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LAND USE IN THE MANAWATU -
POSSIBLE IMPACT OF A NEW AGRICULTURAL PROCESSING INDUSTRY

A thesis presented in partial
fulfilment of the requirements for the degree
of Master of Arts
in Geography at
Massey University

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1978

ABSTRACT

The decision of the Canterbury (N.Z.) Malting Company to expand and to locate its second barley processing plant near Marton has meant that considerable land use changes may occur in the surrounding farming area, particularly the Manawatu coastal lowlands and terraces.

A mail survey of 600 farmers in the Kairanga, Manawatu, Oroua and part of the Rangitikei counties found that of those responding, 51 farmers had definite intentions of growing barley for processing into malt and 74 possibly would do so. It was difficult to establish how much land would be affected because policy matters, such as returns, had not been established at the time of the survey. The plant requires over 30,000 tonnes or 7,000 hectares of barley annually once maltings are in full operation.

Interesting observations were able to be made, however, with respect to characteristics of farmers likely to grow malting barley, how information about the malting barley plant has been diffused, and attitudes of farmers towards growing barley and engaging in contracts.

The Manawatu is now an established mixed cropping and fat lamb farming region and the establishment of the malting barley plant should strengthen this position. Land use changes may occur in terms of changing cropping patterns if malting barley replaces other crops, but the impression gained is that most of the malting barley will be grown on land formerly in pasture. The nature of barley as a crop, with a short growing period and the ability of the pasture to be renewed with improved species in winter, means that the increased cropping may be complementary to the existing cropping/fattening pattern and enhance agricultural productivity in the region.

ACKNOWLEDGEMENTS

Many friends and colleagues have offered moral support and practical help during the three years of my Masterate studies. With reference to this thesis I wish to thank in particular:

- my Supervisor, Mr E.C.R. Warr of the Geography Department, assisted by Dr A.D. Meister of the Agricultural Economics Department;
- Professor Thomson and other members of the Geography Department, notably Mr R.G. Heerdegen and Dr A.C. Walsh and the secretarial staff;
- staff of the Photographic Unit, Massey University;
- Mr H.P. Kearney, Manager of the Canterbury (N.Z.) Malting Company, and Research Officers Philip Wauchop and John Biggs;
- Peter Whitehead and Ian Lamb for introducing me to the realm of the computer world;
- on the domestic front, considerable help has been proffered by my parents, Win and Allen Coulter, and Karitane Nurse Colleen Oldfield;
- most importantly, I am indebted to the forbearance of my three small children - David, Anne and Clare - and especially to my husband Barrie who has alternately bullied and supported me throughout my studies.

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CHAPTER ONE

RESEARCH PROBLEM AND DESIGN

DESCRIPTION OF THE PROBLEM

Now that a malting industry is being established at Marton, the competition for cereal grains will increase and an upsurge in cropping will result (Ministry of Agriculture and Fisheries, 1977, 23).

On 7 July, 1978, the Canterbury (N.Z.) Malting Company announced that it would definitely proceed with the proposed \$12 million malting barley plant near Marton. Malting, it was hoped, would commence after the 1979-1980 barley harvest, utilising 30,000 tonnes (approximately 7,000 hectares) annually once in full production. The introduction of this firm is likely to have considerable impact on the farming patterns of the Manawatu and adjoining regions and as such is of interest to both geographers and agriculturalists.

The research problem is to study the likely impact of the malting barley plant on established land use patterns in the Manawatu and on the economic life of the region affected by malting company decisions. In doing this, considerable attention is given to farmer behaviour in an attempt to explain why farmers adopt new agricultural ideas and practices. The growing of barley for malting is seen as an example of a new agricultural practice in this region.

The decision of the malting company to locate its second plant near Marton follows a feasibility study finding Marton to be the least cost location of four studied and close to all necessary resources, the most important being a considerable supply of barley. The necessity of the company to expand has arisen from the large domestic demand for malt, ultimately to be used in the brewing of beer, and a new but increasing export trade in malt.

The plant, as a new input in the land use system of the Manawatu, will provide a stable outlet for barley. Over the past decade considerable areas of barley have been grown in the region for stock feeding purposes, with surplus production filling Auckland and Tauranga markets. The recent reduction in this trade due to changing transport policies has meant that the growing of barley for malt may replace some of this area and perhaps some in other crops such as wheat. On the other hand, much of the area growing malting barley may be land taken out of pasture for cropping for a short period of the year. If pasture replacement occurs, followed by the establishment of new pasture with improved species, and is carried out in conjunction with the farm rotation system including lamb fattening in the winter months, then the entrance of the malting barley plant into the region may boost agricultural productivity and confirm the Manawatu's recent position as a mixed cropping/livestock fattening region. Should this occur and should the majority of the plant's requirements be met from within the Manawatu, the impact will not only be felt by farmers but also by those servicing the agricultural industry.

AIMS OF THE STUDY

To study the likely impacts of the plant, this research focuses on analysing the possible changes that may occur in an area affected by malting company decisions. A series of propositions about these likely changes will be formulated and will be tested by means of a major mail survey of farmers and a smaller survey of service companies.

Theories and principles of agricultural geography are utilised to help explain how land use patterns develop and to see how a major land use change represents the aggregate of a number of land use decisions on the part of individual farmers.

Nature of Agricultural Geography

The scope of geography as a discipline is wide, incorporating concepts and methods of other disciplines from the physical sciences to the humanities. Its principle concern is the

investigation and understanding of spatial patterns of human and physical phenomena on the earth's surface, and their interrelationships (Symons, 1970, 1).

Its distinctive point of view is that it puts space and location first. Coppock notes that

ideally there should not be divisions in geography, but in practice it is impossible for anyone to have greater than a superficial acquaintance with the whole field so geographers tend to specialise by area and topic. (Coppock, 1968, 154).

This study topic falls within the realm of agricultural geography which is defined as

the description and explanation of the spatial variations of agriculture. (Gregor, 1970, 2)

and has emerged as an entity since the early twentieth century. Bernhard, as early as 1915, stated that agricultural geography is at the service of both 'agriculture and geography' while Coppock, in 1968, called for greater co-operation between agricultural economists and agricultural geographers (Coppock, 1968, 166).

Agricultural geography is frequently regarded as a branch of economic geography, utilising a number of economic concepts (Morgan and Munton, 1971, 3). Economic models of agricultural location and decision making have been employed but increasingly agricultural geographers, as well as economists, have realised that man is neither fully rational nor fully informed when making economic decisions. Instead, his decision environment is only part of the real environment and his objectives may not be solely economic. Moreover, the element of stochasm or randomness exists - two farmers in identical situations may make quite different land use decisions (Found, 1970, 133). In agricultural geography, the

farmer's decision to opt for a certain enterprise and to adopt innovations which may intensify or alter his production pattern are seen as a product of situational, economic, personality and social forces. The farmer's objectives are thus of paramount importance. If a number of farmers adopt a similar innovation or farming system, the aggregate of these decisions will have a discernible impact on the land use pattern of the area and perhaps be sufficient to mould a distinctive agricultural region.

The ecological or man-environment component of agricultural geography is also relevant to this study topic. It is based on the idea 'that the multitude of natural and human objects and attributes in an area are closely related to each other and interact with one another' (Blunden et al, 1978 vii). In agricultural geography, agricultural systems are recognised simply as distinctive types of man-modified ecosystems and show that while the physical environment does not determine what farming enterprises can occur, it does set broad constraints over which enterprises can be successfully performed. Harris regards agriculture as 'an integral part of the environment in which it practised' (Harris, 1969, 134) while Munton shows that the outputs of the ecological system are transformed by the farmer's decisions and management into inputs of the economic system (Munton, 1969, 148). Rutherford also links the economic and ecological viewpoints by applying general systems theory to the study of agricultural geography, showing how a nested hierarchy of systems exists ranging in magnitude from the on-farm ecosystem to economic links between groups of farms and major national and international markets (Rutherford, 1970, 53-57).

Being a geographic study, this topic also takes note of the spatial analysis paradigm which sees all phenomena located at certain points on the earth's surface and attempts to show patterns and interaction processes. In agricultural geography, the location of agriculture as an economic activity is important, with location theories describing what forms of

agriculture should occur at certain locations or why land use patterns have developed. The location aspect is also important when examining the diffusion of new agricultural ideas and practices.

This study thus utilises the overall framework of agricultural geography, stressing the economic, ecological and spatial components, to look at factors affecting farmers' decisions to adopt or reject innovations which in turn help intensify existing land use patterns or formulate new ones. The individual farmer is seen as the key component, the sum of a number of land use decisions having considerable impact at local, regional and national levels.

RESEARCH DESIGN

A series of propositions has been formulated, some based on previous studies of innovation adoption and diffusion, for example, while others are more predictive in nature. Within each proposition a number of null hypotheses have also been formulated, comparing farmers who intend to grow malting barley with the total population on a number of factors.

The propositions attempt to explain how and why change could take place consequent upon the establishment of the malting barley plant. They attempt to grapple with why farmers adopt innovations and how such innovations (for example, the decision to grow malting barley) spread as well as the likely effects the new firm could have on current land use patterns and agricultural services.

Propositions

The propositions are:

1. That farmers possessing certain characteristics are more likely to be receptive to innovation and change. These characteristics include:
 - youthfulness
 - higher levels of education

- farming experience
 - higher total indebtedness
 - larger size of farm
 - propensity of son(s) to inherit the family farm.
2. That the diffusions of information about the entrance of the malting barley plant will be through three main communication channels:
- i) Face-to-face contact
 - Malting company representatives
 - M.A.F. and private consultants
 - seed and grain agents
 - innovative neighbours
 - ii) Group contact
 - discussion groups
 - field days
 - club membership
 - iii) Mass media
 - agricultural publications
 - television and radio
 - newspapers.
3. That the components of land use are dynamic. At any given point in time, however, they are in a state of equilibrium, but a new input may cause modification of the balance of the components of the land use system. Therefore:
- i) The malting barley plant as a new input will alter the equilibrium of the existing land use pattern by creating a new demand with stable economic returns for a crop readily grown in most parts of the region.
 - ii) For areas designated suitable for intensive cropping by D.S.I.R. Soil Bureau, there will be a move from:
 - feed to malt barley;
 - from other crops, especially potatoes and maize, to barley;
 - from pastoral farming to more intensive cash cropping.
 - iii) The disturbance of the equilibrium for the region will be great if the plant is to obtain its 30,000 tonnes (7,000 hectares) required annually from within the Manawatu, but for the individual farm change will

be relatively small scale and short term.

- iv) This disturbance of the equilibrium could have consequences outside the Manawatu if the plant cannot establish its supply area here. In this case the supply area will have to be extended to the Northern Wairarapa and Southern Hawkes Bay, distance becoming an additional cost factor.
4. The establishment of the malting barley plant at Marton will have only limited impact on the economy of the Manawatu in general and of Marton in particular.

Data Gathering

The initial intention was to attempt to predict the likely impact of the proposed malting barley plant on rural land use on the basis of the actual impact caused by the existing local processing industries. Letters seeking cooperation were posted to two local food processors and met with no response. Further letters to the same firms evoked a telephone call from the manager of one firm who felt that he could be of little assistance because his firm bought its inputs on the open market, with no contracts operating, and was on a small scale. The lack of response from the other firm meant that this part of the study was shelved.

Cooperation from the Canterbury (N.Z.) Malting Company was also sought and confirmed. Initial talks with Mr Philip Wauchop and Mr John Biggs, both research officers, yielded areas of interest and concern and were endorsed by the manager of the firm in Christchurch, Mr H.P. Kearney. The lack of definite intention of the company for many months, due to an internal shareholder takeover bid within Lion Breweries, the major shareholder of the malting company, meant that much of their information and field research was on a hypothetical basis.

A questionnaire was deemed necessary for the main data gathering effort, to attempt to predict the potential area of

malting barley and the types of land use it could replace as well as assessing attitudes of farmers to change in general and malting barley in particular. The final questionnaire comprised two parts. Part A sought demographic data and to build up a profile of the farmer population, particularly attitudes towards change in general. Part B pertained more to cropping - past, present and potential - and sought a commitment of intention as to growing malting barley.

1. Sample Frame

A sample frame, numbering 600, was drawn up at random from the four county electoral rolls, updated to September 1977. One hundred and fifty farmers from each county were selected, a 'farmer' being a ratepayer who was also rated on a Pest Destruction or Catchment Board. Equal numbers were chosen from each county as the number of 'farmers' in each was similar (Table 1.1).

Table 1.1: Sample Frame

County	No. 'Farmers'	No. Selected	Total Responses Percent	Completed Responses Percent
Kairanga	722	150	27	27.3
Oroua	704	150	22	20.0
Manawatu	743	150	29	30.2
Rangitikei ^(a) (part thereof)	750	150	22	22.5
TOTAL	2919	600	100	100.0

Source: Electoral Rolls, 1977, and Field Survey, June 1978.

(a) Rangitikei bounded Turakina Valley to the northwest and Hunterville and Rangitikei River to the north and east.

2. Response

The intention was to look at possible change within the full spectrum of farming types, from small to large holdings and from pastoral to arable enterprises. Of the total of 471 responses, however, only 315 were 'analysable'

due to farmers feeling that the questionnaire was inapplicable due to the scale or type of their enterprise while a few declined to participate. Problems arising from the sample frame meant that over ten percent (62) of the total were actually residential sections only, and four recipients had died prior to September 1977, one as far back as 1973. Thus of the 600 questionnaires sent, the following result was obtained:

315 were completed;

156 were not completed of which: -

62 were residential (less than 5 ha)

15 were smallholders (6 to 50 ha)

17 were not engaged in cropping

26 had leased out their land

8 declined to participate

19 were returned to sender

5 were deceased

4 were duplicated

129 did not respond.

Thus despite the overall response rate of 79 percent, completed returns amounted to only 53 percent of the total mailing. If incompleted responses arising from the sample frame are excluded (namely residential, return to sender, deceased and duplicated - totalling 90) then the response rate of completed returns rises to 62 percent. This was not unexpected and a total of 300 completed returns was the aim. A stratified sample of arable farmers may have reduced this wastage, but would also have reduced certain parts of the analysis desired, for example discovering how many non cropping farmers may change land use.

A smaller questionnaire was posted to seed and grain merchants in Palmerston North, Marton and Feilding and to contractors in the four counties, being a complete sample taken from the yellow pages of the telephone directory. Responses from the merchants was pleasing, with 9 out of

12 replying while only 2 of the 16 agricultural contractors responded.

3. The Mail Questionnaires

The decision to opt for mail questionnaires was based on the obvious advantages of 'low cost, geographic flexibility and simultaneous dispersal' (Kanuk and Berenson, 1975, 440) as well as the absence of interviewer bias and pressure. It was essentially a broad spectrum questionnaire rather than an in-depth survey which may more usefully be carried out in person. The disadvantages of traditionally low response rates (Ambler, 1977, reports variations from 39 to 73 percent; Kanuk and Berenson, 1975, from 28 to 100 percent) and bias from both incomplete returns and nonresponse were felt to be outweighed. Every effort was made to increase the response rate before, during and after first wave mailing of the questionnaire, thus attempting to reduce such bias.

i) Response Rate

The first criticism of mail questionnaires concerns the traditionally low response rates. Attempts to increase both the speed and level of response were classified by Kanuk and Berenson (1975, 441) as by timing (preliminary, concurrent and follow up techniques) and by technique (questionnaire length, format, sponsorship, anonymity and so on). Kanuk and Berenson survey the literature on mail questionnaires in the United States within such a framework.

- a) Preliminary notification of a self administered survey is a recognised means of encouraging response. Bourke (1978) in a survey of New Zealand households found that a preliminary letter and one follow up elicited a faster but not a higher response than two follow ups but no prenotification. Kanuk and Berenson (1975) concluded also that multiple follow ups tended to elicit a better response than preliminary letters.

Prenotification of individual farmers was therefore not undertaken but several attempts were made to increase the response. The questionnaire was posted 16 June so as to arrive near the 20th of the month, the traditional time for farmers to do their monthly bookwork. It was preceded coincidentally by a cover article in *New Zealand Farmer*, 8 June, 1978, on cropping in the Manawatu. There were also considerable feelings of dissatisfaction among farming groups as to the lack of definite intention of the malting company. A personal interview on Radio 2ZA about the questionnaire was conducted and it became an item on local news. Thus interest in the questionnaire was aroused although its effect and possible bias cannot be measured.

- b) Follow ups or reminders are a widely recognised means of increasing both the level and speed of response. Postcards or letters containing replacement questionnaires are sent at certain intervals after first wave mailing, each follow up bringing added returns. Kanuk and Berenson (1975, 441) report response rates of 95 to 100 percent after three follow ups. Single follow ups yield a less dramatic but still significant percentage to overall response. Ambler (1977) noted that a single follow up could increase response by fifty percent.

In this survey 416 follow up postcards were posted 26 June, ten days after first wave mailing. While it is not possible to statistically estimate the effect of the follow up due to the absence of a control group, the probable effect can be observed in Figure 1.1, the daily return of completed returns. An initial surge had dwindled by Day 12 and revived Day 13 by which time the follow up should have been acted upon.

No further follow ups were posted, due to the high initial response and time limits, but a small article written for the Federated Farmers column of the Manawatu Farmer, a small weekly paper going to every rural residence in the four counties, may have evoked the small increase on Day 24. Likewise the malting company's announcement of intention to proceed with the plant may have resulted in the final surge on Day 28. (Figure 1.1). On a weekly basis, over ninety percent of all responses, complete and incomplete, were received within the first four weeks.

- c) Concurrent techniques are 'all the techniques embodied in or peripheral to first wave questionnaires' (Kanuk and Berenson, 1975, 441). They include not only the physical characteristics of questionnaire length and format but also personality features such as the appeal of the cover letter, the degree of anonymity assured and survey sponsorship. In questionnaire design a pilot survey is very beneficial in helping decide the effectiveness of the cover letter, the sequence of questions and the overall rapport likely to be achieved between the absentee interviewer and the unknown respondent in the mail survey situation.

In this study, it was decided that problems of questionnaire design could be partially overcome by sending out a pilot survey. Ten questionnaires were sent to farmers and met with only two responses. Two possible factors for this poor response were believed to be lack of apparent university sponsorship and untitled signature. Certainly, having the cover letter of the main questionnaire printed on official Massey paper improved its appearance and impact. (Appendix A). The length was kept to six pages and the majority

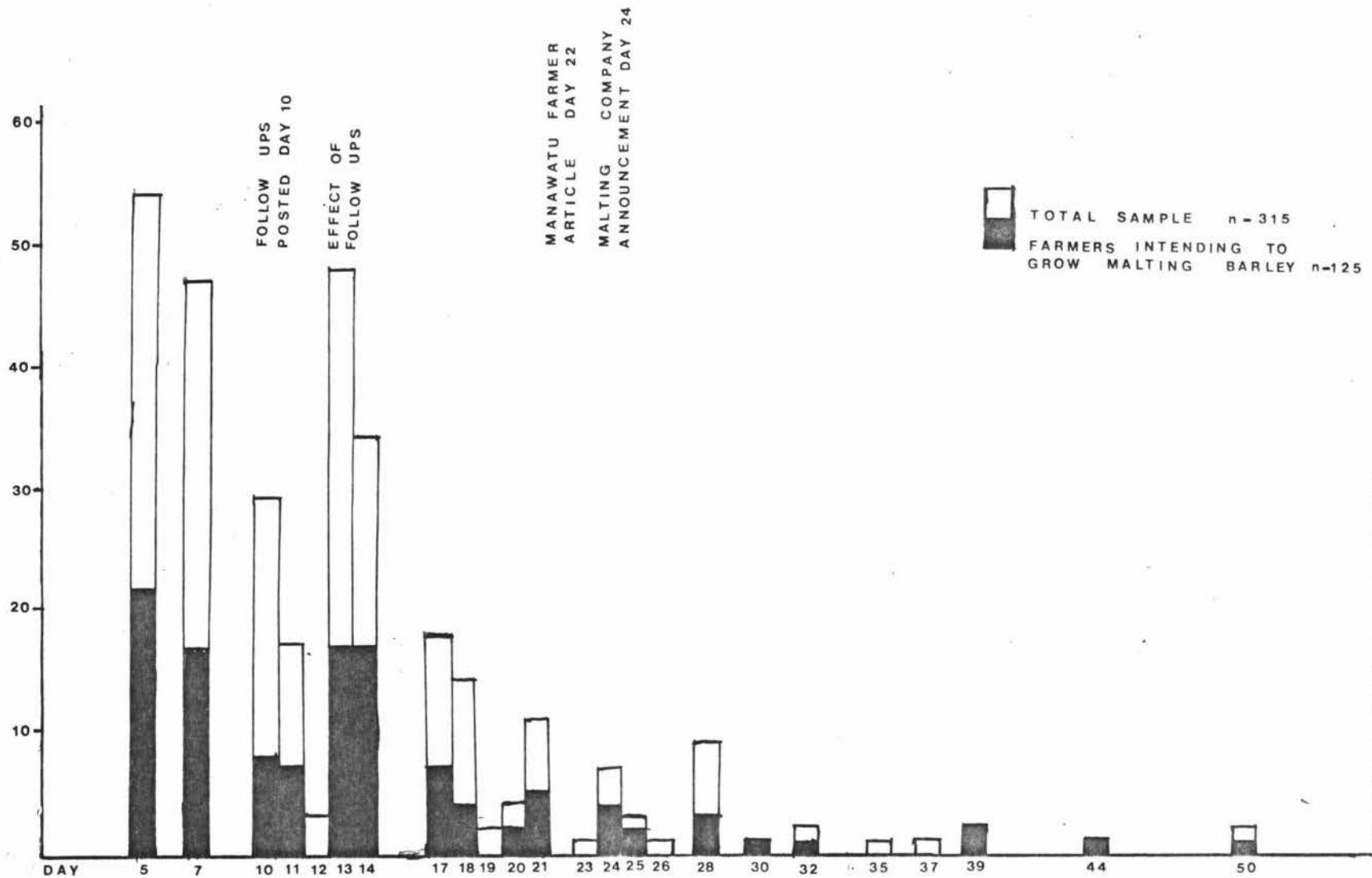


Figure 1.1 DAILY RESPONSE OF COMPLETED RETURNS
Source FIELD SURVEY ; JUNE 1978

of questions multichoice. The outward mailing envelopes had photocopied address labels, fifty percent being typed, the others hand written. Tests found no significant difference of the type of label on response. The format of the reminder postcard was based on Ambler (1977, 17) and bore further photocopied address labels (Appendix B). The format of the questionnaire to seed and grain merchants and agricultural contractors was similar to that sent to farmers but on a much smaller scale (Appendices C and D).

ii) Bias

The second main criticism of mail surveys is the problem of potential bias due to incomplete returns. Parten in 1950 is adamant that

unless every effort is exerted to adjust for nonresponse, or to obtain practically complete returns from everyone solicited by mail, the technique should not be used. (Wells, 1966, 483).

Similarly Goode and Hart (quoted Wells, 1966, 483) suggest that its effectiveness is limited, not so much because bias exists but because its nature and extent are not measurable. Nonetheless it has been and is being a widely used research device, mainly because methods have been devised to estimate the degree of bias and determine a correction factor. A response of at least fifty percent is usually required before analysis can commence.

Methods of estimating bias include comparing information from the sampling frame with that gained by telephoning or personally interviewing a sample of the nonrespondents so as to compare differences between respondents and nonrespondents. Burton and Cherry (1970) note that late respondents have characteristics more align^{ed} to nonrespondents than to early respondents.

Ferber cautions:

The problem of nonresponse bias must be considered with specific reference to a particular question or characteristic. The presence of bias in one question does not mean a priori that the replies to the other questions on the same questionnaire are also biased. (quoted Kanuk and Berenson, 1975, 449).

People likely to respond to mail questionnaires would appear to have reached a higher level of education, have more interest in the topic, be higher in leadership, more responsible, tolerant and so on. Wells noted that the demographic, socioeconomic and personality characteristics of respondents are similar to those ascribed by diffusion researchers to early adopters of new ideas and practices (Wells, 1966, 483). He tested and affirmed a hypothesis which supported the idea that early adopters require a shorter decision making period than do relatively later adopters and that the decision to answer or reject a mail questionnaire is a process similar to the decision to adopt or reject a farm practice or idea. Wells' hypothesis was not supported by this survey. The rate of return was almost identical between the farmers intending to grow malting barley and the total sample. (Figure 1.1). This would also tend to disagree with Burton and Cherry's idea that late respondents have characteristics more align to nonrespondents than early respondents.

Data Analysis

The responses of the major survey were coded and analysed by S.P.S.S. (Statistical Package for the Social Sciences) on the B6700 computer at Massey. Tables of data are presented where description only is required. Where attempts are made at explanation, especially to test the propositions formulated, more sophisticated methods are utilised. Discriminant analysis was attempted to test Proposition One but the large amount of information left unexplained by this method led to

its exclusion from the text although tentative conclusions have been drawn from it. An attempt to use non-parametric correlations was unsuccessful, because the S.P.S.S. Version Six Package for discrete data on the B6700 computer at Massey was then incomplete, but the new S.P.S.S. Version Seven Package has recently arrived from Davis, California. Replacement by the simpler Chi-Squared tests of significance were undertaken for the first three propositions while data for Proposition Four was obtained from the smaller questionnaire and not analysed statistically due to the small number of cases. (Refer Appendix J for details of Chi-Squared test procedure).

THESIS ORGANISATION

The structure of the thesis is based on the four propositions, with literature reviews being interwoven with data analysis due to the wide range of concepts covered in the thesis.

This chapter has outlined the research problem and design. Chapter Two takes a detailed look at the study region - its physical characteristics as well as its development as an agricultural region. Chapter Three studies innovation adoption and tests Proposition One, followed by innovation diffusion and the testing of Proposition Two. Chapter Four outlines location theories while Chapter Five attempts to explain the likely impact of the plant on the land use region of the Manawatu. Chapter Six attempts to assess the impact on agricultural services in Marton and the Manawatu of the plant's establishment. Finally Chapter Seven concludes the research by summarising the results of the analysis and by pointing the way to further research in this field.

Due to the wide scope of the thesis and the lack of definite intention of the malting company for more than half the duration of the research, not all aspects have been able to be covered equally thoroughly and many possibilities exist for enquiry into the actual impact of the plant once it is in full operation.

CHAPTER TWO

THE STUDY REGION

The chosen study area is part of the Manawatu region, comprising the three counties Kairanga, Oroua and Manawatu as well as the southern portion of the Rangitikei county. Rangitikei county is formally part of the Wanganui rather than Manawatu region but its inclusion was considered essential in the survey as it may well be the core supply area for the malting barley plant. (Figure 2.1).

Three counties frequently included in the Manawatu region - Pohangina, Kiwitea and Horowhenua - were excluded from the survey due to the need to limit the study area, although it is recognised that considerable areas in these counties are suited to cropping and sown in barley annually, especially in Kiwitea and Horowhenua (Table 2.1).

Table 2.1: Potential and Actual Crop Land by County 1975-76

County	Total Area (ha)	Potential Crop Land(a) (ha)	Area Actually Sown (ha)			
			Barley	Wheat	Peas	Maize
Rangitikei ^(b)	355635	7053	3740	1609	169	193
Kairanga ^(b)	40870	2666	1284	607	-	183
Horowhenua	81289	3289	748	41	250	210
Manawatu ^(b)	60906	2196	1694	312	111	224
Oroua ^(b)	43966	2675	1551	623	156	-
Pohangina	44197	628	271	-	34	305
Kiwitea	74314	1931	977	155	161	-

Source: Department of Statistics Bulletin 2, Land Use, Cropping and Plantations, 1975-1976, 6, 17.

- (a) Land suitable for all forms of cropping, including horticulture.
- (b) Counties included in the study area.

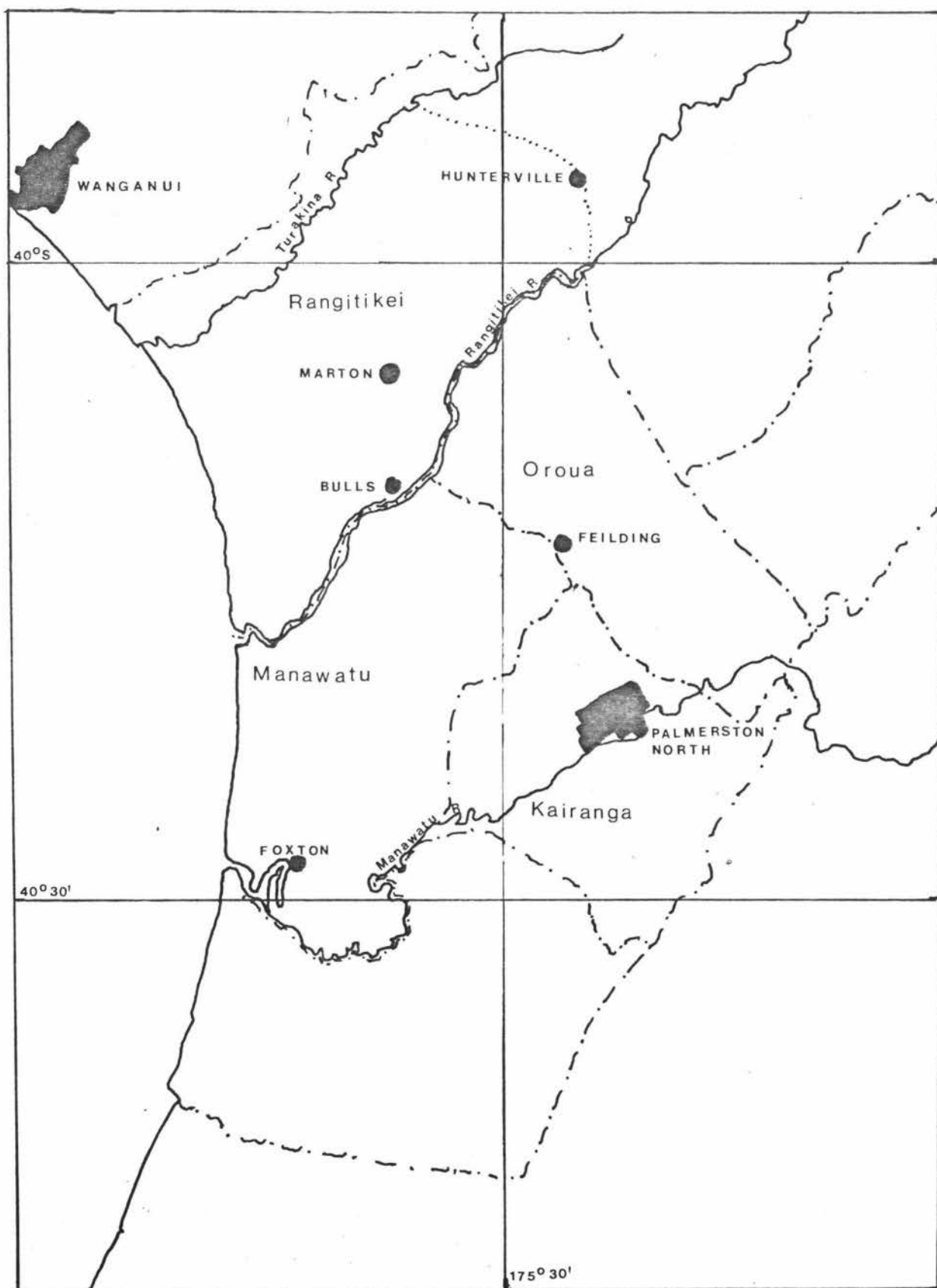


Figure 2.1 STUDY AREA - COUNTIES
 Source Anderson, 1961, 42 and Cowie, 1977, 6.

From Table 2.1 it can be seen that the four counties chosen had the greatest area of barley sown 1975-1976, with the total barley area of Rangitikei being over half the malting company's requirements if feed barley was not grown. The area sown in barley in Rangitikei was more than twice that of the next two biggest barley regions, Manawatu and Oroua. It is important to note, however, that these are areas sown rather than harvested and that requirements of malting barley mean that considerable barley production may be rejected if it is not of sufficiently high quality.

The aim of this chapter is to describe the physical characteristics of the region and their potential for agriculture, especially in relation to the D.S.I.R. Soil Bureau 'limitations for food production' criteria. This is followed by a brief survey of the evolution of agricultural patterns in the region with statistics on the current pattern both from the Department of Statistics and my survey.

TOPOGRAPHY, SOIL TYPE AND AGRICULTURAL USE

The topography of the study area, with related soil, drainage and farming patterns, can best be seen within the framework of the dichotomy of the Manawatu - the coastal lowlands and the eastern ranges and their components. (Based on Cowie, 1961, 15-20).

1. The Coastal Lowlands

The coastal lowlands occupy the majority of the area and rise inland to a height of approximately 550m (1700 feet). Three distinct areas can be distinguished:

i) Sand Country -

- a) Foredune area = unstable raw sand subject to wind erosion which stretches to about a half mile inland from coast and is unsuitable for agriculture.
- b) Dune area = more consolidated, more mature inland sand country, extending inland to a maximum of

sixteenkm (at Rangiotu). For agricultural purposes, the more northern sands (Waiterere and Hokio sands) are suitable only for exotic forestry. Further south with greater profile development, the Pukepuke sands support dairying as do the sands of the Foxton phase while the Himatangi and Omanuku sands provide winter runoffs for rough sheep and cattle grazing.

- * ii) Alluvial plains/river flats - have been built up by the deposition of alluvium from rivers draining the hinterland (in particular the Manawatu, Oroua and Rangitikei Rivers) and are characterised by relatively low elevation, level topography and recent development.
- a) Bordering the main rivers are low lying flats, with frequent flooding and build up of alluvium, the soils generally being sandy and showing little profile development. They are mapped as Rangitikei soils, have excessive drainage and danger of flooding limits utilisation.
 - b) The levees of the main rivers where flooding and accumulation are less frequent, there is slightly more profile development. They are mapped as Manawatu soils and have deep topsoils, are well drained and hold moisture well throughout the year. High natural fertility renders them suitable for market gardening, stock fattening, cropping and dairying although structure deteriorates under intensive cropping or during wet periods.
 - c) Low lying parts of the river flats with poor drainage. These soils are mapped as Kairanga soils and are characterised by greyish brown silt topsoils overlying grey clay or clay loam. They are fairly fertile but need drainage to support dairying and cropping. Even with drainage these soils are wet in winter.

- d) At river mouths the soil is salty and brackish. These soils are mapped Meanee soils. With protection from flooding and with drainage, high producing pastures can be maintained.
 - e) Peat can be found in very low lying areas of the river flats. The Opiki soils are high in plant nutrients and when drained are used for cropping (potatoes and onions), dairying and stock fattening.
- iii) Terraces and hilly land - the apron of semidissected flat land adjacent to the ranges. It is well drained by streams such as the Tiritea and Kahuterawa, and has a maximum width of 6.4 km at Palmerston North. Two soil types predominate;
- a) Yellow grey earths formed from alluvium, loess and sandstone. They are characterised by weak-structured topsoils with compact subsoils which become impervious in autumn, causing topsoils to become waterlogged. These soils dry out in summer but need drainage in winter to remove excess water. They include the Ohakea, Tokomaru, Milson, Marton, Halcombe, Raumai, Aokautere hill and Pohangina steepland soils. They are fairly fertile and with drainage high production is possible, mostly stock fattening with some dairying and cropping (wheat and barley).
 - b) Yellow brown loams have been formed from sediments laid down in the late Tertiary and Pleistocene periods and which have been exposed by the dissection of the terraces, containing also appreciable quantities of andesitic ash. They are mapped as the Kiwitea, Levin and Kawhatau soils. They have dark brown topsoils with well developed structures overlying yellowish brown friable subsoils. They occur under higher rainfall than the yellow grey earths and are moderately fertile and well draining, being used mainly for fattening stock with some dairying. (Figure 2.2).

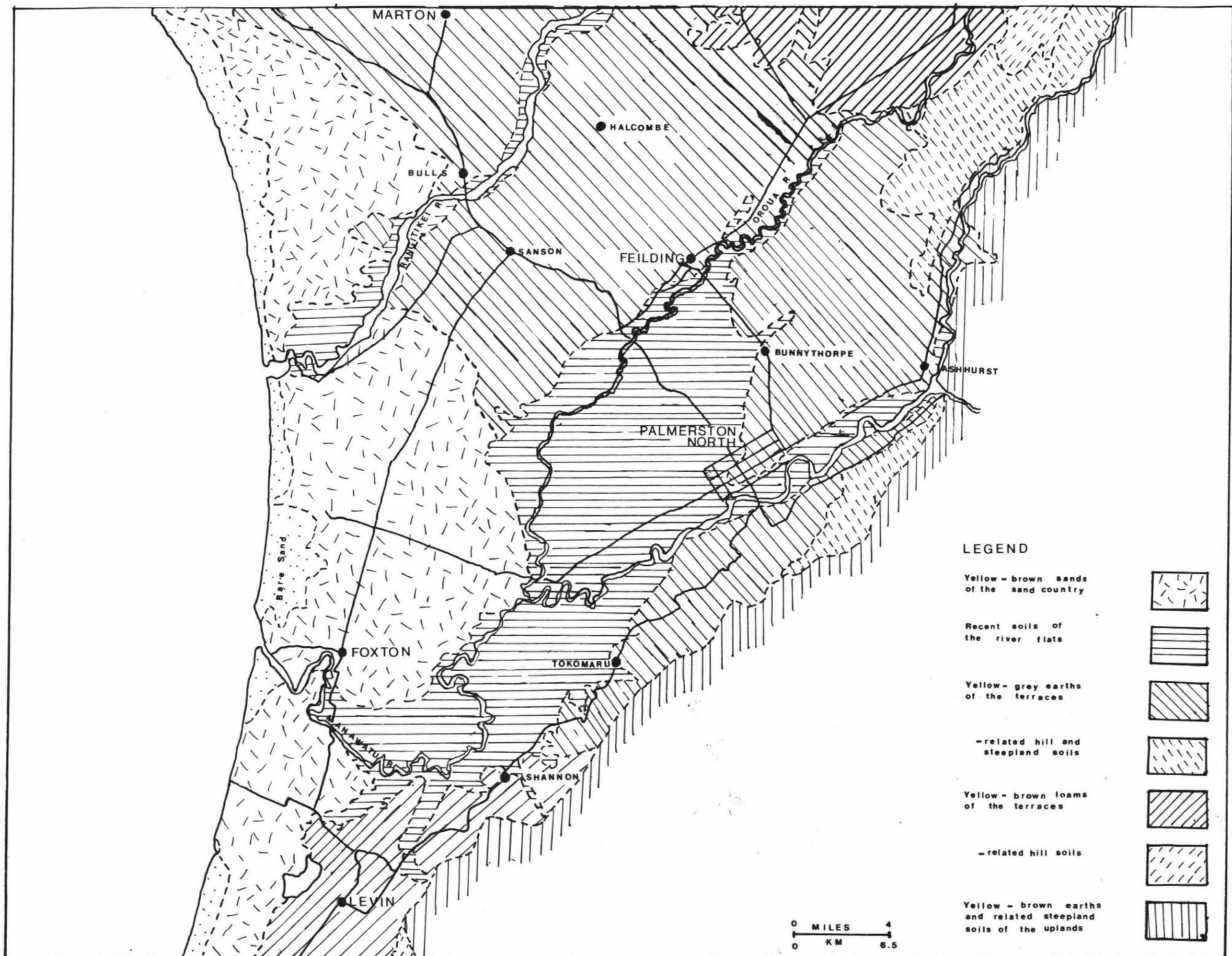


Figure 2.2
Source

SOIL MAP OF THE MANAWATU DISTRICT
Cowie, 1961, 19.

The rising of the coastal plain from the coast as it moves eastward has been associated with the rapid emergence of a series of six anticlines running northeast-southwest and which are associated with the river regimes which also have a strong westerly tendency.

2. The Ranges

The ranges have been formed from greywacke sandstone and comprise the lower lying Tararuas to the south of the Manawatu Gorge and the more sharply rising Ruahines to the north. While a marginal area for intensive agriculture, there are in the Tararuas extensive areas of hilly, rolling and even flattish slopes in the 1,270 mm - 1,778 mm (50-70 inch) rainfall belt which, although of moderate to low fertility, can support ryegrass-white clover pasture if topdressed. The Ramiha and Makara soils, for example, support store sheep and beef grazing. (Refer Heerdegen (1972) for geological formation of these areas).

Soil Limitation for Cropping

The soil description presented in the preceding section has been widely used and is well known. In 1974, however, Mr Cowie of the D.S.I.R. Soil Bureau in Palmerston North presented a rating of local soils as to their limitations of drainage, susceptibility to flooding and other factors on potential urban use and on food production. Within 'food production' he further rated the soils according to their suitability for horticulture, cropping and pastoral farming.

The classification of soils by their limitations for cropping purposes, while not widely known, is presented due to its relevance to the topic. Maps showing the distribution of these soil ratings for the study area and the classification details are to be found in Appendices E to I. The maps do not correspond to the four counties apart from that of Oroua, however all of the study area is included with

Kairanga county, for example, encompassing part of the Palmerston North and part of the Tangimoana map.

An attempt was made to plot the location of farmers intending to grow malting barley on the soil limitations for cropping maps. A large number (50) of those intending to grow malting barley, however, have leased additional land yet location maps only give the homestead site on the home farm. Thus any attempt to correlate intention to grow malting barley with soil type are invalid, for even on home farms two or three different soil types may be encountered. Moreover, respondents were assured anonymity and confidentiality so the location of farmers intending to grow malting barley have not been published. It appears, however, that much of the land is Class 2B, especially surrounding Marton and in the Kairanga. Elsewhere pockets of land are to be found of varying suitability for cropping. (Appendices E - I).

CLIMATE

The Manawatu experiences a relatively moderate climate with few extremes of temperature or rainfall. The rainfall is adequate for cropping with 813 mm (32 inches) near Foxton increasing to 2540 mm (100 inches) at the crest of the ranges. The area utilised for cropping experiences 813 mm (32 inches) to 1143 mm (45 inches) annually. Summer droughts in recent years have led to the introduction of water harvesting around the Halcombe area (conserving winter run-off in earth dams) for irrigation on some properties. Drainage is necessary on many farms to support intensive cropping. Over the years the rainfall has shown an even annual distribution, with major summer droughts occurring in 1969 and 1972.

The temperatures are also moderate, but large diurnal ranges occur especially in summer. The average annual temperature at Palmerston North is 20°C (54.8°F). Sunshine hours are reduced by the general windiness and associated cloud cover, with calm conditions occurring only 30 percent of the year.

Ground frosts occur on an average of 61 days per year, being worst during the months May through to September.

TRANSPORT AND COMMUNICATIONS

The Manawatu is well serviced by road and rail. Foxton was important when the first railway was established in the late nineteenth century, but the main trunk railway line, completed in 1909, bypassed Foxton assuring its stagnation. Palmerston North was established later than Foxton, but grew at Foxton's expense once the line was put through, Palmerston North being the junction to the Wairarapa and Hawkes Bay. Similarly Marton grew as a rail junction to Taranaki and Auckland.

With improved road transport, smaller service centres such as Rongotea and Sanson stagnated for some years but recently have grown as dormitory settlements. The key agricultural service centre of the Manawatu is Palmerston North, in which the head offices of many of the firms in Marton and Feilding are located. The relaxing of the forty mile limit on road transport has meant that the development of bulk road carriers will continue.

It is usual practice for farmers to pay for the transport of their grain to the nearest rail-head themselves, the purchaser paying transport costs thereafter. Policy matters such as transport to the plant have not yet been publicised by the malting company but will be outlined at the next field day to be held February, 1979.

DEVELOPMENT OF A LAND USE REGION

While models have been utilised to help explain areal variations in agricultural land use, the identification of these variations has been facilitated by the concept of the land use region, used for descriptive purposes in agricultural geography.

Land use regions or type of farming areas are often difficult to identify and define due to variations in scale and complexity. They are defined by Found as 'a spatially contiguous grouping of aerial units which exhibits a degree of uniformity in land use type and/or intensity' (Found, 1970, 83). The land use region is thus an idealised model or concept developed to characterise or simplify aspects of the real world.

Famous land use regions in the United States include the wheat, corn and cotton belts, yet a land use region may be on a much smaller scale, perhaps a dozen contiguous farms. Even within a recognised land use region, the predominant enterprise may be relatively small compared to the total area. Found, for example, notes that much of the U.S. cotton belt has only about five percent of available cropland actually in cotton (Found, 1970, 84). Difficulties also arise in defining the boundaries of land use regions, boundaries varying between broad transitional zones and abrupt changes.

Spencer and Horvath (1967) differentiate between a mature or established agricultural region and a distinctive landscape. Both are elements of an evolutionary process, the mature region not being static but subject to secondary changes. Spencer and Horvath regard the American corn belt as a clearly identified, mature agricultural region while the Philippine coconut and Malayan rubber landscapes have not yet reached such maturity. They see six forces at work in the evolutionary process - psychological, political, historical, technological, economic and agronomic - the result representing the landscape expression of a farming 'mentality'.

A farming "mentality" in this context refers to the totality of the beliefs of the farmers over a region regarding the most suitable use of land in an area. (Spencer and Horvath, 1969, 498).

The Development of the Manawatu as a Land Use Region

The Manawatu is now regarded as a mixed stock/cropping region but has not always been so. The pattern established by the early settlers when the Manawatu was opened up from the

1850's was initially small scale dairying with the introduction of sheep and other livestock following soon after. Cropping was undertaken solely for fodder purposes, with the main crop being oats to feed the horses. Clark (1945) notes that the pattern in New Zealand as a whole may not be that imported from England or other origins of the settlers, but may have been more greatly influenced by pastoral developments along the east coast of Australia with which communication patterns developed.

In the early twentieth century in the Manawatu pastoral farming still predominated, especially dairying as evidenced by the existence of 26 dairy factories in the five counties normally comprising the Manawatu region. The area of oats declined from the 1930's concomitant with the decline in the use of horse power. While the region, especially the flood-plain area, had high natural fertility, major floods in 1902 and 1953 were physical disasters which pointed up the need for considerable flood control efforts.

Since the flood control programme of the lower Manawatu has gone into effect in 1961, coupled with better drainage of low lying areas, considerable changes in farm production have occurred. Dairying has diminished, with only one buyer of milk (the Manawatu Co-op at Longburn) left - 'certainly economies of scale (and amalgamation) have taken effect but there has been a fifty percent drop in the number of suppliers in the last ten years' (de Lacy, 1978, 16). Much of the sheep and beef production now occurs in the surrounding hill areas, with a slowing of the increase in stock numbers on the flat areas. On the flat areas fat lamb farming remains important but is frequently undertaken in conjunction with cropping. Perhaps evidence that cropping has gained its predominance in the last 10 years is its exclusion from Kear's land use map and discussion of land utilisation in Kairanga county in 1965. (Kear, 1965, 38-52).

To minimise risk, maximise profit and other objectives discussed in following chapters, single cropping is rarely

undertaken but a variety of crops grown with varying soil requirements, yields, growing periods and other production characteristics. A range of cash crops are now grown in the Manawatu to meet both the demand from grain and vegetable processors. A Feilding firm, for example, has the capacity for 1,200 hectares of peas, 400 hectares of beans, 100 hectares of sweet corn annually and the possibilities of other crops. Potatoes and onions are grown both in the Rangitikei and in the Opiki area. Wheat and barley have been the major grain crops, with increasingly maize, grass seed and recently birdseed and oilseed crops being sown. Crops grown for fodder include lucerne, chou moellier, rape and turnips. The area of crops threshed and production for the 1976-1977 season are presented in Table 2.2 for the four counties in the study area. The relative importance of various crops, including barley, on a national basis and their considerable increase since 1970 can be seen in Appendix K.

But the development which puts the seal on the Manawatu as a cropping area is the planned building of a malting factory at Marton. Once in full production, this factory will have an appetite for no less than 45,000 tonnes of barley a year. Even with local yields at up to 6.5 tonnes per hectare (about 120 bushels per acre) such a capacity calls for around 7,000 hectares of barley. (de Lacy, 1978, 16).

Figures of reported requirements by the malting company vary (as do yields per hectare) but point up the importance of the Manawatu (including Rangitikei) as a cropping region which would appear to be reaching maturity as a land use region. The complementary enterprises of fat lamb farming and summer cropping is clearly established, with a number of farmers employing economies of scale by investing in such things as on-farm storage silos and large scale equipment.

The current pattern of land use in the coastal lowland of the Manawatu is not readily described by models such as Von Thunen's concentric zones of land use, but does show the influences of the environment in terms of relief, flood damage and need for drainage as well as other decision

variables such as the wish to optimise utility or the desire to enjoy mixed farming as a way of life. The multitude of individual farmer decisions, without perfect knowledge and in the face of fluctuating market and sometimes climatic conditions, give us in aggregate form the current land use pattern of the Manawatu.

Cropping in the Study Area

The relative importance of cropping in the four counties can be observed in Tables 2.2, 2.3 and 2.4. Rangitikei, with almost three times the potential cropping area than any of the other three counties, produces the majority of the barley and also has the largest areas of wheat, maize, fodder crops and potatoes. (Table 2.2). Almost twice as much barley was grown in the four counties in 1977 as wheat, while areas of maize, peas and potatoes were much smaller but still important.

From the mail survey, Kairanga county emerged as the most important cropping region, with largest areas of all crops except barley and oil seed. The average area in crops of the respondents from the Kairanga was 18.8 hectares, more than twice that of the Manawatu and Oroua respondents. The high area of unproductive land per farmer in the Kairanga county can be accounted for by farmers in the marginal area close to the Tararua Ranges.

Dairying appears most important in the Manawatu county from the survey, with high mean sheep numbers in Oroua and Rangitikei. High beef numbers in Rangitikei would also be accounted for by responses from hill country farmers. (Table 2.3).

The relative importance of each crop by county in the survey of all farmers in the region by the Statistics Department varies somewhat from their importance from the June random survey, perhaps pointing up possible bias in those who responded. There was a noticeable lack of response from

Table 2.2: Area and Yield of Crops by County 1976-1977

	KAIRANGA		MANAWATU		OROUA		RANGITIKEI	
	Threshed ha	Tonnes/ ha	Threshed ha	Tonnes/ ha	Threshed ha	Tonnes/ ha	Threshed ha	Tonnes/ ha
Wheat	822	4.6	337	3.9	674	3.5	1562	4.2
Barley	1180	3.6	1510	3.5	1272	3.3	2642	4.0
* Maize	139	7.8	227	6.9	79	8.5	343	6.4
Other Grain	13		36				21	
Oats	24	3.1	41	3.1	5	2.6	118	2.2
Fodder	873		1383		1168		3868	
Potatoes	314		96		39		909	
Peas	247	3.2	105	3.3	207	3.1	221	3.1
Potential Cropping Land (ha)	2666		2196		2675		7053	

Source: Department of Statistics, unpublished survey data June, 1977

Table 2.3: Mean Area of Farms by County (Hectares)

	Kairanga	Manawatu	Oroua	Rangitikei
Mean size	132.9	102.8	126.2	266.0
Pasture	91.0	85.9	100.7	222.0
Cash crops	18.8	8.3	8.9	13.0
Fodder crops	1.3	2.9	2.1	3.2
Unproductive	18.8	4.1		15.3

Source: Field Survey, June, 1978, questions 8 and 10, Part A.

Table 2.4: Total Area of Crops by County (Hectares)

	Kairanga	Manawatu	Oroua	Rangitikei
Barley	354	431	277	1623
Wheat	480	75	148	199
Peas	206	83	75	93
Other veges	271	37	24	91
Grass seed	86	32	65	6
Oil seed		41		
Maize	87	22		21
Bird seed			6	

Source: Field Survey, June, 1978, question 3, Part B.

potato growers in the Rata area, for example.

Such a pattern is not fixed, annual variations occurring due to farmers changing their perceptions of the utility of various enterprises. Farmers have shown considerable ability to change their farming system comparatively rapidly and to meet a new demand as was evidenced by the introduction of a process foods firm in the region.

The fact that the farmer is operating in a situation of imperfect knowledge, with motivations not always being economic, can be seen by the high production of barley despite its relatively poor financial return compared to other crops.

CHAPTER THREE

INNOVATION ADOPTION AND DIFFUSION

Implicit in the study of the spatial location of rural economic activity is the availability and spread of new agricultural ideas and practices. The individual farmer is exposed to a new idea, and evaluates it according to its perceived relevance to his situation, then makes a decision as to whether he will accept or reject the innovation. After acceptance comes full use or adoption of the innovation which is then communicated to other farmers. In aggregate form, the total of a number of individual decisions to adopt an innovation can have considerable impact in intensifying and perhaps altering the farming pattern of an area.

Innovation diffusion emerges as an area of study in the 1920's and 1930's by anthropologists and sociologists and rural sociologists. After a lapse during which time mass media became the focus of interest, it was realised that innovations spread not only via the mass media but also through other channels of communication. Taking account of the fact that people talk to their neighbours, 'that farmers talk to other farmers' and that such interaction has consequences for individuals and groups, diffusion studies proliferated after the 1940's, particularly within the field of rural sociology. Interest in diffusion studies within agricultural geography has arisen from two sources. A spatial emphasis was given by Hagerstrand who

was able to demonstrate that the most probable adopter of a new farm practice is the farmer living in the vicinity of someone who has just adopted it; and on a macro level an innovation spreads from a primary centre until its original source of influence is exhausted, whereupon some new centre springs up. (Katz, Levin and Hamilton, 1963, 243).

The other source has been its contribution towards understanding the behavioural component of decision making.

Definitions of innovation diffusion range from

a latent behavioural disposition which is manifested in the acceptance of specific recommended practices (Copp, 1958, 105),

to

the acceptance over a period of time of some specific idea or practice by individuals or other adopting units lined to a social structure with a given system of values or culture and specific information channels (Katz, Levin and Hamilton, 1963, 240).

Sociologists thus see four essential components;

1. the innovation
2. its communication from one individual to another
3. in a social system
4. over time (Rogers, 1962, 12).

Geographers, as already noted, add a spatial dimension as well.

An innovation is an idea or practice perceived as new by the individual after being exposed to it via the mass media, a neighbour, a change agent or through some other channel of communication. The diffusion of the innovation is the process by which the new idea spreads from its point of creation to its ultimate users or adopters. Adoption is the decision to continue full use of the innovation after a trial period, a process which is a vital part of the decision making progress. Rejection, the decision to discontinue use of the innovation, is just as important as adoption.

Adoption is more than acceptance of the innovation as a good idea; it is its 100 percent use. The whole adoption and diffusion process (which may also be considered as two distinct processes) is neither instantaneous nor simultaneous but evolves and spreads over a period of years.

The aim of this chapter is to consider malting barley as an example of a new agricultural practice in the Manawatu.

While barley for feed purposes has been grown in this region for many years, requirements specific to barley for malting purposes put it into the classification of an agricultural

innovation. This is consistent with Jones' view that the term 'innovation' used in an agricultural context may be given wide definition:

Agricultural innovations may range from items which are only slightly different from existing practices and techniques to those which involve completely new concepts in farm technology. (Jones, 1967, 4).

The requirements specific to malting barley such as low soil nitrogen and potential rejection for malting due to wind and harvest damage or insufficient moisture, are considered sufficient to justify malting barley as an agricultural innovation in this region.

STUDIES OF INNOVATION ADOPTION AND DIFFUSION

Interest in innovation diffusion amongst farmers was aroused by the rural sociologists Ryan and Gross in Iowa, U.S.A., in 1943. Their research, like most of rural sociology, was aimed to help improve farm advisory or extension services, viz. to aid communication between change agents and farmers. Ryan and Gross interviewed 259 farmers who had adopted hybrid seed corn (an agricultural innovation of the 1930's also studied by Griliches (1957)) and from their findings proposed several major generalisations which have formed the basis of much further research. The generalisations were:

1. Three stages in the adoption process could be recognised: awareness, trial and adoption.
 2. Farmers' first use of an innovation followed a bell-shaped (but not exactly normal) distribution when plotted over time. Adopters could then be classified into four categories according to the time of first use of the innovation.
 3. The adoption period from awareness to full use averaged about nine years.
 4. The typical farmer first heard of the innovation from a salesman but neighbours were the most influential source in leading to adoption, especially for later adopters.
- (adapted from Rogers, 1962, 34-35).

Much later work elaborated these generalisations which form the general framework for many rural sociology studies. Such generalisations relevant to this study include:

characteristics of the innovation, stages in the adoption process and rate of adoption.

Characteristics of the Innovation

Important in the rate of adoption is the appeal of the intrinsic characteristics of the innovation itself. Slower adoption may stem in part from differences in perceptions of the same innovation by different adopters, which are related to such factors as market opportunities, quality of farmland and alternatives in farming decisions. Rogers (1962, 146) identified five characteristics of innovations which were expanded by Kivlin and Fliegal (1964) to include fifteen attributes. Rogers' five major characteristics are:

1. Relative Advantage - the degree to which an innovation is superior to the ideas it supercedes. Attributes include costs (both initial and continuing), efficiency (both the saving of discomfort and time), returns (utility or pay-off, social approval, recovery of initial investment) and risk and uncertainty vis-a-vis alternatives.
2. Compatibility - the degree to which an innovation is consistent with existing values and past experience of adopters (and therefore appeal to conservative farmers).
3. Complexity - the degree to which an innovation is relatively difficult to understand and use, an important factor for less educated farmers.
4. Divisibility - the degree to which an innovation may be tried on a limited basis, important for minimising risk, especially for early adopters.
5. Communicability - the degree to which results of an innovation may be diffused to others, which is related to such factors as complexity and clarity of results, and the extent to which the new practice is 'visible' to other farmers. (Rogers, 1962, 146; Kivlin and Fliegal, 1967, 85-89).

Rogers warns that adoption of all innovations is not necessarily desirable, overadoption occurring when an individual adopts a new idea under conditions when experts would consider him irrational to do so. (Rogers, 1962, 147). These behavioural considerations are discussed by Campbell (1966) in terms of apparent rationality and non-rationality and must be seen in terms of the individual farmer's objectives - viz. whether he is wanting to maximise returns, minimise risk or satisfice.

In Rogers' terms, malting barley is readily conceptualised as an agricultural innovation:

1. Relative advantages/disadvantages when compared with feed barley: -
 - a) costs - seed costs of malting barley are higher than feed barley.
 - b) efficiency - while barley is characteristically 'easy to grow', malt barley requires low soil nitrogen and greater care during harvesting.
 - c) risk - wind damage shattering heads and insufficient moisture giving pinched, dried grain are two climatic risks specific to malting barley.
 - d) returns - in light of the higher requirements of malt barley, a premium will be paid above the feed barley price.
2. Compatibility - for cropping farmers, the growing of malting barley will be consistent with current patterns. Of those intending to grow malting barley, 58 percent had grown barley previously, 42 percent had not so the new farming type could be inconsistent in this sense.
3. Complexity - the relative difficulty perceived by farmers has stemmed from the lack of information about key factors such as disposal of rejects, harvest technology, transport of crop, nitrogen requirements and most suitable malting varieties. Malting barley is not really a complex agricultural

innovation, but rather a specialised demand has arisen for a crop readily grown in most parts of the region.

4. Divisibility - a crop such as this is highly divisible in that it can be tried on a limited basis (although all will be under contract) and discontinued if found to be unsuitable.
5. Communicability - the results of the growth of malting barley will be easily communicated re yield, costs and returns once the barley plant is in operation.

Thus malting barley as an agricultural innovation can be readily analysed in Rogers' terms.

Stages in the Adoption Process

Wilkening (1953) outlined a model of the adoption process following from Ryan and Gross's finding that the individual farmer appeared to progress from a stage of awareness of the new practice through to a stage where he became so convinced of its applicability to his situation that he was prepared to try it. Assuming satisfaction was obtained from this trial, complete adoption followed. Wilkening's model had four stages:

- initial ideas about a practice
- its mental acceptance as a good idea
- its acceptance on a trial basis
- and its final adoption

(Wilkening, quoted Gibbs, 1973, 4).

Since then Rogers has split the first two stages into three, giving the widely accepted model:

1. Awareness - the individual learns of the idea or practice but has little knowledge about it.
2. Interest - the individual develops interest in the idea seeks more information about it and considers its general merits.
3. Evaluation - the individual makes a mental application of the idea, weighs its merits for his own situation.

4. Trial - the individual actually applies the idea or practice - usually on a small scale.
5. Adoption - the stage of acceptance leading to continued use. (Hassinger, 1959, 52).

The process can be terminated at any of the stages.

Farmers in the Manawatu likely to adopt the innovation malting barley are only at the early stages of the adoption process. Knowledge of the proposed establishment of the malting barley plant has been widespread since 1977. A field day held on 25 January, 1978, attracted 125 people who included farm advisors, seed and grain agents and others in the agricultural service sector as well as farmers. The malting barley plant received further coverage over local radio due to its uncertain intentions then through local press, M.A.F. publications and journals since the intentions of the malting company became clear. Thus most farmers in the Manawatu are aware of the future potential demand for malting barley, many have expressed interest and are at the evaluation stage. In this survey, of 315 farmers completing the questionnaire, 125 indicated that they would possibly or probably grow malting barley. As many as 53 were not aware of the introduction of this firm, that is a surprising 17 percent. Growing of malting barley for seed purposes is currently commencing (1978-1979 season) with contracts being let for 100 hectares. Thus likely early adopters are at the evaluation stage. It will not be until after the malting plant comes into operation 1980-1981 that adopters will move towards the adoption stage, the process thus covering several years. Not all adopters are likely to continue to grow malting barley indefinitely either. For individual adopters the process may be terminated at any stage and rejection may follow any of the stages.

Hassinger and Campbell have questioned Rogers' model. Hassinger (1959, 53) noted that the farmer is not a passive recipient of an innovation but that the initiation of the adoption process may arise from a condition of doubt or

dissatisfaction on behalf of the farmer who becomes involved in the problem solving process. Similarly, Campbell (1964, 458) criticises the traditional model for being too simple and inflexible a heuristic device for attempting to explain something as complex as decision making with regard to accepting or rejecting something new. He suggests that the adoption process can have either of two starting points;

1. the awareness that a problem exists - problem-oriented decisions,
- or
2. the awareness of an innovation which may create a problem (dissonance) - innovation-oriented decisions.

Awareness may therefore arise either from the need to solve a problem or from exposure to an innovation which would constitute an improvement over the existing situation.

Other criticisms concern the interest and evaluation stages. The individual perceives the utility of the new idea as it would benefit his situation and makes a decision as to whether he will accept or reject the innovation in light of his situational, personality and socio-economic characteristics. This assumes rationality, i.e. a reflective, carefully thought-out decision, in which all possible alternatives and consequences are considered. Impulsive or non-rational decisions, however, are frequently made and most are between the two extremes, but are difficult to measure. In his paradigm, Campbell includes rationality - non-rationality to conceptualise four ideal-typical decisions:

1. Rational - problem-oriented
2. Rational - innovation-oriented
3. Non-rational - problem-oriented
4. Non-rational - innovation-oriented.

(Campbell, 1965, 465).

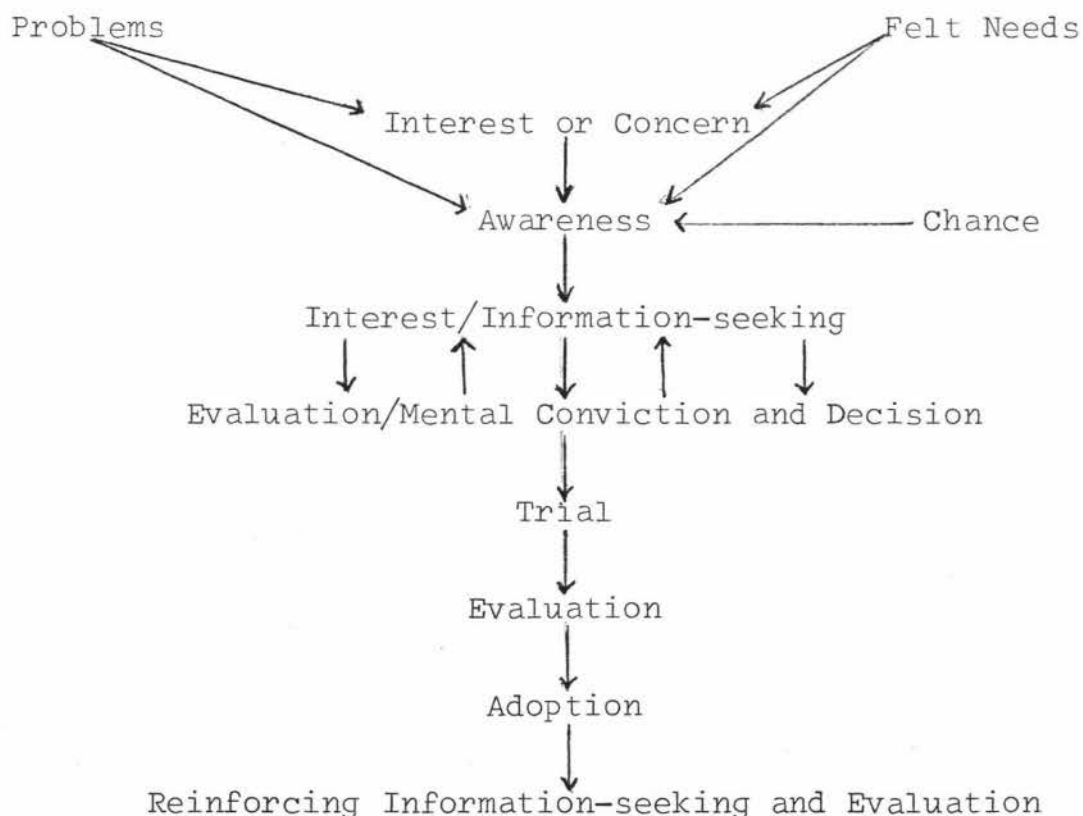
Campbell accepted that in real life most decisions incorporate elements of all four types. Such factors, however, are difficult to measure due to the gap between the level of

rationality reported by the adopter and the real case. Reports are often justifications rather than real motivations which further complicate measuring of adoption decisions in these terms. Thus most reported adoption decisions fall at the centre of Campbell's model.

It is thought that farmers adopting the innovation malting barley are making an innovation oriented decision - a new demand has arisen for a crop already easily grown. Very few are likely to make a non-rational adoption due to the length of time between making the decision and implementing it.

Jones also outlines a model which takes into account factors occurring before awareness is reached and which also takes into account rejection at any of the stages and 'dis-adoption' or discontinuance of a particular practice. (Figure 3.1).

Figure 3.1: The Adoption and Diffusion of Agricultural Factors.



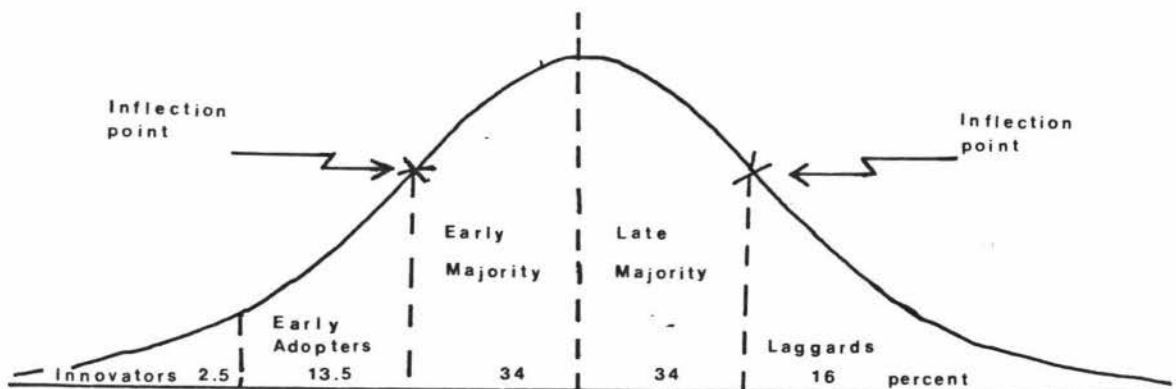
Source: Jones, 1967, 9.

Some of these factors will be discussed further in the next section dealing with characteristics of adopters.

Rate of Adoption

Another simplified heuristic device which has become entrenched as a useful concept is the classification of adopters on the basis of their relative time of adoption of an innovation. (Gibbs, 1973, 9). The characteristics of early adopters have been found to be quite different to those of later adopters, Ryan and Gross being the first to find such a distribution when plotted approached a bell shape or normal curve of distribution. Rogers (1958 & 1962) also showed how one could categorise mathematically individual adopters according to their relative time of adoption on the basis of standard deviations from the mean. The device may be used whether examining adoption of a single innovation or a series of innovations over time.

Figure 3.2: Classification of Adopters on the Basis of their Relative Time of Adoption of Innovations



Source: Rogers (1962, 162).

Rogers ascribed values to the five ideal-typical categories of adopters according to their time of adoption:

- innovators - venturesome
- early adopters - respect
- early majority - deliberate
- late majority - sceptical
- laggards - traditional

with an individual shifting from one adopter category to the next over time (Rogers, 1962, 192). Thus early adopters are conceived as younger, with higher social status, a better financial situation, more specialised operations and a different type of mental ability from later adopters. Griliches in 1960 outlined an S-shaped curve, relating relative profitability of adopters to time of adoption (quoted Found, 1970, 152).

The value of the device is to examine the situational, personality and socio-economic characteristics of adopters according to the time they adopted certain practices. Copp (1958) has compared adoption rates in different communities, Kivlin and Fliegel (1967) between farm operators of different economic scales, and Gross (1949) between acceptors and nonacceptors. Such studies have conceptualised

adoption of recommended farm practices as a product of the farm operator's life situation, including such aspects as economic status, social position and characteristic work orientations. However, one-way causation is not implied. (Copp, 1967, 105).

Copp found significant correlations between economic status, social position and personality characteristics when comparing samples of Kansas and Wisconsin farmers (Copp, 1967, 106). Gross found that earlier adopters were better educated, were younger, had higher social participation, read more experiment station bulletins, subscribed to magazines and newspapers more frequently, participated more fully in co-operatives and had larger farms and higher incomes than later adopters. He concluded that tenure status, interfarm mobility, extent of neighbouring and nationality background, however, had little or no association with rapidity of adoption (Gross, 1949, 149).

Many of the personality characteristics are difficult to measure, different indices used making comparisons between different researchers difficult.

Jones (1967) outlines the key factors affecting adoption behaviour as situational, personality, sociological and psychological characteristics of the adopter. (Figure 3.3).

Predicting Innovativeness

In a study such as this, whereby the innovation has yet to be tried or adopted, being able to predict which farmers are likely to adopt the new idea or practice is beneficial. Methods for predicting innovativeness include multiple correlation and the configurational approach.

Multiple correlation, is a

statistical method whereby a series of "independent" variables are related to one "dependent" variable such as innovativeness in an attempt to explain a maximum of the variation in the dependent variable. It is then possible to determine the relative contribution of each independent variable in explaining the dependent variable. (Rogers, 1962, 287).

Five independent variables used by Rogers in his study of truck vegetable gardeners in Ohio, together explained 64.1 percent of the variation in adoption of new techniques.

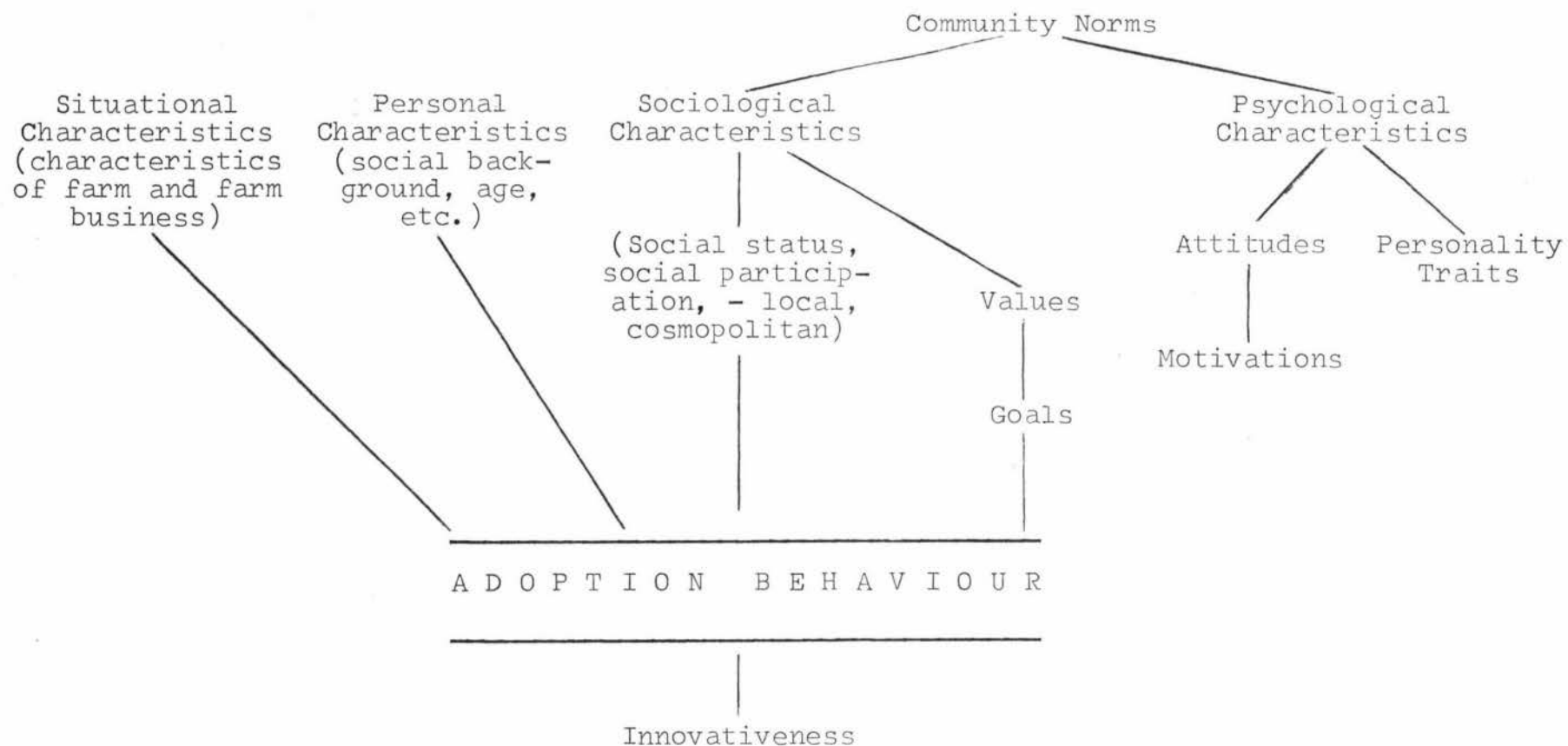
Individually, the relative contribution of each was:

- | | |
|--|--------------|
| 1. Community norms (group expectations to which the individual feels obliged to conform) | - 20 percent |
| 2. Size of the farm | - 14.4 " |
| 3. Opinion leadership (self concept) | - 14.4 " |
| 4. Communication behaviour (willingness to seek information and advice) | - 8.9 " |
| 5. Social status | - 6.4 " |

(Rogers, 1962, 291).

Chattopadhyay and Pareek (1967) also used multiple correlation plus regression analysis to predict multi-practice adoption behaviours amongst farmers in a North Indian village. The

Figure 3.3: Summary of Factors Influencing Adoption and Diffusion



Source: Jones, (1967, 16).

variables utilised were psychological - value orientation, change-proneness and level of aspiration. Whilst change-proneness and level of aspiration were eliminated by multiple regression, the three value orientations (conservatism-liberalism, fatalism-scienticism, and authoritarianism - non-authoritarianism) contributed 59 percent of the predictability of adoption behaviour.

Similarly, Moulik et al (1966) utilised multiple correlation analysis to test the likelihood of North Indian farmers adopting nitrogenous fertilisers. The five independent variables - attitude towards and knowledge of nitrogenous fertilisers, self rating of innovation proneness, economic motivation and closeness with extension agents - were found to jointly contribute eighty percent of the variation of levels of adoption of such fertilisers. Only self-rating of economic motivation showed a negative correlation (Moulik et al, 1966, 467).

Stuckert's Configurational Approach to Prediction of 1958 attempted to reduce predictive error to a minimum. It was utilised by Finley (1968) who tested a 1957 instrument sample with three validating samples and found significant inaccuracies in the 1957 sample but none in the validating samples. His aim was to prove that it was possible to construct an instrument that will predict adoption behaviour of farmers at a level exceeding that which could be obtained by chance. Moreover, he concluded that

within limits, through knowledge obtained from theoretical considerations and past research, it is possible to specify factors that will best predict adoption behaviour. (Finley, 1968, 17).

In this study it was the intention to differentiate adopters (that is farmers intending to grow malting barley) from non-adopters, or to differentiate early adopters from laggards and to use the differentiating characteristics to predict what type of farmer is likely to grow malting barley. Farmers were classified into 'Probably' and 'Possibly' groups depending on

the combination of responses to questions 7 and 8 of Part B of the survey (Appendix A). Characteristics of farmers used in the analysis were obtained from the profile data in Part A of the survey, in particular questions 1, 4, 5, 7, 8, 14-20. Multiple correlation and regression analysis would have been suited to the analysis of factors affecting adoption but the multi-variate technique, Discriminant Analysis, was chosen, with three dependent variables - past land use change, intention to grow malting barley and adoption of small scale innovations. The inability of this discriminant analysis to correctly classify more than 68 percent of the farmers into adopter-nonadopter groups and the statistically significant amount of information left unexplained led to its replacement first by non-parametric correlations which were unsuccessful and then by the simpler chi-squared technique (Appendix J).

PROPOSITION ONE TESTED

In order to establish a relationship between 'innovators' and certain situational, personality, and socio-economic characteristics, a series of Chi-Squared tests were conducted between farmers indicating a definite intention to grow malting barley (that is, the "probables", $n = 51$) and the whole sample ($n = 315$) to test a number of null hypotheses.

The proposition was 'That farmers possessing certain characteristics are more likely to be receptive to innovation and change. Such characteristics include:

- youthfulness
- farming experience
- higher levels of education
- higher total indebtedness
- propensity of son(s) inheriting the farm
- size of farm.

The variables chosen to measure these were:

- age
- experience - years in a position of responsibility
 - attendance at meetings of farmer organisations
 - economic analysis of farm
 - adoption of relatively small scale innovations
 - self concept in terms of leadership
- higher levels of education;
 - attendance at courses
 - reading farming journals
- size
- indebtedness - years on current farm
- propensity of son(s) to inherit farms - this could not be tested due to very small number on farms of smaller group.

The null hypotheses and their results are - (refer Table 3.1)

- 1.1 'That there is no difference between farmers intending to grow malting barley and the total population in age structure'. This was rejected, the farmers intending to grow malting barley being proportionately more numerous in the 20-29 and 40-49 age groups, and considerably less so in the 50-59 and over 60 age groups, while percentages were similar in the 30-39 group. Thus it would appear that younger farmers, especially those in their 20's starting out in farming and those in their 40's, perhaps in a position to expand and diversify, are more receptive to the innovation, malting barley, than those in the other age groups.
- 1.2 'That there is no difference between farmers intending to grow malting barley and the total population in terms of the number of years the farmer has held a position of responsibility on a farm'. This hypothesis was also rejected with a considerably greater proportion of farmers in the 1-9 and 20-29 years of responsibility intending to grow malting barley. These would correspond with the age categories

significant in hypothesis 1.1.

- 1.3 'That there is no difference between farmers intending to grow malting barley and the total population in terms of attendance at Federated Farmers, an example of a farming organisation'. This too was rejected. Farmers intending to grow malting barley were more likely to attend such meetings than the total population.
- 1.4 'That there is no difference between farmers intending to grow malting barley and the total population in terms of conducting economic analyses of their farms themselves'. This hypothesis was also rejected, with twice the proportion of farmers intending to grow malting barley performing regular economic analysis (budgeting) than the total sample. Similar proportions occurred in the 'occasionally' group and consequently considerably more in the total population never conducted such analysis themselves.
- 1.5 'That there is no difference between farmers intending to grow malting barley and the total population in terms of adopting relatively small scale innovations to improve stock health and pasture management as well as adopting new technologies and growing new crops'. This hypothesis was rejected, with a small but significantly greater proportion of farmers intending to grow malting barley adopting such measures, especially stock health. Conversely a larger proportion of the total population reported no adoption of such innovations.
- 1.6 'That there is no difference between farmers intending to grow malting barley and the total population in terms of attending farming courses ranging from conferences and short courses to university diplomas and degrees'. This hypothesis was accepted, as the distribution of attendance at such courses by farmers intending to grow malting barley was very similar to that of the total population.

- 1.7 'That there is no difference between farmers intending to grow malting barley and the total population in terms of reading of such agricultural journals as "Straight Furrow"'. This too was accepted with both populations being similarly distributed in terms of reading habits.
- 1.8 'That there is no difference between farmers intending to grow malting barley and the total population in terms of size of farm'. This hypothesis was rejected with proportionately more farmers operating large farms showing an intention to grow malting barley. For farms less than 100 hectares the total population was more highly represented; on the other hand for farms larger than 100 hectares, farmers intending to grow malting barley were more highly represented.
- 1.9 'That there is no difference between farmers intending to grow malting barley and the total population in terms of length of tenure of current farm, assuming the shorter the tenure, the higher the total indebtedness.' This hypothesis was accepted, with distributions of both populations being remarkably similar, especially in the groups having less than ten years' tenure.
- 1.10 'That there is no difference between farmers intending to grow malting barley and the total population in regarding oneself as a neighbourhood leader with respect to applying new ideas and practices on one's farm'. This hypothesis also was accepted, with distributions for each population being similar. Farmer modesty may have played a part in this result!

Thus there are significant relationships between 'Innovators', defined in this survey as farmers showing definite intention to grow malting barley, and such personality, situational and socio-economic characteristics as age, years of responsibility, attendance at meetings, economic analysis of farms, size and adoption of innovations. In order to predict

Table 3.1: Summary of Results of Null Hypotheses for Proposition One

Variable	Chi-squared	Degrees Freedom	Significance	Level	Rating	Accept/Reject
Age	16.64	4	Significant	0.01	Moderate	Reject
Responsibility	25.25	5	Significant	0.01	Strong	Reject
Meetings	12.44	2	Significant	0.01	Moderate	Reject
Economic Analysis	21.71	2	Significant	0.01	Strong	Reject
Innovations	12.34	4	Significant	0.05	Weak	Reject
Self Concept	7.29	4	Not Significant	0.05		Accept
Courses	6.2	6	Not Significant	0.05		Accept
Reading	1.17	3	Not Significant	0.05		Accept
Size	14.69	3	Significant	0.01	Moderate	Reject
Current	4.12	7	Not Significant	0.05		Accept

Source: Field Survey, June, 1978.

innovators in future, that is farmers who are likely to grow malting barley, these appear to be the most distinguishing variables. Conversely, the variables concerning attendance at courses, reading an agricultural journal, current tenure and self concept showed no significant differences between the two populations.

The results of the step-wise discriminant analysis undertaken for each of three dependent variables (past land use change, intention to grow malting barley, and adoption of innovations) utilising 26 independent variables, have not been included in the text in detail because less than 68 percent were correctly classified into 'adopter' and 'nonadopter' groups by the independent variables used. That is, a statistically significant amount of information remained unaccounted for. Certain standardised discriminant functions, however, occurred repeatedly for each of the three dependent variables. These included reading agricultural journals, having economic analysis done by self or advisory officers and being brought up on farms. These results are felt to complement those obtained by the less sophisticated Chi-Squared technique, as well as to study just a few of the many situational, personality and socio-economic characteristics of innovators outlined in rural sociology research.

The value of Proposition One was to point up variables which distinguish between farmers who chose to adopt or reject the innovation malting barley in the Manawatu. All are at the early stages of the adoption process, with only the 'probablies' having reached the evaluation and perhaps trial stages. The 'probablies' are more likely to be early adopters with those showing less definite intention being rated as late majority or even laggards in Rogers' terms. The fact that the malting barley plant is not yet operational means that the emphasis is on predicting likely innovators rather than studying farmers who have already adopted.

The Diffusion Process

The diffusion process refers to the spread of new ideas and is therefore essentially a process of the communication of information. Communication channels have been studied widely in rural sociology and related fields, on the assumption that

people can easily be asked to recall the channels of information and influence that went into the making of their decisions to adopt an innovation ... viz. "reconstruction" or "reason analysis" is used stressing the importance of interpersonal relations in the flow of influence and innovation in modern society. (Katz, Levin and Hamilton, 1963, 245).

Channels or avenues of communication of new ideas from their source to ultimate adopters have been classified by Jones (1967) into three types:

1. Mass Media - radio, television, newspapers and journals (cosmopolite sources).
2. Personal contact - professional advisors, technical representatives, extension personnel in either individual or group situations.
3. Interpersonal or face-to-face contacts between friends and neighbours, these usually being other farmers. Other frameworks in the literature refer to such channels as commercial, peer, printed and oral extension and opinion leaders, which can be subsumed under Jones' classification. (Gibbs, 1973, 16).

Much of the recent research on the communication of new ideas and practices has attempted to relate the most useful communication channel to the stages in the adoption process. Copp et al (1958, 149-151) note that at the awareness stage of the farm operator first hearing about the new practice, mass media play an important role, especially magazines and printed extension rather than radio and television. At the interest stage when the farm operator feels the practice is a workable solution for a farm problem, face-to-face sources, both personal and interpersonal, are cited more frequently corresponding with a decline in references to mass media. Similarly at the acceptance stage when the farm operator

feels the practice would be of value on his farm, face-to-face sources are of greater importance than the mass media. At this point, the farmer has conceded that the innovation may be a good idea and needs persuading of its application to his situation. In the trial stage of the farm operator trying the practice on his farm, mass media from commercial firms and printed extension sources regain importance, when questions of when and how to apply the practice are crucial. Copp et al did not ask for information sources to be cited after the trial stage because results of a successful trial were considered to be self-evident by the farmer although 'extension agents and peers may help the farmer interpret trial results.' (Beal and Bohlen, quoted Copp et al, 1958, 151).

Such studies also attempt to predict the likelihood of a farmer adopting a certain practice according to the information source he used in the early stages of the adoption process. Copp et al found that there is no key information source for a given stage (1958, 153) as did Mason (1964, 40), but that all sources related to all stages. Early adopters of an innovation were more likely to use mass media or another authoritative or institutionalised source, for example an extension agent, for information. This is partly due to the absence of a number of peers having tried the practice and also due to the more objective and usually positive rationale given to recommended practices by the media. Later adopters are more likely to learn of the innovation from peers and to view it more subjectively in terms of its success or failure. By the time the information has percolated down from its source to the professional agriculturalist to the layman, it has lost much of its original accuracy and been coloured by farmers' perceptions of the innovation as it pertains to their individual situations. Mason noted also that the use of all information sources increases as farmers pass through the stages of the adoption process regardless of the source's relative influence (Mason, 1964, 51). Moreover, more information may

be used to gain support for a new practice that has been adopted than is used to acquire knowledge prior to its adoption. (Mason, 1964, 52). Sheppard noted a gap between responses and the actual truth, with farmers thinking it preferable to quote a neighbour as a source of a new idea rather than an advertising source. (Sheppard, 1963, 127).

Smith (1964) noted that research on the relative importance of sources of information must take into account the intensity of that information. Intensity is defined as:

the efficiency with which each stimulus from the source of the information reaches the farmer and produces an effect. For example, a leaflet may be written clearly or obscurely, a radio programme may be explicit or confused, a personal interview may inspire confidence or scepticism. (Smith, 1964, 345).

Thus early adopters

..... who act before the informal sources become important do so because they react quicker to stimuli, or have more stimuli, and therefore act quicker in time, but not because their attitude predisposes them to favour normal sources of information. (Sheppard, quoted Smith, 1964, 346).

Buang noted a perception gap which exists between the source and the receiver, misinterpretations occurring which are critical to the effectiveness of communication (Buang, 1974, 56).

McMillion (1960), in a study of one hundred Canterbury sheep and dairy farmers, correlated sources of information as well as situational and personal characteristics to farm practice adoption in an effort to inform farm extension workers (advisory personnel) on the best methods of disseminating new information to farmers. He found the most effective means of communication were face-to-face media, especially in situations where past experiences had created an attitude of mind receptive to new ideas (for example, attitudes engendered by post primary education in rural areas, farmer membership in farm organisations and extension agents being personally known in the community in which they work). Meanwhile

while

radio and printed matter are effective now, those responsible for them should not become complacent, because at least fourteen percent of the farmers had not heard about a practice which had been recommended for two years. (McMillion, 1960, 24).

Like Copp et al, McMillion did not test the efficiency of television as a channel of communication to farmers because it was then in its infancy. Its effectiveness is limited by its accessibility, that is the timing of farming programmes to easy viewing parts of the day.

PROPOSITION TWO TESTED

To operationalise the second proposition:

That the diffusion of information about the new agricultural idea (malting barley) will be through three main communication channels:

- i) Face-to-face contact
 - Malting company representatives
 - M.A.F. and private advisors
 - seed and grain agents
 - innovative neighbours
- ii) Group contact
 - discussion groups
 - farming groups
 - field days
- iii) Mass media
 - agricultural publications
 - newspapers
 - radio and television;

the group of farmers probably and possibly intending to grow malting barley was compared with the whole sample on the matter of their source of information about the proposed malting barley plant, bearing in mind that the final 'go-ahead' had not been given at the time the questionnaire was sent. Group contact was not included, the key sources being regarded as the mass media and personal contact by malting company and other interested personnel.

Of the total of 315 responses, all but 17 percent (53) had heard of the plant - still quite a high proportion not yet at the awareness stage. Of those indicating an intention to

grow malting barley (numbering 125), only 8 percent had not before heard of it.

Three null hypothesis have been formulated to this end.

- 2.1 'That there is no difference between farmers intending to grow malting barley and the total population in terms of awareness of the proposed malting barley plant'.
- 2.2 'That there is no difference between the farmers intending to grow malting barley and the total population in terms of source of information about malting barley'.
- 2.3 'That there is no difference between farmers intending to grow malting barley and the total population in being approached by malting company and other interested personnel'.

Table 3.2: Sources of Information about the Malting Barley Plant

	Intend to Grow M.B.	Total Population
n =	125	315
Unaware	8.0%	17.0%
Chi-Squared = 5.73 at 1 degree freedom, significant at 0.05		
Aware:		
Read - Journal	.8%	3.8%
- Newspaper	54.4%	60.7%
Heard - Radio, T.V.	6.4%	8.8%
All of these	13.6%	12.6%
Neighbour	2.4%	3.1%
Chi-Squared = 3.91, not significant at 0.05 at 4 degrees of freedom		
Approached:		
Seed-grain agent	35.2%	19.8%
Malting Co. Rep.	11.2%	6.9%
Advisory Officer	.8%	.4%
More than one	3.2%	1.5%
Yes but did not specify	15.2%	8.0%
Chi-Squared = 24.09, significant at .01 at 5 degrees of freedom		

Source: Field Survey, June, 1978, questions 1 and 2,
Part B.

The first hypothesis was rejected, with more of the total sample being unaware of the proposed malting barley plant than of those intending to grow malting barley. Of those who were aware of the plant, there was no significant difference in distribution between the two groups. Thus the second hypothesis was accepted. The third hypothesis, comparing the two samples in terms of being approached by malting company and other personnel, was rejected. The main differences were between those who were approached but who did not specify

by whom.

Of the sources of information most frequently quoted, newspapers emerged the most popular. The farming pages of the 'Manawatu Evening Standard' and the free weekly newspaper going to every rural residence in the four counties, 'The Manawatu Farmer', were anticipated to be the main papers read in this respect. Of those intending to grow malting barley, 35.2 percent had been personally approached and many indicated a desire for more information about the specific requirements of the growth, harvest and transportation of malting barley. Seed and grain agents and advisory officers were rarely quoted but may have been more active in disseminating the information since the time of the questionnaire due to the definite intention of the malting company to proceed with the plant and the letting of contracts for malting barley for seed for the 1978-1979 season. A field day to be held by the company in early February, 1979, is hoped to clarify such policy matters. (Appendix L).

This result reinforces the sequence of the adoption process, with many farmers having passed the awareness stage and some having progressed from the interest to the trial stage. It also points up the relative importance of the various information sources as they apply to this innovation.

Farmers were also asked in the survey to record two innovations adopted over the last two years in the field of stock health, pasture management, a new crop or a new technology (question 19, Part A). In addition, the source of the innovation was requested. This question was poorly answered but of the 84 responses -

- 23 gave an agricultural journal as the main source
- 14 a neighbour
- 12 extension (advisory) officers
- 10 'thought of it myself'.

Veterinary surgeons were more likely to disseminate information about stock health, stock and grain agents about new crops,

and neighbours and journals about pasture management (Appendix O). Thus, in terms of recorded adoption of agricultural ideas and practices, agricultural journals and neighbours appeared to be the main agents in the diffusion process.

CHAPTER FOUR

TOWARDS UNDERSTANDING CURRENT LAND USE PATTERNS

The analysis of land use patterns has always been a basic concern of the geographer. It is in this respect that agricultural geography comes closest to economic geography, relying heavily on economic concepts and models of behaviour. Such concepts or models have been utilised in agricultural geography in an attempt to describe and explain why certain types and intensities of production occur at certain locations. They tended to be either descriptive (that is, describing what is the pattern which actually exists) or normative (describing what ought to be the pattern under certain assumptions). Moreover, these models have two major differences:

1. Partial equilibrium models hold all but one factor constant, i.e. they may hold all location, population density and similar factors constant and place primary emphasis on minimising all cost factors. These models tend to be too simplistic and naive to represent the complexities of the real socio-economic system.
(Eliot Hurst, 1972, 106-107).
2. General equilibrium models are those 'that, under ideal conditions, would enable us to explore every aspect of the behavioural and operational milieux',
(Eliot Hurst, 1972, 107). Isard, for example, emphasised links and interdependencies between all sectors and location sites of the economy. They are more applicable to the real world situation than partial equilibrium models but are very complex and therefore difficult to operationalise.

No attempt is made in this thesis to operationalise the models presented, due to the magnitude of the task, but the models are briefly outlined due to their relevance to the study

topic, bearing in mind Harvey's caution that to make such models

... operational for real world application, one faces problems involving spatial variance in environmental conditions, spatial variance in agricultural technology or productive practice time, and evolutionary change through time. (Harvey, 1966, 361).

EARLY LOCATION MODELS - RICARDO AND VON THUNEN

In the early nineteenth century, two men arrived independently at a concept which has remained vital to theories of location - that of "economic rent". "Economic rent" need not have any relationship to actual rent, but is 'the return which can be realised from a plot of land over and above that which can be realised from a plot of the same size at the margin of production'. (Tarrant, 1974, 20).

Ricardo was attempting to explain why competition for land had increased land rents, consequent on the then high price for grain. His was a descriptive, partial equilibrium theory which looked at differences in soil fertility and population density and considered only a single crop.

On the other hand, von Thunen's 1826 model held all locational factors, including soil fertility and population density constant, but made transport cost the only variable in his initial model. His model, developed concurrently with, but independently of, that of Ricardo, has been more popular because of its spatial emphasis. Von Thunen intended his work to be 'a method of approach to a difficult subject rather than a model to which all farming systems must approximate'. (Tarrant, 1974, 22). It was a descriptive partial equilibrium model but in the twentieth century many normative interpretations have been made. Detailed analyses of his model may be found in Tarrant (1974), Found (1971), Dunn (1954), Eliot Hurst (1972), Harvey (1966), Chisholm (1962), Chorley and Haggett (1967) to name a few.

Von Thunen's method of approach was to establish the agricultural production needed within the urban market and the controlling factors of its production, which need not necessarily be transport costs, and to show the effects of these controls on economic rent and the pattern of differentiated agricultural production (Tarrant, 1974, 21). More simply, 'he sought to find laws that could determine what form of agricultural production would best be carried on at a given place'. (Eliot Hurst, 1972, 107). He began with a set of simplifying assumptions:

1. The existence of an 'isolated state'.
2. One central city as the sole market.
3. A uniform plain surrounding the city.
4. The horse and cart were the only mode of transport.
5. The plain was inhabited by farmers supplying only the city.
6. The maximisation of profit by farmers with automatic adjustment to the needs of the central market.
7. The only variable was transport cost which is directly proportional to distance and was borne entirely by farmers, who shipped all produce in a fresh state.

Von Thunen then considered the relationship of three factors:

1. The distance of the farms from the market;
2. The prices received by the farmers for their goods;
3. Economic rent, (Eliot Hurst, 1972, 108),

and showed how concentric zones of land use would emerge, with farmers at each margin receiving nil return for their produce after transport costs had been met. Thus for a single crop, most intensive production would be nearer the central market where transport costs would be lowest. Where a single commodity such as milk could be processed into a variety of end products, the most bulky and perishable would be located in the inner zone (Figure 4.1). For a variety of crops, the more bulky and perishable ones, for example horticultural products, would occupy the inner zone while less bulky goods would be grown at the periphery. (Figure 4.2).

In later models Von Thünen relaxed some of his assumptions to allow for possibilities such as another transport artery, growth of a subsidiary town or a physiographic difference. (Figure 4.3).

Figure 4.1:

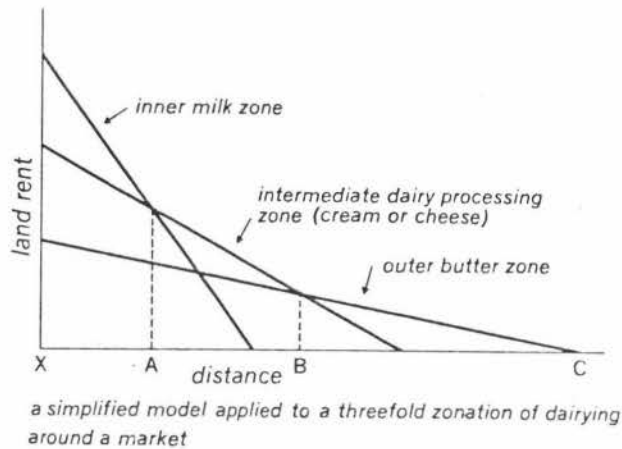


Figure 4.2:

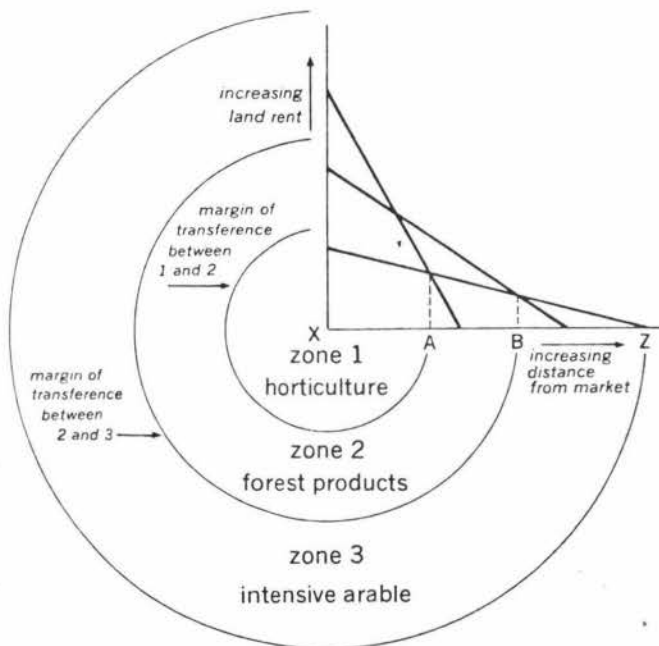
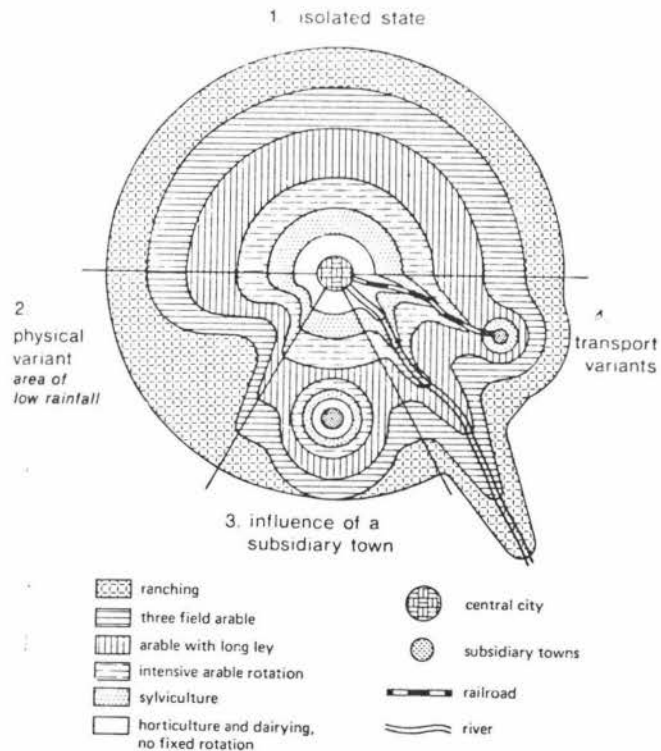


Figure 4.3:



Von Thünen: (4) the spatial expression of the basic model (the "isolated state") and three variants.

Source: Eliot Hurst, 1972, 110-111

Von Thunen's model was limited by certain inbuilt assumptions, namely that the farmer had complete availability of information and behaved in a totally rational economic manner. Other problems arise due to it being static and deterministic, disregarding the time element, for example technological changes, changing demand patterns and economies of scale. Its advantage is

that it can be seen to operate continuously over space, and through the use of marginal analysis it shows how land use systems will grade into one another over a continuum. (Harvey, 1966, 364-365).

Such a descriptive model is not of great value to this study which is attempting to look at future change rather than analyse how present patterns have emerged. It has been utilised by Eliot Hurst to study land use patterns around Sydney and would be of value in looking at intensities of horticultural production in Hawkes Bay for example.

ECONOMIC MODELS

Von Thunen was concerned above all with the spatial dimension Instead of using this spatial technique, however, some economic models conceptualise such areas as points. Producers or farmers, production factors, products and consumers are all treated as if they were located at a series of discrete points with transport costs held constant. Provided trade takes place, analysis of comparative advantage indicates differences in the type of production at different points. (Eliot Hurst, 1972, 113).

Economic models are of two types:

1. Input-Output Models

These were originally devised to cope with entire national economic structures, but were modified by Isard and others to look at regional agriculture. With reference to agricultural production, Heady and others used such a model to describe existing interrelationships between various sectors of agriculture and industrial sectors of the economy. Such models are very generalised

and difficult to operate because of the many regions and commodities that have to be specified before the model is to have any meaning. Examples of its operation are outlined by Eliot Hurst (1972), Found (1970) and Tarrant (1974). Their overall value is that

assuming the stability of technological coefficients it can be used to project the impact of overall economic changes (or policy changes on the production pattern of different sectors of production within different regions. (Harvey, 1966, 366).

Again this is an historical model and does not deal with predicted changes. Once areas and yields of malting barley are established, it would be useful for studying income multiplier effects on the region.

2. Spatial Equilibrium Models

Unlike partial equilibrium models, all factors in these models are variable with none held constant.

The purpose is not just to analyse the agricultural economy at one point in time, but to determine if possible where agricultural production ought to be located if certain goals are to be achieved The whole approach is very difficult to summarise because each model used varies according to the problem to be solved and the data available. (Eliot Hurst, 1972, 114).

The most operational of these models is linear programming to determine the optimal pattern of production of one, or perhaps several, types of enterprise. Provided certain information is known, it is possible to determine where production should be located if certain goals are to be achieved, for example the highest average profit among all producers or some other measure of profit maximisation. Results of changes in such variables as resource availability, technology, market customs and values have been studied. No claims are made to represent actual behaviour in these studies. 'Rather they analyse the alternatives implicit in the ecological, technological

and economic components of the operational milieu' (Eliot Hurst, 1972, 116).

The major assumption of such a model is income maximisation which is not relevant to this study which is attempting to assess farmer behaviour and recognises that the farmer may have objectives which are not solely economic.

DECISION MAKING MODELS

All the models presented so far have been essentially static and therefore not easily able to take account of changes in technology, ideology, motivation or demand. Other factors which have been ignored in economic models are the farmer's decision making process and the general absence of complete information and economic rationality on behalf of such decision makers. This involves a less deterministic approach and takes into account

the great multiplicity of factors, past and present, that actually determine land use patterns and farming behaviour. Any pattern that is studied is the result of a large number of individual decisions made for less than rational reasons with only incomplete knowledge to hand. (Eliot Hurst, 1972, 116; refer also Found, 1970; Metcalf, 1969, Tarrant, 1974; Wolpert, 1964).

There have, as a result, been moves away from normative economic models of location to the study of decision making at the level of the individual farmer.

Game Theory

Game theory is a type of decision making model which is a mathematical discipline developed in the 1940's. It concerns the rational choice of strategies in the face of competition from an opponent, which could be a certain location, by a man or group choosing certain strategies to overcome or outwit his opponent. It incorporates decision making at the level of the individual farmer:

who is able to derive a solution to a problem about which a decision has to be made in circumstances of a measurable degree of risk and uncertainty. (Tarrant, 1974, 37-38).

In agricultural studies,

a "game" is set up whereby the farmer is playing his environment in some form. The environment has a number of gambits it can play, for example it can produce a drought, a wet year or an intermediary year. As a consequence of each of these gambits the yield of the farmer's crops are affected in a number of ways. On the other side of the game the farmer also has a number of moves he can make. This might mean growing different crops, some of which will do well in dry years while some will do well in wet years In order to optimise the decision of the farmer in the face of risk and uncertainty, the theory of games permits us to draw up a pay-off matrix showing the outcomes of each possible move by the farmer against each possible move by the environment. (Tarrant, 1974, 38).

A number of solutions can then be considered, which may involve the selection of the best combination of each of the alternatives.

Wright and others used farm management games, developed in the 1960's from business management games, for use in final year undergraduate farm management teaching at Massey University. Such games vary from those of business management in that there is no interaction between the decisions of the individual managers. The uncertainty inherent in the management of bioeconomic systems is a feature of the farm management game. Student assessment was that it was a valuable addition to the lecture situation in trying to identify with decision making on farms. (Wright et al, 1978, 62-63).

While game theory may seem a cold blooded solution to the problem of explaining reactions to a state of risk, its importance lies in its recognition of behavioural elements in the decision making process. However, it limits farmer objectives to minimising risk, yet maximisation of profit

and the desire to satisfice are recognised and worthwhile objectives also. These are considered further when discussing behavioural models. Such a model would be useful in this study but is a major undertaking in its own right, requiring sophisticated computer knowledge, and is recommended as a study topic emerging from this exploratory research.

Diffusion Models

A second approach to decision making concerns the diffusion of information and resulting patterns of land use. The key distinction is between the physical and social distribution of the same geographic phenomenon, emphasising the tie between landscape patterns and elements of culture. Acceptance of a new idea, such as a new crop, is related not only to the receipt of new information but also to various behavioural, psychological and economic factors. (Eliot Hurst, 1972, 118; refer also Chapter 3).

Hagerstrand, a Swedish geographer, has made important contributions to the spatial dimension of innovation diffusion while studying the spread of a government subsidy to improve pasture and the control of bovine tuberculosis in southern Sweden. 'Hagerstrand's work is less important for its empirical aspect than for its general specification of the diffusion process'. (Hagett, 1972, 350). He outlined six essential elements of spatial diffusion: -

1. The area or environment in which the process occurs. It may be uniform and isotropic or highly differentiated.
2. Time - it may be continuous or differentiated into phases such as days or years.
3. Item being diffused - it may be material (for example agricultural technology) or non-material (an idea) and may vary in the degree of communicability and acceptability.
4. Places of origin.
5. Places of destination.

6. Paths of movement.
(Haggett, 1972, 350).

He noted that a wave-like pattern comprising four stages, each of which forms a distinct part of the innovation wave:

1. The primary stage which marks the beginning of the diffusion process by the establishment of adoption centres and by a strong contrast between the innovating centres and remote areas.
2. The diffusion stage - a powerful centrifugal effect accompanied by the creation of new, rapidly growing centres in distant areas (daughter nuclei) and by a reduction in the strong regional contrasts typical of the primary stage.
3. The condensing stage in which the relative increase is equal in all three locations.
4. Saturation - indicates a slowing and eventual cessation of the diffusion process as well as general but slow asymptotic increase towards a maximum. (Haggett, 1972, 350-351).

Hagerstrand's Monte Carlo Simulation model is a probability method of replicating the diffusion process through time and space. Keys (1969) used the model as a framework for studying the spread of herringbone cowsheds in the mid-Waikato. Such a model incorporates resistances or constrictions in the channels of communication with the result that lags can occur in the diffusion of information with unmistakable effects on agricultural land use. (Eliot Hurst, 1972, 118).

Keys' study traces an innovation after its full adoption, i.e. all five stages of the adoption process have taken place by adopters. It would make another interesting possible research topic once the malting plant is operational and farmers are committed, through the contract system, to growing

malting barley, recognising that this commitment is only for one season at a time.

BEHAVIOURAL MODELS

The biggest criticism of the previous models is that they make unrealistic assumptions, especially regarding farmers' objectives. They almost universally assume that farmers wish to maximise profit. Such economic motives, however, are not always paramount and maximisation is infrequently achieved due to the farmer's perception of his decision environment. The notion of stochasm is important here, two farmers in identical situations likely making different decisions due to their different perceptions. Simons' concept of 'bounded rationality' is also pertinent, bounds or limits being set on a person's decision environment due to such socio-psychological factors as limits of experience.

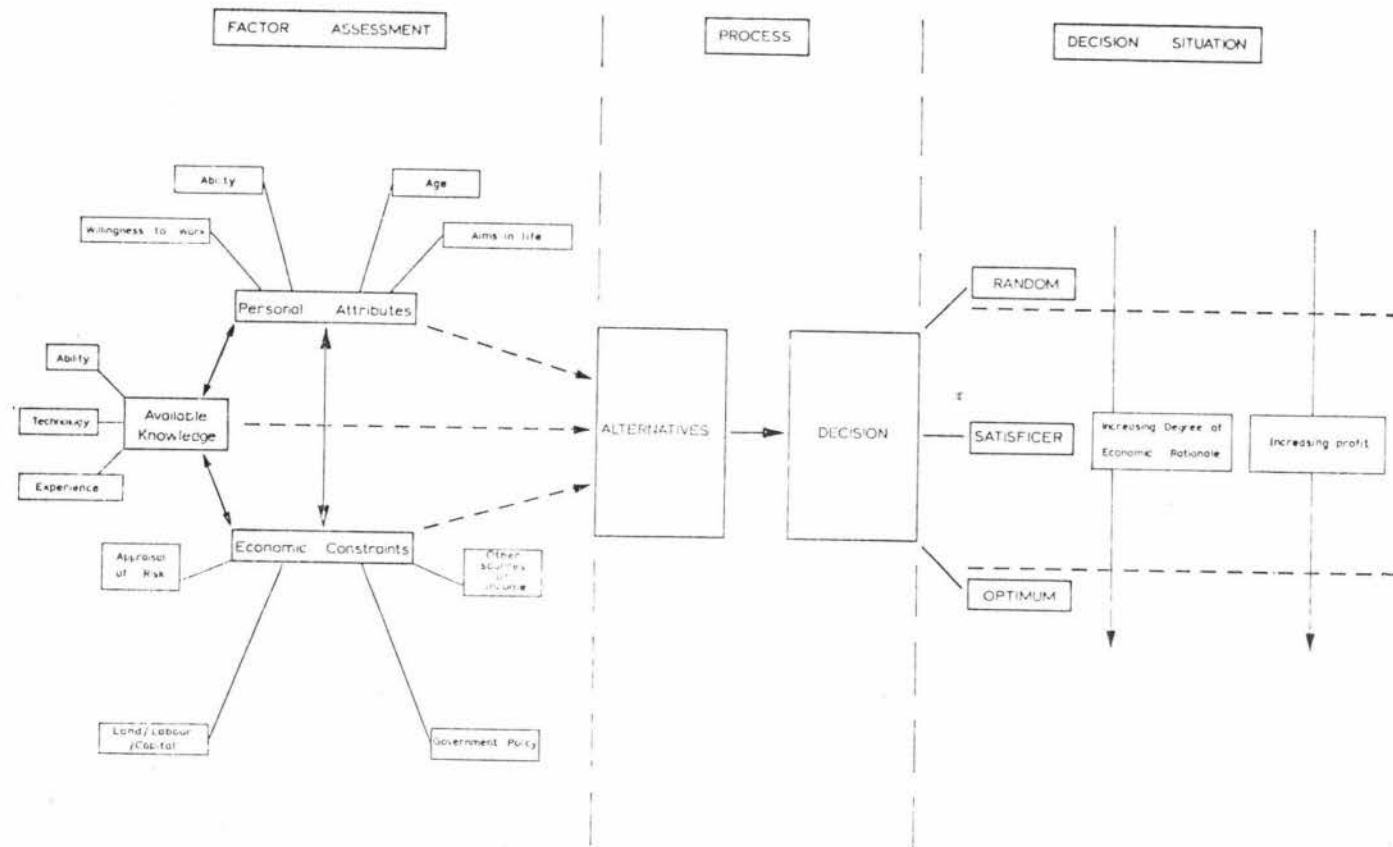
Actions may be intendedly, though boundedly, rational in terms of an individual's perception of crop failures or success, while in statistical and absolute terms the only term for them is sub-optimal. (Eliot Hurst, 1972, 119; refer also Found, 1970; Wolpert, 1964).

Much of the work in this field has been concerned with labour productivity, with labour units frequently achieving less than two-thirds of potential productivity. Kaplan, 1978, in an indepth study of social factors affecting the productivity of hill country sheep farmers in the Mangamahu Valley near Wanganui, found that the farmers more likely to attain production potential shared two key characteristics. The most important of these was not just age per se, but age of coming into financial management of the farm. The farmers who had achieved over sixty percent of potential productivity had universally taken over financial control of the farm by age 25. This, combined with 'world view' - that is, having been away from home for work, education and/or travel - was the most important factor in identifying farmers who were making decisions which would optimise utility on their farms.

Farmers who seek to satisfice need not necessarily have limited experience and horizons, however, but may purposefully do so. Social factors such as increasing age, the wish to participate in service organisations, play more sport or health problems are only a few of the social factors which may influence a farmer's decision making process. Factors involved in the decision making process can be seen in Figure 4.4. The farmer, influenced by his personal attributes and economic constraints, as well as his availability of information, assesses the alternatives available to him and makes the decision which may be of three types. It may be random (that is, have occurred by chance), it might be to satisfice (a social motive) or to optimise (gain maximum productivity) - the last being the most economic of the outcomes.

This decision making process, involving noneconomic as well as economic variables, is regarded as an important aspect of this research. It is anticipated that financial incentives will rate highly in the farmer's decision to adopt or reject the innovation malting barley, but that other factors will be important also. These may include genetic factors in agriculture, that is maintaining soil fertility, which is ultimately an economic objective. They may also include such factors as age, distrust of contracts, dislike of the brewing industry and other such factors.

Figure 4.4: Decision Making on the Farm



Source: Munton, 1969, 146

CHAPTER FIVE
POSSIBLE IMPACT OF THE MALTING PLANT
ON THE CURRENT LAND USE PATTERN

SYSTEMS THEORY

An interdisciplinary approach, which has been used in recent years in the study of a wide variety of problems, is that of General Systems Theory. The systems approach is frequently utilised to help solve a real world problem which can now be achieved through computer technology, for example linear programming.

Within agriculture, an agricultural system is

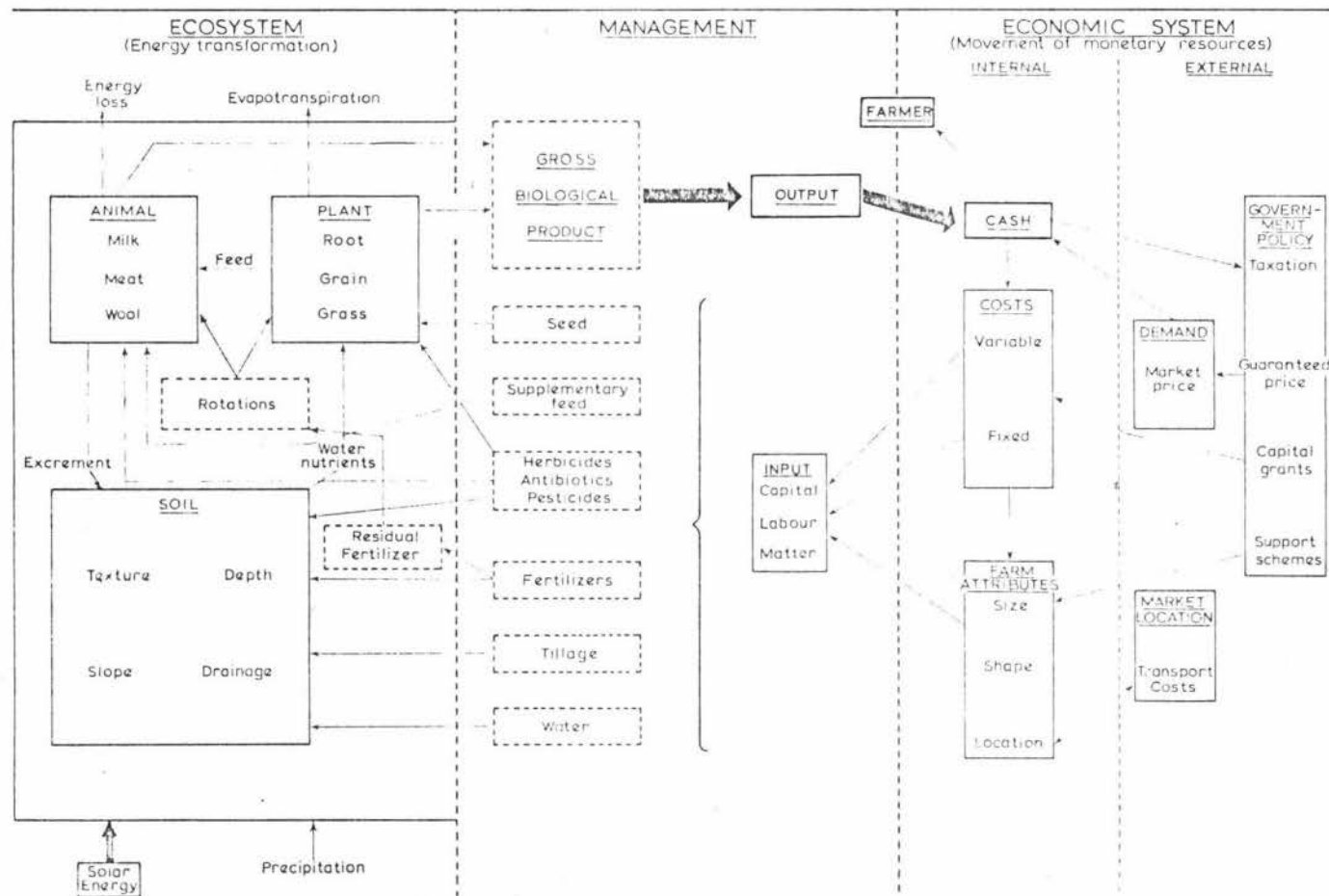
a set of interrelated elements, including the elements through which cultivation takes place, that is functionally related to the natural resources and to the total economic and cultural systems in such a way as to satisfy the society's elementary needs. (Eliot Hurst, 1972, 81).

The farmer as the decision maker makes the management decisions which convert the outputs of the ecological farm system to inputs of the economic system, combining factors and products in a variety of ways. (Figure 5.1). Such an activity, being located at certain points in space, is of interest to the geographer, who is concerned with the spatial components - that is relative location, distance and extent.

The distinguishing features of agricultural systems are listed by McDaniel and Eliot Hurst (1968, 22) as:

1. Environmental constraints such as the weather and biological characteristics of crops and livestock.
2. Attitudinal variations of farmers - motivations, knowledge and ability to perceive tools and strategies which are provided with the economic system.

Figure 5.1: Model of Farm Systems



Source: Munton, 1969, 148

3. Farm size - which affects the type of enterprise established.
4. Tenure. Long term tenure encourages the performance of genetic agriculture, that is seeking to maintain soil fertility whereas short term tenure encourages extractive agriculture, neglecting soil fertility.
5. Marketing - the marketing system has an important effect on the type of enterprise chosen.
6. General economies of agriculture. Land is not productive on its own but needs the infusion of other inputs such as labour and capital (for example in machinery investment) to become productive. An agricultural area tends to produce those products for which it has a special ability or physical advantage compared with other areas - thus the principle of comparative advantage is important in the general economics of agriculture.

Rutherford (1972) regards Western economies as consisting of -

a series of overlapping and interlocking systems and subsystems, which can only be hinted at because they are so numerous and complex in their actual interplay that they defy abstract summation They are embraced in a "nested hierarchy" in which "inferior" systems are embraced by, but lock with, "superior systems". (Rutherford, 1972, 53).

These can be considered from the smallest to the largest as:

Micro System (1) - the on-farm ecosystem, the smallest in the nested hierarchy. It is the man - land - animal ecosystem, an open system with various natural and human inputs, components being such things as land, management, labour and capital. Connectivities are established between components and natural and man-made outputs, and show how land users manipulate systems for productive advantage.

Micro System (2) - the single farm as a business. At this level the single farm as a firm in which the farmer, as the managerial unit, takes decisions which, when farms are aggregated, result in the development of land use patterns. Each farmer, as a business man, faces four interrelated questions:

- i) What goods to produce?
- ii) Where to locate production?
- iii) How to carry out production - product/factor relationships.
- iv) What factor and product markets to be linked to.

Meso System (3) - links between the farm and the local urban node. Links between a small group of farms and a local urban centre which are usually bi-polar linkages, for example between dairy farms and local processing factories operating in a region of factory supply or wheat/sheep farms linked with local grain and livestock facilities. Backward and forward linkages exist between these poles.

Meso System (4) - links between groups of farms and intermediate urban nodes - this is an extension of (3) and involves the movements of ideas as well as goods, innovation diffusion being an important concept here.

Meso System (5) - links between farms and major regional nodes, this subsystem encompasses (1) to (4).

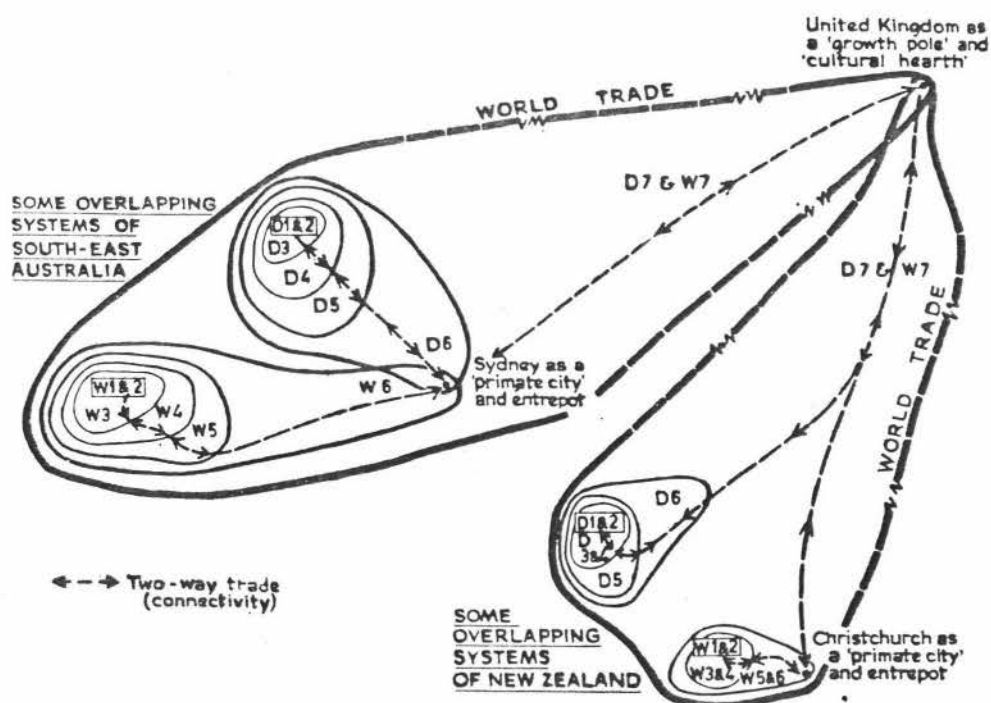
Macro System (6) - links between farms and primate cities (state or national capitals) acting as factor and product markets.

Macro System (7) - links between farms and external trade, all the above links being subsumed by the largest at all, the international market system. (Rutherford, 1972, 54-57).

The relationships within this nested hierarchy of systems can be seen in Figure 5.2. The links for malting barley

will initially be between farm and malting plant, then more widely dispersed breweries throughout the North Island, and for some barley, the ultimate link will be the international export market - Japan or Latin America.

Figure 5.2: Illustration of how single dairy farms and their internal eco-systems (compare Figure 2) belong to a nested hierarchy of local, regional, national, and international systems. ('D' refers to Dairying; 'W' to wheat farming, The numbers refer to micro, meso, and macro systems discussed in the next text).



Source: Rutherford, 1972, 52

PROPOSITION THREE

The basis of proposition three is that the existing land use system will be modified by the new input, the market demand for a 'new' crop which will affect not only on-farm systems but the whole regional agricultural system.

Proposition three states that 'The components of a land use system are dynamic. At any given point in time, however,

they are in a state of equilibrium, but a new input may cause modification of the components of the land use system'. To test this a number of null hypothesis have been formulated within four subpropositions, although some concepts are not able to be tested statistically and observations have to be used.

Proposition 3.A

'The malting barley plant as a new input will alter the equilibrium of the existing land use pattern by creating a new demand with stable economic returns for a crop readily grown in most parts of the region'.

It may be argued that malting barley is not a new crop, but rather another demand for a crop readily grown in the Manawatu. Feed barley and malt barley share certain characteristics - both require a relatively short growing period and dislike competition from weeds, will not tolerate soil acidity and prefer a season which is long and cool during the growing period, being unable to thrive under excessive rainfall or in hot humid conditions.

Barley to be used for malt manufacture, ultimately to be brewed for beer making purposes (description Appendix N), has a number of conditions beyond those of barley for feeding stock.

In New Zealand only the two-rowed barleys are used for malting. To be acceptable the grain must be dry, plump, bright, sound, clean and pure. It should be circular in cross-section, the furrow almost completely filled and the seed coat finely wrinkled. A high and even germination and a low nitrogen content are essential. (Claridge, 1972, 102-103).

A high soil nitrogen content will produce a high stalk susceptible to wind damage (lodging). Damage to the grain also can occur during the threshing process or during conditions of insufficient rainfall which gives pinched dried grain. As a result of the additional care required,

growers will expect a premium over and above the price paid for feed barley. The two, however, will be complementary, rejects for malting being resold for feed purposes. Malting barley will be grown on a contract basis, contracts being arranged via seed and grain agents but signed directly between farmer and malting company.

While economic motives such as profit maximisation may not always be the key motivation in adopting the innovation, the farmer growing it on a large scale or changing his land use system to incorporate malting barley will no doubt be motivated by monetary rewards. The considerable and unexpected drop in barley price following the 1977-1978 harvest, from \$104 to \$97 per tonne, has led to fewer contracts being let for barley 1978-1979 and a negative perception of the utility of the crop by many farmers.

Pryde, 1978, in a survey of New Zealand farmer intentions, expectations and opinions, found that fewer of his sample intended growing barley, clover and processed crops this season (1978-1979) than the previous season (1977-1978). Wheat areas were expected to remain the same and only grass-seed showed considerable improvement. The reduction of barley can perhaps be traced to overproduction last year, over 5,000 tonnes in the Manawatu alone. This oversupply has been regarded as a consequence of higher yields (three quarters of a tonne higher per hectare than previously) due to the elimination of net blotch disease and favourable climatic conditions, according to seed and grain merchants. The intentions of nationwide cropping farmers can be seen in Table 5.1.

Table 5.1: Comparison of 1977-1978 and 1978-1979 Cropping Areas

	No. of valid observations	Average hectares 1977-1978	Average hectares 1978-1979	Percent change
Wheat	51	8.9	8.9	-
Barley	41	43.7	39.9	- 8.8
Processed crops	28	37.2	32.4	-12.4
Grass for seed	25	26.9	39.7	+47.5
Clover	34	46.4	43.1	- 7.1

Source: Pryde, 1978, 21

In purely economic terms, gross margins analysis gives the possible gross income for a crop-per hectare after direct costs (seed, fertiliser, harvesting, transporting and so on) have been met. They can be calculated in matrix form for a number of different yields at differing returns. The gross margins booklet prepared by the Ministry of Agriculture and Fisheries in Palmerston North, using expected average returns and costs, shows barley to be the least attractive proposition in purely economic terms. (Table 5.2).

Table 5.2: Gross Margins for Crops, 1978-1979

Crop	Yield	Price/Tonne	Gross Margin/Hectare
Wheat	4.7 tonnes/ha	\$114 ^a	\$ 289.50
Barley	4.0 tonnes/ha ^b	\$104 ^c	\$ 172.00
Maize	8.0 tonnes/ha	\$108	\$ 318.00
Seed peas	4.0 tonnes/ha	\$146	\$ 293.00
Ryegrass seed	900 kg/ha	55 cents/kg	\$ 319.00
Bird seed	2.5 tonnes/ha	\$200	\$ 282.00
Sweet corn	15.0 tonnes/ha	\$ 42	\$ 308.00
Process peas	3.8 tonnes/ha	13.2 cents/kg	\$ 276.00
Potatoes	38.0 tonnes/ha	\$100	\$1016.00
Mangolds	125 tonnes/ha	\$11/tonne	\$ 918.00
Lucerne Hay	500 bales/ha	\$ 2/bale	\$ 554.00

Source: Cropping and Livestock Gross Margins, 1978-1979, 5.

- Notes:
- a) 1979 price announced \$130/tonne
 - b) This yield only reached Rangitikei, 1976-1977, next seasons production not yet analysed.
 - c) This season price \$97/tonne

Thus individual decisions are not purely economic, or else all farmers would logically be growing potatoes and mangolds this season. Other factors, such as differing soil nutrient requirements, disease risk, susceptibility to wind damage, length of growing period and variations in market demand, all influence the farmer in his crop planting decision. The aggregate of a large number of similar land use decisions can therefore have considerable impact on the farming pattern of the region as was evidenced by the swing to process peas and other vegetable crops when a process plant was established near Feilding. Despite the apparent poor price of barley, a premium paid by the malting company could likewise have a considerable impact in increasing current areas of barley.

Economic factors as motivations for growing malting barley are discussed within the following null hypothesis:

3.A.1 That there is no difference between farmers who have grown barley in the past and farmers who intend to grow malting barley with respect to reasons for having grown barley.

This information, as for incentives for future growing of barley, was requested in an open-ended question to obtain a variety of responses. Farmers were asked to give one main reason for including barley in their farming system if they had grown it in any of the past five seasons. If more than one reason, only the first was coded. The results can be seen in Table 5.3.

Table 5.3: Reasons for Growing Barley in the Past

Reason	Past Growers	Intend to grow Malting Barley
	n = 96	n = 125
Financial returns	13.5%	10.4%
Short growing period	16.7%	15.2%
Pasture renewal	29.2%	21.6%
High yields	4.2%	3.2%
Ease of growing	6.3%	5.6%
Reliability	14.6%	10.4%
Diversification	7.3%	4.0%
No reason given ^a	8.3%	29.6%
Chi Squared = 8.56 at 6 degrees of freedom, not significant at 0.05 .		

Source: Field Survey, June, 1978, question 4a, part B.

Notes: a) Excluded from Analysis.

b) 0.05 = 95 percent confidence level;
0.01 = 99 percent level.

Such reasons applied to farmers having grown barley over any of the past five seasons. Of the 125 farmers probably or possibly growing malting barley, 41.6 percent did not grow barley this last season (1977-1978), but may have done so during some of the previous seasons.

The major reasons quoted for growing barley in the past were the short growing period and pasture renewal, basically genetic reasons with economic consequences - the short growing period allows the land to be returned to pasture at a faster rate and renewed pasture enables a higher stocking rate to be attained. Reliability of the crop (minimising risk) and financial returns (maximising profit) were also important goals.

Hypothesis 3.A.1 was thus accepted with similar distributions occurring between the two groups when the 'no responses'

were excluded. For both samples, pasture renewal was the key reason, followed by short growing period, financial returns and reliability.

3.A.2 That there is no difference between farmers who have grown barley in the past and farmers who intend to grow malting barley as to incentives for growing barley.

Table 5.4: Comparison of Incentives

Incentive	First Incentive		Second Incentive	
	Past ^a	Intend M.B.	Past	Intend M.B.
Economic returns	60.4%	57.6%	8.3%	8.8%
Ease of growing	2.1	3.2	2.1	2.4
Pasture renewal	8.3	7.2	17.7	12.8
Drop in returns of alternatives	3.1	4.0	5.2	7.2
Yields	7.3	5.6	10.4	9.6
Previous experience	5.2	3.2	3.1	2.4
Labour	1.0	—	2.1	2.4
Demand	4.1	5.6	9.3	9.6
No response	6.2	12.8	41.6	44.8
Chi-Squared =	8.57 at 8 d.f. ^c		3.06 at 8 d.f.	
=	not significant at 0.05.		not significant at 0.05.	

Source: Field Survey, June, 1978, question 5a, Part B.

Notes: a) Have grown barley in past five seasons.

b) Intend to grow malting barley.

c) Degrees of freedom.

The hypothesis was accepted with very little difference in distribution occurring between the two groups. It is interesting to note that the first incentive quoted was overwhelmingly financial. Over forty percent of both samples gave no second incentive, but of those who did, pasture renewal, yields and the existence of a market

demand were important. As malting barley should not follow pasture, however, it appears that malting company policy on this should be made clear to farmers.

3.A.3 That there is no difference between farmers who have grown barley in the past and those who intend to grow malting barley in terms of disincentives to growing barley.

Table 5.5: Disincentives to Growing Barley

Incentive	First Incentive		Second Incentive	
	Past ^a	Intend M.B. ^b	Past	Intend M.B.
Returns	40.6%	36.0%	5.2%	6.4%
Soil Deterioration	4.1	2.4	3.1	1.6
Yield	4.2	3.2	6.2	4.0
Costs	18.7	16.0	10.4	9.6
Risks	5.2	8.0	6.2	7.2
Dislike contracts	2.1	.8	2.1	.8
Higher returns of alternatives	7.3	8.0	9.3	11.2
Unsuitability	4.1	3.2	5.2	4.0
No disincentives	2.1	2.4	1.0	.8
No response	11.4	20.0	51.0	54.4
Chi-Square =	9.64 at 9 d.f. not significant at 0.05.		6.09 at 9 d.f. not significant at 0.05.	

Source: Field Survey, June 1978, question 5b, Part B.

This hypothesis was also accepted, the distributions of each sample being similar. The major disincentives were returns, which is not surprising as the price of barley fell unexpectedly to \$97 per tonne during the 1977-1978 season from \$104 per tonne.

Costs, such as that of seed and transport, and the better returns from alternatives are also economic factors operating against the growing of barley, substantiated by the low gross margin estimated for barley for 1978-1979. (Table 5.2).

3.A.4 That there is no difference between farmers growing barley in the past and those intending to grow malting barley in the future with regard to their attitude that cropping increases or decreases the carrying capacity on mixed farms.

Table 5.6: Effect of Carrying Capacity on Mixed Farms

	Past Growers	Intend to grow M.B.
Increases	87.3%	83.2%
Decreases	12.7%	16.8%
Chi-Squared =	1.00 at 1 degree of freedom, not significant at 0.05.	

Source: Field Survey, June 1968, question 10, Part B

This hypothesis was accepted. In terms of attitude, the majority felt that carrying capacity was increased, but many qualified this question by stating that the amount of fertiliser, climatic conditions and stocking rate were just a few of the factors influencing this. In general terms, it can be seen that a crop in the ground for approximately four months, followed by new pasture containing improved species, may enable increased stocking rates for fat lamb farmers. If this is so, then the additional land put into barley for the malting plant may not decrease pastoral farming, fat lamb farming in particular. This issue has important implications but is difficult to measure at this stage. Much depends on whether mixed farmers retain a breeding flock or intensify production through the practice of buying in lambs in winter and reselling them in time to put their whole farm into crops.

3.A.5 That farmers intending to grow malting barley expect to be paid a premium over and above that price paid for feed barley.

The higher quality requirements of malting barley and therefore the greater possibility of rejection mean that farmers expect to be paid more per tonne for malt barley than for feed barley. One seed and grain merchant quoted a minimum premium of \$7 per tonne.

Of those showing an intention to grow malting barley, over half expected at least \$125 per tonne. Considering that the gross margin for feed barley, calculated at \$114 per tonne for an average yield of 4 tonnes per hectare, gives \$212 per hectare, barley still does not pay well compared to other crops. Moreover, yields reached 4 tonne per hectare only in Rangitikei county in 1976-1977, being less in the other three counties (Table 2.2). The gross margin takes into account only variable costs such as seed, planting, fertiliser, weed spraying and so on but does not take into account fixed costs such as capital invested in land and equipment. Even at \$125 per tonne, assuming the same variable costs as for feed barley, and production at 4 tonnes per hectare the gross margin is \$256 per hectare - still lower than wheat, maize and other crops. Noneconomic factors, however, such as short growing period, absence of major crop risks and so on may operate to make barley more attractive in comparison to other crops.

3.A.6 That there is no difference between farmers intending to grow malting barley and the total population in terms of perceived advantages and disadvantages of engaging in contracts.

The attitude of the manager of a food processing firm in Palmerston North expressed the attitude that farmers in the Manawatu are not 'contract conscious' as compared with farmers in Hawkes Bay, for example, who have long had experience with the contract system.

To test this attitude, farmers were asked whether or not they had engaged in contracts and if so, to state their perceived advantages and disadvantages. Of the farmers intending to grow malting barley, 67 had previously engaged in growing crops under contract while 58 had not. Malting barley will be contracted out via seed and grain merchants and this surety of market is seen as a key factor in the proposition that the malting barley plant will provide an outlet with stable economic returns. The fluctuations of returns in the livestock industry and the plight of farmers left with surplus grain which they grew without a contract when the price slumped means that contracts may be increasingly attractive.

Table 5.7: Perceived Advantages and Disadvantages of Contracts

	Intend to grow M.B.	Total Sample
<u>Advantages</u>		
Secure price	36.7%	35.4%
No storage	4.4	4.7
No capital outlay	13.3	23.1
Saves time	4.4	4.7
Market access	38.9	30.6
Help from firm	2.2	1.4
Chi-Squared = 6.96 at 5 d.f. not significant at 0.05.		
<u>Disadvantages</u>		
Price inflexibility	54.7	48.2
Tied to a firm	24.0	29.5
Disposal of rejects	2.6	1.8
Unsuitability	4.0	6.2
Unreliability	6.7	8.0
Inability to fill contract	5.3	4.5
Lack of personal satisfaction	2.6	1.8
Chi-Squared = 3.79 at 6 d.f. not significant at 0.05.		

Source: Field Survey, June 1978, question 12, part B.

Both components of this hypothesis were accepted, with distributions of both samples being similar. The main advantages perceived were security of price, market access and lack of capital outlay - all primarily economic motives. On the other hand disadvantages were perceived to be price inflexibility (the inability to take advantage of price increases occurring after the contract has been signed) and the feeling of being tied to a firm. The former disadvantage is primarily economic whereas the latter may be psychological as well as economic.

Thus all null hypotheses within this proposition have been accepted, the two samples chosen in each case being similarly distributed. Most of the questions to obtain this data were deliberately open-ended to obtain a variety of responses, some of them perhaps beyond the realm of 'bounded rationality'. That the responses were all 'rational' and primarily economic can be evidenced by the results presented above. Stable economic returns would appear to be the major factor encouraging farmers to adopt the innovation malting barley, a response to the fluctuations frequently experienced in the livestock section of the current land use system.

Proposition 3.B

'For areas designated suitable for intensive cropping by D.S.I.R. Soil Bureau, there will be a move from:

- feed to malt barley;
- other crops, especially potatoes and maize, to barley;
- pastoral to arable farming'.

As mentioned in Chapter Two, it was found to be too difficult to assess a farmer's whole property in terms of its suitability for intensive cropping because many of the farms extended over more than one soil type and 39.7 percent of the farmers lease additional land which may be used for cropping but could not be identified on location maps.

In terms of soil suitability for intensive cropping, the homestead blocks of farmers intending to grow malting barley were located as follows:

	Class
14.4%	were 1A
24.0	1C
0.8	2A
36.0	2B
4.0	2C
3.2	3A
4.8	4
12.8	could not be located

The majority were thus located on 1C and 2B soil classifications (after Cowie, 1974, 41-42, Appendix E). Soil class 1C have slight limitations of imperfect to poor drainage, requiring some drainage before cropping and the period during the year when they can be cultivated is somewhat restricted. They include Kairanga silt and fine sandy loams and Te Arakura silt and sandy loams. The soil class 2B comprise soils with poor drainage and compact subsoils, cropping being largely restricted to annual cropping of cereals and field crops in rotation with pasture. They include Ohakea silt loam, Tokomaru silt loams, and Marton silt loams and are well represented around Marton (Appendix F).

When asked what malting barley would replace if grown, the majority of farmers responded that pasture would be replaced. Insufficient numbers thought potatoes or maize would be replaced to be included in the analysis. The major land uses which could be replaced by malting barley are:

Table 5.8: Possible Crop Replacement by Malting Barley

	Probably ^a	Possibly ^b
Pasture	64.1%	78.0%
Fodder	12.8	12.2
Feed barley	12.8	4.9
Wheat	6.4	4.9
n =	39	41
Chi-Squared = 15.71 at 3 d.f., significant at 0.01		

Source: Field Survey, June 1978, question 8, part B.

- Notes: a) Indicated definite intention of growing malting barley
- b) Farmers indicating that they were interested in growing malting barley but made no firm commitment.

The hypothesis that 'there is no difference between the "probabilities" and "possibilities" in terms of land uses which would be replaced by the growing of malting barley' was rejected. More farmers in the 'possibly' group malting barley would replace pasture, whereas more in the 'probably' group thought that feed barley would be replaced. Note that actual numbers of respondents to such a question are quite small.

If pasture is to be replaced by malting barley it should be done via the rotation of malting barley after wheat or another barley crop. Again, if it is true that carrying capacity is increased by the inclusion of crops as part of the farm's rotation, then increased cropping should not reduce livestock numbers, fat lambs in particular.

The small questionnaire sent to seed and grain merchants also asked what crops would be replaced if the malting barley plant is to meet its requirements from within the Manawatu. The impression was that wheat and perhaps feed barley would be reduced in area, but that the main area would be out of pasture. The reduction in feed barley exports to the northern North Island may lead to replacement by malting barley. Potatoes and maize would not be affected which is understandable when comparing their gross margins (Table 5.2).

Not all varieties of barley currently grown for feed purposes are also suited to malting. Hassan and Pirouette, for example, are considered poor in malting quality. Farmers were asked in the survey which two varieties they had experienced most success with. The overwhelming response was Zephyr, followed by Julia and Carlsburg. (Table 5.9; refer also Table 5.10).

Table 5.9: Preferred Types of Barley by County

Area	Kairanga	Manawatu	Oroua	Rangitikei
n =	29	27	17	41
Zephyr	58.6%	44.4%	52.9%	46.3%
Mata	6.9	-	-	9.7
Julia	17.2	2.2	11.2	7.3
Carlsburg	6.9	18.5	23.5	9.7
Hassan	-	14.8	5.8	9.7
Rika	-	-	-	4.8
Lara	-	-	-	2.4
Manapou	3.4	-	5.8	4.8
Impala/Universe	6.9	-	-	4.8

Source: Field Survey, June 1978, question 4b, Part B

No Chi-Squared performed because of very small actual numbers in most categories.

Table 5.10: Production of Barley by Variety by County, 1976-1977

Area	Kairanga	Manawatu	Oroua	Rangitikei
<u>Threshed (ha)</u>				
Carlsburg	119	189	72	387
Research	5	3	10	13
Zephyr	999	1205	1065	1968
Other	54	97	66	248
Manapou	3	-	-	16
Kenia	-	16	59	10

Source: Department of Statistics, unpublished data, June 30, 1977.

Thus Zephyr was the most popular variety as indicated both by the 1978 survey and production figures for 1976-1977. Research and Kenia were not mentioned at all in the survey responses, while Mata, Julia, Hassan, Rika, Lara, Impala and Universe were all subsumed under 'Other' in the Department of

Statistics figures. Julia ranked second in preferred types while Carlsburg, not well suited to malting, also ranked highly both in preference and in production. Farmers will need to be informed of varieties best suited to malting to avoid rejection of unsuited varieties.

Proposition 3C

'The disturbance of the equilibrium for the region will be great if the plant is to obtain the 30,000 tonnes (7000 hectares) required annually once in full production from within the Manawatu, but for the individual farm change will be short term and small scale'.

As has been noted, the aggregate of a number of individual land use decisions can have considerable impact on the overall land use pattern. The decision to grow malting barley, may, for many farmers, be on a trial basis initially. They may only be prepared to plant a small area and consider it an impermanent part of their land use until its utility can be evaluated. To attempt to establish this trend, the following null hypotheses have been tested:

3.C.1 'That there is no difference between the "probabilities" and "possibilities" with respect to intention to grow malting barley on a permanent basis'.

Table 5.11: Attitude Towards Growing Malting Barley on a Permanent Basis

	Probably	Possibly
n =	51	74
No response	11.8%	32.4%
Permanent	66.7	36.5
Impermanent	21.6	31.1
Chi-Squared = 41.0 at 2 degrees of freedom, highly significant at .01.		

Source: Field Survey, June 1978, question 8, Part B.

This hypotheses was rejected with considerable differences occurring between the two groups. The "probablies" who indicated a greater commitment to growing malting barley than the "possiblies" were thus well represented in the permanent group. On the other hand, relatively more of the possibly group gave no commitment (no response) or were considering growing malting barley on an impermanent basis.

3.C.2 'That there is no difference between "probablies" and "possiblies" in terms of attitude towards possible increased costs and risks incurred when growing malting barley'.

Table 5.12: Difference in Attitude Towards Increased Costs and Risks

	Probably	Possibly
n =	51	74
No response	30.0%	65.7%
Increased costs/risks	20.0	11.4
No increase in costs/risks	50.0	22.9
Chi-Squared = 58.0 at 2 degrees of freedom, significant at 0.01		

Source: Field Survey, June 1978, question 10, Part B.

Again this hypothesis was rejected, due to considerable differences in those not responding and in those feeling that there were no increased risks or costs.

Those of the total sample responding in the affirmative to this question saw 'quality' as the major risk.

Table 5.13: Increased Costs and Risks Associated with Malting Barley

n =	100
Price of seed	2.0%
Quality	49.0
Ground preparation	3.0
Disposal of rejects	7.0
Transport costs	8.0
Insufficient information	4.0
Harvest technology	5.0
Nitrogen levels affected	8.0

Source: Field Survey, June 1978, question 10, Part B.

Thus 'quality', which is also related to nitrogen levels and harvest technology, was the major reason stated by farmers for assuming increased risks and costs would be incurred when growing malting barley over and above those incurred in growing feed barley. Many farmers wanted to know more of malting company policy and some had heard negative reports by South Island farmers of the company. It is suggested with respect that it is in the field of public relations as much as in pure economics that many farmers will decide whether or not to grow malting barley on a permanent basis.

3.C.3 'That there is no difference between "Probabilities" and "Possibilities" in terms of anticipated area to be planted in malting barley'.

Table 5.14: Anticipated Area of Malting Barley

	Probably	Possibly
n =	51	74
No response	21.6%	89.2%
1 - 5 ha	13.7	4.1
6 - 19 ha	39.2	6.8
20 - 29 ha	13.7	-
30 - 49 ha	3.9	-
50 - 99 ha	7.8	-

Source: Field Survey, June 1978, question 8, Part B.

A Chi-Squared test was not performed due to the absence of responses by the "possiblies" in the categories over 20 hectares as well as the very-large proportion in that group not responding. This was not unexpected, due to the questionnaire being sent before the malting plant was given the final 'go-ahead' and when farmers were unsure of returns and other matters of policy. Of the "probablies", those farmers more willing to commit themselves, the biggest single response was in the 6 to 19 hectare range, with four farmers showing intention to grow between 50 and 99 hectares.

Proposition 3.D.

'This disturbance of the equilibrium could have consequences outside the Manawatu if the plant cannot establish its supply area here. In this case, the supply area will have to be extended to the northern Wairarapa and Southern Hawkes Bay, distance becoming an additional cost factor'.

Deciding whether the malting barley plant will meet its requirements within the Manawatu is at this stage fairly much an academic question. Malting company personnel are confident of obtaining their total requirements within the lower North Island. It is perhaps not too difficult to envisage seventy farmers growing one hundred hectares each in a region well suited to cropping.

Of the seed and grain merchants responding to the small mail questionnaire, only one felt that the malting company would meet its requirements within the Manawatu. Reasons for the company not meeting its requirements vary from economic reasons to malting company policy. If a very high price per tonne is offered initially, there may well be a large swing to malting barley which will only be sustained if prices and public relations continue to be perceived in favourable terms by farmers.

An unrealistic price for any commodity will only attract a large number of growers from other crops which would not otherwise have been the case. Should common sense prevail and a realistic price for malting barley be paid in relation to other crops (e.g. a premium of approximately \$6 per tonne above feed barley) then we are of the opinion that the malting company will require to draw significant quantities of barley to make up their requirements from other areas. Should a totally unrealistic price be struck then it may well be that malting barley would replace 90% of other crops.

Respondent, Seed and Grain Merchant's Survey.

If the plant does not meet its requirements within the Manawatu, transport costs will add considerably to the variable costs and therefore decrease the gross margin even further. Thus a high price per tonne would have to be offered to offset such transport costs or alternatively, these would need to be met by the malting company.

Taking the average cost of transport of barley to be 2.2 cents per tonne per kilometre, the additional costs can be seen in Table 5.15, depending on distance from the plant.

Table 5.15: Schedule Prices of Transporting Bulk^a
Barley to Marton

Origin	Distance to Marton	Cost/tonne ^b
Dannevirke	88 km	\$13.94
Woodville	64 km	\$12.55
Pahiatua	80 km	\$13.70
Wanganui	37 km	\$ 9.26
x	50 km	\$11.12

Source: Manager, Glen Oroua Transport Limited

- Notes:
- a) Bagged barley costs an additional \$1 per tonne to transport.
 - b) These are schedule costs. Total costs are often calculated on time spent as well as weight. The carrier estimated \$4 per mile for a load of 19 tonne of bulk barley, as an average cost which is lower than schedule.

In conclusion, the equilibrium of the current land use pattern will inevitably be disturbed by the establishment of the Canterbury (N.Z.) Malting Company's new plant near Marton. The large demand for malting barley means that the balance of interrelationships between individual crops and between arable and pastoral usage will be altered. Initially the disturbance will be great, especially if a 'high' price is perceived by farmers. The new equilibrium will be maintained if success is perceived by farmers in terms of their economic and social motivations.

CHAPTER SIX

POSSIBLE IMPACT OF THE MALTING BARLEY PLANT ON THE
ECONOMIC LIFE OF THE REGION

The recent emergence of regional economics as an area of study, derived from both traditional economics and geography, has concepts and theories pertinent to this chapter. Regional or spatial economics is summed up by Hoover in the question 'What is where, and why - and so what?' The first 'what' refers to all types of economic activity; 'where' refers to location in relation to other economic activity; the 'why' and 'so what' refer to the variety of economic interpretations that can be made (Hoover, 1975, 3). The region is regarded as a functionally integrated area rather than a homogeneous area. Thomas has defined a region as a

delineated part of a country within which economic growth is studied and growth and development are desired. (Thomas, 1975).

The study of regional economics looks at forces shaping a region's development and what may be done to engender future growth by channelling resources into 'sluggish' or else well-favoured nodes. A basic assumption given by Perroux in 1955 is that

growth does not occur everywhere all at once but it appears in points or growth poles with varying intensity, it spreads via various channels and with various effect. (quoted Moseley, 1974, 2).

The term 'development' is regarded as structural change rather than a change in magnitude which is regarded as growth. Development is 'the emergence of new structures or resource combinations or new classes of goods and services' which are analysed in spatial terms. Measures of regional development usually compare the region in question with a benchmark (the nation, for example, or another region) in economic terms such as employment, income per capita or output.

Two theories of how regions develop may be relevant to this study in the attempt to assess the impact of the establishment of the malting barley plant on the economic life of Marton and the Manawatu.

REGIONAL DEVELOPMENT THEORIES

Growth Pole or Growth Centre Theory

This theory, termed growth pole theory, was originally outlined by Perroux in 1955 and was given impetus as growth centre theory by Moseley in 1974. It takes account of the fact that growth is selective in its initial incidence and tends to originate at a 'locational constant' such as a port, mine or another historical settlement. Subsequently unbalanced development took place at these key nodes from which development impulses spread, but being best placed for further development they were likely to become cumulatively more developed. It was at these centres that there was a greater propensity to adopt innovations.

Growth pole policies deliberately channel growth into these favoured nodes, having a suction pump effect on the rest of the region - that is the core develops at the expense of the periphery. Moseley indicated that growth centre policies aim at achieving more than one of the following objectives:

1. An improvement in the region's potential for adopting innovations;
2. A programme of regional growth that is faster, greater or more assured than would otherwise occur;
3. A saving in public investment in infrastructure;
4. A more efficient pattern of service provision;
5. The dissemination of growth impulses throughout a problem region;
6. The interception of would-be migrants from the region. (Moseley, 1974, ix)

He added that a minimum size of 30,000 is necessary for economies of scale in the public sector infrastructure to be reaped and that for self-sustaining growth to occur the

minimum viable size for smaller towns is 25,000.

Such self-sustaining growth can be brought about via a number of 'rounds of growth' initiated by propulsive industries (sometimes called lead firms). A round of growth may be initiated by output expansion in an industry whose growth is greater than average, due to the adoption of an innovation which enhances efficiency or the development of a new product or utilisation of a new resource. Mobility of resources such as labour and capital is essential, with increasing returns from the increased efficiency or new product leading to a productivity rise which gives a rise in real income. In turn this leads to increases in effective demand which through the income multiplier and accelerator effect give rise to further rises in real income. This benefits the growth centre through increased investment in infrastructure and service provision and which transmit growth impulses throughout the region.

Such rounds of growth may occur of various magnitudes and durations and several may occur at once. For long period growth to be attained (that is, greater than 25 years) two necessary conditions must be met:

1. the demand for commodities must be elastic
2. returns must increase

Such economic concepts as multiplier (the amplified effect of consumer spending and investment), accelerator (a moderate increase in consumption giving a large increase in investment spending) and industrial linkages (the relatedness of firms in terms of both materials and ideas, with firms supplying inputs to others who in turn provide their outputs to other firms) are all important in such a theory.

Export Base Theory

North's export base theory regards the role of export industries as the key to growth, with expansion of the export sector giving increases in regional income both directly and

indirectly via increased internal demand for local goods and services. The establishment of linkages and the effect of the income multiplier and accelerator are also vital to an understanding of this theory.

This is a demand growth theory, with the region being sensitive to external economic conditions. If the region loses its comparative advantage vis-a-vis other trading regions then the nonbasic (alternatively termed following, residentiary or internal) sector will be greatly affected unless there is an injection of outside investment, internal industries grow rapidly or there is an improvement in the region's terms of trade.

THE MALTING BARLEY PLANT

The above theories were outlined because the establishment of the Canterbury (N.Z.) Malting Company's No. Two plant at Marton may give to Marton a 'round of growth' by an industry which meets both local and export demand. It is possible that the Wanganui region, which is eligible for Government Development Assistance because of its 'sluggish' economy and which formally contains Marton and the Rangitikei County, may notice the effect more than the Manawatu region which enjoys a healthier economic climate. Both regions rely greatly on pastoral industries for export income and the settlements originating as service centres for the agricultural hinterland. The processing of agricultural products is important to both.

The construction of the malting barley plant is to begin in April 1979 with Stage I of the project costing an estimated \$12 million. While tenders have been called overseas for plant construction and equipment, company policy is to use as much local labour and inputs as possible. The plant will use considerable quantities of natural gas, the pipeline being extended to Marton to benefit the plant and in doing so, will also benefit the population of Marton. Less than twenty people are estimated to be employed at the plant,

with six semi-skilled persons per shift as well as management staff. The establishment of the Canterbury Seed Company, an independent seed and grain merchant on the same site, will also involve staff as will laboratory facilities in later years.

In general terms, however, the income multiplier and accelerator effect of the staffing of the plant is expected, by the manager of the Malting Company, Mr Kearney, to be less than that generated by the related services such as transport companies to transport grain to the maltings and malt to the breweries, seed and grain merchants, growers, servicemen and so on.

The Marton site was chosen after a feasibility study considered situations at Heathcote, Marton, Palmerston North and Auckland. An area of three to four hectares of well drained, relatively flat Industrial C or D land, with freedom from contamination risk to storage or to the malting process, and with resources such as water, electrical and natural gas energy supplies, road and rail access and certain temperature and humidity levels were considered important criteria. Marton and Palmerston North had the least cost location of the four and the Marton site, with road and rail access as well as the other resources, was chosen. Another criteria is distance from residential areas for whom the maltings may be deemed offensive. The welcoming of industry by Marton as well as the Government Development Assistance being available for the Wanganui region were also important factors. The establishment of the plant may not create a 'round of growth' of the magnitude outlined by Moseley but may well enhance the economic well being of the Rangitikei in particular and add to regional consciousness.

The Canterbury (N.Z.) Malting Company not only supplies malt to the domestic market, but also is in the process of establishing an export trade. Demand is from such countries

as Japan and the Latin American nations and last year the Christchurch malting plant exported 46,000 tonnes of malt (1977-1978) worth \$3.5 million.

When the maltings at Marton are in full swing, we confidently expect an even greater overseas trade in barley, together with exports of significant quantities of malt for the first time in the history of New Zealand. (Thompson, 1978, 1).

The expansion of this firm can be viewed within the three-fold classification of industries as quoted by Le Heron and Warr (1976) in their study of Watties as an example of agribusiness development. Although they were looking at corporate structures, this classification is relevant to all types of industry.

Type I : generally limited to a single product line, emphasising one function, with decision-making being retained in the hands of a single problem solver.

Type II : generally vertically integrated and functionally co-ordinated. These firms are limited to one or a few product lines, and if successful the firms diversify to minimise risk and to ensure continuation of the business after the major product has completed its cycle.

Type III: characterised by diversification but in addition these firms are multi-divisional, geographically dispersed and often functionally decentralised. They are corporate organisations with varying degrees of integration between producers, processors and distributors, for example Watties.

The Malting Company per se is basically a Type I industry, concentrating on a single product line, though to some extent it is integrated with growers through the contract

system (backward linkage) and by ownership by the breweries (forward linkage to the breweries by supplying their malt). The breweries themselves are examples of Type III organisations with the malting company being one division of a functionally co-ordinated process.

PROPOSITION FOUR

Proposition Four stated that the establishment of the malting barley plant would have limited impact on the economic life of Marton in particular and the Manawatu in general. This was not possible to test statistically and rather tentative subjective assessments have had to be made. No null hypotheses have thus been formulated. The mail survey of seed and grain merchants met with a good response but that of the contractors met with a very poor response and thus was of no benefit for analysis.

Seed and Grain Merchants

Of the twelve seed and grain merchants receiving questionnaires, three were located in Marton, two in Feilding and the remainder were in Palmerston North, some being the head offices for the firms in Feilding and Marton. Of the nine who responded, six indicated that they would have an area to contract for the malting company but only one indicated that they would need to employ more staff. On the other hand, six indicated that the establishment of the malting company gave a more stable demand for their services, competition between firms being high. The establishment of the Canterbury Seed Company will provide further competition in this respect. Changes in transport pricing systems has meant that Manawatu feed barley, which has traditionally gone to markets at Tauranga and Auckland, has been replaced by that from the South Island and Napier. Malting barley may replace this type of trade undertaken by the merchants and any other crops replaced by malting barley. On the other hand, should malting barley not replace other crops to a great extent but be in areas formerly in pasture, then the

increased cropping activity will increase work for the seed and grain merchants.

Contractors

While there was insufficient response from contractors to be analysed, questions in the main survey relating to use of contractors by farmers found that the average farmer would prepare the ground, sow and spray by himself, leaving harvesting and transporting to contractors. Such contractors are well distributed throughout the rural areas. The breakdown can be seen in Table 6.1.

Table 6.1: Use of Contractors by Farmers Intending to Grow Malting Barley

Operation	Self		Contractor		n
	No.	%	No.	%	
Ground preparation	97	80.8	23	19.2	120
Sowing	82	68.3	38	31.6	120
Spraying	72	60.0	48	40.0	120
Harvesting	27	22.5	93	77.5	120
Transporting	34	28.3	81	67.5	115

All operations by self - 20 farmers

All operations by contractor - 20 farmers

Average = preparation, sowing and spraying by self, harvesting and transporting by contractor.

Source: Field Survey, June 1978, question 11, Part B.

From Table 6.1 it can be seen that considerable business could arise for contractors, especially harvesters and transporters. While transport companies were not included in the survey, one operator spoken to by telephone did not anticipate any increase in work. The impact on transporters, as on seed and grain merchants, may depend on whether other crops are replaced by malting barley or whether the majority will be land taken out of pasture. Whatever the case, the transport of the 28,250 tonnes of malt annually from the maltings to the breweries once the plant is fully operational will be 'new' work.

The general conclusion of the merchants was that Manawatu farmers show a considerable capacity to rise to the demand of a new crop providing the financial incentive is high enough. The establishment of a frozen foods plant at Feilding, for example, was expected to replace grain growing but instead led to an upsurge in all forms of cropping. The establishment of the malting barley plant is likewise felt to lead to an upsurge in agricultural productivity so that malting barley may not in fact so much replace other crops on a large scale as be complementary to them and fat lamb farming. If higher productivity levels are achieved in this way, then the plant is likely to affect service industries considerably in terms of the extra produce generated.

In more general terms, Marton does not automatically become a 'growth centre' because of the establishment of one new firm. It has not been possible in this predictive survey to estimate the actual economic impact of the plant on Marton or the region or to test whether such an impact will be as great as envisaged by the malting company management. The desire of Marton to attract new industry, however, and the regional consciousness generated may help boost this centre whose development has been based on the servicing and processing of goods from the farms of the region.

CHAPTER SEVEN

SUMMARY AND CONCLUSIONS

As this research was mooted, undertaken and concluded, it became increasingly apparent that only the surface of a number of topics was being scratched and that a number of questions remained to be dealt with.

As a geographical study the prime concern was to set the study in a spatial or location context. While this theme was repeated throughout the literature, the nature of geography and especially of agricultural geography was outlined in Chapter One. The first chapter essentially stated the research problem and the research design. Considerable attention was given in the latter section to the method of conducting mail questionnaires as it was felt to be an increasingly popular survey method in New Zealand which needs to be more widely documented, both in terms of survey design and increasing response rates.

Chapter Two outlined the study area which comprises the three counties Kairanga, Manawatu and Oroua as well as the major portion of Rangitikei County, these being felt to be the counties most directly influenced by malting company decisions. After a description of the physical characteristics of the region, the development of agriculture and particularly cropping over the last decade was given.

Chapter Three delved into the realm of rural sociology to look at the adoption and diffusion of new agricultural ideas and practices, of which barley grown for malting purposes is seen as an example in the Manawatu. The adoption of such innovations, either to enhance efficiency or to create new products, is important for the economic advancement of the farmer, and in aggregate terms is important for the agricultural region.

Proposition One found that the farmers most likely to adopt the innovation malting barley were younger, more likely to attend farmers' meetings and do their own economic analysis, has larger farms, adopted more innovation and had fewer years of responsibility on the farm than the total sample.

Proposition Two studied ways in which information was diffused about the malting barley plant and found that the newspaper was by far the most important mass media source while seed and grain agents and malting company personnel had been the most active personal sources of disseminating information.

The intention of Chapter Four was to look at theories and models of agricultural location, showing that increasingly behavioural variables have been included in traditional economic models with the realisation that man is neither fully rational nor fully informed in his economic decision making. Instead he is limited by his 'bounded rationality' - boundaries are created by his perception of situational, socio-economic and personality factors are related to his objectives, whether they are economic or noneconomic in character.

Chapter Five contained the bulk of the data analysis, within the four components of Proposition Three. These related to the possible impact of the malting barley plant on the land use system of the Manawatu.

Proposition 3A stated that the malting barley plant as a new input would modify existing land use by creating a new demand with stable economic returns for a crop readily grown in most parts of the region. For farmers who had grown barley in the past and for those who showed the major incentives for growing barley followed by pasture renewal. Disincentives to growing barley were also primarily financial, being quoted as poor returns and high costs. Financial considerations were also deemed important with respect to

the perceived advantages and disadvantages of engaging in crop contracts. Thus the availability of a stable outlet for this crop could well be a major inducement to farmers, providing the returns are high enough.

Proposition 3B indicated that malting barley could replace feed barley, other crops such as wheat or maize, or pasture. The analysis showed that the majority of the malting barley area is likely to be out of pasture, with perhaps some wheat and feed barley being replaced. Malt and feed barley are often regarded as complementary operations, with rejected grain for the malting process being resold for feed purposes. Certain barley varieties are more suited to malting than others and it was clear that Zephyr, a good malting variety, was favoured by most of the farmers. Over eighty percent of the farmers intending to grow malting barley felt that cropping on mixed farms increased carrying capacity, especially if complemented with fertiliser usage. If this is true and if most of the malting barley area is 'new' land for cropping, then a general upsurge in agricultural productivity could result. This view was confirmed by several of the seed and grain merchants.

Proposition 3.C stated that while the impact on aggregate land use would be great if the plant meets its requirements from within the Manawatu, for the individual farmer change will be small scale and short term depending on returns and other advantages of alternative land uses. Of farmers intending to grow malting barley, only 66 percent of the 'probabilities' and 36 percent of the 'possibilities' perceived it as a permanent proposition. Small proportions felt that increased costs and risks would be incurred in growing barley for malt as opposed to growing barley for feed purposes. Of these, 'quality' requirements were the greatest concern. Most expected a premium over and above the price of feed barley, of approximately \$6-\$10 per tonne. Many farmers were unwilling or unable to specify a certain area that they would plant in malting barley, which was not unexpected as the definite intention of the plant had not been announced at

the time the questionnaire was sent out and a number of policy matters, such as prices, were unknown. Of those who did indicate an area, the majority were in the 6-19 hectare range. Thus for the individual farmer, change will be relatively small scale and could be short term if price and conditions are perceived as unfavourable.

Proposition 3.D stated that should the malting company not meet its requirements from within the Manawatu/Rangitikei area, then the supply area would have to be extended to such areas as southern Hawkes Bay and northern Wairarapa, distance becoming an additional cost factor. It is very difficult at this stage to estimate if the malting company will meet its requirements within the Manawatu. Malting company management are confident of obtaining their requirements from within the southern North Island, and may consider importing barley from the Auckland area and even Australia if necessary. Increased costs of upwards of \$15 per tonne for transport from southern Hawkes Bay or northern Wairarapa would be incurred at current rates. At present it is unclear whether farmer or malting company would meet this cost, although it is likely that the farmers would only pay transport to the nearest railhead.

The impact of the malting barley plant on the economic life of the region was the subject of Chapter Six. It was impossible to test Proposition Four due to insufficient evidence. At this stage it is difficult to estimate the actual multiplier and accelerator effects that the increased investment and employment could accrue. It is tentatively suggested that the establishment of the plant should initiate a 'round of growth' in Marton which may be more significant for the Rangitikei than the Manawatu.

Many topics for further study arise from this research. Innovation adoption and diffusion has an associated wealth of literature, and the actual adoption and diffusion of malting barley in future years could form a follow up study. The models presented in Chapter Four, particularly those

studying factors influencing a farmer in his decision making such as game theory and linear programming, lend themselves to major studies. Similarly land use mapping of the Manawatu, an economic cost/benefit study of malting barley vis-a-vis other crops and/or livestock enterprises and the measurement of the actual economic and social impact of the plant after its establishment could prove worthwhile studies. For the author, the study was essentially exploratory, and some aspects such as conducting the mail survey and the use of S.P.S.S. Package for analysing the data were new.

The overall impression is that the Canterbury (N.Z.) Malting Company, in establishing its second plant near Marton, is likely to meet its requirements should the financial incentive be high enough. Its impact on land use can be viewed in two ways. If other crops, such as wheat and feed barley, are replaced, then land use changes in terms of cropping patterns will be affected. On the other hand, if most of the malting barley is grown on land formerly in pasture and if it is performed in conjunction with fat lamb farming, then the impact will be to strengthen the Manawatu's position as a mixed farming region and to boost overall productivity.



Massey University

PALMERSTON NORTH, NEW ZEALAND

69-099, 69 089.
TELEPHONES, ~~50-059~~, ~~50-002~~

In reply please quote:

DEPARTMENT OF GEOGRAPHY

6 June 1978

Dear

I am an agricultural geography student attempting to assess the likely impact of the proposed malting barley plant at Marton. While I am not employed by or in any way connected with the Canterbury (N.Z.) Malting Company, the introduction of this firm could have considerable impact on the farming patterns of this region and is of interest to both geographers and agriculturalists.

This research is being undertaken for my Masterate thesis. To be able to assess land use changes, I need your help in providing information on past, present and future use of your land and factors which influence any changes you make. Your name has been chosen at random from electoral rolls and to ensure the validity of my results, your response is very important. Individual information will not be published and your confidentiality will be respected.

This study has the personal recommendation of the Secretary of Federated Farmers for this area, Mr Guido de Bres.

To save me having to contact you again, it would be much appreciated if you would please fill in this questionnaire and return it promptly. If you feel the questionnaire is inapplicable because your land is leased out or for another reason, please state this on the final page of the questionnaire and return it.

I look forward to receiving your completed questionnaire and enclose a reply paid envelope for your convenience.

Yours sincerely,

Rowena Ridler

Rowena Ridler,
Post-graduate Student.

Guido de Bres

PART A

Some information about yourself and your farm please.

1. Your age please (tick)
- | | | | |
|----------|--------------------------|-----------|--------------------------|
| under 20 | ☐ | 40-49 | ☐ |
| 20-29 | ☐ | 50-59 | ☐ |
| 30-39 | ☐ | 60 + over | ☐ |

2. Are you:
- | | | |
|---------------------|------------------------|--------------------------|
| (tick the main one) | the owner | ☐ |
| | the manager | ☐ |
| | the lessee | ☐ |
| | other (please specify) | ☐ |

3. If you are the owner, is this your first farm? Yes ☐
No ☐

4. How long have you been full-time farming?

As paid employee on another farm

In position of responsibility

☐
☐

5. How long have you been on your current farm? ☐ Years

6. Were you brought up on a farm?

(tick one) - right till leaving secondary school

- for part of your childhood

- not at all

☐
☐
☐

7. Are any of your family employed on your farm?
(if more than one in any of these categories, please indicate).

	unpaid	paid part-time	paid full-time
son(s)			
wife			
other(s)			

8. What is the size of your farm?

Home farm

acres

OR

hectares

Additional land

acres

OR

hectares

9. Please specify below the approximate head of stock (including young and replacement stock) carried by your farm as at 1.1.78.

Total

OR

As stock units

Sheep

Beef

Dairy

Other (please specify)

10. Please specify areas in (as at 1.1.78.)

acres

OR

hectares

Pasture

Fodder crops

Cash crops

Unproductive land (eg. swamps)

11. Is part of your farm leased out?

☐	Yes
☐	No

If yes, please: specify area acres

or hectares

: indicate major use
(tick one)

☐	cropping
☐	grazing
☐	mixed cropping/grazing
☐	other (specify)

12. Have you made a major change in your farming system on your homestead block, e.g. from dairy to sheep, from sheep to mixed stock/cropping etc.

☐	Yes
☐	No

If yes, please: specify from

to

(if more than one, most recent)

: the year of the change

13. If you have made a change in farming system, what was the main factor influencing your decision to change? (tick one please).

☐	a new crop or technology was introduced
☐	amalgamation or subdivision necessitated change
☐	wanted a change of lifestyle
☐	neighbour had success with new farming system
☐	better returns from new enterprise
☐	wanted to diversify
☐	other (please specify)

14. Do you read any agricultural journals? (tick where appropriate)

	Regularly	Occasionally	Never
N.Z. Journal of Agriculture			
N.Z. Farmer			
Straight Furrow			
Other (specify)			

WITH REFERENCE TO AGRICULTURAL TOPICS:

15. Do you: Listen to radio programs

: View television programs

: Read local newspapers

: Read farming reference books

16. Do you: Attend local discussion groups

: Have advisory officers visit

: Attend meetings of:
Federated Farmers
Young Farmers
Other

17. Do you have economic analyses of costs and benefits of alternative farming systems e.g. comparative budgets, done by:

	Regularly	Occasionally	Never
Yourself			
Advisory officer			
Accountant			
Other (specify)			

18. Have you attended any farming courses or studied agriculture through:
(indicate where appropriate)

	Short course	Diploma	Other (eg conference)
Flock House/Telford			
Lincoln			
Massey			
Technical Correspondence Inst.			
Other (specify)			

19. Please give 2 examples of new farm practices you have applied over the past 2 years and indicate, if possible, the source of the new ideas e.g. advisory officer, farming journal.

For example, with respect to

Stock health:

Pasture management

A new crop:

A new technology:

20. Please indicate whether you regard yourself as a leader in terms of applying new practices on your farm. Do you have a neighbour whom you regard as such a person?

	Very often	Occasionally	Rarely
Self			
Neighbour			

PART B

Cropping. Please read right through even if not currently engaged in cropping and answer where appropriate.

1. Had you heard about the proposed malting barley plant which will require 30000 tonnes of barley annually and which is hoped to begin operation in approximately 2 years? ☐ Yes

	Yes
	No

2. If yes: did you first - read about it in an agricultural journal
- read about it in a local newspaper
- hear about it over radio or T.V.

: have you been personally approached by, for example,
a seed and grain merchant, (specify)

Yes	No

3. If you have already engaged in cropping, please provide the following information about each crop grown last season (1977-1978).

Crop	Area (specify area or hectares)	Total production	Under contract Yes/No

- 4.a If you have grown barley during any of the past 5 seasons, please give one main reason for including it.

- b Which varieties did you have the most success with?

- 5.a What would be 2 main incentives to grow barley in the future?

- b What would be the 2 major factors discouraging you from growing barley in future?

6. Would you grow barley if the price was

\$105 per tonne

\$115 per tonne

\$125 per tonne

\$135 per tonne

Feed Barley

Malting Barley

Yes

No

Yes

No

7. Do you actually anticipate growing barley?

1978-1979

1979-1980

1980-1981

Feed Barley

Malting Barley

Yes

No

Yes

No

8. If yes, what area would you anticipate? (tick one for each)

less than 6 ha

6 - 19 ha

20 - 29 ha

30 - 49 ha

50 - 99 ha

100 ha plus

Feed Barley

Malting Barley

Would this replace

☐
☐
☐

Pasture

Fodder crops (specify)

Cash crops (specify)

Would you regard this as a permanent part of your land use? Yes ☐ No ☐

9. Do you feel that there are extra costs and/or risks involved in growing malting barley as opposed to feed barley?

☐ Yes ☐ No

If yes, please specify reasons

10. If you are now mixed farming, do you feel that a crop such as barley, followed by new pasture, increases or decreases the carrying capacity of your farm? (tick one)

Increases

☐
☐

Decreases

11. If you were to engage in growing barley, which of the following operations would you perform yourself and which would you leave to contractors. (tick where appropriate)

	self	contractor
ground preparation	☐	☐
sowing	☐	☐
spraying	☐	☐
harvesting	☐	☐
transporting	☐	☐

12. Have you grown any crops (excluding grass-seed and hay) on contract during any of the past 5 seasons

Yes

☐

No

☐

What is the main advantage of contracts as you see them?

What is the main disadvantage of contracts as you see them?

Thank you for your co-operation

If you were unable to fill in the questionnaire please fill in this portion:

a. The questionnaire was inapplicable because:

b. Mr _____ manages/leases/operates my land and would be better able to answer most questions.

His address and phone number are:

Geography Department,
Massey University.

Dear

A few days ago, I sent you a questionnaire regarding the past, present, and potential use of your land. If you have already returned the questionnaire, please regard this as a special 'thank you' for your promptness. If, as I often do myself, you have put the questionnaire aside to finish later, why not complete it and return it today? There will probably never be a more convenient time and your response is vital to the success of my research.

Thank you for your help.

Yours sincerely,

ROWENA RIDLER.



Massey University

PALMERSTON NORTH, NEW ZEALAND

TELEPHONES, 69-099, 69-089.

DEPARTMENT OF GEOGRAPHY

In reply please quote:

7 December 1978

Dear Sir:

I am an Agricultural Geography student attempting to assess the likely impact of the proposed malting barley plant at Marton on farming and services in the Manawatu-Rangitikei region. Earlier in the year I sent out a questionnaire to 600 farmers which met with a good response and has enabled me to gauge farmers' reactions to the new plant.

I would be obliged if you would be able to help me conclude my research by indicating how the establishment of the plant could affect you and your business. Contracts are currently being let for seed barley for the plant which, it is hoped, will commence malting operations in 1980. The 7000 hectares (30000 tonnes) of barley required annually once the plant is fully operational may create a major land use change in the Manawatu or else utilise barley previously grown for seed and feed purposes, if the plant is to obtain the majority of its requirements from within the local region.

The information you give will be regarded as confidential and will not be published in identifiable or individual form. I am not employed by or in any way connected with the Canterbury Malting Company. Would you please answer the few questions on the following page and return in the reply-paid envelope enclosed.

Thank you for your co-operation.

Yours faithfully,

Rowena Ridler
Post-graduate Student

RR/mjb

ENCL.

1. What was the overall extent of the surplus barley production in the Manawatu/Rangitikei region last season? _____ tonnes.

Why was this? _____

2. Do you anticipate that the malting company will meet its requirements from within the Manawatu/Rangitikei region? YES / NO

What crops do you think it would replace?

3. Can you indicate the area of land contracted by your firm for barley over the past five seasons? (please specify whether acres or hectares)

1973-1974 _____

1974-1975 _____

1975-1976 _____

1976-1977 _____

1977-1978 _____

4. Do you anticipate having an area to contract for the malting barley plant (Canterbury Malting Co.)? YES / NO

If yes, do you think this might affect your firm by -

- having to hire additional staff? YES / NO
 - providing a stable demand for your services? YES / NO
 - other, please specify. _____
- _____

Thank you for your co-operation.



Massey University

PALMERSTON NORTH, NEW ZEALAND

TELEPHONES, 69-099, 69-089.

In reply please quote:

DEPARTMENT OF GEOGRAPHY

7 December 1978

Dear Sir:

I am an Agricultural Geography student attempting to assess the likely impact of the proposed malting barley plant at Marton on farming and services in the Manawatu-Rangitikei region. Earlier in the year I sent out a questionnaire to 600 farmers which met with a good response and has enabled me to gauge farmers' reactions to the new plant.

I would be obliged if you would be able to help me conclude my research by indicating how the establishment of the plant could affect you and your business. Contracts are currently being let for seed barley for the plant which, it is hoped, will commence malting operations in 1980. The 1000 hectares (30000 tonnes) of barley required annually once the plant is fully operational may create a major land use change in the Manawatu or else utilise barley previously grown for seed and feed purposes, if the plant is to obtain the majority of its requirements from within the local region.

The information you give will be regarded as confidential and will not be published in identifiable or individual form. I am not employed by or in any way connected with the Canterbury Malting Company. Would you please answer the few questions on the following page and return in the reply-paid envelope enclosed.

Thank you for your co-operation.

Yours faithfully,

Rowena Ridler
Post-graduate Student

RR/mjb

ENCL.

1. Can you please indicate the amount of barley contracted by you for local farmers over the last 5 seasons? (please specify whether acres or hectares, bushels or tonnes)

	<u>Planted</u> area	production	<u>Harvested</u> area	production
1973-1974				
1974-1975				
1975-1976				
1976-1977				
1977-1978				

2. How much barley will you be planting this season?

_____ hectares

How much barley will you be harvesting this season?

_____ hectares

3. In future years do you anticipate an increase in the barley planted and harvested by you? YES / NO

4. If yes to (3), would you anticipate having to -

- buy new equipment? YES / NO

- hire more labour? YES / NO

- other? (please specify) _____

in order to cope with this increase.

5. Are there any aspects of planting and harvesting malting barley that you are unsure about?

Please specify. _____

Thank you for your co-operation.

APPENDIX E

SOIL LIMITATIONS FOR CROPPING

Class 1 - Soils of flat and easy rolling land with minimal to slight limitations for crop production.

1A - Soil limitations are only minimal with high actual
☐ production most of the year for a wide range of crops.

1C - Soils with a slight limitation of imperfect to poor
☒ drainage. The soils require some drainage before they can be cropped successfully and the period during the year when they can be cultivated is somewhat restricted.

Class 2 - Soils of flat and rolling land with moderate soil limitations for crop production."

2A - Limitations of insufficient moisture. These soils
☐ are shallow, stony or sandy and irrigation is necessary for intensive cropping.

2B - Limitations of poor drainage and compact subsoils.
☒ Cropping is largely restricted to annual cropping of cereals in rotation with pastures.

2C - Limitations of coarse texture, imperfect to poor
☒ drainage and wide variations of moisture content through the year.

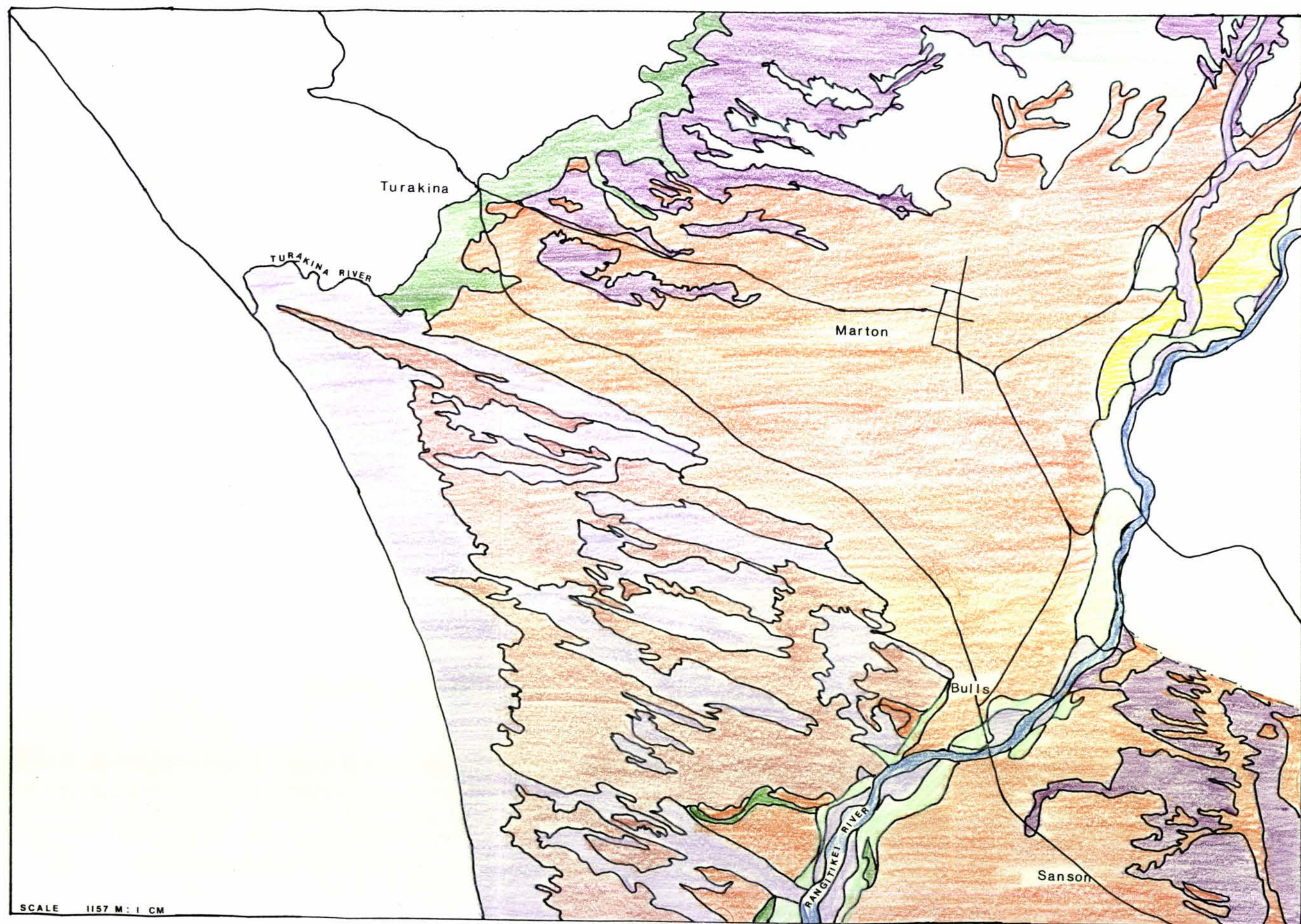
Class 3 - Soils of flat and easy rolling land with severe soil limitations for cropping.

3A - Limitations of excessive drainage and susceptibility
☐ to flooding. Some cropping can be done on the deeper soils but the risk of crop loss is high.

3B - Soils of high altitudes or poorly drained soils
☒ which are difficult to drain.

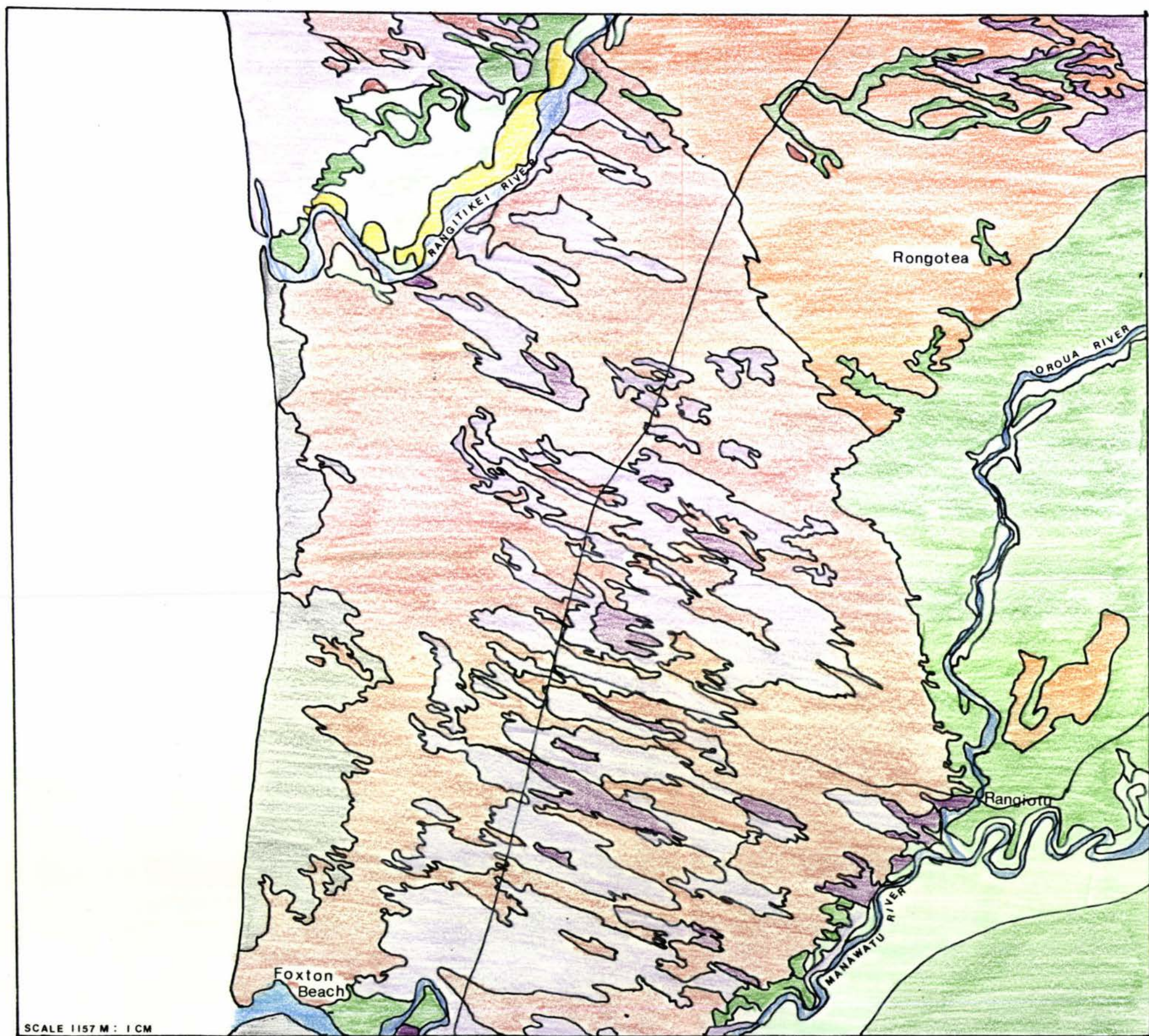
Class 4 - Soils of strongly rolling, hilly and steep land, considered unsuitable for cash cropping.

(Source: Cowie, 1974, 41-42; examples of soil types within each of these groupings is also given).



APPENDIX F MARTON; Soil Limitations for Cropping

SOURCE D.S.I.R. Soil Bureau

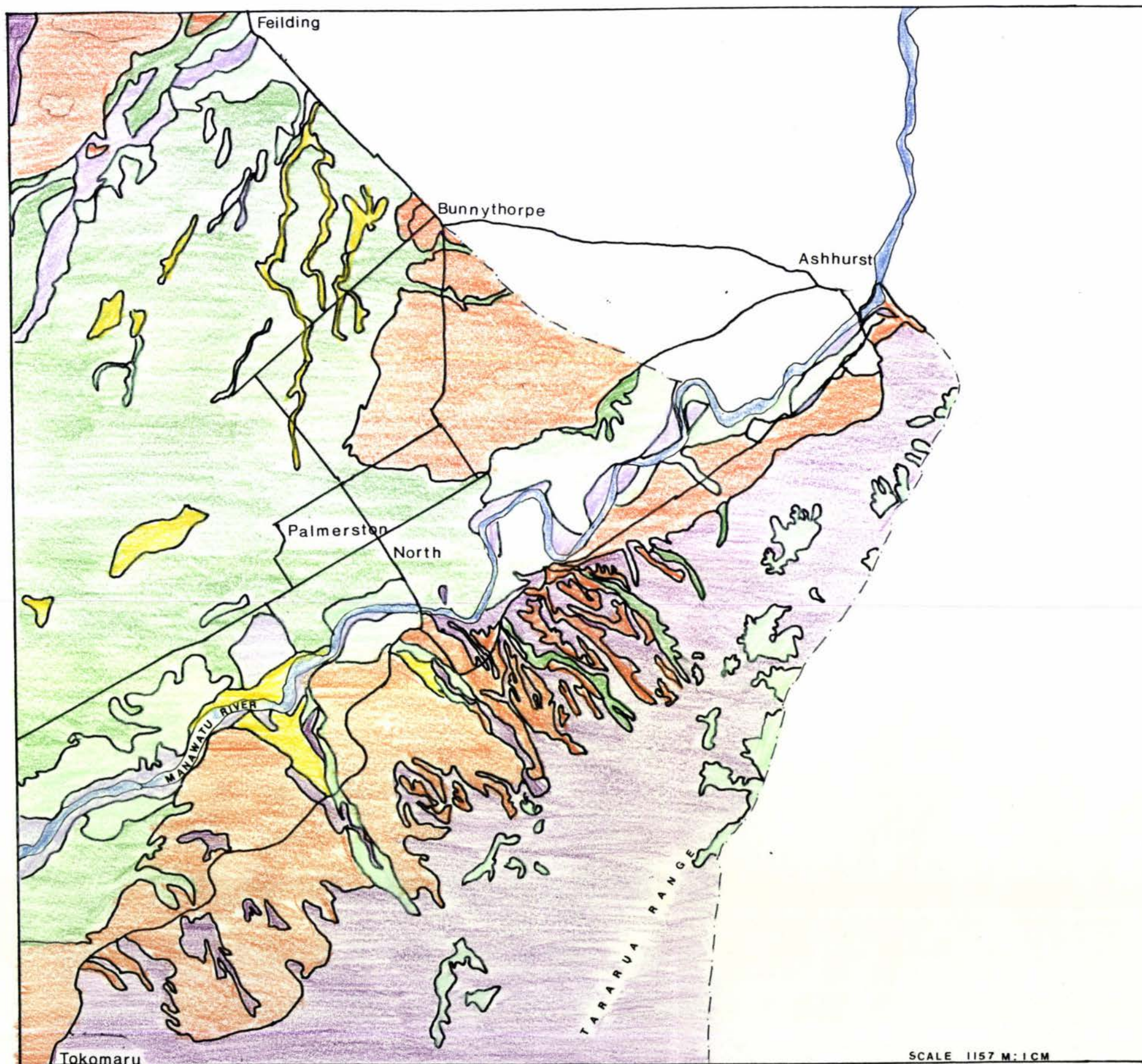


APPENDIX G

TANGIMOANA; Soil Limitations for Cropping

SOURCE

D.S.I.R. Soil Bureau



APPENDIX H

PALMERSTON NORTH; Soil Limitations for Cropping.

SOURCE

D.S.I.R. Soil Bureau



APPENDIX I PROVISIONAL SOIL MAP OF OROUA COUNTY

SOURCE D.S.I.R. Soil Bureau

APPENDIX J

THE CHI-SQUARED TECHNIQUE

The chi-squared technique is an inferential theoretic method by which the researcher can compare the actual distribution of the sample population for a certain factor with a distribution which would have existed had certain conditions been important. The method can only be used where the data set is in grouped or discrete form and it is an example of a non-parametric statistical technique - that is, it does not assume the data under analysis conforms to the 'normal' distribution curve. (Toyne and Newby, 1971, 60).

It is usual to set up a null hypothesis which is a precise statement to be tested by the chi-squared technique. The null hypothesis states that the two samples (i.e. actual/observed and theoretical/expected) are part of the same population, and that there is a high probability that the observed differences between the two distributions are due to chance variations (McCullagh, 1974, 29). For each data set, the expected value (expressed as a rank or percentage) is subtracted from the actual value, this is squared then divided by the expected value. This is done for each category in the data set, the final values being added to give the chi-squared score.

The chi-squared score is then tested to see if the variation is due to chance. The chi-squared table gives a number of scores at certain degrees of freedom (the number of categories in the data set minus one) for two levels of confidence - 95 percent (0.05) and 99 percent (0.01). The relationship between the two distributions can be deemed to be significant if the chi-squared score is greater than or equal to the score in the table at the precise number of degrees of freedom. If the score is significant then factors other than chance are deemed to have caused the differing distributions. If the score is not significant then chance is said to have caused any differences in the distributions.

Finally, the researcher can then accept or reject the null hypothesis. If the relationship is significant then the null hypothesis is rejected and factors other than chance are said to have contributed to the differences in distributions. Conversely if the score is not significant, the hypothesis is accepted and chance is said to have contributed to any variation that exists between the distributions of the actual and theoretical population distributions.

APPENDIX K

NEW ZEALAND'S PRINCIPAL CASH CROPS - TIME SERIES

Season	Area	Yield	Yield Per Hectare	Area	Yield	Yield Per Hectare
	<u>Wheat for Threshing</u>			<u>Oats for Threshing</u>		
	Ha (000)	Tonnes (000)	Tonnes	Ha. (000)	Tonnes (000)	Tonnes
1900-01	84	178	2.13	182	346	1.90
1905-06	80	185	2.06	143	231	1.61
1910-11	130	226	1.73	123	184	1.50
1915-16	133	193	1.45	86	139	1.61
1920-21	89	187	2.10	60	95	1.59
1925-26	61	126	2.05	41	75	1.80
1930-31	101	206	2.05	35	61	1.74
1935-36	101	241	2.40	31	60	1.91
1940-41	98	226	2.30	29	57	1.95
1945-46	65	148	2.27	23	51	2.19
1950-51	59	171	2.91	14	33	2.29
1955-56	28	72	2.61	17	35	2.07
1960-61	76	253	3.35	18	43	2.42
1965-66	81	292	3.61	16	44	2.77
1970-71	98	326	3.34	22	60	2.70
1971-72	107	384	3.60	16	49	3.02
1972-73	108	376	3.49	15	45	2.98
1973-74	67	215	3.18	21	63	2.94
1974-75	58	180	3.12	19	50	2.64
1975-76	104	388	3.74	13	42	3.27

Season	Area	Yield	Yield Per Hectare	Area	Yield	Yield Per Hectare
	<u>Barley for Threshing</u>			<u>Maize for Threshing</u>		
	Ha. (000)	Tonnes (000)	Tonnes	Ha. (000)	Tonnes (000)	Tonnes
1900-01	12	23	1.87	5	15	2.87
1905-06	12	23	1.94	4	16	3.79
1910-11	14	21	1.55	5	14	2.74
1915-16	12	19	1.52	3	9	2.64
1920-21	19	36	1.90	5	13	2.73
1925-26	11	21	2.04	3	11	3.13
1930-31	10	19	1.96	3	8	2.77
1935-36	8	17	2.02	3	8	2.68
1940-41	13	24	1.87	4	13	2.99
1945-46	20	42	2.16	3	9	3.12
1950-51	19	43	2.31	2	9	3.72
1955-56	20	46	2.31	..	..	..
1960-61	27	77	2.92	3	10	3.86
1965-66	34	114	3.36	3	19	5.93
1970-71	81	259	3.19	12	101	8.44
1971-72	96	335	3.49	15	116	7.85
1972-73	74	258	3.50	13	118	9.13
1973-74	87	242	2.77	13	88	7.05
1974-75	104	263	2.52	21	158	7.67
1975-76	85	285	3.37	26	184	7.09

Season	Area	Yield	Yield Per Hectare	Area	Yield	Yield Per Hectare
	<u>Peas for Threshing</u>			<u>Potatoes</u>		
	Ha. (000)	Tonnes (000)	Tonnes	Ha. (000)	Tonnes (000)	Tonnes
1900-01	4(1)	9(1)	2.40(1)	12	172	14.88
1905-06	5	11	2.01	11	125	11.55
1910-11	6	14	2.32	12	144	12.24
1915-16	4(1)	5(1)	1.20(1)	13	136	10.86
1920-21	6(1)	10(1)	1.65(1)	9	129	14.41
1925-26	5(1)	8(1)	1.65(1)	10	146	15.37
1930-31	4	7	1.54	12	154	13.37
1935-36	10	15	1.55	9	123	13.23
1940-41	14	20	1.43	7	96	13.90
1945-46	13	22	1.68	9	143	15.16
1950-51	9	17	1.94	7	122	17.90
1955-56	10	17	1.69	7	102	14.31
1960-61	11	25	2.21	9	193	21.41
1965-66	12	29	2.47	10	235	23.72
1970-71	23	52	2.30	8	210	25.33
1971-72	22	58	2.56	8	220	27.83
1972-73	21	60	2.79	9	244	27.15
1973-74	20	53	2.59	9	206	23.95
1974-75	22	48	2.18	9	226	25.47
1975-76	19	55	2.87	9	248	26.15

(1) Includes beans for threshing

Source: New Zealand Agricultural Statistics, 1975-1976, 76.

APPENDIX L

MALTING COMPANY POLICY AS OUTLINED AT THE FIELD DAY

The Canterbury (N.Z.) Malting Company's field day held at Mr R.C. Grace's property near Sanson on 7 February, 1979, attracted fewer farmers than the 1978 field day. Policy matters such as price, transporting the grain to Marton and disposal of rejects were not outlined and are not expected to be announced until May, 1979.

Mr H.P. Kearney, Manager of the Company, outlined the present state of development of the plant, with malting to commence in August 1980. Requirements of malting barley are expected to be 40,000 tonnes annually, he stated, once the plant is in full operation. Drying facilities for grain at the plant will enable harvesters to work during wetter weather, earlier in the morning and later at night, which should place less pressure on contractors at harvest time.

Mr Philip Wauchop, research officer, outlined results of a trial testing the response of barley to phosphate and nitrogen application. It was noted that application of nitrogen beyond the soil's nitrogen requirement would increase yield but also increase the level of screenings (rejected grain). Thus, with malting company policy to set the price at five percent screenings and deduct \$1.40 for each additional one percent screenings, nitrogen application may result in decreased returns.

The South Island policy of recommending that malting barley follow another cereal crop will not be held in the Manawatu as a large percentage is expected to be out of new pasture. Malting barley is not rejected due to its nitrogen content but high soil nitrogen produces a taller stalk more susceptible to lodging (wind damage).

APPENDIX M

CURRENT LAND USE OF FARMERS INTENDING TO GROW MALTING BARLEY

<u>Sheep</u>	<u>Category</u>	<u>No.</u>	<u>Percent</u>	<u>Beef</u>	<u>Category</u>	<u>No.</u>	<u>Percent</u>
No's	Nil	34	27.2	No's	Nil	33	26.4
	1 - 99	14	10.4		1 - 99	53	42.4
	100 - 999	24	19.2		100 - 199	21	16.8
	1000 - 1999	21	16.8		200 - 499	13	10.4
	2000 - 2999	15	12.0		500 - 999	3	2.4
	3000 - 3999	7	5.6		1000 - 1999	-	-
	4000 - 9999	8	7.2		2000 +	2	1.6
	10000 +	2	1.6				
	Total	125	100.0		Total	125	100.0

<u>Dairy</u>	<u>Category</u>	<u>No.</u>	<u>Percent</u>	<u>Cash Crops</u>	<u>Category</u>	<u>No.</u>	<u>Percent</u>
No's	Nil	84	67.2	(Hectares)	Nil	32	25.6
	1 - 99	15	12.0		1 - 9	28	22.4
	100 - 199	17	13.6		10 - 49	44	35.2
	200 - 299	6	4.8		50 - 99	14	11.2
	300 +	3	2.4		100 +	7	5.6
		125	100.0			125	100.0

Farmers Intending to grow Malting Barley
who are currently growing: -

	<u>No.</u>	<u>Percent of Sample</u>
Wheat	73	58.4
Barley	73	58.4
Peas	33	26.4
Vegetables	17	13.6
Maize	4	3.2
Grass seed	10	8.0
Bird seed	1	.8
Oil seed	1	.8

APPENDIX N

THE MALTING PROCESS

'Malting consists of promoting the growth of the barley grain for a sufficient period to permit the breakdown of the cell walls and the conversion of the cell contents, namely the starch and protein, into soluble carbohydrates (malt sugar and dextrose) and soluble nitrogenous compounds respectively. This is effected by soaking the grain in water for 24 hours and then spreading it in a germinating compartment, where germination is promoted by regulating the moisture supply and controlling the temperature. When the modification in the composition of the grain has proceeded far enough, the grain is dried in a kiln and the resultant product is known as malt. During this process a weight loss of about 12 percent takes place.

The changes are completed in the brewing process during which the ground malt is mashed with warm water to stimulate further action, and the soluble carbohydrates are extracted. Ultimately about 80 percent (by weight) of the malt is brought into solution to produce a sweet fermentable liquid'.

(Claridge, 1972, 102).

APPENDIX 0

SOURCES OF NEW AGRICULTURAL PRACTICES

Practice ^a	Journal	Radio-TV	Neighbour	Extension	Self	Stock	Vet	Institution
Stock health	8	2	1	5	3	1	7	3
New crop	3	-	4	3	6	6	-	3
New technology	2	-	-	1	1	-	-	-
Pasture management	10	-	2	9	3	-	-	1
Total	23	2	7	18	13	7	7	7

Source: Field Survey, June 1978, Question 19, Part A

^a Only first practice recorded

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