 6 suppliers were accordingly drawn to complete the sample. Suppliers were rejected for the reasons shown in Table 4.1

Table 4.1 Reason for Rejection of Suppliers Drawn at Random

Reason for rejection	Number of Suppliers
Farm manager changed since the 1956-57 season	1
Farm purchased since the 1956-57 season	3
Farmer refused to co-operate	1
Dairy Company would not give supplier's name	1
Farmer ran sheep on the same farm	1
Farmer on holiday overseas	1
Not required as sample completed	2
Number of rejections	10
Suppliers visited	8
Number of suppliers drawn at random	18

A similar procedure to that outlined in Section 4.2,4 was adopted for checking the eligibility of suppliers selected at random.

4.2,6: Eligibility criteria

The following farms were excluded from selection :

(a) Farms producing less than 10,000 lb. of butterfat in the 1960-61 season.(14)

(b) Farms with herds of fewer than 30 milking cows in the 1960-61 season.

(c) Farms on which less than 90% of the gross farm income was derived from the sale of butterfat and cull stock in the 1960-61 season.

(14) This excluded about 14% of dairy factory suppliers in the survey area.

(d) Farms which had changed ownership since the 1956-57 season, except where the purchaser was a 50% sharemilker who had operated the farm prior to the 1956-57 season.

(e) Farms whose owners had purchased additional land since the 1956-57 season.

(f) Town milk supply farms.

(g) Farms operated by a manager for an absentee owner, with the exception of 50% sharemilkers.

(h) Farms on which sharemilkers had changed, or been engaged for the first time, since the 1956-57 season.

4.2,7: Interpretation of the eligibility criteria

While, as previously discussed, care was taken to check the eligibility of selected farms, seven farms were visited during the survey which violated eligibility criteria. This fact only became apparent to the author after the commencement of each interview. Thus there was no question of curtailing the interview and proceeding to the next selected farmer.(15)

Table 4.2 shows the ineligible farms visited and the criterion of elegibility violated.

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(15) Even if the author had felt that the interview could be curtailed arrangements would not have been made to visit any other farmers on that day.

Table 4.2 Farms Visited Which Violated Eligibility Criteria

Farm	Selection criterion*	Eligibility criterion violated
1	(iv)	Change of ownership, 1957.
8	(v)	Sharemilker engaged, 1958 .
11	(v)	Sheep and dairy.
15	(i)	Large contract income.
17	(v)	Change in manager, 1961.
20	(i)	Additional land purchased.
27	(i)	" " "

* Defined in Section 4.2.

Records from Farms 1, 8 and 15 were retained for subsequent analysis as they provided valuable information about the management system under consideration. The remaining four farms were discarded.

4.2,8: Availability of suitable farm accounts as a criterion of eligibility

Availability of suitable farm accounts was not adopted as a criterion of farm eligibility since it was not envisaged that any difficulty would be experienced in obtaining farm accounts. Seventeen percent of farmers visited in the survey refused to supply accounts while the accounts of a further 28% of farmers were unsuitable for subsequent analysis.(16)

The fact that the farmer would not provide accounts or that these would be unsuitable only became apparent after the start of each interview. These farmers could not, therefore, be excluded from the survey sample. The author is confident that if a second visit to these farmers had been possible usable accounts could have been obtained from over 90% of the survey farmers.

Between 10% and 15% of "non-account" farmers is probably acceptable

(16) Accounts were unsuitable because they were either Trust Accounts, or Sharemilker Accounts.

in a survey sample. Detailed knowledge of development methods and results of non account farms should allow generalisations to be made about the profitability of development. These generalisations would, of course, be based on profitability estimates for the remaining survey farmers.

4.3: The survey

The survey here refers to the author's interview survey and to a supplementary questionnaire mailed to the survey farmers. A questionnaire mailed to an additional 1,670 dairyfarmers in the area is discussed in Appendix B.

4.3,1: Conduct of the survey

Each farmer selected for interview was sent a letter explaining the survey, how he had been selected and asking for his co-operation with the survey. A tentative date for interview was suggested. Each farmer was subsequently contacted by 'phone a few days before the suggested interview date.

Interviews were carried out between February and mid-June, 1962. One farm visit was made per day, except on one occasion, when two visits were made.

4.3,2: The field questionnaire

A field questionnaire was compiled by the author and tested on one farmer prior to the commencement of the general survey. After the first few interviews, however, the author found that discussion with the farmer invariably covered a much wider range of problems than those suggested by the questions originally formulated for the field questionnaire. The field questionnaire accordingly formed only a very broad basis for the conduct of each interview.

4.3,3: The supplementary questionnaire

A supplementary questionnaire was mailed to the survey farmers in March, 1963. The purpose of this questionnaire was to obtain stock, fertilizer and production figures for the 1961-62 and 1962-63 seasons. Farmers were asked to estimate production for the 1962-63 season. Seven farmers

did not return the questionnaire. Data obtained with this questionnaire are summarised in Appendix D.

4.3,4: The conduct of interviews

The nature of the interview varied widely between visits. Some began with a walk around the farm and a general discussion with the farmer while others began with the recording of stock and production figures before leaving the farm house. All interviews included a walk around the whole farm, however, since this was the only way in which the author could obtain a proper understanding of the development and management of the farm. Most of the survey farmers were more responsive to questions when "out on the farm".

Data relating to butterfat production, stock numbers, fertilizer usage, and other physical data, were usually entered in the questionnaire while on the farm. Much of the remaining information about development methods and problems, and general management, was not recorded until the completion of the visit.

Each interview thus took a "free flow" form with little reference being made to the original questionnaire. This form of interviewing has several advantages :

(a) Information obtained in previous interviews can be incorporated into the discussion. New aspects of the original hypothesis can be considered.
(b) A free flow form of interview allows questions to be asked which relate directly to individual farms and farmers. Development methods for a wet soil farm are likely to be greatly different to those used on a farm situated on drier soils. Completely different questions are likely to be required for each farmer.
(c) Greater rapport can be established between interviewer and farmer.

This form of interviewing demands however, that the survey worker

have each evening free in which to record the days interview. This in turn necessitates farm selection being completed before the commencement of the survey. A fixed abode for the survey worker is also desirable.

Interviews commenced each morning at about 9.30 a.m., a convenient time for most farmers. On several occasions the author assisted farmers with routine farm work before commencing the interview. This often provided an opportunity for obtaining physical information about the farm such as layout, paddock numbers and soils.

Farm accounts were usually obtained from the farmer at the close of the interview. No attempt was made to discuss this with the farmer before leaving the farm. Where the farmer was unable to locate accounts for each season between the 1956-57 and 1960-61 seasons the author obtained written permission to visit his accountant. A similar policy was adopted when the farmer could not provide complete stock, production or fertilizer records. Dairy companies and produce firms were approached for this information.

4.3,5: Cost of the survey

Total cost of the survey was approximately £260. Car hire and petrol accounted for about £225 and meals, toll calls, printing of the mail survey questionnaire and return postage, and stationery for the balance.

About 5,500 miles were travelled during the survey. Farmers provided accommodation for the author for the ten weeks he spent in the survey area.

4.3,6: Suggested work schedule for a study involving a farm survey

A suggested work schedule[18] for a study similar to the one reported in this thesis is as follows :

Stage 1: 2½ months

Reading, preparation of a memo outlining in detail the aims of the study and the analytical procedures to be used, farm selection and preparation of a field questionnaire.

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(18) This schedule is based (in part) on the time spent by the author on various stages of this study.

Stage 2: $2\frac{1}{2}$-3 months

Farmer interviews. This is an allowance of $1\frac{1}{2}$ farms per day for a survey of forty farms.

Stage 3: $3\frac{1}{2}$-4 months

Analysis of data

Stage 4: 4 months

Publication of a survey report and an extension bulletin.

This schedule demands 13 to 14 months for the completion of the study.

CHAPTER 5

THE SURVEY FINDINGS

Three basic farm groupings are discussed in the opening section of this chapter. Management changes made over the survey period specific to each of these groups are then considered, followed by a discussion of management changes common to each group. Management practices for increased production on three classes of South Taranaki land are then discussed, and finally, some conclusions are drawn about the scope for increased production in the survey area.

Supplementary data for this chapter are given in three appendices. Appendix C summarises some of the major descriptive characteristics of the survey farms while Appendix D shows season by season changes in production per acre, stocking rate, fertilizer rate and production per cow between the 1956-57 and 1962-63 seasons. Development of six of the survey farms is discussed in Appendix F, "Case Farm Studies." These case farms illustrate various aspects of the management practices to be considered in this chapter.

The profitability of increasing production on the survey farms is discussed in the next chapter.

5.1: Three basic farm groupings

One objective of the survey was to look for a fairly well proven farm development plan (or management system) for increasing production on South Taranaki dairy farms. The term Farm Development normally describes the process by which a comprehensive series of new inputs is added to an existing farm organisation.(1) In the case of a dairy farm development plan these inputs may include the addition of extra stock and fertilizer, changes in the quantities of conserved feed, provision of housing for

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(1) Hodgson, J.N., Farm Development, Discussion Paper No. 8, Department of Agricultural Economics and Farm Management, Massey University College of Manawatu, April 1963, p. 1.

additional labour, drainage and fencing. Addition of these inputs is likely to be spread over several years.

In evaluating a farm development plan the following points are of importance :(2)

(a) The inputs, or resources available for a given plan on a specific farm vary in type, size and grade and they may be added at different times in relation to each other. Thus problems of development arise which are unique to each farm. An individual farmer contemplating development is faced with alternatives of what to do, when to do it and how far to go with any changes made.

(b) Farms vary widely in their initial stage of development. There is thus a wide range in starting points for plans from farm to farm and therefore in the way in which each plan is carried out. For example, development of Farm 10 involved the addition of stock and fertilizer with some changes in feed organisation. Development of Farm 14 has involved, however, a continuing programme of bulldozing, draining, fencing, extra stock and fertilizer and a new cowshed.

(c) Inputs, or resources interact with each other and cannot be considered in isolation. Interactions can be very complex and necessitate the study of the farm as a whole. Thus additions of stock to a farm may involve increased rates of fertilizer after a certain point. Pasture growth patterns may change both from the effect of added fertilizer and from the effect of added stock. Subsequent additions of stock and fertilizer to the land resource may necessitate changes in winter feeding methods. Use of agistment may become profitable. Additional labour may need to be employed. Increased milk production means increased whey and this may

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(2) Ibid.

> critically affect pig husbandry practices. The success of the plan will only be assured if these interactions are recognized and if resources are added at the appropriate point and in the appropriate quantity.

Thus the evaluation of a farm development plan necessitates the study of the farm as a whole. Points discussed under (a), (b) and (c) cannot be considered by making a cross-sectional breakdown of the inputs used on a group of farms. Neither can the study of a two way table provide any real insight into the operation of the farm as a whole.(3)

Salter, in making a plea for the study of case farm groupings rather than the study of input groupings not related to individual farms, also stresses the importance of considering the management of the whole farm.(4) Salter continues by suggesting a method by which case farm studies can be grouped for purposes of analysis :

> "A first sort of the survey schedules should be based only on a few attributes which are certain to have a direct and important bearing on the way the problem will be reflected in all the units of observation."

This procedure demands, of course that the investigator have a clear definition of the problem and a well defined hypothesis as to the attributes (or inputs) likely to be important on all the case farms.

The hypothesis on which the study under discussion is based is that increased rates of stock, and fertilizer, lead to increased production. Since changes in either, or both, of these inputs are likely to have important effects on the management of all the survey farms it appeared to the author that a grouping of case farms on the basis of these changes should

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(3) Candler, W.V., "Production Economics and Problems of Animal Production", Proceedings of the New Zealand Society of Animal Production, 22, 1962, pp. 142-158.

(4) Salter, L.A., "Cross Sectional and Case Grouping Procedures in Research Analysis," Journal of Farm Economics, 24, 4, 1942, pp. 792.

be possible. Examination of the survey data showed, in fact, that the survey farms fell into three groupings :

Group A : Farms on which increases in stocking rate were made between the 1956-57 and 1960-61 seasons, but fertilizer usage remained roughly constant. This group will subsequently be referred to as the "Cows increased" group.
Group B : Farms on which increases in stocking rate and fertilizer rate were made over the period. This group will subsequently be referred to as the "Cows and Fertilizer increased" group.
Group C : Farms on which no changes were made in stocking rate or fertilizer rate over the period. This group will subsequently be referred to as the "No change" group.

These three groupings provide a framework within which associated management changes are discussed. Common patterns of inputs and experiences are derived, where possible. "Exceptional" farms are considered. References to specific farms are interspersed throughout the discussion which follows. These farms are used as examples of particular aspects of management.

Management changes specific to each group of farms will now be considered.

5.2: Group A : "Cows increased" farms

This group includes fourteen farms on which increases in stocking rate were made over the period, but fertilizer usage remained roughly constant. Butterfat production increased on all these farms. Changes in production per acre are summarised in Table 5.1.

Table 5.1 Changes in Production per Acre, "Cows Increased" Farms

Level of production per acre	Number of farms in each range	
	1956-57	1960-61
51 - 100	1	
101 - 150	4	1
151 - 200	5	3
201 - 250	4	5
251 - 300		4

Management changes specific to these farms will now be discussed. Farmers considered that these changes had contributed to increased production.

5.2,1: Changes in stocking rate

Changes in stocking rate are summarised in Table 5.2. Although replacement stock are not included in the calculation of stocking rate, all farmers in this group maintained normal ratios of replacement stock, that is, 23 - 25% of heifer calves and 18 - 20% of 2 year heifers.

Table 5.2 Changes in Stocking Rates, "Cows Increased" Farms

Stocking rate (cows per 100 acres)	Number of farms in each range	
	1956-57	1960-61
31 - 40	2	
41 - 50	4	
51 - 60	2	3, (1)
61 - 70	6	4, (1)
71 - 80		5, (2)
81 - 90		2, (1)

Farmers grazing replacement stock away from their home farms in the 1960-61 season are shown in brackets. Replacement stock were grazed away for periods ranging from 8 months to 18 months.

5.2,2: Fertilizer usage

With three exceptions fertilizer rates did not change on these

farms over the period. Fertilizer usage increased by 0.5 cwts. per acre on Farm 4, by 0.2 cwts. per acre on Farm 6 and fell by 0.7 cwts. per acre on Farm 29. Table 5.3 shows fertilizer rates used on "Cows increased" farms.

Table 5.3 Fertilizer Rates, "Cows Increased" Farms

Fertilizer rate	Number of farms in each range
2.6 - 3.0	6
3.1 - 3.5	2
3.6 - 4.0	3
4.1 - 4.5	1
4.6 - 5.0	2

While these rates of fertilizer had been applied for at least five seasons prior to the 1956-57 season, use of potash had increased considerably over this period. Table 5.4 shows the types of fertilizer used in the 1956-57 season.

Table 5.4 Types of Fertilizer, 1956-57 Season, "Cows Increased" Farms

Type of fertilizer	Number of farmers using
33% potassic serpentine	7
20% potassic serpentine	4
Superphosphate	2
Serpentine	1
Slag	1

The same pattern of fertilizer types was found in the 1960-61 season with the exception of one farmer who had changed from using slag to 20% potassic serpentine.

Seven farmers split fertilizer dressings between spring and autumn. These farmers considered that total pasture production was increased by splitting fertilizer dressings, although this hypothesis lacks experimental

verification on Taranaki soils. The remaining seven farmers applied fertilizer as a single autumn dressing. Spring dressings were usually applied to hay and silage paddocks by those farmers using split dressings.

Fertilizer usage increased on five "Cows increased" farms subsequent to the 1960-61 season, as shown in Appendix D.

5.2,3: Herd wastage

Only Farmer 24 reported an increased incidence of bloat as cow numbers had been increased. Stock diseases were not thought to have increased at all on other farms.

5.3: Group B : "Cows and Fertilizer Increased" Farms

Changes were made in stocking and fertilizer rates on twenty-five survey farms. Butterfat production increased on all these farms. Changes in production per acre are summarised in Table 5.5.

Table 5.5 Changes in Production per Acre, "Cows and Fertilizer Increased" Farms

Level of production per acre	Number of farmers in each range	
	1956-57	1960-61
100 - 150	3	1
151 - 200	9	2
201 - 250	11	5
251 - 300	1	12
301 - 350		4
351 - 400		1

Table 5.4 shows that large changes in production per acre were made on most of these farms, while high levels of production were attained on several farms in the 1960-61 season. Management changes specific to these farms will now be considered.

5.3,1: Changes in stocking rate

Changes in milking cow stocking rates are summarised in Table 5.6.

Table 5.6 Changes in Stocking Rates, "Cows and Fertilizer Increased" Farms

Stocking rate (cows per 100 acres)	Number of farms in each range	
	1956-57	1960-61
31 - 40	1	
41 - 50	4	1
51 - 60	2	3
61 - 70	10	3, (1)
71 - 80	7	5, (4)
81 - 90		6, (2)
91 - 100		4, (3)
101 - 110		2, (2)
111 - 120		1, (1)

The number of farmers grazing replacement stock away from their home farms in the 1960-61 season are shown in brackets. Replacement stock were grazed away for periods ranging from 7 to 18 months. In the 1960-61 season Farmers 14, 16, 18 and 19 were rearing between 20 and 25 two-year-old heifers for sale in addition to heifers required for herd replacement purposes.

5.3,2: Changes in fertilizer rate

Changes in fertilizer usage on these farms are summarised in Table 5.7.

Table 5.7 Changes in Fertilizer Usage, "Cows and Fertilizer Increased" Farms

Fertilizer rate (cwts. per acre)	Number of farms in each range	
	1956-57	1960-61
1.1 - 2.0	2	
2.1 - 3.0	10	1
3.1 - 4.0	9	
4.1 - 5.0	3	5
5.1 - 6.0		8
6.1 - 7.0		5
7.1 - 8.0		3
8.1 - 9.0		2
9.1 -10.0		1

The length of time for which the rates of fertilizer shown in the 1956-57 season had been applied varied widely. On Farms 3, 10 and 25, for example, a 3 cwt. dressing of superphosphate or slag had been applied each year for at least 15 years prior to the 1956-57 season. Farm 21, however, had received almost no fertilizer prior to the 1952-53 season. Farm 2 received 2 cwts. per acre of superphosphate between 1945 and 1955, which was increased to 4½ cwts. per acre in the 1956-57 season.

Types of fertilizer used are shown in Table 5.8.

Table 5.8 Types of Fertilizer, "Cows and Fertilizer Increased" Farms

Type of Fertilizer	Number of farmers using	
	1956-57	1960-61
33% potassic serpentine	15	24
20% potassic serpentine	8	
Superphosphate	1	
Slag	3	2
Nitrogen	3	7
Crop	1	1

Fertilizer is applied as a split dressing on most of these farms with spring dressings largely applied to hay and silage paddocks. Many of these farmers had started using an increased rate of fertilizer by top-dressing hay and silage paddocks one spring and topdressing the whole of the farm the following spring in addition to usual autumn topdressing. This policy enabled hay and silage reserves to be built up as an insurance against feed shortages when subsequent increases in stocking rate were made.

5.3,9: Herd wastage

"Cows and Fertilizer increased" farmers, in general, reported that stock losses from disease, and the incidence of various stock diseases had not increased as stock numbers had increased. Ten farmers reported however, that the incidence of bloat had increased. Four of these farmers thought that bloat incidence was higher on new grass pastures. These new pastures were, in general, clover dominant for much of the season. On the other hand, one farmer reported that bloat incidence was the same on pastures of all ages on his farm. Pasture spraying had in all cases been successful in reducing bloat losses and several farmers had purchased spraying equipment at a cost of between £80 and £100.

5.4: Group C : A farm on which no changes were made in stocking and fertilizer rate

This farm, Farm 30, is a 70 acre farm situated near the South Coast in a 40 inch rainfall area. Although production increased by 14% over the period this increase was obtained mainly in the 1960-61 season when production reached 313 lb. of butterfat per acre. Over the period a stocking rate of between 84 and 86 cows per 100 acres was maintained and a fertilizer rate of 3.5 cwts. per acre of 33% potassic serpentine.

The farmer considered that an important factor contributing to increased production in 1960-61 was the excellent pasture growth experienced in the winter and spring of 1960. Careful shed management, and long term benefits from herd improvement, grass grub control, and regular use of potassic fertilizers had also contributed.

Features of the management of Farm 30 are the use of permanent pastures at least 10 years old, mid-July calving, rotational grazing in both summer and winter, nine paddocks, purchase of pedigree yearling bulls for mating, off farm grazing of replacement stock for 12 months and the purchase of hay from time to time.

At the time of the author's visit to the farm (9th June, 1962) the farmer had ordered sufficient crop manure to spread over the farm at 3 cwt. per acre in July, in addition to the usual autumn dressing. Three to four additional cows were to be milked in the 1962-63 season. That is, this farmer was hoping in the future to increase production by the type of management system described elsewhere in this thesis.

5.5: Management changes common to the survey farms

The management changes which will now be considered are those common to all farms or those indirectly related to the criteria on which the survey farms were grouped for discussion.

5.5,1: Labour and housing

Over the survey period labour complement changed on several farms as cow numbers were increased. Five farmers employed a youth who, on two farms, was an addition to the married permanent labour already employed. A further two farmers adopted a policy of employing student labour for the first six months of each season. One farmer, Farmer 33, engaged a single man.

Five farmers engaged a sharemilker over the period. One farmer, Farmer 8, subsequently left his farm. The owners of the remaining four farms had retired before the 1956-57 season and on these farms a son, who had been managing the farm for several seasons, was engaged as a sharemilker. The permanent labour on these five farms cannot be said to have increased over the period.

Additional housing was not required on any farms over the period.

In all cases, youths lived with their employers.

On 31 farms, cow numbers were increased with no increase in hired labour. Labour organisation was changed in several ways, however, to enable extra stock to be handled by the existing labour. Eight farmers built herringbone cowsheds, five of them converting their old cowsheds to a herringbone type. A further five farmers added herringbone cowsheds in the winter of 1961.(5)

Reasons given by two farmers for changing their cowsheds were :

(a) Farmer 24 was tired of stooping while milking. Cow numbers increased by 20 following conversion of the shed. Labour required for milking did not change yet milking time fell by 45 minutes. Conversion cost £350 with an additional £250 for a flushing plant, a jetting system and a motor driven yard gate.

(b) Farmer 13 considered that he was spending too much time in his old shed, which had been condemned. Since converting his shed at a cost of £500 (including provision for tanker collection) cow numbers had increased by 25, while labour used for milking had not changed, but milking time had fallen by 45 minutes.

On eight farms capital investment in a herringbone cowshed has partially substituted for additional labour. Other labour saving practices adopted included the use of tanker collection of milk, contract spreading of fertilizer (handled in bulk), once per day calf feeding, dispensing with silage as a supplementary feed and dispensing with supplementary feed crops.

5.5,2: Herd improvement

Attitudes to herd improvement, and actual herd improvement practices, varied widely. Herd improvement practices used in the 1960-61 season are shown in Table 5.9.

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(5) Changes in cows milked per man hour and in labour requirements following the erection of herringbone cowsheds have been reported in a survey conducted by the New Zealand Dairy Production and Marketing Board. See : New Zealand Dairy Production and Marketing Board, Herringbone Cowshed Survey, Farm Production Report No. 39, 1962-63 Season, pp. 45-51.

Table 5.9 Herd Improvement Practices, All Farms

Practice	Farmers using
Herd testing and artificial breeding	16
Herd testing and farm reared bulls	4
Herd testing and pedigree bulls	6
Artificial breeding alone	7
Farm reared bulls alone	4
Pedigree bulls alone	3

Many farmers considered that herd testing had made only a limited contribution to increased production over the period. In most cases rapid increases in herd numbers had reduced the opportunity for culling on a productive basis, and necessitated the keeping of all heifer calves. On some farms culling opportunities had been further reduced by T.B. testing, bloat losses and infertility.

Artificial breeding was thought to have contributed to increased production on many farms. In addition to a direct contribution to the genetic merit of herds, A.B. had eliminated infertility problems on at least three farms and enabled the farmer to rear a larger number of heifer calves.

Herd improvement programmes of particular interest were found on two farms.

Farmer 37 had used herd testing since the 1951-52 season and artificial breeding since the 1954-55 season. He began to use artificial breeding due to herd infertility. The farmer stated that he would only be satisfied when the average production of his herd exceeded 400 lb. of butterfat per cow. He was not at all interested in production per acre as he would rather carry fewer stock and "do them better". In fact the farmer's increase in stocking rate from 70 to 75 cows per 100 acres over the period was accompanied by a 37% increase (from 282 to 378 lb. butterfat) in production per cow.

On Farm 21, cow numbers increased from 117 to 150; an increase of 28% over the period. Stock losses have been heavy. In 1959-60 five cows were lost from bloat, another nine cows were lost from bloat in 1960-61, and five cows from metabolic diseases over the period. In addition, 17 cows were culled for T.B. between the

1958-59 and 1959-60 seasons and 40 cows from T.B. in the 1960-61 season.

Sustaining the above increase in herd numbers (and covering losses) has involved the retention of cull cows, the rearing of every heifer calf for 3 successive seasons prior to the 1960-61 season and the purchase of additional stock. Consequently, in the 1961-62 season the herd of 156 cows included 130 first and second calving cows. Understandably, the farmer thought that herd quality had made little contribution to increased production over the period.

Because of the large changes in herd composition and numbers the farmer has not used herd testing since the 1956-57 season. The first A.B. heifers entered the herd in the 1962-63 season.

In summary, the author suggests that artificial breeding can profitably be used at all stages of a development programme involving increased stock numbers, and herd testing as herd numbers stabilise.

5.5,3: Use of D.D.T.

Over the period the number of farmers using D.D.T. for the control of grass grub increased from 11 to 34, (or from 27% to 85%). Grass grub damage was evident on four of the six farms on which D.D.T. was not used. Understandably, the farmers using D.D.T. generally believed that grass grub control had contributed to increased production on their farms.

5.5,4: Drainage

Drainage was intensified on ten farms over the period. On eight of these farms localised wet spots and meandering streams were drained. On Farms 14 and 33, however, drainage had been a major component of the development programme over the period.

Farm 33 is a 200 acre farm situated on hummocky volcanic soil underlain by an ironstone pan. Approximately 150 acres of this farm have been drained since the 1952-53 season. The farmer used both open and tiled drains at an intensity of between 5 and 10 chains per acre. Open drains have been placed along fence lines and the tiled lateral drains empty into them. Pasture renewal, fencing and provision of watering points has been carried out in conjunction with drainage. While this farmer was unable to provide cost estimates for developing this class of land, Farmer 14, whose farm is adjacent, stated that it cost between £40 and £50

per acre.(6)

5.5,5: Pasture improvement

While pasture improvement cannot be discussed as an operation divorced from the management of the whole farm a broad division of pasture improvement programmes used on survey farms is attempted here. This division is :

Method (a) A continuing programme of ploughing and regrassing old pastures.

Method (b) Improving permanent pastures by means other than regrassing.

This division is not completely clear cut since both methods were being used on many farms. Pasture improvement programmes not only varied widely between farms but many farmers changed their improvement programme over the period. These changes resulted from a complex of factors - increased cow numbers and fertilizer use, use of D.D.T. and potash and in some cases, the completion of stumping and draining.

5.5,5.1: Pasture improvement by regrassing

This method involved the ploughing and regrassing of old pastures. In some cases, this operation included bulldozing, stumping and draihing prior to regrassing, as on Farms 14, and 21, while on other farms pastures which had been established for many years were being regrassed.

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(6) An approximate allocation of this sum would be :

	Cost (£)
Bulldozing	3 - 5
Drainage	15 - 20
Cultivation	6
Fertilizer	10
Seed	2
Water and fencing	5
Cost per acre	41 - 48

Winter or summer cropping was usually included as a part of the regrassing programme. Thirty-two of the survey farmers, in fact, were cropping and regrassing an area of their farm in the 1956-57 season. On several farms regrassing was taking place on a grass to grass basis in addition to the area regrassed after a crop. Most farmers used perennial ryegrass - white clover seed mixes with, in some cases, the addition of 5-10 lb. of H_1 ryegrass per acre. Pastures on the remaining 8 farms varied in age from 6 to 40 years.

> Farmer 21 made several comments about practices which were essential for the successful establishment of new grass pastures. One hundred and ten acres of his 150 acre farm had been regrassed between 1952-53 and 1961-62 inclusive. He considered that new pastures needed 2 cwt. D.D.T. superphosphate with seed, 5-6 cwt. per acre of 33% potassic serpentine following sowing (autumn) and a further 3 cwts. per acre of 33% potassic serpentine in September. The new pasture would then be autumn topdressed at the rate of 4-5 cwts. per acre of potassic serpentine. New pastures were close grazed shortly after sowing to encourage pasture density and soil compaction.

5.5,5.2: Improving established pastures

Over the survey period pasture improvement programmes changed considerably, with an increase from 8 to 21 farmers who were relying on permanent pastures. Thirteen "permanent pasture" farms are "Cows and Fertilizer increased" farms. This change to permanent pasture largely reflected improvements in pasture production, especially the improvement in production of older pastures. Farmers thought these improvements were attributable to many factors - increased rates of phosphate and potash, use of D.D.T. for grass grub control, changes in winter and summer grazing methods, controlled winter treading and increases in stocking rate. Thus the changes in winter grazing management discussed in the following section have aimed both at improving pastures and utilizing the changed and improved pasture growth pattern.

Pasture improvement methods, and the changes which have taken place in these methods, are discussed for five "Cows and Fertilizer increased" farms and one "Cows increased" farm in Appendix F. Pasture improvement

will now be described in detail for a further two farms.

Farm 19, a "Cows and Fertilizer increased" farm, is a farm where regrassing was last carried out in 1955-56. Pasture improvement has subsequently been based on the use of increased rates of potassic fertilizers and increased stocking rates.

Farm 19, a 200 acre farm with 180 productive acres, is situated in the Kapuni area at an altitude of 650 feet above sea level; rainfall is 55 inches; and about 30 of the productive acres are underlain by an ironstone pan.

When purchased by the present owner at the start of the 1948-49 season the farm carried 85 cows. Pastures were poor and infested with blackberry and gorse. The farm was fenced into fifteen paddocks while the stock water supply was limited to 4 troughs. Thirty acres of pan country became waterlogged each winter.

Development work carried out between the 1948-49 and 1956-57 seasons included the regrassing of 160 acres, installation of 20 troughs and associated piping, tile draining of 30 acres, concreting 500 yards of the central race, increasing paddock numbers to 22, clearing of gorse from a 10 acre creekbed by spraying, oversowing, topdressing and heavy stocking; and the use of D.D.T. for the control of grass grub. The whole farm was regularly topdressed with 3 cwts. per acre of a mixture of super and slag until the 1952-53 season when this mixture was changed to a super potash mixture. Between 8 to 10 acres of crop was grown in each of these seasons and fed in the winter in conjunction with one or more sacrifice paddocks.

By the 1956-57 season cow numbers had increased to 136 while in that season, 18 heifers and 30 calves were also run on the farm. Butterfat production was 41,200 lb. or 206 lb. per acre, and four cwts. of fertilizer per acre, largely 33% potassic serpentine, was applied.

No regrassing has been carried out since (and including) the 1956-57 season. Over the survey period paddock numbers were increased to 28 and the stock water supply extended by four troughs.

Fertilizer rate had increased to 6.7 cwts. per acre in the 1960-61 season and included 31 tons of 33% potassic serpentine, 20 tons of D.D.T. super and 10 tons of slag. Stock wintered on the farm in 1960 included 160 cows, 41 heifers, 60 calves and 4 bulls while butterfat production had increased by 29% over the base period to 53,000 lb. or 266 lb. per acre. Increases in

stocking rate subsequent to the 1960-61 season have been accompanied by an increase in production to an estimated 54,500 lb. of butterfat or 272 lb. per acre in the 1962-63 season.

Winter feeding is now based on the use of a split herd system while summer grazing management involves a 14 day rotation.

Thus on farm 19 pasture improvement since the 1956-57 season has been based on the use of higher rates of potassic fertilizers and increased stocking rates. The farmer thought that the adoption of a split herd system of winter feeding had contributed to improved pasture production by reducing winter pugging and through control of winter treading. The farmer now considers that he could probably have improved old pastures without regrassing by using high rates of fertilizer and stock.

Farm 43 is a farm on which regrassing is justified by the need for a winter forage crop. The crop appears to have outlived its purpose, however, while little improvement is resulting in pastures as stocking rate is too low to give complete feed utilization.

This 148 acre farm was purchased by the present owner in 1916. The farm is situated in the Oaonui area, about four miles inland from South Coast. Rainfall in this area is 50 inches. Since 1916 the farm has been stumped, levelled, drained and regrassed. Seven to eight acres were ploughed, winter cropped and regrassed each season. The farmer stated that regrassing was necessary in the early stages of development as the farm was rough, wet and covered by gorse and blackberry.

The farmer's justification for this regrassing policy (which he had no intention of stopping) was that "cows needed a winter crop to keep healthy". At the time of the author's visit (20th June, 1962) the farm was covered with rank feed. Pastures were yorkshire fog dominant and mossy, and appeared to have been laxly grazed for many seasons. The crop did not seem to be necessary in view of the large amount of pasture going to waste.

Production increased on this farm by 24% to 200 lb. of butterfat per acre over the period. Stocking rate increased over the same period from 47 to 65 cows per 100 acres. No other management changes had been necessary. The farmer had no intention of making a further increase ih stocking rate. In the author's opinion, and on the basis of other farms cited in this thesis production could be increased by at least another 50% by control of grass grub,

increasing the present 1 ton of potash used each year to 10 tons or more, increasing stocking rate to at least one cow per acre and relying on permanent pastures. Wet winters would require the use of a split-herd system of wintering and not the mob stocking system at present followed on the farm. The only capital expenditure required would be for additional stock, and possibly a larger water pump. The present labour force of two men would be able to handle the increased cow numbers in the existing 5 bail, doubled-up walk through cowshed.

5.5,6: Summer grazing management

Few changes were made in summer grazing management over the period. All farmers used some form of rotational grazing over the summer, although the intervals between grazing and the severity of each grazing varied from 9 to 30 and the interval between grazings from 4 days to 28 days. On at least 5 farms, the length of the rotation varied according to changes in pasture production.

Most farmers judged the efficiency of their summer grazing system on the criterion of "no surplus grass in spring". Measures adopted to ensure this situation included high stocking rates, intensive subdivision and fast grazing rotations. On several farms areas closed in the spring for hay and silage making had fallen as stocking rates had increased. This reduction had been possible as a result of improved winter growth of pastures and reduced wastage of conserved feed. A reduction in the area closed for hay and silage enabled more pasture to be eaten in situ, and enabled a greater number of cows to be grazed without an increase in stocking rate on the balance of the farm.

Five farmers grew summer crops as a regular practice. These crops were usually grazed between January and April, and the paddock resown to pasture in the autumn. Crop paddocks were usually those which had been pugged the previous winter. At least two farmers used a "grass cropping" system as an alternative to a forage crop. Hay and silage paddocks on these farms were usually closed for 3-6 weeks after cutting and were then break fed in January and February. This practice is illustrated by Case Farm 8, Appendix F.

Four of the five farmers growing summer crops considered that pasture production was inadequate between January and March. Experiences of other survey farmers suggest that on three of these farms late summer growth would be improved by an increase in topdressing rate from the present 3.5 to 4 cwts. per acre of 20% potassic serpentine to about 6 cwts. per acre of 33% potassic serpentine. Both summer and winter growth of pastures is likely to be improved by following this policy. Supplementary feed requirements would accordingly be reduced. The area of the farm at present closed for hay in the critical summer period could then be reduced slightly. If the crop were dispensed with then an additional 3 to 5 acres of pasture would be available for the whole of the season. The fifth farmer grew a crop as part of a pasture renewal programme.

Calving date varied from mid-July to late August on the survey farms. August calvings were used by farmers at higher altitudes where spring growth is several weeks later than on farms at lower altitudes. Late calving reduced the requirement of autumn saved pasture for several weeks following calving.

Several farmers stressed the importance of varying the grazing intensity throughout the season. Farmer 21, for example, outlined his summer grazing plan for the 1962-63 season as follows :

(a) Calving from 4th August until mid-September.
(b) Break grazing of autumn saved pasture until early September.
(c) Close control of grazing over the spring and early summer period, particularly in October and November. To achieve this control, and accompanying high feed utilization, the farmer was prepared to withdraw paddocks from the rotation for silage making. The farmer considered that complete utilization of feed over this period was essential if summer slumping of growth was to be prevented. A 21 day grazing rotation was planned for this period.

(d) Some relaxation of grazing control over the summer and early autumn. The grazing rotation was to be lengthened to 28 days over this period. Hay was to be cut behind the herd and the farmer had no plans for shutting paddocks especially for hay. This system would result in a long period of growth followed by hard grazing, a few days recovery than a cut taken for hay. The farmer was confident that this system

would assure complete feed utilization at each grazing and mowing and the maintenance of a 2-3 inch cover of grass over the whole farm during the hot summer period. The slumping in pasture production which invariably followed the shutting of a paddock for hay would be prevented.

This system of making hay from "toppings" would probably only be economic where a farmer had his own pick-up baler.

(e) Farmer 21 considered that two factors which would assure complete feed utilization in the 1962-63 season would be his planned stocking rate of 112 cows per 100 acres; and 25 paddocks.

5.5,7: Winter grazing management

Winter grazing management changed on many survey farms over the period, as shown in Table 5.10.

Table 5.10 Winter Grazing Management, 1957 and 1961

Management practice	Number of farmers using	
	1957	1961
Split herd	5	19
Winter crop	30	14
Wintering on A.S.P.*	1	4
Mob stocking	3	1
Grazing off		2

* A.S.P. is autumn saved pasture

There were wide variations in the practices listed in Table 5.10. For example, the feeding of a crop was usually preceded by 3 to 6 weeks pasture grazing. Over this period the herd may have been rotationally grazed on pasture saved from late summer, or set stocked to clean up rank feed accumulated through the preceding season. Stocking rates under the split herd system of winter feeding varied from two to ten cows per acre.

Important factors considered by farmers in deciding on winter management were stocking rate, winter and spring pasture growth, amounts of hay and silage on hand and soil moisture levels. The management systems used, and the way in which adjustments were made in winter feeding

to changes in the above criteria will now be considered.

5.5,7.1: The split herd system

Under this system cows are separated into mobs on the basis of calving date and condition. Each mob is set stocked at a level judged to avoid pugging. On the survey farms this varied from between 2 and 10 cows per acre. Hay and silage are fed. Survey farmers considered that the main advantages of this system were :

(a) Pugging damage, which can result from higher stocking rates, is reduced. The area on which stock are wintered is left in good growing order for the spring. Grass is available throughout the winter for stock.
(b) Less hay and silage is fed per cow.
(c) Cows can be fed according to condition and calving date.
(d) Controlled winter treading is possible. This may improve poor pastures.

These advantages express themselves in several ways. A reduction in the amount of hay and silage fed per cow means that the area of the farm closed in spring and early summer is not increased as stocking rates are increased. More pasture is eaten in situ by cows at the peak of their lactation. Improved condition of cows at calving is likely to be reflected throughout the whole season. Undamaged pastures provide earlier and better spring growth than pugged pastures.

5.5,7.2: Winter cropping

As discussed in Section 5.5,5; cropping was a part of pasture improvement programmes on several farms, while on some farms the crop was grown for its own sake. While a crop may be useful on low fertility farms where winter growth is poor, or as a substitute for feed reserves used in a drought, cropping has several disadvantages. These include cost, likelihood of fertility depletion, labour required for cultivation and feeding out, wastage when feeding in situ and difficulty in establishing new

pastures. Other problems are that the feeding of a crop is generally associated with considerable stock movement, and that an area of the farm is out of production in the critical spring and early summer period.

5.5,7.3: Other "all grass" wintering systems

These include rotating the herd as a mob, set stocking the herd or break feeding of autumn saved pasture.

In general the winter rotation and set stocking systems were used by farmers with stocking rates of less than three quarters of a cow per acre or on higher stocked farms in coastal areas. At higher stocking rates, especially in higher rainfall areas, pugging damage and wastage of conserved feed are limitations of these two systems.

Break feeding of pasture depends on restricting the intake of cows during the autumn and feeding hay, silage or possibly a crop at this time so that a large area of the farm can be closed for winter. The main advantages of this system are that excellent grazing control is possible, pugging damage is confined to a small area in bad weather, and where a back fence is used, regrowth is encouraged. This system is particularly useful therefore, in seasons of winter feed shortage or where high stocking rates (1 to $1\frac{1}{4}$ cows per acre) are used.

One limitation of this system is that cows must be restricted in the autumn, although on high fertility farms paddocks may not need to be closed for spring feed until early June. (See Case Farm 10, Appendix F).

Many farmers mentioned the importance of maintaining flexibility in winter feeding systems so that unsual situations could be handled as they arose. Farmer 10, for example, often makes an arrangement with his neighbour for the use of an area of sandy country in very wet winters. Several farmers maintained a small reserve of hay for use in winters of especially poor grass growth. Farmers 7 and 41 used an area of stony river flat in particularly wet winters. Farmer 5 (see Appendix F) fed his herd under a large hedge to prevent pugging damage.

The adjustments made by farmers to winter feed shortages varied. Some grew late autumn crops, others dried the herd off earlier than usual so that feed could be saved for winter. Grazing off, and the use of nitrogenous fertilizers were alternatives used by some farmers. Farmer 21 made a complete change in winter management to overcome shortages of conserved feed.

Farmer 21 used a split herd system of feeding in the winter of 1961. Dry conditions in the summer of the 1961-62 season resulted in only 900 bales of hay being made for the herd of 165 cows to be carried through the winter of 1962. Alternative winter feeding methods were necessary to compensate for this reduced amount of conserved feed. A five acre paddock was ploughed and sown to turnips in January, 1962. Pasture intake of the herd was restricted from early April until drying off. This restriction allowed 60 acres of the farm to be closed progressively between mid-April and mid-May. A further 90 acres of the farm was shut on May 10th.

The herd was dried off in mid-May, a fortnight earlier than usual, and grazed on the crop until the 20th June. A runoff paddock was not used. Hay was fed in the crop paddock at the rate of 5 cows per bale. On completing the crop the herd was break fed on the 60 acres of pasture closed from mid-April. This area was allocated on the basis of an acre of saved grass for 3 cows for the period from 20th June to calving in early August. Saved pasture was break fed to 145 cows at the rate of $1\frac{1}{2}$ acres per day. No hay was fed from mid-June until calving. Twenty late calvers and 30 calves were wintered on the farmer's runoff.

A back fence was used throughout the period of winter grazing to confine pugging to a small area and, prevent overgrazing of the previously grazed area and to encourage spring regrowth.

These changes enabled the farmer to winter a cow per acre with less than 10 bales of hay per cow. Cows calved in excellent condition and adequate supplies of autumn saved pasture were available for milkers following calving. The farmer considered that in view of the excellent winter growth and utilization of pastures the autumn crop was unecessary.

Various aspects of winter management are considered in the Case Farm Studies of Appendix F.

In particular, Case Farms 3, 5 and 25 illustrate the use of the "split herd" system, and Case Farm 8, the "break feeding of saved pasture" system.

5.6: Exceptional farms

Table D.1 shows that on four "Cows increased" farms (Farms 8, 24, 37 and 42) production increased by more than 25% to over 280 lb. of butterfat per acre over the period with, in two cases, relatively low levels of fertilizer. Development of Farm 8 is discussed in Appendix F.

Some features of the development of the remaining farms will now be considered. Season by season changes in production per acre and stocking rate on these farms are shown in Table 5.11.

Table 5.11 Changes in Stock and Production Over the Period, Farms 24, 37 and 42

Season	Production per acre			Stocking rate		
	24	37	42	24	37	42
1956-57	230	198	204	69	70	62
1957-58	247	237	247	73	66	66
1958-59	247	258	273	76	69	75
1959-60	250	249	251	80	73	77
1960-61	290	283	290	87	75	79
1961-62	266	258	229	87	80	81
1962-63	244			81		

Farmers 37 and 42 did not return the supplementary questionnaire which would have provided information about production and stock for the 1962-63 season. Table 5.11 shows that production per acre increased on these farms with a fall in the case of Farms 37 and 42 in the dry summer of the 1959-60 season. High levels of production were attained in the 1960-61 season, when each farm experienced good growing conditions.

Farmer 24 thought that his production gain in the 1960-61 season was largely attributable to the excellent growth conditions on his farm in that season and to herd quality resulting from several seasons use of pedigree bulls. With a high stocking rate and an 11 day grazing rotation he was

able to obtain good pasture utilization. Following the results of the 1961-62 and 1962-63 seasons the farmer now considers that he will have to commence spring topdressing in addition to his usual autumn application of 3 cwts. per acre of potassic serpentine if production is to increase. Farmer 24 grazes replacement stock on his home farm. Five hundred bales of hay were purchased in the 1960-61 season and 1,000 bales in the 1961-62 season.

Farmer 37 attributed his production increase in the 1960-61 season to excellent pasture production. He also thought that since the 1956-57 season a new milking plant, the intensive use of A.B., a change from a mob stocking to a split herd system of feeding in the winter of 1960, increased use of potash (a change from 20% potassic serpentine to 33% potassic serpentine in 1956-57) and the reliance on all grass feeding since the winter of 1957, had contributed to increased production. The farmer had no intention of increasing his fertilizer rate.(7) All replacement stock are reared on the farm and no hay is purchased.

Farmer 42 thought that good pasture growth had been the main factor contributing to increased production in the 1960-61 season. Five hundred weights per acre of 33% potassic serpentine (and regular dressings of D.D.T. superphosphate) had been applied for at least six seasons. Poor summer pasture production was largely responsible for the decline in production in the 1961-62 season, the farmer thought. Between 2 and 3 tons of nitrogenous fertilizers are used on this farm each spring at the rate of 1 cwt. per acre and replacement heifers are grazed away for an 8 to 12 months period.

5.7: Management for increased production on South Taranaki dairy farms

Survey findings show that there are three broad development situations facing dairyfarmers in South Taranaki. These situations are the development of previously unworked land; the development of cleared farms, partly

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(7) Although in the author's opinion further production increases may necessitate an increase in fertilizer rate.

drained, fenced and watered, and with poor pastures; and the development of farms already in a "well developed" but low producing state.

Management systems for increasing production on these three classes of farms will now be considered. These management systems are based on development methods used on survey farms. The development plan for an individual farm must be considered within the framework of the resources available on the farm. It is hoped, however, that this discussion will provide some basis for extension recommendations within the survey area.

5.7,1: Development of "undeveloped" land

This class of land is largely restricted to the Opunake - Oaonui - Rahotu area at the western extreme of the survey area, and has been cleared from forest for many years. In the typical development situation pastures are poor and infested with gorse and blackberry. Survey Farms 14 and 33 have been developed from land of this class. Development has involved a continuing programme of stumping, levelling, removal of rocks, drainage, ploughing, cropping, regrassing and subdivision. High rates of potassic fertilizer, together with the use of D.D.T. are essential prerequisites for the establishment of improved pastures on this land.

Cropping has been found to be a useful practice in the early development of this land, providing winter feed at a stage of development of the farm when winter pasture production is poor. Between 6 and 10 cwts. per acre of potassic fertilizer will be essential to prevent fertility depletion by the crop. Initial pasture sowings could include between 5 and 10 lb. of H_1 ryegrass to supplement spring and winter production of perennial ryegrass.

Development also includes grass to grass establishment of new pastures. High rates of fertilizer, say 5 to 6 cwt. of 33% potassic super are again essential at sowing, together with close control of grazing to encourage pasture density and soil compaction for at least the first six months.

Development on Farm 14 in recent years has been as follows. The area to be regrassed has been "rough" drained with open drains to take off the worst of the water. Stock were then wintered, and fed hay, on this area to provide some build up of fertility prior to giant discing, and cropping for winter feed. Cropping assisted levelling and also allowed stones to be removed prior to regrassing. The crop area is often left fallow for a year to enable the farmer to find impervious pan areas and to site drains accordingly. Tile drains at an intensity of between 7 and 10 chains per acre are then installed, followed by spring or autumn sowing to pasture. Six cwts. per acre of 33% potassic serpentine are applied at time of sowing.

Some improvement to original pastures has been possible by adopting a policy of heavy stocking and topdressing. This policy has been limited by high soil moisture and shortage of winter feed in the initial stages of development. If these problems can be overcome improvement of original pastures should allow a rapid increase in production in the initial stages of development. Pastures improved in this way might need to be drained, levelled and regrassed at a later stage.

Cropping can be discontinued as winter pasture production improves. Initial subdivision should be limited to between 10 and 15 paddocks and be of a temporary nature. Herd testing is unlikely to be of value during initial increases in herd size. Use of artificial breeding should, however, provide an increase in the herd's genetic merit.

5.7,2: Development of "partly developed" farms

In the typical case these farms have been cleared and levelled, partly drained and fenced with "reasonable" pastures free of gorse and blackberry. This was the state of development of Farm 21 when purchased by its present owner in 1952 and is the present state of Farm 28. Soils are of low fertility and large areas are potash deficient, following repeated day and night paddock grazing and hay conservation. Grass grub infestation

is usual.

Development of this class of farm can be based on the use of increased rates of stock and fertilizer and the control of grass grub. Any rough pastures can be cropped, and regrassed with perennial ryegrass - white clover seed mixtures. Regrassing of pastures (and cropping) however, can be kept to a minimum. Use of a crop during initial increases in herd size provides some insurance against feed shortages.

As stocking rates approach one cow per acre subdivision would probably need to be intensified to 15 to 20 paddocks. Meandering streams and localised wet patches will need to be drained before this stocking rate is approached while a metalled access race is needed to prevent pugging damage when shifting the herd around the farm during wet conditions. In wet winters some form of split herd winter feeding can be used to minimise pugging damage to pastures, while a system of break feeding saved pasture throughout the winter is of value in drier winters or when there is a shortage of conserved feed. Artificial breeding can be used at all times, and herd testing would probably be worthwhile as stocking rate approaches one cow per acre and substantial culling becomes possible.

Maximum utilization of pasture in situ is important and is most easily attained through some form of rotational grazing.

Six survey farms were developed from this state in the 1956-57 season. Additional capital was required on these farms largely for herringbone cowsheds, extra fences and watering points, facilities for the tanker collection of milk and for additional stock. On four of these farms additional stock accounted for 50% or more of the additional capital invested. Season by season analysis of the development of one of these farms (Farm 5) suggests that finance is unlikely to be a limiting factor in the development of this class of farm, even after the payment of additional taxation.

5.7,3: Development of "well developed" farms

These farms are completely fenced, drained and watered. Typically, however, cowsheds and labour are not being used to capacity. Pasture are likely to be cosmopolitan in content as a result of lax grazing. Between 3 and 5 cwts. per acre of fertilizer are likely to have been applied for many

seasons. Five survey farms came into this category, while Farm 43 (briefly discussed in Section 5.5,5.) illustrates the development potential of this class of land.

Development can be based initially on increased rates of stock, especially on farms with a history of regular topdressing. Use of D.D.T. and potash can contribute to increased production as stock numbers are increased. Emphasis needs to be placed on a rapid build up in herd numbers by the purchasing of A.B. calves or heifers. Artificial breeding should again be used, unless a farmer is keeping enough heifer calves to prove a bull. Herd testing can profitably be used once herd numbers stabilise.

Cropping need not be used at any stage except possibly on farms at high altitudes. Winter feeding can again be based on the use of a system which will minimise pugging and provide pasture feeding for as much of the winter as possible. Low rates of hay and silage feeding reduce the area of the farm which has to be closed over the summer period. Rotational grazing should be used during the milking season and feed rationing will become increasingly important as stocking rates are increased. The extent to which stocking rates can be increased without any increase in fertilizer rate depends inpart on the skill of the manager in matching this increase with other resources on the farm.

Major capital requirements in the initial stages of production expansion on these farms will be for additional stock. Capital could subsequently be required for the erection of a herringbone cowshed, and increase in the capacity of the stock water supply, provision of housing for additional labour and for expansion in the piggery.

5.8: The scope for increased dairy production within the survey area

A survey should only be expected to answer those questions it was designed to answer. The aim of this survey was to examine production potential (both technically and economically) from the point of view of the individual farmer. The survey has, however, thrown some light on the overall

scope for dairy expansion in South Taranaki. The following rather tenuous discussion involves a number of arbitrary assumptions, exactly because the survey was not designed to collect the sort of facts needed to answer the question now under discussion.

Survey farmers increased production over the period, on average, by 33% (see Table C.9, Appendix C) while some farmers increased production by up to 65% over the same period. Management for achieving similar production increases has been discussed. The suggested management system is not an involved one - permanent pastures providing the bulk of herd requirements in situ are the basis of its operation, while the use of herringbone cowsheds and other labour saving practices, especially at milking, permit extra cows to be carried without an immediate need for more labour.

Some indication of the number of farmers in the survey area who could be expected to achieve production increases similar to those achieved on the survey farms is provided in Table 5.12.

Table 5.12 Percentage Distribution of Farms on the Basis of Production per Acre

Production per acre	Percentage distribution of farms					Total farms
	100–149	150–199	200–249	250–299	300+	
Source (a)	13.0	25.0	28.0	26.0	8.0	129
Source (b)	10.0	32.0	35.0	17.0	6.0	174

Source : (a) Mail fertilizer questionnaire, see Appendix B. These data relate to farmers who do not own a runoff. Survey farmers are not included in this distribution.

(b) New Zealand Dairy Production and Marketing Board, "Survey of Output per Acre on Testing Members Farms, 1961–62," Farm Production Report, No. 39, 1962–63 Season, Table 4, p. 74.

These data relate to self contained farms in the Taranaki Herd Improvement Association. Herds from North Taranaki are included. Production levels are based on "at the pail" butterfat figures.

Both sources of information used in Table 5.12 may tend to include above average farmers, either because the farmer is willing to reply to a mail questionnaire or because he herd tests. At the same time inclusion of North Taranaki figures may tend to depress South Taranaki figures.

In discussing the scope for increased production it is important, of course, to consider the level of production per acre to which we assume production can increase. Since this survey, the Waimate West Demonstration Farm has produced 500 lb. of butterfat per acre (with all replacements grazed off and with productive area essentially the same as farm area), while the author has herd of one farmer who has produced 400 lb. of butterfat per acre under commercial conditions. The management system used on these farms was the "high fertilizer - high stock" system discussed elsewhere in this thesis. It is probably true, however, that the knowledge of how to produce over 400 lb. of butterfat per acre under commercial conditions is not widely disseminated. The top eight survey farmers, for example, produced 360, 329, 315, 313, 310, 300, 296 and 296 lb. of butterfat per acre respectively in the 1960-61 season. It is reasonable, then, to take a more conservative view of the level of production to which a large number of farmers can increase.

The information in Table 5.12 has been used to give the approximations of Table 5.13, assuming a production "potential" of 300 lb. butterfat per acre.

Table 5.13 Approximate Distribution of Farms By Average Level of Production Per Acre

	Production per acre (lb. butterfat)					
	140	180	225	260	310	Total
Percentage of farms	11	30	32	20	7	
Potential increase	160	120	75	40	0	
Strata "present production"	1,540	5,400	7,200	5,200	2,170	21,510
Strata "potential increase"	1,760	3,600	2,400	800	0	8,560

In Table 5.13 the "Potential increase" row refers to the increased production per acre if all farms produced at least 300 lb. of butterfat per acre. Assuming production per acre to be unrelated to farm size and that all farmers could increase production to 300 lb. butterfat per acre then output would increase by about 40%. Taking a less conservative view and assuming that all farms could produce 325 lb. butterfat per acre then output could increase by 50%. Taking a more conservative view and assuming that farmers cannot be expected to increase production by more than 50% in five years, then production could still increase by 31% in five years, on the basis of previous assumptions.

The author considers that a 50% increase in output from the area in five years is practical, for the following reasons :

(a) The distribution of production per acre shown in Table 5.13 probably represents above average farmers, and consequently tends to overestimate present levels of production.

(b) The Dairy Board distribution is based on production "at the pail" and so overestimates production per acre in comparison with fertilizer survey farms.

(c) Per acre production is probably inversely correlated with farm size. This means that farms with low production per acre probably cover a larger area than suggested by Table 5.13.

(d) Farmers at present producing at 280-300 lb. butterfat per acre can probably produce at least 400 lb. butterfat per acre.

The attainment of the suggested rate of expansion would, of course, require an aggressive estension programme. Requirements of this programme are likely to include one Extension Officer for 200 farmers and a South Taranaki "Regional Extension Director." One of the first moves in such a programme would need to be a survey to define the production potential more closely. This should be a survey using random sampling from farms stratified on the basis of production per acre, and would provide information about :

(i) Farm tenure arrangements
(ii) Labour supplies
(iii) Farm sizes and land types
(iv) Stock and fertilizer requirements for increased production
(v) Capital requirements for increased production
(vi) Agistment requirements for increased production
(vii) Possibilities for amalgamating low output farms
(viii) The scope for the utilization of increased quantities of whey in pig production
(ix) The financial resources of low output farmers

This survey would enable an assessment to be made of the resources available for increased production in the survey area.

CHAPTER 6

PROFITABILITY OF DAIRY FARM DEVELOPMENT IN THE SURVEY AREA

This chapter opens with a discussion of some problems involved in assessing the profitability of development. Specific criteria of profitability and their limitations are then discussed. One estimate of the profitability of increasing production on 22 of the survey farms is then presented. This group of farms will subsequently be referred to as the "Rate of return on capital" group. Finally, a detailed analysis of one development plan is given together with several measures of its profitability. This farm will be referred to as the "Alternative criteria" farm.

6.1: Problems in assessing the profitability of development

Financially, a development programme may be viewed as a stream of expenditures and receipts, which would not otherwise have been incurred. Although development involves this series of expenditures and receipts it is usual to express its profitability in terms of some one figure. This necessitates the use of some form of compounding or discounting procedure(1). In addition, it is necessary to decide which particular figure, or set of figures, summarises the "profitability" of development most adequately.

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(1) Discounting finds the present value of future incomes (or costs). The discount factor d is defined as :

$$d = \frac{1}{1+r}$$

where r is the rate of interest defined as a decimal.

The Present Value formula then becomes :

$$P.V. = C_0 + dC_1 + d^2C_2 \ldots\ldots + d^nC_n$$

Where : P.V. refers to the Present Value of future incomes,
d is the dicsount factor, and
C_1 the net income in year 1.

In addition to these problems of principle, there are problems of fact. Ex poste, it may not be at all easy to tell what stream of extra receipts and expenditures has, in fact, been involved in the development programme. This is because the farmers taxation accounts, usually the only source of financial information available, may not be closely related to the physical and financial aspects of development over the period considered. This disparity between accounts and actuality is likely to be greatest on higher output farms where there is greater incentive for adopting "taxation saving" accounting.

These problems of principle and fact are now considered in greater detail.

6.1,1: Problems of principle

The objective in assessing the profitability of the development programmes followed by survey farmers is to provide information which will assist farmers in South Taranaki with similar farms to decide whether or not to pursue similar development programmes. From the farmers' point of view there are two principles by which alternative measures of profitability might be evaluated. The first is the principle of clarity, the second is the principle of compactness.

(a) Principle of clarity

To be useful a measure of profitability must make it quite clear what is being measured. Some discounting type formulae, if presented without adequate explanation, tend to violate this principle.

(b) Principle of compactness

A second objective is to provide a measure of profitability with a minimum of coefficients. This objective might be described as the principle of compactness.

The principles of clarity and compactness can thus be seen as two facets of the problem of ensuring that the measure of profitability is readily understood.

(c) Principle of computational simplicity

From the investigators point of view another principle can be established. He would prefer the measure of profitability to be computationally simple. The third principle might then be called the principle of computational simplicity - a computationally simple measure being preferable to a complex one.

Two common criteria of the profitability of an investment are the profit from the investment, and the rate of return to some factor of production, usually capital. Rate of return is the ratio of net profit (after all other costs have been met) to the amount of the factor used.

A profit (i.e., the surplus after all factors have been paid a return, including labour and capital) can either be expressed as a capital sum or as an annual payment. As a capital sum it is called the present value of the investment, as an annual payment it may be called the annual profit from the investment. If taxation and the possibility of capital gains are ignored then these two measures are simply related to each other :

$$P.V._d = \frac{apd}{r} \qquad (6.1)$$

where : $P.V._d$ is the Present Value of the development programme,

apd is the annual profit from the development programme, and

r is the appropriate rate of interest expressed as a decimal.

Assuming the appropriate interest rate to be the annual payment required to secure the services of capital for a development programme, then the rate of return to capital is :

$$rC_d = \frac{apd + rC}{C} \qquad (6.2)$$

where : rC_d is the rate of return to capital from development, and

C is the amount of capital used in development.

If the development programme is profitable then the rate of return to capital from the programme will exceed the rate of interest.

Two other guides to the wisdom of undertaking a development programme are the time taken to repay the added capital investment and the maximum level of indebtedness likely to be reached during the programme. Where extra taxation and interest on any deficits arising during the programme are included a more realistic indication of the cash balances during development will be provided. The first of these criteria will subsequently be referred to as the "payback period".(2)

These measures are not directly related to the first two since they depend largely on the pattern of income and expenditure over the period of development. They also depend on the amount of tax exempt capital expenditure made during the development programme. As such they are not direct measures of profitability.

It should be noted however, that the higher the rate of return to capital, the shorter the period needed to repay the investment and the smaller the amount which has to be borrowed is likely to be.

Some further problems of principle will now be considered.

6.1,1.1: Current or historic prices?

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(2) The use of the "payback period" as a criterion of profitability is discussed by H.A. Wadsworth in a paper : "Evaluating Farm Investments by Capital Budgeting," Journal of Farm Economics, 44, 5, December 1962, pp. 1444 - 1449.

The profitability of development depends not only on the physical inputs and outputs used, but also on the prices paid and received. If we wanted to find the profitability of past development programmes (ie., profitability in a historical sense), then actual prices paid and received should be used. The objective in this thesis has been however, to find if proven farm development plans will pay if undertaken now. Consequently, current prices and costs have been used in estimating profitability.

Information about future prices and costs would have been used, of course, had they been available.

6.1,1.2: Actual or standard costs?

The arguments for using actual costs in estimating profitability are overwhelming. Although these may be difficult to obtain, even from farmers' accounts, actual costs have been used wherever possible in this study. An exception is the "Alternative criteria" farm.

Farm accounts, which were available from 22 of the 40 survey farmers were used as a source of cost information. Use of accounts implies, of course, that all changes in costs over the period have been attributed to development, except where discussion with the farmer provided a basis for excluding "unusual" costs.

Limitations of standard farm accounts and adjustments made by the author to overcome these limitations are discussed in Section 6.1,2. We can note in passing, however, that on many farms the annual cost of running the farm in its "developed" state is likely to be overcharged simply because it was impossible to exclude all non-developmental costs from the accounts. Non-developmental costs could have included, for "tax saving" reasons, stockpiling of fertilizer and other farm requisites, and many repairs and maintenance items such as painting, fencing and the like.

An alternative procedure would have been to use standardised costs. While it would have been possible to decide on a standard cost for running an extra cow for example, checking this standard against actual costs would have been impossible. Then would also have been a problem of deciding how to treat "residual" costs where farm accounts were available - should these be ignored or should they be included as an added annual cost?

It is interesting to note that if standard costs had been used then it would not have been necessary to collect accounts from farmers and an estimate of profitability could have been made for all the survey farmers.

There would still have been a problem, however, of relating this standard cost to actual costs.

Standard costs used in this study and their justification are :

(a) Costs used in deriving alternative criteria

As mentioned earlier two useful guides to the wisdom of undertaking a development programme are the payback period and the maximum level of indebtedness likely to be reached during the programme. Since actual season by season costs fluctuated widely on the one farm (Farm 5) for which these criteria were derived, standard costs were used. These were £4 for each additional cow (including the cost of artificial breeding and herd testing, shed, veterinary, feeding and general expenses) and £15 per ton for additional fertilizer (delivered and spread by contract). These standard costs closely approximate the actual changes in total costs over the period, as derived from the farmer's accounts.

It should be noted that these standard costs are used for Farm 5 in calculating rate of return to capital, Section 6.2,1.

(b) Depreciation

Depreciation was claimed on additional plant, buildings and machinery at the following straight line rates :

Tractors and machinery; 20% of cost price,
Plant; 10% of cost price,
Buildings; 5% of cost price.

These rates, used for both the "Rate of return" and "Alternative criteria" estimates, are more realistic rates than the accelerated rates claimed for taxation purposes.

(c) Value of farm labour

Many capital improvements made in the course of development had used the farmer's labour (or that of his hired labour) almost exclusively. The question then arises as to whether this labour should be charged as a capital cost. In most cases this labour could not have been used very profitably elsewhere on the farm, neither could it be sold. That is, this labour had little (or zero) opportunity cost.

The convention used in this study is that the value of farm labour used in improvements has not been charged as a capital cost. This convention is justified on the opportunity cost argument and the very real difficulty of estimating the amount of farm labour used.

The net farm income figure used in deriving a rate of return to capital should be a residual after all other factors of production have been paid the going rate. This implies the imputation of a return to the extra work of the farmer as a result of development; the milking of additional cows, for example. It was apparent however, that on many farms capital had substituted for labour. On these farms investment in herringbone sheds and associated labour saving equipment had meant that more cows could be handled without working longer hours. As mentioned elsewhere, work had also been saved by not growing crops and feeding hay and silage at reduced rates.

It was also apparent that on some survey farms, the existing labour force, or additional labour employed over the period, had allowed the farmer to shift to an almost purely managerial position. Several farmers interviewed did not do any milking.

The convention used is to allow the farmer a constant labour and managerial return over the period, regardless of the amount of additional work done. Any additional labour hired by the farmer has been included as an annual cost even where it was suspected that this resulted in considerably less effort by the farmer. The use of this convention is justified on the basis of the "capital substituting for labour" argument and on the

difficulty of estimating the amount of extra work done by the farmer.

On farms operated as partnerships the convention used is to charge the labour of one of the partners at £1,000.

(d) Extra housing

None of the survey farmers employed additional married labour over the period. Eight farmers, however, employed single labour over the period. While in each case these employees lived with the farmer it would probably be in the interest of farmers considering development to provide separate quarters for this class of labour. The convention used is that a £300 batch has been charged as a capital cost of development on six farms on which single labour was employed over the period, and for which accounts were available.

(e) Stock sales

Difficulties arose in determining additional stock sales, since these varied widely from season to season on most of the survey farms. Reasons for this variation included deaths from disease, retention of culls for building up herd numbers and abnormal sales following T.B. testing. To obtain a more realistic estimate of changes in stock sales, herd size and composition were assumed to be static in the 1956-57 and 1960-61 seasons. Maintenance stock sales were then calculated for each herd. This procedure will have understated the value of stock sales on farms rearing a larger than usual (23%) ratio of replacement heifers.

Standard sale values (as outlined in Section 6.1,3.) were used since accounts often gave no indication of the class of stock sold, or the price received per head.

(f) Capital costs associated with development

Information about capital improvements over the period was obtained from the farmer at the time of the interview and from his accounts. Improvements were valued at cost and included the value of contract labour. The value of farm labour was excluded. The capital value of additional stock was obtained by comparing stock inventories in the 1956-57 and 1960-61 seasons. Additional stock were valued at the rates shown in Table 6.1.

Table 6.1 Average Sale value of Dairy Stock, 1962-63 Season

Class of Stock	Average sale value, 1962-63
Cows	£35
Rising 2 year heifers	£32
Yearlings	£19
Yearling bulls	£25
Aged bulls	£50

Source : "Guide to Current (1962-63) Rural Costs and Prices," Department of Agricultural Economics and Farm Management, Massey University of Manawatu.

For some farms the level of additional capital is overstated since all items of a capital nature added were included as a development cost. It is a little unrealistic, perhaps, to insist that the development plan should pay a return on the full cost of these items, some of which (replacement tractors, water pumps, milking plant) would have had to be purchased even if there was no development plan. The author found it impossible however, with only one visit to the farmer, to find what proportion of capital expenditure of this type was directly attributable to development.

6.1,2: Problems of fact

A superficially obvious source of information about changes in costs, returns and capital investment associated with development are the accounts maintained by farmers for taxation purposes. Limitations in standard farm accounts as a source of this data became apparent to the author when estimation of profitability commenced. Some of these limitations are :

(a) Farm accounts represent whole farm operations.
(b) Items of capital expenditure (tax exempt or taxable) cannot be differentiated from general farm costs.
(c) Capital improvements which are not exempt from taxation and which cannot be depreciated do not appear specifically ih either the profit and loss account or balance sheet. These improvements include new fences and water troughs.
(d) Costs shown in the profit and loss account do not necessarily represent the cost of inputs actually used on the farm in a

given season. This applies particularly to items such as fertilizer, which may be stored and applied in a subsequent season, and to many items which appear under the heading "Repairs and maintenance". These include repairs to buildings and plant, and the painting of buildings. The profit in any one season can, therefore, be greatly influenced by expenditure on inputs from which the benefit may be forthcoming over a period of several years. It is usually impossible to identify these costs.

(e) Stock trading accounts often have shortcomings. These include a mixing of stock classes in the inventory and no indication of the reasons for "unusual" sales and purchases in any season. Prices paid and received for stock are often not recorded. Estimation of the changes in stock sales and purchases attributable to the development plan are difficult.

(f) Depreciation claimed in the profit and loss account often includes accelerated depreciation allowances on new buildings and plant.

(g) There is often a discrepancy between interview and accounts, particularly in respect of stock numbers and fertilizer usage.

Standard costs used to overcome some of these limitations have been discussed. In addition, physical data collected from the farmer at the time of the interview allowed items of capital expenditure to be removed from the profit and loss account. These data also allowed fertilizer expenditure to be adjusted to a seasonal basis and allowed contract expenses of a capital nature to be removed. Where a wide discrepancy was apparent between farmer and accounts in respect of fertilizer usage the convention used was to use the produce firm figure for fertilizer sales and to charge this at £15 per ton.

The balance sheets were examined and a record compiled of depreciable capital items added each season. This information supplemented information about capital expenditure collected from the farmer at the time of the interview.

The author now believes that many of the limitations of standard

farm accounts could be overcome by making two visits to the farmer during a survey. Information about development and general management would be collected at the first visit while farm accounts would be discussed with the farmer at the second visit. In the case of farms operated by sharemilkers for an absentee owner three visits may be necessary, two to the sharemilker and one to the farm owner to check cost sharing arrangements and to obtain his accounts.

Careful preparation would be necessary for this second visit. A "Case Farm Study" would need to be written and the physical activities as related by the farmer at the interview checked with farm accounts (which would be collected at the first visit). Budgets would also be prepared from the standard accounts, and any "unusual" costs noted for subsequent checking. Particular attention would be given to the stock inventory and reasons obtained from the farmer for any large changes in sales and purchases. A record of season by season capital investment over the period would also be prepared and checked both with the farmer and with his accounts.

6.1,3: General prices and costs used in estimating profitability

As mentioned earlier, current prices were used in estimating profitability. These were 37d. per pound for butterfat, whey at 0.25d. per pound of butterfat supplied, 45/- per head for bobby calves and £18 per head for cull cows, net of marketing charges. Pig sales were entered at book values since records did not permit adjustment to 1962-63 prices. These prices were used for both the "Rate of Return" and "Alternative" criteria.

Farm costs were corrected to 1962-63 costs on the basis of the Index of Dairyfarmers' costs published by the New Zealand Dairy Production and Marketing Board. With the 1956-57 season as a base this index indicated that the level of farm costs had risen 9.2% by the 1962-63 season. In using this index the author assumed that farmers' cost ratios were similar in the 1956-57 and 1962-63 seasons. The complete index is shown in Appendix E.

6.2: Criteria of profitability

The previous discussion has suggested that a criterion of profitability should be clear, compact and computationally simple. Since it requires few calculations and because it is an easily understood measure of profitability, rate of return on capital has been calculated for 22 farms for

for which accounts were available. In addition, a series of criteria are presented for one farm, Case Farm 5. Although these criteria are not compact, and are certainly not computationally simple, they do provide useful information about season by season cash balances during development. A less conservative rate of return on capital has also been calculated for this farm.

6.2,1: Rate of return on capital

The basic data used to calculate this measure of profitability are :

(a) Net farm income in the 1956-57 season
(b) Net farm income in the 1960-61 season
(c) Total investment over the period

It has then been assumed that the investment was financed out of borrowing at a 6% rate of interest, that equal investments were made at the beginning of each of the five seasons 1956-57 to 1960-61, that no extra income was derived until the 1960-61 season; but that this extra income would be maintained without further investment.

This is a fairly conservative measure of rate of return since it ignores entirely any extra income obtained during the development programme, or any deficits arising over this period. It is, however, a reasonably clear and simple measure : If the actual investment had been spread evenly over the development period, if there had been no extra income until the final year of the programme, and if this income had then been maintained without further investment, then the quoted "rate of return on capital" gives the ratio of extra annual income to capital invested (both expressed in terms of their value at the commencement of the development period).

Formulae for calculating rate of return on capital are :

Present Value of investment

$$= \frac{C}{5}\left[1 + \frac{1}{1.06} + \frac{1}{(1.06)^2} + \frac{1}{(1.06)^3} + \frac{1}{(1.06)^4}\right] \qquad (6.3)$$

Where C is the total capital invested over the period.

Present Annual Value of extra income

$$= \frac{R_1 - R_7}{(1.06)^5} \qquad (6.4)$$

Where R_1 and R_7 are, respectively, the net farm incomes in the 1960-61 and 1956-57 seasons.

Rate of Return on capital

$$= \frac{\text{Present Annual Value of the extra income}}{\text{Present Value of the investment}} \times \frac{100}{1} \qquad (6.5)$$

It is emphasised again that this is a fairly conservative measure since it ignores the extra income earned during the first four years of the development plan, or the fact that capital investment may not have spread evenly over the period. Deficiencies in farm account data did not permit the use of a less conservative measure.

Net farm incomes for the 1956-57 and 1960-61 seasons were obtained from whole farm budgets prepared from farm accounts. Adjustments made to farm accounts, and standard costs used, have been discussed in previous sections. Capital invested over the period was obtained from farmer's at the time of the interview and from farm accounts.

Income changes, added capital investment and rate of return on capital on 22 survey farms are shown in Table 6.2. Table 6.3 shows how additional capital was allocated on each farm.

Although a conservative measure, the calculated rate of return shows that development has been very profitable on most farms. The negative rates of return on three farms are difficult to explain. In the case of Farms 6 and 2 a large investment in plant over the period, with an associated increase in running costs, may have contributed to the fall in income. Development of Farm 2 has included drainage and bulldozing and it is possible that "unidentified" capital costs were included in the whole farm budgets. It is interesting to note that on both Farms 22 and 23, production increased by a relatively small amount over the period.

6.2,2: Alternative criteria

The farm for which these measures are derived is Case Farm 5 on

Table 6.2 Change in Income, Additional Capital Invested and Rate of Return on Capital on 22 Survey Farms

	Group A				Group B																	
Farm	6	24	29	40	2	3	5	7	9	10	14	19	21	22	23	25	26	35	36	38	39	41
Area (acres)	77	150	80		116	160	100	99	106	113	219	200	150	130	163	148	100	120	118	180	13	76
% Production increase	7	26	70	41	20	50	46	38	39	59	40	29	27	7	8	52	15	43	48	12	66	51
Net income: (£)																						
1956-57	2213	3610	1175	1275	2471	3247	1938	886	1221	2331	2214	3206	3641	2659	3031	4199	2165	2470	1091	2905	1199	1601
1960-61	2143	4651	1757	1869	2325	4651	3176	2447	1509	3117	3757	4136	4484	3068	3245	5456	2726	3268	1939	2414	2889	2172
Increase		1041	582	594		1404	1238	1561	288	1086	1543	930	843	409	214	1257	561	798	848		1690	571
Decrease	70				146															491		
P.V. of income*	-52	778	435	443	-109	1049	925	1167	215	812	1153	695	630	305	159	939	419	596	634	-367	1263	427
Capital investment (£)	2581	3000	1212	2582	4548	3610	2720	2655	1821	2939	6203	5686	4685	4701	4512	4992	3174	3400	2553	4716	2326	1250
P.V. of investment*	2303	2679	1080	2303	4058	3223	2429	2370	1625	2625	5536	5076	4183	4197	4027	4456	2835	3036	2277	4210	2076	1116
Rate of return on capital (%)	-2	29	40	19	-2.5	32.5	38	49	13	31	21	13.5	15	7	4	21	15	19.5	28	-9	61	38

* P.V. means Present Value

Table 6.3 Percentage Allocation of Additional Capital On 22 Survey Farms

Item of Expenditure	Group A										Group B											
	6	24	29	40	2	3	5	7	9	10	14	19	21	22	23	25	26	35	36	38	39	41
Improvements*	10	20	29	35	13	7	21			3	27	17	20	14	13	7	7	19	16	7	43	
Buildings**	11	22		12	14	53		55	7	27	24	14	11	51	40		24	37	12	56		24
Plant***	49	19		16	53	18	5		44	6	13	26	8	5	16	14	38	6	16	11	17	40
Tractors							15	9	22		11	10	11	4	13	29	21	9			15	
Stock	30	39	71	37	20	22	59	36	27	64	25	33	50	26	18	50	10	29	56	26	25	36
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total Added Capital (£)	2581	3000	1212	2582	4548	3610	2720	2655	1821	2939	6203	5686	4685	4701	4512	4992	3174	3400	2553	4716	2326	1250

* Improvements include troughs, fences, races, pumps, bridges, bulldozing, drainage; at cost with the value of farm labour excluded.

** Buildings include new cowsheds, alterations to cowsheds, milk rooms for tanker vats, hay sheds, batches for single labour; at cost with the value of farm labour excluded.

*** Plant additions include implements and shed plant at cost.

which production increased by 46% over the period. Development and management of this farm is considered in detail in Appendix F. Stock, fertilizer and butterfat production changes, together with associated capital costs are shown in Table 6.4. Additional stock are assumed to be purchased at the beginning of each season.

The basic data used in calculating these measures are :

(a) Change in net farm income for each season from 1956-57 to 1960-61 inclusive.
(b) Capital investment in each of these seasons.
(c) Taxation payments in each of these seasons.

It has then been assumed that the 1956-57 season is a base season and that capital is invested at the beginning of each of the subsequent four seasons (i.e., the decision to develop is made at the end of the 1956-57 season), that income increases at the end of the 1957-58 and subsequent seasons and reaches a peak at the end of the 1960-61 season, that this increase is maintained without any further capital investment and that the discount rate is 6%. Prices and costs used have been discussed in previous sections. The farmer's personal taxation exemption is assumed to be £1,000.

Each measure will now be considered in detail.

6.2,2.1: Maximum level of indebtedness over the period

Although the development plan results in an increase in income, as shown in Table 6.2, there is no indication of the amount of capital likely to be required to finance the plan in addition to that earned by the plan itself. Neither is there any indication of when this capital will be required.

The capital requirements and maximum level of indebtedness of a development plan can be assessed from a season by season marginal analysis incorporating capital costs, and interest and taxation payments.(3) This

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(3) Hodgson, J.N., Farm Development, op.cit, p. 11. Marginal analysis here is concerned with costs and returns which are a direct result of development.

analysis is illustrated for Case Farm 5 in Table 6.5. Taxation payments have been derived from the taxation budgets of Table 6.6. Marginal changes in costs and returns are based on the physical data presented in Table 6.4. Depreciation on added capital items has not been included in the estimation of cash balances since the sum "claimed" would normally be invested in the development plan.

Season by season marginal cash balances are accumulated in the final row of Table 6.5. The accumulated cash balances show that the development plan has been self financing with the exception of a £34 deficit in the third season. Interest has not been charged on this deficit. Where large deficits arise during a development plan and this deficit is financed by a bank overdraft or other source of external credit interest must be charged and added to the seasonal deficit. A monthly, or more frequent, summary of receipts and expenses must be prepared to find the exact amount of the interest charge in each season. Where increased tax payments arise provisional taxation payments must be included in the seasonal summary of income and expenditure. Overdraft interest payments are exempt from taxation and must accordingly be included in the estimation of taxation.

6.2,2.2: The payback period

The payback period - the time required for a stream of cash proceeds to equal the capital investment required for the programme - is a similar assessment of the development plan to the marginal analysis of Table 6.5. Table 6.7, derived from Table 6.5, shows that the capital outlay has been recovered after 4 years. Inclusion of depreciation and interest payments extends the payback period by one year.

6.2,2.3: Rate of return on capital

As emphasised earlier, the rate of return to capital calculated for the 22 survey farms is a somewhat conservative measure in that income gains over the period of the development programme are ignored while equal capital outlays are assumed to have been made each season. A less conservative measure based on season by season marginal changes in net income will now be considered.

With this measure consideration is given not only to the incomes

Table 6.4 Physical Data and Capital Investment for the Development of Case Farm 5

	Season				
	1956-57*	1957-58	1958-59	1959-60	1960-61**
Total milking cows	66	67	79	89	101
Cumulative increase in milking cows		1	13	23	35
Total tonnage of fertilizer used	18	18	7	33	31
Cumulative change in fertilizer usage			-11	15	13
Nitrogenous fertilizer***					1
Total butterfat production (pounds)	22,676	25,860	26,931	29,102	32,884
Cumulative increase in butterfat production		3,200	4,255	6,426	10,208
Total cull cows for sale	10	10	12	14	16
Cumulative increase in cull cow sales			2	4	6
Total bobby calves for sale	46	46	52	59	68
Cumulative increase in calf sales			6	13	22
Total number of yearlings	15	15	18	20	23
Cumulative additional yearlings			3	5	8
Total number of 2nd. yr. heifers	11	11	14	16	18
Cumulative additional heifers			3	5	7
Capital invested each season					
Heifers			60	40	40
Cows	40		480	400	480
Drainage	55		70		
Shed conversion				500	
Bulldozing					35
Troughs			20		
Plant				130	
Tractor					370
Total capital invested each season	95		630	1070	925
Cumulative capital investment	95		725	1795	2720

* Base season before development

** Final season of development

*** Valued at £30 per ton

Table 6.5 Marginal Analysis of Development, Case Farm 5

	Season			
	1957-58*	1958-59	1959-60	1960-61**
Marginal expenditure: (£)				
Herd expenses	4	52	92	140
Fertilizer		-165	225	210
Tanker collection			12	42
Capital expenditure	95	630	1070	925
Total expenditure	99	517	1399	1317
Marginal income: (£)				
Butterfat and whey	497	660	997	1584
Cull cows		36	72	108
Bobby calves		14	29	50
Total income	497	710	1098	1742
Marginal cash position: (£)				
Cash balance	+398	+193	-301	+425
Additional taxation	101	155	68	332
Cash balance net of tax	+297	+ 38	-369	+ 93
Cumulative net cash balance	+297	+335	- 34	+ 59

* First season of development

** Last season of development

Table 6.6 Seasonal Estimation of Taxation*

	Season				
	1956-57**	1957-58	1958-59	1959-60	1960-61
Exemptions: (£)					
General running costs***	1600	4	-113	329	392
Interest on mortgage	470				
Depreciation claimed	265			38	112
Stock written down to standard values		10	135	110	130
Capital expenditure		55	70	300	35
Total exemptions	2335	69	92	777	669
Income: (£)					
Butterfat cull cows and bobby calves	3803	497	710	1098	1742
Additional taxable income	1468	428	618	321	1073
Total taxable income	1468	1896	2086	1789	2541
Income tax: (£)					
Taxable farm income	1468	1896	2086	1789	2541
Less personal exemptions of	1000	1000	1000	1000	1000
Tax payable on	468	896	1086	789	1541
Tax payable	67	151	190	126	333
Social Security tax: (£)					
Taxable farm income	1468	1896	2086	1789	2541
Less personal exemptions of	104	104	104	104	104
Tax payable on	1564	1792	1982	1685	2437
Social Security tax payable	117	134	149	126	183
Summary: (£)					
Total tax	184	285	339	252	516
Increase over base year		101	155	68	332

* Tax estimates are based on 1962-63 tax rates. Stock have been written down to a standard value of one quarter of their purchase price.

** Base season before development. The exemptions shown for this season are assumed to remain unchanged over the period of development. Exemptions shown for the remaining seasons are marginal exemptions resulting from development.

*** The fall in general running costs in the 1958-59 season is due to the fact that the farmer applied 7 tons less fertilizer in this season than in previous seasons.

Table 6.7 Payback Period of the Development Plan, Case Farm 5

	Season			
	1957-58*	1958-59	1959-60	1960-61**
Marginal expenditure: (£)				
General costs (excluding deprtn.)	4	-113	329	392
Taxation	101	155	68	332
Total expenditure	105	42	397	724
Marginal income: (£)				
Total marginal income	497	710	1098	1742
Marginal cash position: (£)				
Cash balance	392	668	701	1018
Cumulative cash balance: (£)	392	1060	1761	2779
Cumulative capital expenditure: (£)	95	725	1795	2720

* First season of development

** Last season of development

forthcoming during development but also to future incomes. An implicit assumption is that the level of income in the last year of development is maintained indefinitely without additional capital investment. The procedure used is that this "long term" income has been discounted and capitalized at a 6% interest rate, and then summed with the discounted incomes of each season of the development programme. This figure, the Present Value of the programme, is then expressed as an annual profit. The calculated rate of return is the ratio of this annual profit to added capital (both expressed in present value terms).

The formulae used in calculating this rate of return are :

Present Value of investment

$$= C_1 + dC_2 + d^2C_3 + d^3C_4 \qquad (6.6)$$

Where : d is the discount factor, and

$C_1 \ldots C_4$ are, respectively, the capital sums invested at the start of the first and last seasons of the development programme.

Present Annual Value of extra income

$$= 0.06 \left[dI_1 + d^2I_2 + d^3I_3 + d^4I_4 + \frac{d^4I_4}{0.06} \right] \qquad (6.7)$$

Where : d is the discount factor, and

$I_1 \ldots I_4$ are, respectively, the net incomes in the first and last seasons of the development programme.

Discount factors (6% interest rate) are :

$$\begin{aligned} d_2 &= 0.9434 \\ d^2 &= 0.8899 \\ d^3 &= 0.8396 \\ d^4 &= 0.7921 \end{aligned}$$

Rate of Return on capital

$$= \frac{\text{Present Annual Value of extra income}}{\text{Present Value of the investment}} \times \frac{100}{1} \qquad (6.8)$$

This measure is calculated for Case Farm 5 in Table 6.8. Comparing this measure of rate of return (47%) with that calculated earlier (38%) re-emphasises the fact that the rate of return calculated for the 22 survey

Table 6.8 Rate of Return on Capital, Case Farm 5

	Season			
	1957-58*	1958-59	1959-60	1960-61**
Marginal expenditure: (£)				
Herd expenses	4	52	92	140
Fertilizer		-165	225	210
Tanker collection			12	42
Depreciation			38	112
Total expenditure	4	-113	367	504
Marginal income: (£)				
Butterfat and whey	497	660	997	1584
Cull cows		36	72	108
Bobby calves		14	29	50
Total income	497	710	1098	1742
Balance: (£)	493	823	731	1238
Capital investment: (£)	95	630	1070	925

Present Value of investment

$$= 95 + d(630) + d^2(1070) + d^3(925)$$

$$= 95 + 594 + 952 + 777$$

$$= £2,418$$

Present Annual Value of extra income

$$= 0.06 \left[d(493) + d^2(823) + d^3(731) + d^4(1238) + \frac{d^4(1238)}{0.06} \right]$$

$$= 0.06 \left[465 + 732 + 614 + 981 + 16,350 \right]$$

$$= £1,148$$

Rate of return on capital

$$= \frac{1,148}{2,418} \times \frac{100}{1}$$

$$= 47\%$$

* First season of development

** Last season of development

farms is a fairly conservative measure.

In summary, development of Case Farm 5 has been extremely profitable, with an increase in taxable income of £1,238 over the period. The development programme has been self financing, with the exception of a £34 deficit at the end of the 1959-60 season (after the payment of additional taxation). The full capital outlay had been recovered by the end of the period. In addition to a 47% rate of return on added capital, it appeared from the interview that the farmer was working little harder than he did before development commenced. Conversion of the old shed to a herringbone had helped with the milking of extra cows while the adoption of an all grass management system had saved the work involved with cropping.

CHAPTER 7

SUMMARY AND CONCLUSIONS

Results of a dairy farm survey conducted in the South Taranaki area of New Zealand have been presented in this thesis. This survey was made to test the hypothesis that a management system based on the use of increased rates of stock and fertilizer can lead to increased butterfat production on South Taranaki dairy farms. This management system was one actually being adopted by an increasing number of farmers in the area, and some extension personnel were recommending its adoption.

The specific objectives of the survey were to find if increases in stocking rate and fertilizer rate had been accompanied by increased production; to document the associated management changes necessary when stocking rates and fertilizer rates were changed; and to assess the profitability of making these changes.

The farm survey technique - involving a series of interviews with farmers - enabled information to be collected to satisfy these objectives. Forty farmers were visited in the survey. Twenty-four of these were selected on the criterion of either an increase in fertilizer rate, an increase in stocking rate or an increase in production between the 1956-57 and 1960-61 seasons. Eight farmers were recommended by Mr. S.A. McKenzie, Dairy Production and Marketing Board Consulting Officer, Hawera. The remaining eight farmers were selected at random.

Butterfat production increased on each survey farm between the 1956-57 and 1960-61 seasons, with a maximum increase of 70%. Survey farmers increased production, on average, by 33%, while butterfat production from the survey area increased by 7.6% over the same period.

Fourteen survey farmers kept their fertilizer rates constant but increased stocking rates and made other management changes over the period.

Production on these farms ranged from 135 lb. to 296 lb. butterfat per acre in the 1960-61 season. At least five of these fourteen farmers increased fertilizer rates subsequent to the 1960-61 season.

Twenty-five survey farmers increased stocking rates and fertilizer rates and made other management changes over the period. Production on these farms ranged from 150 lb. to 360 lb. butterfat per acre in the 1960-61 season. Five of these twenty-five farmers produced over 300 lb. of butterfat per acre in this season. These five farms were characterised by fertilizer rates of at least 6 cwts. per acre of potassic serpentine.

One survey farmer increased neither stocking rate nor fertilizer rate over the period. Production increased on this farm to 313 lb. butterfat per acre in the 1960-61 season. Three hundredweights per acre of potassic serpentine had been applied to this farm each season over a long period.

"Other" management changes made over the period included an increased use of potash, changes in labour organisation, reduced supplementary feeding rates, cropping and regrassing of older pastures, use of D.D.T. for grass grub control, adoption of all grass feeding and changes in winter grazing management.

Changes in winter grazing management had been particularly important on many farms as stocking rates were increased. The main objectives of these changes were to prevent pugging damage to pastures, to reduce the wastage of conserved feed and to improve pasture utilization. On many farms a change was made from winter cropping to all grass winter feeding. The usual reason given for this change was that winter growth of pastures had improved (farmers' thought) as a result of increased stock and fertilizer rates, control of grass grub and reduced winter pugging damage.

Additional capital was invested over the period in stock, herringbone cowsheds, land clearing, drainage, water supplies, farm buildings, new shed plant, bloat sprayers and facilities for the bulk collection of milk. Capital was not required on any farms for housing.

It was apparent from the survey that on many farms added capital had substituted for labour. On these farms investment in herringbone sheds and associated labour saving equipment had meant that more cows could be handled without working longer hours. Work had also been saved by feeding hay and silage at reduced rates, and not growing crops. On eight of the survey farms, only, had additional labour been employed over the period. On several farms the farm owner had assumed an almost purely managerial position as stock numbers had increased.

Several measures of profitability were used in this study. One measure of rate of return on added capital was calculated for 22 of the 40 survey farms. Rate of return on added capital ranged from 4% to 61% on these farms. A rate of return of above 20% was obtained on 11 farms. Season by season marginal analysis of the development of one of the survey farms shows that after paying additional social security and income taxes, the development plan was self financing with the exception of a £34 deficit at the end of the fourth season of the plan. Taxable farm income increased by £1,238 following the completion of the development plan. A less conservative measure of rate of return calculated for this farm showed a rate of return on added capital of 47%.

Survey findings show that a management system based on the use of increased rates of stock and fertilizer can lead to increased production and profits on dairy farms in South Taranaki. This management system is not an involved one. Permanent pastures are used while herringbone cowsheds and other labour saving practices permit extra cows to be carried without an immediate need for more labour.

On many farms adoption of this management system would only require additional capital for stock, alterations to cowsheds and possibly for increased stock water supplies.

Readers should remember, however, that one farm producing over 300 lb. of butterfat per acre in the 1960-61 season achieved this with only 3.5 cwt. per acre of potassic serpentine and a stocking rate of about 85 cows per 100 acres, although the farmer indicated at the time of the interview that he intended increasing his fertilizer rate the following spring.

The author is confident that with the widespread adoption of a management system based on increased rates of stock and fertilizer butterfat production from the survey area could be increased by 50% in a five year period. At present cheese prices the increased output of butterfat would have an annual value of approximately £5M. f.o.b., excluding the value of increased pig production. Thus the South Taranaki area could make a vital contribution to the extra exports needed if per capita real income in New Zealand is to rise by 2 per cent per annum. This production increase will not be obtained, however, without an intensive extension programme.

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APPENDIX A

SURVEY AREA DAIRY COMPANIES, DAIRY COMPANY SUPPLIERS AND SUPPLIERS USED IN RANDOM SAMPLING

In Table A.1 which follows, the number of suppliers in the 1956-57 and 1960-61 seasons refers to suppliers with herds of all sizes. In the 1960-61 season there were 160 suppliers with herds of less than 10 cows, leaving 1,766 suppliers with herds of 10 cows and above.

Suppliers used in random sampling refers to the number of suppliers with herds of 10 cows and above in the 1957-58 season.

Table A.1 Survey Area Dairy Companies, Dairy Company Suppliers and Suppliers Used in Random Sampling

Company	Number of suppliers (a) 1956-57	1960-61	Suppliers used in random sampling (b)
Alton	37	37	37
Awatuna *	98	100	57
Cardiff *	36	40	36
Eltham *	213	215	141
Hawera *	301	224	150
Hurleyville	16	12	**
Ihia Road *	19	22	**
Joll *	249	264	251
Kakaramea	48	44	47
Kaponga *	97	94	93
Kaupokonui *	232	213	233
Lowgarth *	30	34	30
Mangatoki *	130	130	141
Manutahi *	23	23	23
Melrose	13	14	**
Mokoia	44	50	**
Ngaere *	68	71	69
Normanby *	67	63	63
Oaonui *	82	83	82
Ohangai	21	21	21
Opunake *	49	43	32
Pihama *	69	70	69
Riverdale	60	59	61
Total	2,002	1,926	1,636

* Companies who provided records for use in farm selection.
** Suppliers to these Companies were excluded from the population from which the random sample was drawn.

Sources: (a) New Zealand Department of Agriculture, Dairy Division, Palmerston North, pers. comm.

(b) Government Register of New Zealand Creameries, 1958.

APPENDIX B

THE MAIL FERTILIZER SURVEY

No general information was available about fertilizer usage on survey area dairy farms. The author considered that this information would provide some indication of the potential for increased fertilizer usage. A questionnaire was accordingly mailed to survey area dairy farmers to obtain this information. In addition the questionnaire enabled farm size data to be collected. This data has subsequently been used in calculating production per acre and stocking rate for farmers who returned the questionnaire. Production per acre figures have been used in estimating possible production increases from the survey area.

B.1: Form of the questionnaire

The questionnaire included a letter from the author explaining its purpose, a pro-forma for details of fertilizer usage for each season between, and including, the 1956-57 and 1960-61 seasons, and a pro-forma for the farmers name and address, farm size and runoff area, and dairy company supplied.(1) No attempt was made to collect butterfat production or cow number records. This information was available for the 1956-57 and 1960-61 seasons, from dairy company records collected for farm selection purposes. It was thought that a direct request for these records might prejudice many farmers against returning the questionnaire.

The questionnaire was printed in a form which allowed it to be return mailed without an envelope. A "reply paid postage" authority was obtained and each questionnaire was printed with the author's address.

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(1) A copy of the questionnaire is lodged with the Department of Agricultural Economics and Farm Management, Massey University of Manawatu.

B.2: Distribution of the questionnaire

One thousand six hundred and seventy copies of the questionnaire were distributed to the suppliers of 18 of the 20 dairy companies operating in the survey area in the 1962-63 season.(2) Questionnaires were not distributed to the suppliers of the Awatuna and Mokoia Companies.(3) The remaining companies distributed the questionnaire free of charge with butterfat statements of August and September, 1962.

B.3: Questionnaire yield

Two hundred and nine questionnaires were returned, representing a 12.5% yield. No attempt was made to increase this yield by mailing a reminder letter. Farmers who returned questionnaires are assumed to be a random sample of survey area dairy farmers although it is possible that, having returned the questionnaire, they are an above average sample.

Not all the questionnaires returned were useful. Some farmers did not provide farm area, others did not give their name and dairy company, while others did not provide complete information about fertilizer usage. Production per acre and stocking rate could not be estimated for those farmers supplying companies who did not provide records for use in farm selection. Other farmers could not be identified on supplier lists. Fertilizer rate was calculated for 206 farmers in the 1960-61 season, production per acre for 152 farmers and stocking rate for 150 farmers.

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(2) Three dairy companies amalgamated between the 1960-61 and 1962-63 seasons.

(3) Neither of these companies acknowledged the author's letter requesting assistance with distribution.

B.4: The questionnaire findings (4)

B.4,1: Fertilizer rate

The distribution of fertilizer rates used on 128 farms in the 1960-61 season is shown in Table B.1. Average fertilizer rate used on 206 farms in this season was 4.0 cwts. per acre and on 175 farms in the 1956-57 season 3.1 cwts. per acre. Potassic serpentine, either 20% or 33%, was the predominant fertilizer used.

B.4,2: Butterfat production per acre

The distribution of butterfat production per acre on 128 farms in the 1960-61 season is shown in Table B.1. Twenty four farmers who owned runoffs are excluded, although the remaining farmers may have grazed replacement stock away from their home farms. Average production on 128 farms in the 1960-61 season was 217lb of butterfat per acre, and on 126 farms in the 1956-57 season 197lb of butterfat per acre.

B.4,3: Stocking rate

The distribution of stocking rate on 128 farms in the 1960-61 season is shown in Table B.2. Twenty two farmers who owned runoffs are excluded. Average stocking rate on 128 farms in the 1960-61 season was 70 milking cows per 100 acres.

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(4) Fertilizer rates, production per acre and stocking rates for the farmers visited in the interview survey are excluded.

Table B.1 Distribution of Fertilizer Rates and Production Per Acre, 1960-61 Season

Fertilizer Rate (cwts. per acre)	Production per acre (lb. butterfat)							Total	Percentage of Total
	50-99	100-149	150-199	200-249	250-299	300-349	350-399		
1.6 - 2.0		2	1	1				4	3.2
2.1 - 2.5		1	4	2		1		8	6.2
2.6 - 3.0	1	4	7	7	6	2		27	21.0
3.1 - 3.5	1	4	4	6	4			19	14.8
3.6 - 4.0		1	5	10	12	2		30	23.4
4.1 - 4.5		2	4	1	2	1		10	7.8
4.6 - 5.0	1		3	3	4			11	8.6
5.1 - 5.5			2	2	3	2		9	7.0
5.6 - 6.0			1	1		1		3	2.4
6.1 - 6.5				1	1			2	1.6
6.6 - 7.0			1	1	1		1	4	3.2
7.1 - 7.5				1				1	.8
Total	3	14	32	36	33	9	1	128	
Percentage of Total	2.4	11	25	28	25.8	7.0	0.8		100

Table B. 2 Distribution of Stocking Rates and Production Per Acre, 1960-61 Season

Stocking Rate (cows per 100 acres)	Production per acre (lb. butterfat) 50-99	100-149	150-199	200-249	250-299	300-349	350-399	Total	Percentage of Total
31 - 35	2	1						3	2.4
36 - 40		1						1	0.8
41 - 45	1	4	1					6	4.7
46 - 50		1	4					5	3.8
51 - 55		4	6					10	7.8
56 - 60		2	7	2				11	8.6
61 - 65		1	6	4				11	8.6
66 - 70			2	11	1			14	11.0
71 - 75			4	10	6			20	15.6
76 - 80			1	5	10	1		17	13.3
81 - 85				3	5			8	6.2
86 - 90			1	1	7	4		13	10.0
91 - 95					2	1		3	2.4
96 - 100					2	1		3	2.4
101 - 105						2		2	1.6
106 - 110									
111 - 115							1	1	0.8
Total	3	14	32	36	33	9	1	128	
Percentage of Total	2.4	11.0	25.0	28.0	25.8	7.0	0.8		100.0

APPENDIX C

MAJOR DESCRIPTIVE CHARACTERISTICS OF THE SURVEY FARMS

The location of the forty survey farms is indicated in Figure 4.1.

Table C.1 shows the size distribution of the survey farms.

Table C.1 Distribution of Farm Size

Size range (acres)	Number of farms	Percentage of farms
50- 74	1	2.5
75- 99	6	15.0
100-124	12	30.0
125-149	5	12.5
150-174	6	15.0
175-199	2	5.0
200-224	6	15.0
225-249	1	2.5
250-274	1	2.5
Total	40	100

Twenty-one of the survey farmers grazed replacement heifers away from their "home" farms each season for periods ranging from 7 months to 18 months.

The size range of herds on the survey farms is shown for two seasons in Table C.2.

Table C.2 Distribution of Herd Size, Survey Farms

Herd size (cows at 15 January)	Season 1956-57 Number of farms	1956-57 Percentage of farms	1960-61 Number of farms	1960-61 Percentage of farms
20- 39	2	5.0		
40- 59	4	10.2	3	7. 5
60- 79	12	31.0	5	12. 5
80- 99	10	25.6	8	20. 0
100-119	7	18.0	13	32. 5
129-139	4	10.2	5	12. 5
140-159			4	10. 0
160-179			2	5. 0
Total	39*	100	40	100

* One farm was not operating as a self contained unit in the 1956-57 season.

A distribution of butterfat production per farm is shown in Table C.3.

Table C.3 Distribution of Butterfat Production Per Farm, Survey Farms

Butterfat supplied to the factory per farm (lb)	Season 1956-57 Number of farms	1956-57 Percentage of farms	1960-61 Number of farms	1960-61 Percentage of farms
10,000 - 14,999	4	10.3		
15,000 - 19,999	8	20.5	3	7.5
20,000 - 24,999	10	25.5	4	10.0
25,000 - 29,999	6	15.4	10	25.0
30,000 - 34,999	4	10.3	9	22.5
35,000 - 39,999	4	10.3	2	5.0
40,000 - 44,999	3	7.7	3	7.5
45,000 - 50,000			7	17.5
50,000 - 54,999			2	5.0
Total	39*	100	40	100

* One farm was not operating as a self contained unit in the 1956-57 season.

Table C.4 shows the distribution of stocking rate on the survey farms, for two seasons. Stocking rate is defined as milking cows at the 15th January per hundred acres of home farm area. No allowance is made for stock grazed off the farm, supplementary feed purchased or any ungrazable area on the home farm.

Table C.4 Distribution of Stocking Rates, Survey Farms

Stocking rate (milking cows per 100 acres)	Season 1956-57 Number of farms	1956-57 Percentage of farms	1960-61 Number of farms	1960-61 Percentage of farms
30- 39	2	5.0		
40- 49	8	20.5	1	2.5
50- 59	5	13.0	5	12.5
60- 69	13	33.5	6	15.0
70- 79	10	25.5	10	25.0
80- 89	1	2.5	11	27.5
90- 99			3	7.5
100-109			3	7.5
110-119			1	2.5
Total	39*	100	40	100

* One farm was not operating as a self contained unit in the 1956-57 season.

Distribution of production per acre on the survey farms is shown in Table C.5. Production per acre is defined as butterfat supplied to the factory divided by total farm area. No allowance has been made for gullies, plantations or other unusable areas, for the off farm grazing of replacement stock or for the purchase of supplementary feed. Neither has any allowance been made for the number of dry stock reared.

Table C.5 Distribution of Production Per Acre, Survey Farms

Production per acre (lb. butterfat)	Season 1956-57 Number of farms	1956-57 Percentage of farms	1960-61 Number of farms	1960-61 Percentage of farms
50- 99	1	2.5		
100-149	7	18.0	1	2.5
150-199	13	33.5	6	15.0
200-249	16	41.0	10	25.0
250-299	2	5.0	17	42.5
300-349			5	12.5
350-399			1	2.5
Total	39*	100	40	100

* One farm was not operating as a self contained unit in the 1956-57 season.

Tables C.6 and C.7 show the percentage changes which took place in herd size and total production on the survey farms between the 1956-57 and 1960-61 seasons. Since farm areas remained constant (although some farmers may have adopted a policy of grazing out heifers since the 1956-57 season) these changes may also be considered as changes in stocking rate and production per acre.

Table C.6 Distribution of Percentage Changes in Herd Size on the Survey Farms, Between the 1956-57 and 1960-61 Seasons

Percentage increase in herd size (milking cows at 15 January)	Number of farms	Percentage of farms
0 - 9.9	6	15.4
10 - 19.9	9	23.2
20 - 29.9	11	28.2
30 - 39.9	7	18.0
40 - 49.9	3	7.8
50 - 59.9	1	2.5
60 - 69.9	1	2.5
70 - 79.9	1	2.5
Total	39*	100.0

* One farm was not operating as a self contained unit in the 1956-57 season.

The percentage changes shown in Tables C.6 and C.7 have not been corrected in any way. One farmer, for example, who increased his herd size by 75%, was short of labour in the 1956-57 season. For this season alone his herd size dropped to half its usual number. Neither has an allowance been made for any increase in numbers of dry stock reared as an alternative to an increase in milking cow numbers.

Table C.7 Distribution of Percentage Changes in Butterfat Production Per Survey Farm Between the 1956-57 and 1960-61 Seasons

Percentage change in production per farm (lb. butterfat supplied to the factory)	Number of farms	Percentage of farms
0 - 9.9	3	7.7
10 - 19.9	7	18.0
20 - 29.9	7	18.0
30 - 39.9	3	7.7
40 - 49.9	8	20.5
50 - 59.9	9	23.1
60 - 69.9	1	2.5
70 - 79.9	1	2.5
Total	39*	100.0

* One farm was not operating as a self contained unit in the 1956-57 season.

The percentage changes in herd size and levels of production per farm shown in these tables should not be considered as typical for the area. Eight of the survey farmers were selected because they had made large increases in herd size while another eight were selected because they had made large production increases.

Table C.8 shows how the number of cows milked by 39 of the survey farmers increased between the 1956-57 and 1960-61 seasons. This increase is compared with the increase in cows milked within the survey area as a whole, over the same period.

Table C.8 Changes in Cows Milked on Survey Farms and on all Farms within the Survey Area

	Milking cows at 15 January		
	1957	1961	Percentage change
Survey farms	3,238	4,027	24.5
All farms (a)	130,754	137,577	5.2

Source: (a) Dairy Company Annual Returns to the New Zealand Dairy Production and Marketing Board, for herds of 10 cows and above; Dairy Industry Information Service, pers. comm.

Table C.8 shows that the survey farms accounted for just over ten percent of the increase in stock carried in South Taranaki over this period even though the survey included only about two percent of the farms in the area.

Table C.9 shows how butterfat supplied by 39 of the survey farmers increased between the 1956-57 and 1960-61 seasons. This increase is compared with the increase in butterfat supplied by all farmers within the survey area over the same period. The two percent of farmers in the survey contributed six percent of the increase in production in the survey area over this period.

Table C.9 Changes in Butterfat Production on Survey Farms and on All Farms within the Survey Area

	Butterfat supplied to survey area dairy companies (lb.)		
	1956-57	1960-61	Percentage change
Survey Farms	987,341	1,313,445	33.0
All Farms (a)	37,710,473	42,729,699	7.6

Source: (a) Dairy Company Annual Returns to the New Zealand Dairy Production and Marketing Board for herds of 10 cows and above; Dairy Industry Information Service, pers. comm.

Changes in herd sizes and levels of total production have been accompanied by changes in average production per acre on the survey farms. Production per acre increased from 187 pounds in the 1956-57 season to 251 pounds of butterfat per acre in the 1960-61 season.

Randomly selected farms are in some respects "atypical" when compared with farms within the survey area as a whole. Cow numbers on the random farms increased by 23.5% between the 1956-57 and 1960-61 season although cow numbers within the survey area increased by only 5.2% over the same period. Butterfat production increases were also large. Randomly selected farmers increased production by 32% between the 1956-57 and 1960-61 seasons while farmers within the survey area increased production, average, by only 7.6%. Some of this "larger than expected" increase in stock and production may be attributable to the fact that average production per acre on the random farms was 174 pounds of butterfat in the 1956-57 season when average production per acre on 126 farms replying to the mail fertilizer survey questionnaire[1] was 197 pounds of butterfat.

(1) The mail fertilizer survey is discussed in Appendix B.

Average per acre production on the randomly selected farms had increased to 230 pounds of butterfat in the 1960-61 season.

Fertilizer rates changed markedly on many of the survey farms between the 1956-57 and 1960-61 seasons. A distribution of fertilizer rates used in each of these seasons is shown in Table C.10.

Table C.10 Distribution of Fertilizer Rates used on Survey Farms

Fertilizer rate (cwts. per acre)	Season 1956-57 Number of farms	1956-57 Percentage of farms	1960-61 Number of farms	1960-61 Percentage of farms
1 - 1.9	1	2.5		
2 - 2.9	4	10.0	2	5.0
3 - 3.9	27	67.5	11	27.5
4 - 4.9	7	17.5	7	17.5
5 - 5.9	1	2.5	7	17.5
6 - 6.9			6	15.0
7 - 7.9			3	7.5
8 - 8.9			3	7.5
9 - 9.9				
10 - 10.9			1	2.5
Total	39	100.0	40	100.0

Potassic serpentine, either 20% or 33% was the predominant fertilizer used on the survey farms. Several farmers had used small amounts of basic slag, crop manure and mineral mixes from time to time.

D.D.T. use increased on the survey farms between the 1956-57 and 1960-61 seasons as farmers became aware of the benefits of grass grub control. Eleven farmers used D.D.T. in the 1956-57 season, while 34 used D.D.T. in the 1960-61 season. All farmers who had used D.D.T. considered that grass grub control had been an important factor contributing to increased production.

All of the farms visited in the survey were freehold properties. Eight farms were operated by sharemilkers, who in seven cases, operated the farm for an absentee owner. Four sharemilkers operated under 50% share agreements. Sharemilkers were, in general, allocated fixed quantities of fertilizer which they could apply each year. Most agreements included clauses limiting the number of young stock which could be reared.

Two or more houses were present on 18 of the survey farms for the use of either a partner in the enterprise (3 farms) a sharemilker or permanent employee. Permanent labour, employed either by the farm owner or a sharemilker, was used on 29 of the survey farms in the 1960-61 season.

APPENDIX D

SEASON BY SEASON CHANGES IN PRODUCTION PER ACRE, STOCKING RATE, FERTILIZER RATE AND PRODUCTION PER COW BETWEEN THE 1956-57 AND 1962-63 SEASONS

D.1: Sources of data presented in Table D.1

Data for the 1956-57 to 1960-61 seasons inclusive from farmer interviews.

Data for the 1961-62 and 1962-63 seasons from a supplementary questionnaire mailed to the survey farmers in March, 1963. Production figures were estimated by each farmer for the 1962-63 season. Farmers 6, 16, 18, 30, 31, 37 and 42 did not return the questionnaire.

D.2: Definition of terms used in Table D.1

Production per acre (expressed as lb. of butterfat per acre) is defined as butterfat supplied to the factory divided by total farm area.

Stocking rate (expressed as cows per 100 acres) is defined as milking cows at 15th January per hundred acres of home farm area. No allowance is made in the calculation of production per acre and stocking rate for unproductive areas on the home farm, for stock grazed away from the farm or for supplementary feed purchased. Neither is any allowance made for the number of dry stock reared.

Fertilizer rate (expressed as hundredweights per acre) is defined as tonnage of fertilizer, less nitrogenous fertilizers and mineral mixes, divided by the area to which the farmer said this was applied.

Production per cow (expressed as pounds of butterfat per cow) is defined as pounds of butterfat supplied to the factory in a season divided by number of cows.

Criterion of selection, discussed in Section 4.2, Chapter 4, are defined as follows:

Criterion (i) A large percentage increase in stock numbers between the 1956-57 and 1960-61 seasons.

Criterion (ii) A large percentage increase in fertilizer usage between the 1956-57 and 1960-61 seasons.

Criterion (iii) A large percentage increase in butterfat production between the 1956-57 and 1960-61 seasons.

Criterion (iv) Recommendation by Mr. S.A. McKenzie, Dairy Production and Marketing Board Consulting Officer, Hawera.

Criterion (v) At random.

Final classification refers to the groups in which the survey farms are discussed in Chapter 5. These groups are defined as follows:

Group (A) "Cows increased".
Group (B) "Cows and fertilizer increased".
Group (C) "No change".

N.A. means that a particular record was unavailable.

Table D.1 Season By Season Changes in Production Per Acre, Stocking Rate, Fertilizer Rate and Production Per Cow Between the 1956-57 and 1962-63 Seasons

Farm	Area (acres)	Criterion of selection	Final classif-ication	Production Per Acre							%	Stocking Rate							%	Fertilizer Rate							%	Production Per Cow							%	Farm
				1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	increase	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	increase	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	increase	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	change	
4	200	(v)	A	138	170	171	169	162	155	190	17	40	37	45	53	56	60	67	40	3.3	3.8	3.8	3.8	3.8	3.0	2.7	13	345	310	315	300	290	258	283	16	4
6	77	(v)	A	211	218	209	193	225	N.A.	N.A.	7	67	65	65	69	71	N.A.	N.A.	6	3.7	3.3	2.7	1.5	3.9	N.A.	N.A..	4	313	336	322	280	316	N.A.	N.A.	0	6
8	98	(v)	A	211	245	235	233	296	271	270	40	69	77	75	73	83	86	84	21	4.5	4.5	4.5	4.5	4.5	4.7	4.7	0	304	315	310	315	353	313	331	27	8
13	200	(v)	A	121	101	146	151	187	190	193	55	47	34	48	60	66	63	63	34	2.8	2.8	2.8	2.8	2.8	2.3	3.0	0	255	300	300	250	294	298	303	15	13
24	156	(i)	A	230	247	247	250	290	266	244	26	69	73	76	80	87	87	81	26	3.0	3.0	3.0	3.0	3.0	3.6	3.6	0	332	338	326	312	332	305	299	0	24
28	200	(iii)	A	85	94	93	81	135	135	143	59	43	48	44	49	51	51	52	17	3.0	3.0	3.0	3.0	3.0	2.0	2.0	0	200	196	211	165	266	265	274	33	28
29	87	(v)	A	136	240	256	225	232	225	259	70	39	62	66	67	69	76	79	76	3.9	2.7	3.5	3.2	3.2	6.0	5.7	0	349	279	336	294	337	296	326	-3	29
31	150	(v)	A	213	231	231	212	271	220	N.A.	27	70	77	73	72	79	73	N.A.	12	3.0	3.0	3.0	3.0	3.0	N.A.	N.A.	0	304	302	318	295	343	300	N.A.	13	31
33	200	(i)	A	115	140	155	151	180	161	180	57	43	46	49	49	58	55	60	35	3.0	3.0	5.5	5.5	3.0	4.7	5.7	0	267	305	313	305	310	293	300	16	33
37	140	(iii)	A	198	237	258	249	283	258	N.A.	43	70	66	69	73	75	80	N.A.	7	3.0	3.0	3.0	3.0	3.0	3.0	N.A.	0	282	356	376	338	378	322	N.A.	34	37
40	81	(i)	A	154	190	192	179	217	232	247	41	56	64	62	62	72	80	86	29	3.5	3.5	3.5	3.5	3.5	3.5	4.2	0	278	297	310	290	303	289	286	7	40
42	160	(iii)	A	204	247	273	251	290	229	N.A.	42	62	66	75	77	79	81	N.A.	26	5.0	5.0	5.0	5.0	5.0	5.0	N.A.	0	326	373	364	327	368	284	N.A.	13	42
43	148	(i)	A	164	175	190	185	204	201	203	24	47	55	63	64	65	67	64	38	4.3	4.3	4.3	4.3	4.3	4.5	4.0	0	347	320	303	280	310	297	316	-10	43
44	118	(v)	A	178	195	208	227	242	266	268	36	59	61	63	67	70	73	76	19	3.8	3.8	3.8	3.8	3.8	5.0	5.7	0	300	319	328	339	344	365	350	15	44
1	175	(iv)	B	N.A.	204	215	222	256	240	246	N.A.	N.A.	61	63	66	70	76	73	N.A.	N.A.	5	7.5	7.0	7.0	7.0	7.0	N.A.	N.A.	335	341	37	364	314	337	N.A.	1
2	116	(iv)	B	213	237	254	270	254	273	271	20	49	52	60	64	64	95	92	30	4.6	6.0	7.3	7.5	7.7	7.0	7.0	75	432	420	421	420	400	386	362	-8	2
3	160	(iv)	B	200	233	248	257	300	245	316	50	75	76	77	82	84	95	92	13	3.3	3.0	4.5	6.0	6.0	4.5	5.5	100	266	306	320	312	366	256	343	34	3
5	100	(iv)	B	227	259	269	291	329	281	305	46	66	67	79	89	101	103	103	53	4.0	4.0	1.5	7.0	6.7	6.8	8.3	67	344	385	340	325	326	274	296	-5	5
7	99	(iv)	B	195	216	240	245	268	310	325	38	62	67	72	76	82	107	111	34	2.5	4.3	4.3	4.3	4.3	4.3	5.3	74	316	340	335	325	324	290	292	3	7
9	106	(iv)	B	108	113	148	153	150	138	132	39	37	39	43	46	42	45	45	15	1.0	1.3	2.0	2.5	2.5	4.0	3.5	145	293	290	339	332	353	305	291	20	9
10	113	(ii)	B	175	184	181	205	278	288	318	59	63	60	66	71	93	111	117	48	3.0	3.0	3.8	6.7	8.5	7.7	7.7	184	278	306	273	289	299	261	273	6	10
12	113	(ii)	B	239	N.A.	N.A.	N.A.	270	271	283	13	76	N.A.	N.A.	N.A.	92	93	88	21	3.0	3.0	4.0	5.5	6.0	5.6	5.6	100	314	N.A.	N.A.	N.A.	294	292	320	-6	12
14	219	(iv)	B	157	165	173	194	219	236	247	40	49	47	50	57	66	76	79	33	4.8	7.0	7.5	7.6	8.8	8.0	9.4	105	318	360	345	342	335	309	312	5	14
15	100	(i)	B	137	209	265	230	210	200	220	54	64	71	82	90	104	94	94	62	2.0	3.0	4.0	5.0	10.0	8.5	9.0	400	213	290	323	255	200	214	234	-6	15
16	234	(ii)	B	187	180	184	189	209	206	N.A.	12	55	50	48	56	60	66	N.A.	8	3.5	4.0	1.5	5.0	5.2	N.A.	N.A.	50	339	360	384	340	349	311	N.A.	3	16
18	262	(ii)	B	153	168	177	184	190	196	N.A.	24	50	54	56	59	58	61	63	17	2.8	3.5	2.8	4.0	5.3	N.A.	N.A.	89	308	320	320	315	328	320	N.A.	6	18
19	200	(iii)	B	206	241	260	232	266	255	272	29	68	74	75	76	80	81	87	18	4.3	4.2	4.4	6.7	6.5	6.0	7.3	50	303	320	345	295	333	313	311	10	19
21	150	(i)	B	245	286	285	280	310	266	345	27	78	81	85	93	100	104	112	28	3.5	5.0	5.5	5.5	6.0	6.0	6.0	74	312	352	352	300	309	256	309	0	21
22	130	(ii)	B	228	233	221	190	239	258	285	7	65	69	75	80	80	91	88	22	3.6	2.8	3.0	5.0	6.6	5.8	6.7	90	341	336	290	240	298	284	321	-13	22
23	163	(ii)	B	234	233	226	217	253	248	279	8	70	71	71	73	72	80	85	3	3.0	3.3	3.5	4.0	4.5	4.5	6.0	52	331	330	325	300	349	310	327	5	23
25	148	(iii)	B	240	288	311	287	360	270	350	52	78	82	89	97	115	115	108	49	3.0	3.0	3.5	7.0	7.7	8.0	8.0	157	310	353	349	295	318	235	325	3	25
26	100	(ii)	B	255	282	273	255	293	270	300	15	72	86	84	84	88	92	93	22	3.0	4.2	5.5	6.6	6.3	6.0	6.0	110	354	328	325	303	333	294	322	-6	26
32	100	(ii)	B	214	224	234	232	246	250	240	15	65	67	69	72	75	80	80	15	3.0	3.0	3.5	5.0	5.5	5.7	5.3	85	329	334	341	321	327	312	300	0	32
34	100	(iii)	B	208	240	250	260	296	283	290	42	68	70	73	74	83	87	83	22	4.0	4.0	4.5	4.0	4.8	4.5	4.9	21	306	342	347	354	356	324	349	16	34
35	130	(iii)	B	186	215	235	220	267	266	281	43	65	69	73	73	81	84	85	25	3.2	3.2	4.7	4.7	5.0	6.3	4.0	58	287	316	323	302	329	314	328	15	35
36	118	(i)	B	189	216	225	245	280	276	280	48	56	59	63	71	74	77	98	33	3.3	3.5	5.5	5.0	5.3	5.3	6.4	62	338	365	359	344	375	358	284	11	36
38	180	(i)	B	140	150	156	165	158	171	178	12	45	53	53	55	56	57	60	22	3.5	3.5	3.5	3.9	4.3	3.8	4.5	22	308	284	297	303	285	298	296	-7	38
39	113	(ii)	B	168	227	253	229	279	210	279	66	75	80	81	81	82	84	85	9	3.0	3.0	3.0	4.0	6.0	6.0	7.0	100	223	284	310	281	339	250	328	52	39
41	76	(iii)	B	208	245	260	287	315	288	290	51	78	79	76	87	91	92	92	17	4.0	4.0	5.5	5.5	7.5	7.7	8.6	92	269	310	341	331	346	305	310	29	41
30	70	(v)	C	275	273	285	264	313	240	N.A.	14	86	84	84	86	86	86	N.A.	0	3.5	3.5	3.5	3.5	3.5	3.5	N.A.	0	320	325	338	307	365	277	N.A.	14	30

APPENDIX E

INDEX OF PRICES PAID BY DAIRY FARMERS, 1956-57 to 1962-63

Season	Indices
1956-57	1,000
1957-58	1,028
1958-59	1,047
1959-60	1,054
1960-61	1,059
1961-62	1,080
1962-63	1,092

Source: New Zealand Dairy Production and Marketing Board, Dairy Industry Information Service, pers. comm.

APPENDIX F

CASE FARM STUDIES

The following case farm studies report the experiences of six of the survey farmers. Aspects of development and present management are discussed, and an assessment is made of the profitability of increasing production on four of these farms.

Interviews with the owners of these farms were made between February and June, 1962. Stock and production data collected at the time of the interview were supplemented by a questionnaire mailed to the survey farmers in April, 1963. This questionnaire provided stock and production data for the 1961-62 and 1962-63 seasons. Development and management information could not be supplemented except for a few farms the author revisited after completion of the field work.

Case Farm 3 illustrates how a 50% increase in production can be obtained in five years on a farm at present producing at an "average" level. Case Farm 5 is a farm on which rapid increases in stocking rate, fertilizer rate and production were made over a four year period. Permanent pastures and a small number of paddocks are features of Farm 5.

Increased production was obtained on Case Farm 8 over the survey period without an increase in fertilizer rate. Reorganisation of feed was important on this farm as cow numbers were increased.

Production increases were obtained on Case Farm 15 but production per acre has declined since the 1959-60 season. Reasons for this decline, in the author's opinion, include poor grazing management and faulty shed management.

High production per acre, high stocking and fertilizer rates and permanent pastures are features of Case Farm 25. Farmer 10 has increased production very rapidly - a 55% increase in four seasons. Use of a 12 acre runoff has contributed to increased production. A feature of Case Farm 10 is the high level of production per acre attained in what farmers consider a dry area.

The criterion of profitability used in this Appendix is discussed in Chapter 6.

CASE FARM NUMBER THREE

F.1,1: General information about the farm

Case farm 3 (selected in the McKenzie sample) is a farm characterised by increased rates of stock and fertilizer. This 160 acre farm of which 150 acres are productive, is situated in the Kaponga area, with a 57 inch rainfall and an altitude of 750 feet above sea level. The soil of this farm is a free draining yellow brown volcanic loam highly resistant to winter pugging. Natural drainage is assisted on this farm by the absence of the ironstone pan which underlies some of the volcanic soils in South Taranaki.

The farm is fenced into 18 grazing paddocks 15 of which are served by an unmetalled access race. Troughs provide water in all paddocks. Drainage is adequate.

The farm, operated by two brothers, (subsequently referred to as "the farmer") was purchased in the 1948-49 season. The farm has been worked by the farmer with the exception of some neighbour exchange assistance with hay making. Contract assistance is limited to hedge cutting.

Pastures on the farm are perennial ryegrass - white clover dominant with cocksfoot and H1 ryegrass as subdominant species. Table F.1 shows the age of pastures at March, 1962.

Table F.1 Age of Pastures on Farm 3 at March, 1962

Age of Pasture (years)	Area (acres)
Less than 5	29
5 - 10	60
Older than 10	70
Waste	10

When purchased by the farmer in May, 1948, the farm had few fences and a race system comprising several large paddocks. Stock water supply was limited to two troughs. Access to part of the farm was hindered by an unbridged stream. Pastures were poor and run out. Initial development included pasture renewal, additional fencing to give eighteen paddocks, extensions to the stock water supply and the bridging of the small stream.

Development work since the 1956-57 season has included pasture renewal, use of D.D.T. for grass grub control, erection of an implement shed, concreting a portion of the access race and the construction of a herringbone cowshed with a round yard.

The farmer has been a member of a discussion group since the 1958-59 season.

F.1,2: Development and management since the 1956-57 season

Table F.2 shows the production level in the 1949-50 season and the changes which have taken place in stock and production since the 1956-57 season.

Table F.2 Stock and Production Figures for Farm 3

Season	Milking cows	Butterfat production	Stocking rate	Production per acre	Production per cow
1949-50	115	29,600	72	185	257
1956-57	120	31,900	75	200	266
1957-58	122	37,300	76	233	306
1958-59	124	39,700	77	248	320
1959-60	132	41,200	82	257	312
1960-61	135	48,100	84	300	366
1961-62	153	39,200	95	245	256
1962-63	147	50,500	92	316	343
1963-64	160		100		

Management changes which have been made on the farm since the 1956-57 season, and which the farmer believes have contributed to increased production, include:

(i) Stocking rate

An increase in stocking rate. Table F.2 shows that stocking rate has increased from 75 milking cows per 100 acres to 84 cows per 100 acres in the 1960-61 season.

Table F.3 Total Stock on Farm 3 at the Close of Each Season

Class of stock	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
Cows	118	120	122	129	132
Heifers	20	21	27	11	30
Yearlings	20	24	22	25	25
Bulls	4	4	3	3	2
Total Stock	162	169	174	168	189

Stock numbers were decreased slightly in the 1962-63 season to enable hay reserves to build following the drought of the 1961-62 season. The farmer considered that these reserves would be essential in view of the stock increases planned for the 1963-64 season.

(ii) Fertilizer rate

Between three and four cwts. per acre of potassic super had been applied each season prior to the 1956-57 season.

Table F.4 shows fertilizer applied to the farm since the 1956-57 season.

Table F.4 Fertilizer Applied to Farm Three(1)

Type of fertilizer	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
20% potassic serpentine			20		
33% potassic serpentine	20	15		28	28
D.D.T. potassic serpentine		7	10	12	12
Total (tons)	20	22	30	40	40
Cwts. per acre (140 acres)	3	3	4.5	6	6

(1) Fertilizer rate is calculated on the basis of the area to which the farmer said the fertilizer was applied.

Fertilizer is applied as an Autumn-Spring split dressing.

(iii) Use of DDT

DDT was first applied for grass grub control in 1958. The farmer considered that grass grub damage had previously been an important factor limiting increases in production. DDT is applied to a third of the farm each season.

(iv) Stock feeding

When the farmer purchased the farm in the 1948-49 season he decided that pasture improvement by ploughing old pastures, cropping and regrassing would be essential if higher production were to be obtained. Between 1951 and 1959 about 90 acres of the farm were ploughed and regrassed. Eight to ten acres of chou moellier were grown in each of these years for winter feeding. This crop was fed to the dry cows, and early calvers, in conjunction with a sacrifice paddock. New pastures were sown with an H_1 ryegrass - perennial ryegrass - white clover seed mixture.

The farmer found, however, that these new grass pastures were taking several years to establish. Some paddocks were of such low initial fertility that following one seasons cropping, the new pasture was poorer than the old. H_1 ryegrass did not persist beyond three seasons leaving pastures open and prone to clover dominance.(2)

A change in policy was accordingly made in the winter of 1959. Fertilizer rate was increased by $1\frac{1}{2}$ cwts. per acre over the whole farm, DDT use was intensified and no crop was grown. Following drying off in early June the herd was split into four mobs and spread around the farm at the rate of about four cows per acre. Heifers and weaners were similarly spread. This spread of stock left about 100 acres of the farm to be shut from between mid-May to early June for break feeding in spring following calving. Calving commenced in early August.

The farmer has been satisfied with this change to an "all grass" feeding system, and at the time of the authors visit, had no intention of regrassing the remaining fifty acres of old pasture on the farm.(3)

About 3,000 bales of hay are made on the farm each year and this quantity has hardly changed with increased stock numbers. The farmer attributes this to:

(a) Improved winter growth in recent years, and,

(b) Less pugging wastage (both of hay and pasture) with a split herd system of wintering.

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(2) Argentine stem weevil was probably the cause of much of the lack of persistency in H_1 ryegrass.

(3) An "all grass" feeding system is one which does not include a feed crop. Hay and silage are the only supplements used.

Six to seven acres of silage were also made each season prior to the 1962-63 season and fed to milkers following calving. All replacement stock are grazed on the farm and no hay is purchased. The farmer aims at keeping close control of feed at all times, control being achieved partly by a high stocking rate and partly by the use of the electric fence in spring. Summer grazing management involves a 24 hour paddock rotation which is lengthened as feed supplies increase. Hay paddocks are withdrawn from the rotation as surpluses accumulate ahead of the herd.

The farmer considered that an improvement in the level of feeding of the herd resulting from increased usage of potassic fertilizer, control of grass grub and dependence on permanent perennial ryegrass - white clover pastures, had been an important factor contributing to increased production.

(v) Herd improvement

Herd improvement since the 1956-57 season has been based on the use of artificial breeding. An artificially bred bull calf is kept each season for mating heifers, and for use as a 2 year old on cows not holding, or too late, for A.B. The farmer has not used herd testing at any stage. The 1961-62 season was the first season in which a significant number of artificially bred heifers entered the herd. Thirty A.B. heifers entered the herd in that season.

(vi) Stock diseases

Stock diseases have not increased since the 1956-57 season. The incidence of bloat increased sharply in the 1960-61 season, but pasture spraying proved a satisfactory control measure.

(vii) Labour saving practices

Increased cow numbers have made greater demands on the time of the farm owners. Several labour saving practices have accordingly been adopted. These include once per day calf feeding, use of a calfeteria for the feeding of calves and the tanker collection of milk. A herringbone cowshed, complete with round yard and motor driven loading gate was erected in the winter of 1961. Improvements have also been made to the layout of the farm access race.

F.1,3: The profitability of development

Comparing the 1960-61 season with the 1956-57 season shows that the following major changes have been made:

Cow numbers increased by	15
Fertilizer usage increased by	20 tons
Butterfat production increased by	16,200 pounds
Capital investment increased by	£2,377

Table F.5 shows how taxable income increased over the period.

Table F.5 Change in Income with Increased Production

Increased expenditure (£)		Increased income (£)	
General costs	649	Butterfat and whey	2496
Fertilizer	300	Bobby calves and cull cows	64
Depreciation	160		
Balance	1,404	Other income (sacks, hay, discounts, etc.) (-)	47
	2,513		2,513

Table F.6 lists the capital invested in the farm over the period.

Table F.6 Increase in Capital Investment

Item	Cost (£)
Races and tracks	250
Implement shed	400
Machinery and plant	650
Herringbone cowshed	1,500
Stock	810
Total	3,610

Present value of extra income = £1,049

Present value of extra capital = £3,223

Rate of return to capital = $\frac{1,049}{3,223} \times \frac{100}{1}$

= 32.5%

F.1,4: Summary of development

A 13% increase in stocking rate, a 100% increase in fertilizer rate and a 50% increase in production over the period are features of this farm. Management changes associated with increased stocking and fertilizer rates have included the use of DDT for grass grub control, changes in the feeding of the herd, use of artificial breeding and the adoption of several labour saving practices. A herringbone cowshed has assisted the farmer to handle an increased number of cows without extra labour.

The farmer now relies on pasture alone for the feeding of his herd. Close control of feed at all times was the aim of the farmer.

The development programme followed on this farm has been extremely profitable. Using a somewhat conservative estimate of profitability, the rate of return to additional capital invested over the period was 32.5%. Taxable farm income increased by £1,404 over the period.

CASE FARM NUMBER FIVE

F.2,1: General information about the farm

Case Farm 5 (selected in the McKenzie sample) is a farm characterised by increased rates of stock and fertilizer. The 100 acre farm, of which 90 acres are productive, is situated in the Kaponga area. This is a 65 inch rainfall area lying at an altitude of 850 feet above sea level, with yellow brown loam gley soils. These soils are characterised by an impermeable "gley" layer lying 4-6 inches below the surface, which restricts natural drainage. Intensive drainage is necessary if these soils are to support high stocking rates without pasture deterioration.

The farm is fenced into 10 grazing paddocks half of which are served by an unmetalled central race. Troughs provide stock water in all paddocks. Five acres of the farm requires further drainage.

The present owner (subsequently referred to as "the farmer") purchased the farm at the beginning of the 1959-60 season. For several years previously he had sharemilked (50%)

on the farm for an absentee owner. Since the 1956-57 season the farmer has operated the farm with the assistance of a youth. Casual labour is employed for hay making.

All pastures on the farm are perennial ryegrass-white clover dominant. Table F.7 shows the age of pasture and the area of the ten paddocks on the farm.

Table F.7 Age of Pastures on Farm 5 at March, 1962

Paddock number	Area (acres)	Year sown	Comments
1	4	1940	
2	10	1928	
3	15	1952	A swamp prior to draining and regrassing
4	10	1953	
5 (a)	5	1961 (Oct)	
(b)	5	1920	
6	6	1921	
7	7	1955	
8	7	1954	
9	9	1959	
10	10	1920	

Developmental work carried out on the farm since the 1956-57 season has included the laying of 35 chains of tiled drains, conversion of the old milking shed to a herringbone type, provision of facilities for tanker collection of milk, regrassing of pastures and the use of DDT for grass grub control. The farmer considers that the main "developmental" work has involved a complete change in his own ideas about the amount of feed required by a dairy cow.

The farmer has been a member of a Discussion Group since the 1958-59 season.

F.2,2: Development and management since the 1956-57 season

Table F.8 shows the changes which have taken place in stock and production since the 1956-57 season.

Table F.8 Stock and Production Figures for Farm 5

Season	Milking cows	Butterfat production	Stocking rate	Production per acre	Production per cow
1956-57	66	22,676	66	227	344
1957-58	67	25,860	67	259	385
1958-59	79	26,931	79	269	340
1959-60	89	29,102	89	291	325
1960-61	101	32,884	101	329	326
1961-62	103	28,179	103	281	274
1962-63	103	30,500	103	305	296

Management changes made over the period which the farmer believes have contributed to increased production include:

(i) Stocking Rate

An increase in stocking rate. Table F.8 shows that stocking rate has increased from 66 milking cows per 100 acres in the 1956-57 season to 101 cows per 100 acres in the 1960-61 season. Table F.9 shows the stock on the farm at the close of each season since the 1956-57 season.

Table F.9 Total Stock on Farm 5 at the Close of Each Season

Class of stock	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
Cows and in calf heifers	68	83	91	105	110
Empty cows					12
Yearlings	15	20	21	19	20
Bulls	3	1	2	2	1
Total stock	86	104	114	126	143

Prior to the 1960-61 season replacement heifers were grazed off the farm for twelve months each season.(4) Heifers left the farm as yearlings in June, and returned to join the herd at the end of the following June. 143 animals were wintered on the farm in 1961 as the farmer was unable to obtain outside grazing for heifers. Twelve empty cows were also wintered on the farm in 1961.(5)

(ii) Fertilizer rate

Three cwts. of phosphatic fertilizer had been applied each season prior to the 1956-57 season. Table F.10 shows fertilizer applied to the farm since the 1956-57 season.

Table F.10 Fertilizer Applied to Farm 5

Type of Fertilizer	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
20% potassic serpentine	9				
33% potassic serpentine	9	13	7	21	21
Potash		2			
33% DDT potassic serpentine		3		12	10
Total (tons)	18	18	7	33	31
Cwts. per acre (92 acres)	4.0	4.0	1.5	7.0	6.7
Nitrogenous					1

Fertilizer dressings are split between February to March and between July to September.

(4) Off farm grazing cost £12 per head in the 1959-60 season, including £1 per head cartage.

(5) An empty cow is one which fails to conceive. These 12 empty cows were retained to help build herd numbers for the following season.

(iii) Use of DDT

Application of DDT for the control of grass grub commenced in the 1957-58 season.

(iv) Winter grazing management

Changes in stocking rate and fertilizer rate have been accompanied by changes in the winter feeding of the herd.

Prior to, and including, the winter of 1959, winter feeding of the herd was based, in most seasons, on 5-7 acres of crop. Following drying off in early June the cows were set stocked on a 10 acre sacrifice paddock adjacent to the crop paddock. Hay was fed on this sacrifice paddock each day, and the herd spent each night on the crop paddock. The balance of the farm was closed progressively from mid-May to enable pasture to be saved for spring feeding to milkers. The crop was break fed to last the cows and heifers from early June until calving commenced in the first week of August. The crop paddock was regrassed in September.

No crop was grown for the winter of 1960. As an alternative, the farmer rationed the herd from mid-April, 1960. This enabled pasture to be saved at the rate of about five acres per week, until the beginning of June. This saved pasture substituted for the winter feed normally provided by the crop. Thirty acres of the farm was shut by June and the saved pasture on this area was break fed to the herd until calving commenced in August. The daily ration of saved pasture was supplemented by about 2,000 bales of hay.

The farmer stopped growing a winter crop because of:-

(a) The poor performance of new grass pastures on his farm, and

(b) Improved performance of heavier topdressed old pastures.

A further change in the winter feeding of the herd was made in 1961, when 110 cows, twelve empty cows and twenty yearlings were wintered on the farm. A split herd system of winter feeding was used. Following drying off in mid-June the herd was split into mobs of eight to ten cows each and set stocked at the rate of two to three cows per acre. Yearlings were set stocked in a ten acre paddock. This spread of stock allowed thirty-five acres of the farm to be shut from early June for spring feed. Hay was fed at the rate of one bale per ten cows per day.

The system worked well until mid-July. Pugging damage to pastures was negligible, cows were improving in condition and wastage of hay was less than usual. Persistent heavy rain fell throughout the winter. Towards the end of July the area on which the herd was being wintered suddenly became waterlogged and within two days was completely pugged. The resulting feed shortage forced the farmer to sell the 12 empty cows. This pugging, in the opinion of the farmer, markedly reduced the spring growth of these pastures. Additional amounts of hay were fed to the herd between mid-July and

calving and one ton of nitrogen applied in July to the winter caved pastures provided additional spring grass.

The farmer had hoped that by using a split herd wintering system pasture pugging and hay usage would have been reduced. He considered that the lower production in the 1961-62 season could be attributed, in part, to the poor spring growth of pastures on the 40 acres of the farm heavily pugged during the winter of 1961.

A further change in feeding was made in 1962 when autumn saved pasture was fed throughout the winter. Hay was fed beneath a large macrocarpa hedge. The farmer considered that feeding beneath the hedge reduced hay wastage and loss of feed from pugging. Yearlings were grazed away from the farm throughout the winter.

The amount of hay conserved has remained almost constant (with small seasonal variations) since the 1956-57 season. Twenty to twenty-five acres of the farm are cut for hay each year and yield about 2,400 bales. The farmer attributes the reduced amount of hay fed per cow to improved autumn and spring growth of pastures and the adoption of measures to reduce winter pugging of pastures. 400 bales of hay were purchased in the autumn of 1961 as insurance for the increased numbers of stock wintered in 1961.

The farmer considers that the prevention of pugging, which can result from an increased stocking rate, has been an important problem on his farm. Changes in the winter feeding of the stock have, in part, aimed at reducing pugging damage to pastures.

(v) Summer grazing management

Calving commences in the third week of August and continues until early November. Earlier calving would necessitate break feeding of pastures at a time when the soil on this farm is likely to be waterlogged. Winter saved pasture is break fed to milkers following calving, until spring growth is sufficient to support a twenty-four hour, ten paddock rotation. This fast rotation has not lead to any increase in the clover content of pastures.(6)

Paddocks to be saved for hay and silage are dropped from the rotation as feed supplies accumulate ahead of the herd. Between twenty and twenty-five acres of pasture are saved for hay, and a maximum of ten acres for silage. Silage is fed to the milking herd following calving.

The farmer now considers that a larger number of paddocks are required on his farm. Further subdivision to provide five-acre paddocks is planned. Increased paddock numbers will facilitate feed rationing. Feed rationing, in the opinion of the farmer, becomes increasingly necessary as stocking rate is increased.

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(6) One farmer visited in the survey found, however, that the clover content of his pastures increased markedly when a change was made from a 24 hour to a 12 hour rotation.

Closer control of summer feed supplies will be possible with increased paddock numbers while winter management will be facilitated, since the successful operation of a split herd system of winter feeding depends, in part, on a large number of paddocks.

(vi) Drainage

Twenty acres of the farm have been tile drained since the 1956-57 season at a cost of £125. Thirty-five chains of drains were required.

(vii) Shed conversion

The farmer converted his bail type cowshed to a herringbone type in the winter of 1959. The cost of conversion, which totalled £386, included a shed flushing pump, but a round yard with motor driven gate was not installed. In the middle of the 1960-61 season the farmer extended his milkroom to make provision for tanker collection of milk.

The farmer considers that both these alterations have helped him handle more cows without increased labour.

(viii) Stock losses

Stock losses had not increased with increased cow numbers. At the time of the author's visit to the farm (9th March, 1962) the farmer had not lost any cows from bloat since the 1956-57 season.

(ix) Herd improvement

Rapid increases in herd numbers has reduced the opportunity for culling on the basis of cow quality. The farmer hopes that cow quality will make an increasing contribution to production within the next few seasons as annual herd increases became smaller. Herd testing and artificial breeding are the basis of the herd improvement programme.

F.2,3: Future development of the farm

In the farmer's opinion the first developmental priority is to extend the central race to serve all paddocks. In addition, a section of the central race will be concreted to provide a winter feeding platform for the herd.

A long term plan is the erection of a second house on the property. The farmer considers that the farm will need to carry 130 milking cows in order to justify a second full-time labour unit.

F.2,4: The profitability of development

Comparing the 1960-61 season with the 1956-57 season shows that the following major changes have been made:

Cow numbers increased by	35
Fertilizer usage increased by	13 tons
Butterfat production increased by	10,204 pounds
Capital investment increased by	£2,720

Table F.11 shows how taxable income increased over the period.

Table F.11 Change in Income with Increased Production

Increased expenditure (£)		Increased Income	(£)
General costs	182	Butterfat and whey	1,584
Fertilizer	210	Bobby calves and cull cows	158
Depreciation	112		
Balance	1,238		
	1,742		1,742

Capital invested in the farm over the period is shown in Table F.12.

Table F.12 Increase in Capital Investment

Item	Cost (£)
Drainage	120
Shed conversion	500
Improvements	55
Tractor and plant	500
Stock	1,545
Total	2,720

Present value of extra income	=	£925
Present value of extra capital	=	£2,429

$$\text{Rate of return to capital} = \frac{925}{2,429} \times \frac{100}{1}$$

$$= \underline{38\%}$$

F.2,5: Summary of development

A 53% increase in stocking rate, a 67% increase in fertilizer rate and a 46% increase in production between the 1956-57 and 1960-61 seasons are features of this farm. A high level of production (329 pounds of butterfat per acre) was achieved in the 1960-61 season. A particular problem resulting directly from an increased stocking rate has been the winter pugging of pastures. Changes in the winter management of the herd have partly overcome this problem.

Winter rationing of feed and a reduced rate of hay and silage feeding have also been important adjustments associated with an increased stocking rate, and an improvement in winter growth of pastures. Crops are not grown on this farm.

The farmer has demonstrated that intensive subdivision is not an essential prerequisite for high production. On this farm temporary electric fences have in part substituted for intensive permanent fencing, particularly during winter months.

Development has been very profitable. Taxable farm income increased over the period by £1,238. In present value terms this income is a 38% rate of return on the additional capital invested in the farm.

CASE FARM NUMBER EIGHT

F.3,1: General information about the farm

Case Farm 8 (selected in the random sample) is a farm on which an increase in stocking rate and other management changes have been made since the 1956-57 season. This 98 acre farm of which 88 acres are productive, is situated in the Eltham area. The farm lies at an altitude of 850 feet above sea level, and receives an evenly distributed rainfall of 55 inches. Soils in the area are free draining yellow brown loams of volcanic origin.

The farm is subdivided into 17 paddocks, all of which are served by the stock water supply. An unmetalled central race provides access to most paddocks. Drainage is adequate.

The farm was purchased by the owner at the commencement of the 1953-54 season. The owner managed the farm until the close of the 1958-59 season when poor health forced him to leave the farm. A sharemilker was engaged by the owner and has operated the farm since the beginning of the 1959-60 season. The sharemilker was interviewed by the author. Information was obtained

by post from the farm owner about the development and management of the farm prior to the 1959-60 season. The farm owner and the sharemilker are subsequently referred to as "the farmer".(7)

The sharemilker joined a Farm Improvement Club at the commencement of the 1959-60 season.

The sharemilking agreement provides the sharemilker with 55% of the milk cheque.(8) The farm owner received 50% of the value of any heifers sold, and pays 50% of the cost of the 20 tons of fertilizer provided for in the agreement. The sharemilking agreement also stipulates that replacement heifers must be grazed off the farm.

Single labour has been employed on the farm for six months each season since the 1956-57 season. Contract assistance includes haybaling, and hedge cutting (about once every five years).

Pastures on the farm are perennial ryegrass-white clover dominant.

Table F.13 shows the age of pastures in March, 1962.

Table F.13 Age of Pastures on Farm 8 at March, 1962

Age (years)	Area (acres)
2	5
3	7
4	6
5	4
5 - 10	53
10 or more	15

Twenty acres of the farm have been over-drilled since the 1959-60 season.

(7) With strict application of the eligibility criteria of Section 4.2,6 this farm would not have been eligible for selection. The author did not find before visiting the farm that the sharemilker had not been managing the farm since the 1956-57 season. The author considers, however, that useful information was obtained from visiting this farm.

(8) A 50% share of the milk cheque is a more usual sharemilker return when the sharemilker owns the herd. A 55% share is, in this case, conditional upon the sharemilker remaining in the Farm Improvement Club, and using artifical insemmination for mating the herd.

Between the 1953-54 and 1956-57 seasons the farm owner increased the number of paddocks to twelve, extended the stock water supply, laid a culvert across the stream which passes through the farm, built an implement shed, and regrassed about sixty acres. Capital improvements since the 1956-57 season include a hayshed and ensilage pit, semi-permanent electric fencing to increase paddocks from twelve to seventeen, ten chains of piping and three extra troughs, a milk room for a bulk milk vat and, in 1962, a new well.

F.3,2: Development and management since the 1956-57 season

Table F.14 shows the changes which have taken place in stock and production since the 1956-57 season.

Table F.14 Stock and Production figures for Farm 8

Season	Milking cows	Butterfat production	Stocking rate	Production per acre	Production per cow
1956-57	68	20,724	69	211	304
1957-58	76	24,000	77	245	315
1958-59	74	23,000	75	235	310
1959-60	72	22,797	73	233	315
1960-61	82	29,015	83	296	353
1961-62	85	26,570	86	271	313
1962-63	83	26,500	84	270	331

Production per acre closely follows changes in stocking rate except in the 1961-62 and 1962-63 seasons. Production in the 1960-61 season showed a marked increase over previous seasons. Management changes which the farmer believes have contributed to this increase, include:

(i) Stocking rate

An increase in stocking rate. Changes in stocking rate are shown in Table F.14. Table F.15 shows the total stock on the farm at the close of each season since the 1956-57 season.

Table F.15 Total Stock on Farm 8 at the Close of Each Season

Class of Stock	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
Cows	72	69	74	72	82
Heifers	10	10	16	15	19
Yearlings	12	12	15	19	22
Bulls	3	3	2	1	1
Total	97	94	107	107	124

Rising two-year heifers leave the farm at the beginning of October, each year, for seven months off-farm grazing.

(ii) Fertilizer rate

Four and one half hundredweights of fertilizer have been applied annually since before the 1956-57 season. Fertilizer applied since this season is shown in Table F.16.

Table F.16 Fertilizer Applied to Farm 8

Type of Fertilizer	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
33% potassic serpentine	14	14	14	14	14
DDT potassic super	6	6	6	6	6
Total (tons)	20	20	20	20	20
Cwts. per acre (90 acres)	4.5	4.5	4.5	4.5	4.5

Two-thirds of this dressing is applied between March and April, while the balance of six tons is applied in August. The farmer considers that an August application of fertilizer boosts

pasture production over the period of growth from September to October.(9)

(iii) Use of DDT

DDT superphosphate has been applied for grass grub control each season since (and including) the 1955-56 season.

(iv) Winter grazing management

Changes in winter grazing management have aimed at:

(a) Increasing the amount of grass available in winter and early spring, and,

(b) Reducing the amount of hay and silage fed per cow. This allows more stock to be fed during the winter and/or reduces the area of the farm to be shut in the late spring, early summer, period for hay and silage.(10)

Prior to the winter of 1958, the usual wintering practice was to dry the herd off in late May. The herd was then confined to two paddocks and fed hay, silage and crop. The balance of the farm was shut from mid-May for spring feeding to milkers following calving in early August. The area in crop and possibly one of the two paddocks in which the herd was wintered, was ploughed and sown back to grass.

In the winter of 1958 and 1959, the same system was used with the addition of a ration of autumn saved pasture break fed prior to calving.

In the winter of 1962, 84 dairy cows and 29 head of young stock were wintered on 1,150 bales of hay, at least 350 bales less than the number of bales used the previous winter. The herd was break fed on 33 acres of autumn saved pasture throughout the winter, and the farmer considers that this close rationing of pasture probably assisted in reducing hay usage. The area of 33 acres on which the herd was wintered in 1962 had been withdrawn from the rotation in April and May to allow some grass to be saved for winter feeding. The balance of the farm was shut progressively from early May and this saved feed was break fed to milkers following calving.(11)

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(9) Opinion varied widely amongst the survey farmers about the value of a spring application of fertilizer.

(10) A reduction in the area of the farm closed for hay and silage allows stocking rates to be increased over the summer period. The loss of nutrients associated with hay and silage conservation is also reduced, provided of course, that stocking rate is increased to utilize the feed normally conserved. Failure to increase stocking rate may result in 100% loss of nutrients.

(11) Spring pasture production was again poor in 1962 and this was the reason suggested by the farmer for the "lower than expected production" in the 1962-63 season. Although at the time of the interview the farmer thought that grazing management could be further improved to allow 100 cows to be milked on the farm without an increase in fertilizer rate he now thinks that more fertilizer will be necessary if production is to increase.

For the winter of 1960 the farmer dispensed with a crop. Following drying off in late May, 1960, the herd was confined to a ten-acre paddock closed since early May. A ration of hay was fed in conjunction with this saved feed. The balance of the farm, excluding the area occupied by young stock was closed from mid-May. Break feeding of this autumn saved pasture commenced in July at the rate of twenty square yards per cow per day. The daily breaks were not back fenced since the farmer wished to use the earlier grazed area as a "runoff" during very wet spells.(12) Hay was fed in addition to this ration of grass.

Increased stock numbers and the prospects of a wet winter led the farmer to make a further change in the winter feeding of the herd in 1961. At the end of the 1960-61 season the farmer considered that cow numbers could be substantially increased. Not having sufficient finance to purchase cows he retained, at the end of the 1960-61 season, "every cow that had a reasonable chance of producing for a further season." Eight empty cows were milked through the winter, making a total of 99 dairy cows wintered. Following drying off, the herd was spread around the farm at the rate of three cows per acre, but (as the farmer stated):

> "The winter of 1961 was very wet in July and three cows per acre proved to be too many causing severe pugging of a large area of the farm. These paddocks made a very slow recovery in the spring of the 1961-62 season, and this fact, together with the effect of the worst drought that we have ever had, prevented a high level of production being attained in the 1961-62 season".

Thus this winter pugging, together with the unusually dry summer probably explains a large part of the 10.5% fall in production between the 1960-61 and 1962-63 seasons.

Prior to the 1959-60 season, about twenty acres of silage and twelve acres of hay (yielding about 1,100 bales) were made each season. Since the 1959-60 season this pattern has changed. The farmer now closes about eighteen acres for hay yielding about 1,500 bales, and a variable area of silage depending on the amount of surplus feed in the spring. Silage is fed to milkers in the spring following calving, together with any hay left from winter feeding.

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(12) Other Taranaki farmers consider, however, that "backfencing" when break feeding saved pasture has several advantages. These include:

(a) The grazed area is free to commence growth immediately the herd have been shifted forward to a new break. This should increase the amount of feed available for spring grazing.

(b) Pugging is confined to a small strip if soils become very wet. This strip can subsequently be reseeded by hand in the spring. Damage to the previously grazed area of the pasture is minimised.

(c) Repeated defoliation of plants is prevented.

The farmer considers winter pugging to be one of the more important factors now limiting carrying capacity on his farm. A letter from the farmer in 1963 stated,

> "Winter pugging of pasture is now my big problem and after seeing the results of the last two winters I hope this winter (1963) to spread the early calvers around the farm at no more than two per acre over a third of the farm. The later calvers I hope to concentrate in a small paddock close to the dairy shed so that I can feed them on the concrete yard for the greater part of the winter".

(v) Summer grazing management

Pasture is rationed throughout the summer. Calving commences in early August and continues through into early October. Early calvers are break fed on winter saved pastures until the middle of September by which time growth is usually sufficient to maintain a fourteen-day paddock rotation. The length of this rotation is changed according to the availability of feed, and the area of the farm closed for hay and silage e.g. as pasture growth slows in the summer the rotation may be speeded up.

The farmer finds that pasture production tends to slump over the period from December to January. Regrowth from hay and silage paddocks is saved and break fed to milkers over this period. Break feeding of hay and silage regrowth extends into February by which time pasture growth has usually recovered. Paddocks are then shut for break feeding later in the autumn, or if surplus feed is available, for making into silage. This policy of autumn rationing of feed allows pasture on the balance of the farm to be closed progressively for winter-early spring grazing.

(vi) Herd improvement

Artificial breeding and herd testing have been used since and including the 1956-57 season. No production cullings were possible at the end of either the 1959-60 or 1960-61 seasons. Empty cows are taken through the winter only if, in the opinion of the farmer, they are capable of producing at a high level in the subsequent season.

(vii) Stock diseases

The incidence of bloat has remained consistent over the period. Paraffin spraying for bloat control commenced in the spring of the 1961-62 season. A broadcast spray plant for this purpose was purchased at a cost of £25. Stock losses from disease have not increased.

(viii) Labour saving practices

Several labour saving practices have been adopted since the 1956-57 season. Facilities for the tanker collection of milk were installed in the winter of 1959 at a cost of £100. Calves are fed once per day with a "calfeteria" following an initial month of twice per day bucket feeding.

F.3,3: Future development of the farm

Future development of the farm depends largely on the sharemilker being able to purchase the farm. If purchase of the farm can be arranged the sharemilker plans to increase cow numbers to at least 125. He intends making a permanent arrangement for off-farm grazing of his heifers.

Capital commitments faced by the farm owner within the next two to three years include:

(a) The concreting of a short section of the central race to serve as a winter feeding platform,

(b) The erection of a herringbone cowshed,

(c) Additional fertilizer.

F.3,4: Profitability of development

As assessment of the profitability of developing the farm could not be made as complete farm accounts were not available.

F.3,5: Summary of development

An increased stocking rate and an increase in production are features of the changes which have taken place on this farm since the 1956-57 season. Over the period a 21% increase in cow numbers was accompanied by a 40% increase in production. The farmer considers close rationing of feed throughout the season to be an important factor contributing to the high level of production obtained in the 1960-61 season. Application of DDT for grass grub control, maximum utilization of conserved feed and attention to herd improvement have been important associated changes in management. At the same time, the relative slump in production in 1961-62 and 1962-63, largely associated with winter pugging, draws attention to the need to change many aspects of management as stocking rate is increased.

CASE FARM NUMBER FIFTEEN

F.4,1: General information about the farm

Case Farm 15 (selected in the stock increase sample) is a farm on which large increases in stock and fertilizer have been made over the period. Increases since the 1959-60 season have, however, been accompanied by a decline in butterfat production.

The farm is 100 acres in size and is situated in the Auroa area. This area receives an annual rainfall of about 65 inches and lies at an elevation of 700 feet above sea level. The soil on this farm is a free draining yellow brown loam derived from Egmont volcanic ash. Drainage is adequate. Ten acres of the farm is ungrazable. A central race provides access to the 24 paddocks all of which are provided with stock water supply.

The farmer who purchased the property at the beginning of the 1956-57 season, operates a contracting business in conjunction with his farm. This farm should have been excluded from selection on the basis of the eligibility criteria outlined in Section 4.2,6. The author did not know before visiting the farm that the farmer operated this business. While the farmer was unable to supply farm accounts, as these had been destroyed by fire at the close of the 1960-61 season, he was able to estimate capital invested in the farm over the period.

When purchased, the farm was fenced into five paddocks. Cowshed, access race and stock water supply were absent, since the farm had for many years been operated in conjunction with a larger farm.

Table F.17 lists the capital invested in the farm since purchase.

Table F.17 Capital Improvements to Farm 15

Item	Year	Cost (£)
Levelling		200
Water reticulation and fencing	1956-1958	3,000
Cowshed	1957	950
Haybarn	1958	500
Implement shed	1958	1,800
Milking Plant	1960	575
Bore		150
37 dairy cows	1957-1961	2,035
Milk tank	1958	300
Total estimated expenditure		9,510

The farmer estimated that 75% of this expenditure had been met from contracting income.

The large investment in additional stock is explained by the fact that the farmer, had, in part, built up herd numbers by purchasing 37 dairy cows. These had been the "top" cows of several herds, for which the farmer had paid up to £60 per head.(13)

(13) If herd average production per cow figures are any guide to herd quality then this policy of purchasing expensive cows has been spectacularly unsuccessful. A more rational policy would have been to purchase high producing cows from herds with a low average per cow production. Cows performing well in such a herd are likely to be cheap and of above average genetic merit.

F.4,2: Development and management since the 1956-57 season

Table F.18 shows the changes in stock and production which have taken place over the period.

Table F.18 Stock and Production Figures for Farm 15

Season	Milking cows	Butterfat production	Stocking rate	Production per acre	Production per cow
1956-57	64	13,640	64	137	213
1957-58	71	20,861	71	209	290
1958-59	82	26,540	82	265	323
1959-60	90	23,023	90	230	255
1960-61	104	20,955	104	210	200
1961-62	94	20,012	94	200	214
1962-63	94	22,000	94	220	234

Management changes which the farmer believes have contributed to increased production, include:

(i) Stocking rate

An increase in stocking rate. Table F.18 shows that stocking rate increased from 64 milking cows per 100 acres in the 1956-57 season to 104 milking cows per 100 acres in the 1960-61 season, a 62.5% increase. The farmer was unable to provide total stock figures for any of the seasons' shown in Table F.18. Replacement heifers are grazed away from the farm for 12 months.

Increased stocking rates were accompanied by increased production per acre until the end of the 1958-59 season. Subsequent increases in stocking rate have been accompanied by a fall in production per acre.

(ii) Fertilizer rate

Fertilizer applied to the farm over the period is shown in Table F.19.

Table F.19 Fertilizer Applied to Farm 15

Type of fertilizer	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
Superphosphate serpentine	9	13			
superphosphate 33% potassic serpentine					42
DDT super-phosphate			18	22	3
Total (tons)	9	13	18	22	45
Cwts. per acre (90 acres)	2	3	4	5	10

Fertilizer is applied in several dressings throughout the year, usually at the rate of 2 cwts. per acre per dressing. Potash was used for the first time in the 1960-61 season. Use of potash followed the recommendation of an extension worker, who considered the farm to be extremely potash deficient. Less than 3 cwts. per acre per annum of superphosphate had been applied prior to the 1956-57 season.

(iii) Use of DDT

DDT applications for the control of grass grub commenced in the 1958-59 season. The farmer stated that grass grub had been "very bad" when he took over the farm.

(iv) Pasture renewal

Seventy-five acres of the farm were ploughed and regrassed over the period. Perennial ryegrass - H_1 ryegrass - white clover seed mixtures were sown. The balance of the pastures are about 40 years old. A winter crop of between 10 and 20 acres was grown each season in conjunction with the regrassing programme. Pastures appeared to be very poor. Swards were open, lacking in clover and full of flat weeds, although dry conditions were prevailing at the time of the interview.

(v) Stock feeding

For the winter of 1957, 1958, 1959 and 1960 the farmer set stocked the whole herd on about half of the farm between drying off in mid-May and calving in mid-July. The farmer stated that pugging damage to pastures resulted from this system of management, and that cows were calving in poor condition. The balance of the farm was closed progressively from early May to allow pasture to accumulate for spring feeding to the milking herd. Between 10 and 20 acres of crop (chou moellier) were break fed each winter between July and September. About 1,800 bales of hay were fed between June and mid September.

Winter feeding changed in 1961. Ten acres of pasture, closed in early April, were break fed to the whole herd in June and July. 900 bales of hay were fed over this period. The balance of the farm was shut progressively from early May to allow feed to accumulate for feeding after calving in mid-July. Five acres of crop were break fed in July and August. The fall in hay requirements in the winter of 1961 is largely explained by the substitution of break fed autumn saved pasture for hay. Saved pasture is break fed following calving until growth is sufficient to maintain a 12 hour, 12 day grazing rotation. Break feeding of the winter crop continues until the end of August. Paddocks are shut for hay as pasture surpluses build up ahead of the herd. The farmer managed to close 65 acres of the farm, yielding 2,100 bales of hay, in the summer of the 1961-62 season. No silage is made.

(vi) Herd improvement

Herd testing has been used on the farm since the 1956-57 season. Bulls have been bought in or reared on the farm. Artificial breeding has not been used at any stage.

(vii) Stock losses

Stock losses from disease have not increased over the period. About 5 calves are lost each season for various reasons.

F.4,3: Discussion of the development of Farm 15

While production increased by 54% on this farm between the 1956-57 and 1960-61 seasons two particular points emerge:

(a) Increases in stocking rate subsequent to the 1958-59 season have been accompanied by a decline in butterfat production, and,

(b) Production per acre in the 1959-60 and subsequent seasons has been low.

The author suggests the following explanations for this situation:

(a) Overstocking occurred as cow numbers were increased - fertilizer rates were increased, before potassic fertilizers were used and before any attempt was made to control grass grub. Seventy-five per cent of the farm has been sown to new pasture since the 1956-57 season. Experience of other farmers in the survey area with new pastures, and the author's assessment of the pastures at the time of the interview, suggest that cows were probably underfed in the 1958-59, and subsequent, seasons.

(b) Overall grazing management has been poor. In the summer of the 1960-61 season the farmer shut 65% of the farm for hay, at a time when the farm was stocked at the rate of over a cow per acre. The overall effect of withdrawing this area from grazing was to increase the stocking rate on the balance of the farm to an equivalent of about 3 cows per acre - an extremely high figure for even the best of pastures in South Taranaki.

Some of the decline in production in the 1959-60 and 1960-61 seasons may have been attributable to the farmers policy of withdrawing 10-20 acres of the farm in late spring for cultivation. This policy would have further increased the summer stocking rate at a time when pasture production was probably limited by potash deficiency and grass grub.

At the time of the author's visit to the farm, (31st March, 1962) the farmer had a 5 acre paddock which had been shut in early March for feeding towards the end of June. Grass in this paddock was long and "rotting in the bottom". The farmer had not considered grazing this paddock before the end of June. Feed supplies were short on the balance of the farm. Thus the farmer's grazing management resulted in feed going to waste, while the stock were being inadequately fed.

(c) There were some indications that cowshed management was faulty. Milking 80 cows took four men $1\frac{1}{2}$ hours in a 4 bail "doubled-up" shed.(14) The farmer was prepared to spend up to $2\frac{1}{2}$ hours in the shed. He said: "Since I've been getting a lot of cows with second let downs, and many cows not lasting the full season I've decided to start hand stripping again".

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(14) A "doubled-up" shed is one in which two sets of cups have been installed in each bail. This would normally allow two men to milk 80 cows in 80-90 minutes.

F.4,4: Summary of development

A feature of Farm 15 is that although production increased by 54% over the period, increases in cow numbers and fertilizer usage subsequent to the 1958-59 season have been accompanied by a decline in production to low levels of production per acre. The author suggests that the main management failures causing this decline have been overstocking, failure to use potassic fertilizers until the 1960-61 season, too great an area of the farm sown to new pastures over the period, failure to control grass grub, closing too great an area of the farm for hay, closing pastures intended for winter feeding too early in the autumn, withdrawing an area in the spring for cultivation, and possibly, poor cowshed management.

The low production levels achieved by Farmer 15 emphasise the point made in the opening section of Chapter 5 that all aspects of management must be considered when changes are made in important inputs such as stocking rate and fertilizer rate.

CASE FARM NUMBER TWENTY-FIVE

F.5,1: General information about the farm

Case Farm 25 (selected in the production increase sample) is a farm characterised by high rates of stock and fertilizer, and a large increase in production over the period. This 148 acre farm, of which 138 acres are productive, is situated in the Te Ngutu area. This is a 50 inch rainfall area lying at an altitude of 500 feet above sea level. Soils in this area are free draining yellow brown loams highly resistant to winter pugging. The farm is fenced into 16 paddocks all of which are provided with a stock water supply. A central race, partly concreted, provides access to all paddocks.

Two brothers (subsequently referred to as "the farmer") operate this farm in partnership. One hundred and eleven acres of the farm were purchased in 1951 and an additional 38 acres were purchased in 1955. A married man has been employed on the farm since the start of the 1956-57 season. Contract assistance is limited to hay-baling.

This is an all grass farm with dense, perennial ryegrass dominant pastures.. Prairie grass is an important constituent of some of the pastures. Table F.20 shows the age of pastures at March, 1962.

Table F.20 Age of Pastures on Farm 25 at March, 1962

Age of pasture (years)	Area of pasture (acres)
4 - 12	70 - 80
30 - 40	70 - 80

Development work carried out on the farm since 1951 has included the regrassing of 70-80 acres, additional subdivision to increase paddock numbers from 12 to 16, concreting ten chains of the central race, installation of facilities for tanker collection of milk and extensions of the stock water supply to the new paddocks.

F.52: Development and management since the 1956-57 season

Table F.21 shows the changes which have taken place in stock and production over the period.

Table F.21 Stock and Production Figures for Farm 25

Season	Milking cows	Butterfat production	Stocking rate	Production per acre	Production per cow
1956-57	115	35,800	78	240	310
1957-58	121	42,705	82	288	353
1958-59	132	46,072	89	311	349
1959-60	144	42,531	97	287	295
1960-61	171	54,500	115	360	318
1961-62	170	40,000	115	270	235
1962-63	160	52,000	108	350	325

Dry conditions were experienced in the summer and autumn of the 1959-60 season, and again in the summer of the 1961-62 season. The farmer largely attributed the fall in production in each of these seasons to dry conditions. The farmer was confident that production would have shown a greater decline had cow numbers not been increased (in the 1959-60 season) and if stocking rate had been lower (in the 1961-62 season).(15) In both these seasons production fell less than on many other farms in the area, while high levels of production per acre were obtained on the farm.(16)

(15) Similar observations were recorded by Johnston in the Manawatu area. See: Johnston, D.M., "Observations on a Difficult Season", Massey College Dairyfarming Annual, 1962, pp. 77-83.

(16) Drought strategies for Taranaki farmers are discussed in the following article: Anon, "Disaster was a Myth", New Zealand Dairy Exporter, 36,4, 1960, p.9.

Management changes over the period which the farmer considers have contributed to increased production include:

(i) Stocking rate

An increase in stocking rate. Table F.21 shows that stocking rate has increased from 78 milking cows per 100 acres in the 1956-57 season to 115 cows per 100 acres in the 1960-61 season. Table F.22 shows the total stock on the farm at the close of each season since the 1956-57 season.

Table F.22 Total Stock on Farm 25 at the Close of Each Season

Class of stock	Season					
	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62
Cows	105	119	132	147	166	147
Heifers -	17	24	33	28	30	36
Culls	16				6	
Yearlings	24	37	28	29	37	33
Bulls	4	4	5	4	6	4
Total stock	166	183	198	208	245	220

Replacement stock leave the farm as yearlings at the end of April each year for 12 months off farm grazing.

Cow number increases in the 1960-61 season were largely a result of "chance". At the close of the 1959-60 season the farmer tendered for the lease of some additional land adjacent to his property. Anticipating that the tender would be successful the farmer increased cow numbers at the close of the season. Cow numbers were increased by light culling and some purchasing. The tender for the leasehold ground was unsuccessful and 186 cows were wintered on the farm in 1960. Eight of these cows were sold towards the end of July leaving 178 cows to calve at the start of the 1960-61 season.

By mid-September, 1960, when there were 152 cows in milk with 26 still to calve, production had already been lifted above the flush production of the previous season.

(ii) Fertilizer rate

Fertilizer rates have increased since the 1956-57 season. Table F.23 shows fertilizer applied over the period.

Table F.23 Fertilizer Applied to Farm 25

Type of fertilizer	Season 1956-57	1957-58	1958-59	1959-60	1960-61
33% potassic superphosphate	21	21	22½	47½	51½
DDT super-phosphate			2½	2½	2½
Total tonnage	21	21	25	50	54
Cwts. per acre (140 acres)	3.0	3.0	3.5	7.0	7.7
Nitrogenous					2

Shed manure is spread on the farm. Fertilizer is applied as a split dressing. Five cwts. per acre are applied between March and April while the balance is applied between August and September.

Spring applications of fertilizer were first used in 1959-60 when three paddocks were topdressed at the rate of 3 cwts. per acre late in September. These paddocks, according to the farmer, showed a distinct growth advantage over autumn topdressed pastures in the subsequent very dry summer.

(iii) Use of DDT

One third of the farm has been treated each season with DDT superphosphate since 1958-59.

(iv) Stock feeding

Winter feeding methods have changed with increases in stocking and fertilizer rates. Between 1951 and 1958, 8-10 acres of the farm was ploughed each season and sown to a winter crop of swedes. This crop was break fed to the herd throughout the winter in conjunction with a 10-20 acre sacrifice area. The balance of the farm was closed progressively from early May to allow pasture to accumulate for spring feeding to milking cows. Silage was fed each year from June until September. Eight to ten acres of the sacrifice area was spring ploughed for the following winters' crop. The preceding winters' crop area was spring sown to pasture. Drying off took place towards the end of May with calving starting the last week in July.

When purchasing the property the farmer thought that renewing old pastures would lead to a rapid increase in production. Regrassing ceased after the spring of 1958 leaving 70-80 acres of original pasture. Regrassing ceased because:

(a) Old pastures appeared to be outproducing newer pastures, and,

(b) New pastures took 3 years to become fully established.

Winter feeding since 1958 has been based on the use of a split herd system.

Cows are spread around the farm at the rate of $2\frac{1}{2}$ cows per acre allowing the balance of the farm (about 70 acres) to be shut from mid-June for spring feed. Where possible, stock are spread around the silage paddocks to reduce fertility transfer. Yearlings are wintered on saved pasture and hay. Paddocks to be shut for spring feed are cleaned by the herd immediately after drying off. No grass is saved on the paddocks on which the herd are to be wintered except for a 2-3 week period in which they are cleaning the balance of the farm. Winter pasture growth is supplemented by silage. In the spring of 1961, 40 acres of the farm were boosted with two tons of nitrogenous fertilizer.

Following calving, the herd is break fed on saved pasture until the end of August. The herd then commences an 8 day, 12 hour paddock rotation for the remainder of the summer. Pasture is supplemented by hay and silage until early September. The first silage paddocks are withdrawn from the rotation late in September and silage making is completed by the end of November. Hay paddocks are closed in early October. About 40 acres of silage, and between 500 and 700 bales of hay, are made each season. These quantities have not varied as stock numbers have increased. Quantities of hay and silage fed per cow have accordingly fallen.

Comments by the farmer about the behaviour of his pasture in recent years included:

(a) "Pastures have increased in density.

(b) Pastures appear to have greater drought resistance, especially the older pastures.

(c) Spring flush of growth seems to be about a month earlier than it used to be.

(d) I used to be shutting paddocks for spring grass early in May, but now I don't shut any paddocks until late June".

(v) Herd improvement

Herd testing was used on the farm from before the 1956-57 season until the end of the 1959-60 season. Testing for this length of time enabled the farmer to obtain information about the productive ability of cows in his herd.

Records have been used for assessing the performance of farm reared bulls. The bull in use on the farm at the time of the author's visit (11th April, 1962) had a progeny test rating of +37. The farmer considered that the purchase of stock had assisted in the maintenance of herd quality while rapidly increasing herd numbers. Purchases included 7 cows and 6 heifers at the start of the 1958-59 season, and 20 heifers at the start of the 1959-60 season. The farmer considered that maintenance of herd quality had been particularly difficult prior to the 1959-60 season as infertility trouble each season had limited the number of heifer calves which could be saved. Artificial breeding has not been used on the farm.

(vi) Stock diseases

The farmer was unable to provide any detailed information about stock losses and stock diseases. He considered that the incidence of bloat had increased over the period. Spraying of pastures as a bloat control measure commenced in the 1960-61 season. A spray plant was purchased for this purpose.

F.5,3: Future development of the farm

At the time of the interview the farmer stated that he planned to remain at his present stocking rate for one or two seasons. This decision had been reached because of the labour involved with increased cow numbers. He had no intention of erecting a herringbone cowshed. The farmer was considering the replacement of a proportion of his milking herd with sheep.(17)

F.5,4: The profitability of development

Comparing the 1960-61 season with the 1956-57 season shows that the following major changes have been made:

Cow numbers increased by	56
Fertilizer usage increased by	35 tons
Butterfat production increased by	18,700 pounds
Capital investment increased by	£4,992

Table F.24 shows how taxable income increased over the period.

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(17) The farmer changed entirely to sheep at the close of the 1962-63 season. He plans to carry 8 ewes per acre, plus cattle.

Table F.24 Change in Income with Increased Production

Increased expenditure (£)		Increased income (£)	
General costs	986	Butterfat	2,881
Fertilizer	555	Bobby calves & cull cows	277
Depreciation	360		
Balance	1,257		
	3,158		3,158

Capital invested in the farm over the period is shown in Table F.25.

Table F.25 Increase in Capital Investment

Item	Cost (£)
Races, water supply and fences	350
Plant (including tanker facilities)	690
Tractors	1,469
Stock	2,483
Total	4,992

Present value of extra income = £939

Present value of extra capital = £4,456

Rate of return to capital = $\frac{939}{4,456} \times \frac{100}{1}$

= 21%

F.5,5: Summary of development

A 49% increase in stocking rate, a 157% increase in fertilizer rate and a 52% increase in production over the period are features of the development of this farm. Three hundred and sixty pounds of butterfat per acre were produced in the 1960-61 season. General management changes included the use of increased rates of potassic fertilizers, use of DDT for grass grub control and changes in the feeding of the herd.

Herd feeding is based on the use of permanent pastures with silage as a winter supplement. The farmer considered that both the drought resistance and winter growth of pastures had improved over the survey period.

Taxable farm income increased by £1,257 over the period. In present value terms this is a 21% rate of return to the added capital of £4,992 invested in the farm.

CASE FARM NUMBER TEN

F.6,1: General information about the farm

Case Farm 10 (selected in the McKenzie sample) is a farm characterised by increased rates of stock and fertilizer. This 113 acre farm, of which 105 acres is productive, is situated in the Pihama area, one mile inland from the South Coast. This is a 45 inch rainfall area lying at an altitude of about 200 feet above sea level. The yellow brown volcanic soils of this farm are underlain by an ironstone pan, and intensive drainage is necessary if stocking rates of over half a cow per acre are to be maintained.

The farm is fenced into 22 grazing paddocks all of which are provided with a stock water supply. Drainage is adequate. A central race provides access to all paddocks.

The farmer purchased the farm from his father at the commencement of the 1959-60 season, after sharemilking on the farm for several seasons. The farmer has operated the farm since the 1956-57 season with the assistance of a youth. Contractors are engaged for hay-baling, topdressing and hedge cutting.

Pastures on the farm are perennial ryegrass-white clover dominant and, in 1962 varied in age from twenty years to two years. Between 5 and 10 acres of winter crop were grown each season prior to the winter of 1961.

Many improvements to the farm had been completed by the 1956-57 season. Drainage and subdivision had been completed, a central race installed and stock water laid to all paddocks. Between 65 and 70 cows had been milked on the farm for many seasons prior to the 1956-57 season, with production remaining constant at

about 19,000 lb. butterfat. A standing order for 16 tons of superphosphate, and in later years, potassic superphosphate, was maintained with a local produce firm.

F.6,2: Development and management since the 1956-57 season

Stock and production changes over the period are shown in Table F.26.

Table F.26 Stock and Production Figures for Farm 10

Season	Milking cows	Butterfat production	Stocking rate	Production per acre	Production per cow
1956-57	71	19,764	63	175	278
1957-58	68	20,787	60	184	306
1958-59	75	20,504	66	181	273
1959-60	80	23,154	71	205	289
1960-61	105	31,445	93	278	299
1961-62	125	32,564	111	288	261
1962-63	132	36,000	117	318	273

Management changes made over the period which the farmer believes have contributed to increased production, include:

(i) Stocking rate

An increase in stocking rate. Table F.26 shows that stocking rate has increased from 63 milking cows per 100 acres in the 1956-57 season to 93 cows per 100 acres in the 1960-61 season. The stock on the farm at the close of each season since the 1956-57 season are given in Table F.27.

Table F.27 Total Stock on Farm 10 at the Close of Each Season

Class of stock	Season					
	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62
Cows	68	66	67	75	92	120
Heifers	12	17	28	22	37	38
Yearlings	17	28	26	34	28	40
Bulls	3	4	2	2	3	3
Total dairy stock	100	115	123	133	160	201
Sows	11	18	14	12	15	26

Increases in stocking rate have largely been made since the farmer purchased the property.

(ii) Fertilizer rate

Table F.28 shows fertilizer applied over the period.

Table F.28 Fertilizer applied to Farm 10

Type of fertilizer	Season				
	1956-57	1957-58	1958-59	1959-60	1960-61
33% potassic serpentine	16	16	20	35	42
DDT super-phosphate					3
Total tonnage	16	16	20	35	45
Cwts. per acre (105 acres)	3.0	3.0	3.8	6.7	8.5
Nitrogenous					1

Fertilizer is applied as a split dressing at the rate of 5 cwts. per acre in June and 3.5 cwts. per acre in October. The farmer considers that splitting his fertilizer dressings in this way assists in spreading pasture production.

(iii) Use of DDT

DDT was applied in the autumn of 1961 as a precautionary measure against grass grub rather than as a control measure. The farmer has found no evidence of grass grub on his property.

(iv) Use of a runoff

Since October, 1959, the farmer has used 12 acres of leasehold land about five miles from his home farm. Replacement heifers have been grazed on this area for 8-10 months each season since the 1959-60 season. Four hundred bales of hay were made off the area in the summer of 1961. In the winter of 1961 the herd was grazed on this area for three weeks prior to calving.

While the farmer considered that this runoff had contributed towards increased production, largely through reduced winter pugging of the home farm, he did not plan to renew his lease which was to expire in October, 1962. The farmer planned to winter all his stock, comprising 40 yearling heifers, 35 rising 2 year heifers and 110 cows,

on the home farm in 1962. As an insurance against extremely wet conditions he had obtained the lease of 2 acres of coastal sand country adjacent to his farm. He planned to use this area as a feeding platform if pugging became a problem.

(v) Winter grazing management

Changes have been made in the winter feeding of the herd since the 1956-57 season.

For the winter of 1957 to 1960 the herd was mobbed together following drying off in late May and moved around the farm for one to two weeks grazing rank feed. The herd was then divided into two mobs which were set stocked on between 10 and 20 acres of the farm. Saved pasture, accumulated before the end of the milking season, was sometime available on this area.

Five to ten acres of crop were break fed between mid-June and calving; the set stocked area serving as a runoff for the herd between breaks. The winter crop, and the small ration of pasture which grew during the winter on the set stocked area was supplemented by hay. This was fed between mid-April and late July, about 20 bales were fed per cow over the winter period.

Part of the set stocked area was usually ploughed in the spring for the following winters' crop. The balance of the set stocked area often recovered slowly in the spring, since it was invariably heavily pugged. Regrassing of the cropped area was carried out in the spring.

No crop was grown for the winter of 1961. Following drying off the herd was set stocked on 20 acres until the beginning of July. The balance of the farm was closed progressively from early May. At the beginning of July, three weeks prior to the first calvings in late July, the herd was removed to the runoff allowing the whole of the farm to be closed. Pasture was supplemented by hay from the end of June until calving.

The farmer gave the following reasons for changing to an all grass winter feeding policy:

(a) Winter grass growth from older pastures had improved as a result of increased fertility.

(b) The difficulty of establishing new pastures.

(c) The wastage associated with in situ feeding of a forage crop.

Hay usage fell sharply in the winter of 1961, as 1,000 of the 2,000 bales normally fed were left at the end of the winter. One hundred and nine cows and 28 calves were fed on about 1,000 bales.

At the time of the author's visit (25th March, 1962) the farmer planned to use a split herd system of feeding in the winter of 1962. Under this system the herd, and yearlings, would be spread over about 90 acres of the farm at the rate of 2 cows per acre. The balance of the farm was to be shut in June to allow pasture to accumulate for spring feeding. The farmer was quite confident that with the improved winter growth of his pastures, 10 acres of saved feed would be adequate for spring feeding.

The farmer considered that one of the outstanding results of an increased rate of fertilizer on his farm had been the increased autumn and winter growth of pastures. The farmer said,

> "About five years ago I was starting to save feed for the spring in early April. This date has been progressively shifted back and this winter (1962) I plan to close 10 acres in June for spring feeding. Over the same period the amount of hay used has been almost halved yet the number of cows wintered on the farm has increased by 50%".(18)

(vi) Summer grazing management

Calving commences in the last week of July and extends into the second week of September.

Saved feed is break fed to milkers for a period depending on feed supplies. No break feeding was used in the spring of the 1961-62 season. Silage (15 acres) is fed to milkers from mid-August until the beginning of October. A 24 hour rotation around 22 paddocks is maintained for the balance of the season. Paddocks to be conserved as silage and hay are withdrawn from the rotation as feed surpluses become evident. Pastures are grazed short throughout the summer and autumn. The farmer considers that this policy improves pasture utilization and encourages pasture density. Dense pastures, he believes, have greater drought resistance than open swards.(19) This policy of close grazing may, however, be indirectly responsible for the increase in clover content of his pastures.

The farmer finds intensive subdivision particularly useful in early summer when withdrawing areas for hay and silage making. Between 20-25 acres of the farm are closed for hay each year and between 12 and 14 acres for silage. The fall in the amount of hay fed per cow has been partly offset by an increase of 2-4 acres in the area closed for silage. Earlier spring growth is the main reason for the increase in silage area.

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(18) There had, of course, been some contribution from the run-off to winter feeding over this period.

(19) Dry spells of from three to five weeks are occasionally experienced in this area but not severe enough, in the opinion of the farmer, to justify the summer feed crops grown by some of his neighbours.

(vii) Herd improvement

Prior to the 1960-61 season no special effort had been made to improve herd quality. The farmer considered stocking rate to be a more important determinant of total production than cow quality, and for this reason few cows had been culled on the basis of productive ability. This could, in part, explain the low production per cow figures.

Half the herd were artificially bred in the 1960-61 season and the farmer planned to use A.B. over the whole of the herd in the 1961-62 season. Farm reared bulls had been used prior to the 1960-61 season. The farmer planned to test his herd in the 1962-63 season to provide some basis for productive culling.

Herd numbers were increased in the 1959-60 season partly by retaining cull cows and partly by purchasing 11 cows at the start of the season. A further 11 cows were purchased at the start of the 1960-61 season.

(viii) Stock losses

Stock losses from either disease or bloat had not increased over the period. The farmer did not mention bloat as a particular problem except that younger pastures appeared to be more "bloat prone".

(ix) The pig enterprise

Sow numbers remained almost static until the winter of 1961. At this time 11 additional sows were purchased, a fattening house erected at a cost of £500 and rights were obtained for the purchase of whey from 300 cows at a cost of £2 per 1,000 lb. of butterfat.

Sows are wintered on fodder beet, barley meal and pollard while summer feeding is based on pasture and whey, supplemented by meal. Weaners are reared on whey with meal supplementation and are largely marketed as baconers.

The farmer decided to expand the pig enterprise partly for taxation saving purposes (in the short run) since there were few opportunities for taxation exempt farm development expenditure.

F.6,3: Future development of the farm

The farmer considered that the first priority was erection of a herringbone cowshed.(20) Further expansion of the pig enterprise was planned.

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(20) A herringbone cowshed was built in the winter of 1962.

A long term plan is to build a second house on the farm to enable a married man to be employed.

F.6,4: The profitability of development

Comparing the 1960-61 season with the 1956-57 season shows that the following major changes have been made:

Cow numbers increased by	34
Fertilizer usage increased by	29 tons
Butterfat production increased by	11,681 pounds
Capital investment increased by	£2,939

Table F.29 shows how taxable income increased over the period.

Table F.29 Change in Income with Increased Production

Increased expenditure (£)		Increased Income (£)	
General costs	364	Butterfat	1,800
Fertilizer	465	Bobby calves and cull cows	165
Depreciation	55		
Balance	1,086	Other income	5
	1,970		1,970

Table F.30 lists the capital invested in the farm over the period.

Table F.30 Increase in Capital Investment

Item	Cost (£)
Fencing and water supply	100
Piggery and hay barn	800
Plant	150
Stock	1,889
Total	2,939

Present value of extra income	=	£812
Present value of extra capital	=	£2,625
Rate of return to capital	=	$\frac{812}{2,625} \times \frac{100}{1}$
	=	31%

F.6,5: Summary of development

A 48% increase in cow numbers, a 184% increase in fertilizer rate and a 59% increase in production are features of the development of this farm. These changes have, to a large extent, been made since the close of the 1958-59 season. Changes in the winter feeding of the herd and increased use of potash have been associated management changes.

Although production per acre fell below expectations in the 1960-61 and 1961-62 seasons the farmer considers that herd improvement will make some contribution to increased production as annual increases in herd size fall. The planned herringbone cowshed should allow the farmer to improve milking management.

This farm is notable for the increases in production in the 1961-62 season. This was a very dry season in coastal areas of South Taranaki, and production fell on most farms in the Pihama area. The farmer attributed this increased production to:

(a) An increase in stocking rate.

(b) An increase in fertilizer rate. Pastures appeared to respond to light showers which fell from time to time throughout the dry period.

(c) Improved pasture density resulting in part from (a) and (b).

(d) Maintaining a high stocking rate throughout the season. Many farmers started to dry their herd off in January, 1962.

Taxable income increased by £1,086 over the period and earned a 31% rate of return on added capital.