THE DEVELOPMENT

OF

UNPLOUGHABLE HILL COUNTRY

by

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

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CHAPTER 1

INTRODUCTION

This study is an investigation into the relative non-acceptance by farmers of new technology in the form of the Te Awa type of hill country development. It embodies an investigation into the physical and economic aspects of development, and of the factors which are currently limiting or preventing development.

Technological change can be defined as change which results in an objective or end being achieved in a physically different way. Of particular interest are those changes which increase profits, although whether a change is in fact profitable, may require a fairly detailed investigation.

There are three major sources of new technology in agriculture; firstly, from research aimed at developing and proving new techniques, (e.g. the breeding of improved pasture species); secondly, as an unplanned by-product of pure research (e.g. the n-type Romney sheep); and thirdly, from planned or chance discovery by farmers, (e.g. the Hunter fence).

The existence of improved techniques is not in itself a sufficient condition to ensure a growth in the productivity and income status of agriculture. To achieve this it is necessary that the new techniques be made available to, and used by the majority of farmers.

Knowledge of innovations must also be accompanied by an incentive for farmers to use them. The main incentive is likely to be a desire for a higher income, although non-economic factors, mainly sociological and psychological in origin, can markedly affect farmers' management decisions. Thus the demonstration of the profitability of a practice may not be sufficient to ensure its wide-spread and rapid adoption. Even a simple innovation involving no great problems of

adoption may take some time to be generally accepted by the farming community. 1/

Technological change in agriculture is a continuous process and the farmer is constantly faced with problems associated with the acceptance and adoption of new ideas. It is evident that many farmers are slow to take advantage of improved knowledge, and to the author's knowledge little work of any consequence has been done in New Zealand investigating this problem. 2/

Research on the rate of adoption of new technology is essential if the full potential of technological change is to be obtained. Such work is likely to benefit farmers, research workers and policy makers. The results should assist farmers to evaluate the potential of technological change and to overcome the problems of adoption. The research worker, if informed of the problems confronting the farmer, should be able to design his research and present his results in such a manner that farmer acceptance and adoption is facilitated. As most technical research is financed by the State, one would expect this to imply that the State ensures that the results are communicated to, and adopted by the farmers concerned. For this, it is necessary that the policy makers should be informed of the factors which are preventing or limiting the adoption of new technology.

An investigation into the rate of adoption of new practices needs first to study the innovation itself, to discover whether in fact there is a technical and economic improvement over existing practices. This can best be done by studying the innovation on farms where it has already been adopted. If it is found that there is an improvement, (in terms of financial return, or possibly convenience), then it can be assumed that "rational" farmers should adopt the practice, and, that adoption will be of benefit to both the individual farmer and the country.

1/ This phenomenon has been investigated by Zvi Griliches, "Hybrid Corn. An Investigation into the Economics of Technological Change," Econometrica, Vol.25, 1957, p 501.

2/ The only comprehensive studies have been those by, M.B. McMillan, "The Sources of Information and Factors Which Influence Farmers in Adopting Recommended Practices in Two New Zealand Counties," Canterbury Agricultural College Technical Publication No. 19, July 1960, and P.R. Hockey, "The Awareness, Use and Acceptance of the Extension Services by Suppliers of the Tokomaru Dairy Factory." Unpublished Dissertation for Dipl. Agr.Sc. 1962. Massey University of Manawatu.

If, under these circumstances, the rate of adoption is slow, then a study of the reasons for non-adoption would be justified. Such a study is likely to be mainly concerned with extension facilities and social attitudes.

It may be found, however, that for the individual farmer, adoption of the practice is not economic, or only marginally economic. Although adoption may not be in the farmer's interests, it may be in the interests of the nation. In this situation the emphasis should be on studying the factors which are limiting or preventing economic adoption. The aim of such work should be to indicate policy changes that would be needed to provide farmers with the means and incentives for adoption.

Much new technology in New Zealand is characterised by the fact that its development and presentation is based primarily upon physical performance. Physical success, however, does not necessarily imply financial success, and profitability is likely to be the main criterion for farmer acceptance of new ideas. The relatively slow rate of adoption of new technology, may partly be due to a failure by both the research worker and the farmer, to fully appreciate the economic implications of research results.

Hill country development is a notable example of the failure of farmers to make full use of the techniques provided by research. The Te Awa Hill Pasture Research Station has shown that one particular class of hill country can be developed to very high levels of physical production. It is apparent that such development is possible on other classes of hill country, yet very few farmers have successfully followed the lead set by Te Awa.

The Te Awa results are very impressive in terms of increased physical production. On the experimental area, the carrying capacity has been increased from about 1.5 to 6.5 ewe equivalents per acre. One would intuitively expect such development to be profitable, but the apparent unwillingness of farmers to attempt intensive development raises some doubt as to whether, in this case, intuition is correct. Thus the first stage of this investigation was to examine

the profitability of the development of hill country comparable with Te Awa.

The profitability of development can be assessed by budgets, small farm experiments, or by investigating development on commercial farms. The best method is a farm survey, since this disposes of the problem of extrapolation from a theoretical model or a particular small farm experiment, to actual commercial conditions. Small farm experiments designed to study the economics of development, could provide considerable information on which farmers and extension workers could base their decisions. Because of the problem of representativeness, however, it is desirable that such information should be complemented by a farm survey examining the problems and results of development at the farm level.

The uses and limitations of farm surveys have been reviewed by Candler [3] and Schapper. [4] For the purpose of this study, a farm survey has been defined as a series of interviews with farmers by a technically trained agriculturist, to test the hypothesis that a particular management practice is profitable. The management practice in this case being the development of unploughable hill country. This is distinct from the enumerative farm survey, or collection of farm records. The information collected from an enumerative survey may enable a calculation of profitability to be made, but it will provide little information on the factors affecting profitability, particularly factors such as the individual farmer's aims, resources and ability.

Ideally the first step in formulating the hypothesis for the survey would have been to examine the economics of development at Te Awa. Unfortunately this was not possible, as the research work was not amenable to a full economic analysis. This is discussed further in Chapter II. As an alternative, the development of a hypothetical hill country farm, using the Te Awa type of development programme was examined with the aid of development budgets. [5] A large

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[3] W.V. Candler, "Production Economics and Problems of Animal Production," Proceedings of the N.Z. Society of Animal Production, 1962, p. 142.

[4] H.P. Schapper, "Uses and Limitations of Farm Surveys", Review of Marketing and Agricultural Economics, Vol. 25, Nos. 1 - 2, 1957, p. 51.

[5] W.V. Candler, op. cit., p. 155.

number of assumptions had to be made in building up this model, and consequently the results could only be used to give an indication of what the real life situation might be. The indications were, that the profitability of development was only marginal, largely because taxation could absorb a considerable portion of the financial benefits.

Thus it appeared that farmers might well be justified in refraining from development on economic grounds, and that a detailed study of the profitability of development was necessary.

In short, this study was initiated to examine the reasons for the slow rate of hill country development. In view of the implicit assumption that development was profitable, the first logical task was to test this assumption by means of a farm survey.

CHAPTER II

REVIEW OF RESEARCH AT TE AWA

The first step in studying the technology of hill country development was to review the research work at the Te Awa Hill Pasture Research Station, where many of the techniques of development have been evolved. A familiarisation with the technical aspects of development was a necessary pre-requisite to formulating a reasonable hypothesis for the survey. It was also a means of ensuring that the interviewer had sufficient technical knowledge to be able to evaluate the application of development on the survey farms. The rest of this chapter gives a short history and review of research work carried out at Te Awa in the period 1945 - 62.

2.1 Historical

In 1945, the Manawatu Catchment Board initiated work on an area of 50 acres at Te Awa to investigate control methods for the severe erosion affecting some 60,000 acres in the Pohangina County. The work was carried out by both the Manawatu Catchment Board and Grasslands Division, D.S.I.R. The control of active gully erosion was investigated as well as the possibility of preventing erosion by means of pasture improvement. The aim was to develop methods of erosion control and of pasture improvement, which could successfully be integrated with normal farming practices.

The report on the first three years' work [1] commented on the marked success of oversowing and topdressing in improving the carrying capacity of the pastures. When the 50 acre block was taken over, the pastures were predominantly native grasses with very little clover. It had never been topdressed, and the

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[1] F.E.T. Suckling, "Te Awa Soil Conservation Experimental Area," A report presented to the Soil Conservation and Rivers Control Council, 1950.

carrying capacity was about 1.5 ewe equivalents per acre. The area was oversown in 1946 and was topdressed annually at 2 cwt. of superphosphate per acre for three years. The carrying capacity over this period was:-

Prior to 1946	1.5	ewe equivalents per acre (approximately)
1946/47	2.56	"
1947/48	3.27	"
1948/49	3.60	"

i.e. an increase in carrying capacity of 140% in three years.

At this time, (1948), it was uncertain whether pasture improvement or reforestation offered the best prospects for soil conservation on erodable hill country. A soil conservation survey of some 34,000 acres in the Pohangina County [2/] concluded that lax grazing with some reforestation was essential on 50% of the area if erosion was to be controlled. In the past there had been little pasture improvement on hill country, mainly because topdressing and oversowing of country which could not be traversed by machines was a laborious manual task. Continued farming of much of this unimproved hill country had depleted the natural fertility and had resulted in poor pastures, over-grazing and serious erosion and reversion problems. The recent advent of aerial topdressing, however, had opened up possibilities of attempting pasture improvement on a large scale.

As little research had been done on hill pastures, it was decided to conduct further trials at Te Awa to provide information on the potentialities and methods for pasture improvement from both the farming and soil conservation viewpoints. For this purpose a further 130 acres was leased in 1949 and trials were laid down to study the effects of oversowing, topdressing, different stocking rates and different grazing systems. These were continued until 1959, when the current series of trials (see Figure 2.1) were laid down to study:-

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2/ "Pohangina Conservation Survey", Ministry of Works, 1951. Unpublished.

(a) Pasture and animal behaviour on heavily and lightly topdressed pastures,

(b) The effects of very heavy stocking on heavily topdressed hill country,

(c) The effects of graded stocking rates on heavily topdressed hill country, with and without cattle grazing with the sheep.

2.2. Research Results

The research work at Te Awa has been reported in considerable detail, 3/ 4/ 5/ and this section contains merely a summary of the results that have been obtained in the period 1945 - 62.

2.21. Oversowing

At the commencement of the trial work in 1949 the area was oversown with a mixture of grasses and clovers. (Except for control plots). In general the grasses failed to establish, mainly due to lack of fertility. Subsequent work showed that it was possible to establish grasses once fertility had been built up by means of topdressing, clovers and stock. The establishment of both grasses and clovers was found to be improved if large numbers of stock were used to trample the seed into the soil.

Clover establishment was most successful when the pastures had been closely grazed prior to oversowing, and close continuous grazing after oversowing was found to be superior to rotational or intermittent grazing.

The spelling of pastures to allow clover reseeding was found to be very successful in building up the amount of hard seed in the soil.

3/ F.E.T. Suckling, "Pasture Management Trials on Unploughable Hill Country at Te Awa", N.Z. Journal of Science and Technology, Vol. 36(A), No.3,1954, p 237.

4/ _____, "Pasture Management Trials on Unploughable Hill Country at Te Awa," N.Z. Journal of Agricultural Research, Vol. 2, No.3, 1959, p.488.

5/ _____, "Recent Trials at the Te Awa Hill Pasture Research Station", Massey College Sheepfarming Annual, 1962, p. 181.

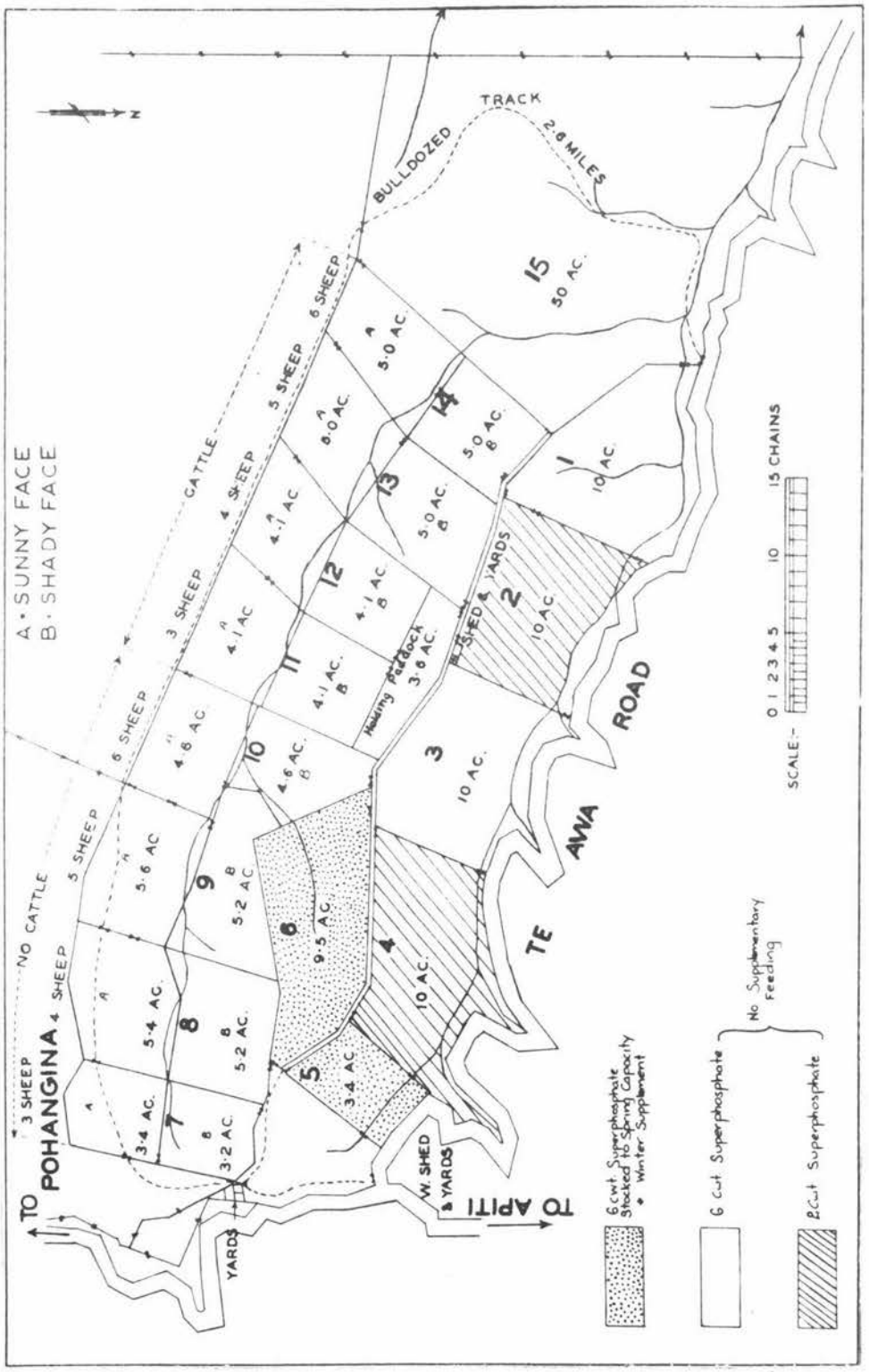

Fig. 2.1 Layout of Current Trials at Te Awa.

(Paddocks 10 and 14 are now stocked at 6.5 sheep per acre)

2.22. Topdressing

The whole area, (excluding control plots), has been topdressed annually with 2 cwt. per acre of phosphatic fertiliser. Under this treatment, the carrying capacity of pastures in one section of the trial had reached a peak of 5.5 ewes per acre [6] by 1959. Subsequent heavy topdressing, (an extra 4 cwt. per acre for each of two years followed by 2 cwt. per acre annually), enabled the carrying capacity to be increased to 7 ewes per acre in three years, i.e. up to 1962.

Similar heavy topdressing of a control paddock enabled the carrying capacity to be increased from 3 to 6 ewes per acre over the same period. Paddocks which did not receive the extra fertiliser could not be increased beyond 5.5 ewes per acre.

These results suggest that the marginal productivity of fertiliser is higher at the commencement of a pasture improvement programme, rather than after several years of maintenance topdressing.

With respect to oversowing it has been found that it is not essential to topdress until the seedling plants are established and able to utilise the phosphate.

2.23. Subdivision

The 130 acres was initially subdivided into 10-acre paddocks. In the first year the carrying capacity of unimproved control pastures rose from 2 to 3.2 ewe equivalents per acre. As these pastures had not been topdressed or oversown, this increase was likely to have been predominantly due to subdivision. On a series of 1/20 acre paddocks the carrying capacity of control plots averaged 7 ewe equivalents per acre in the first year following subdivision. This was subdivision to the extreme, but it indicated that sufficient subdivision to enable full pasture utilisation, can have a very important effect in the initial stages of pasture improvement.

6/ Carrying capacities in the original report were expressed in ewes per acre. The carrying capacity in ewe equivalents per acre, i.e. including cattle grazing days, would be slightly higher.

The amount of subdivision at Te Awa has varied considerably over the duration of the trials, and has mainly been determined by the requirements of the various trials. The experience of the first three years, however, showed that it was essential to separate shady and sunny faces to obtain satisfactory grazing control.

2.24 Method of Grazing

The initial comparison was between rotational grazing and set stocking. It was found that sheep thrift was better under set stocking; in particular it appeared that the regular shifts of rotational grazing adversely affected lamb thrift, probably due to mismothering and fluctuating planes of nutrition. As a result, rotational grazing was replaced in 1953 by a compromise system of grazing management, consisting of mob stocking from January to May, and set stocking from May to January. This compromise system appeared to be the most successful in meeting the requirements of both pastures and animals.

2.25. Stocking Rate

The effect of different stocking rates is being investigated in current trials. The results to date show that as the stocking rate increases, per animal production is decreased and per acre production, especially wool, is increased. (See Table 2.1).

Before the stocking rate trial was laid down, the trial area was mob stocked for several months to get a uniform base pasture. In addition the area was heavily topdressed. (i.e. two annual dressings of 6 cwt. per acre after twelve annual dressings of 2 cwt. per acre. The subsequent pasture changes on the trial area have clearly indicated the necessity to use high stocking rates to obtain the maximum benefits from topdressing and oversowing.

Under the low stocking with sheep only treatment, the pastures became patch grazed in the first year, and at present only about $^{1}/_{5}$ of the paddock is being grazed. The remaining $^{4}/_{5}$ consists of rank unpalatable growth with no

TABLE 2.1

RESULTS OF STOCKING RATE TRIAL*

Stocking rate/ac.	Wool Production (lbs) /lamb	/ewe	/acre	Lambing %	Average live wgt. of ewes(lbs)	Average daily gain in lamb wgt.(lbs)
3 ewes	2.72	13.13	47.14	95.0	120.4	0.38
4 ewes	2.29	13.08	60.63	90.7	126.8	0.40
5 ewes	1.84	12.12	70.48	107.4	109.2	0.34
$6\frac{1}{2}$ ewes	1.95	11.35	83.92	80.0	101.7	0.27
3 ewes plus cattle	2.54	13.28	48.37	112.0	133.3	0.48
4 ewes " "	2.52	13.86	65.22	97.0	128.4	0.41
5 ewes " "	2.49	12.93	76.23	93.0	117.0	0.29
$6\frac{1}{2}$ ewes " "	2.20	10.89	84.43	95.4	99.6	0.27

* The results are based on unpublished data from Te Awa, and are for one year only.

Lambing percentages were based on the number of lambs weaned.

clover, and fern and manuka are beginning to appear.

The proportion of closely grazed pasture increases with increasing stocking rate, until at 6 ewes per acre, practically all the pasture is being fully utilised.

In the other section of the trial, cattle are being used to consume pasture that is surplus to sheep requirements. As a result the pastures are relatively uniform with no patch grazing. The lower the number of sheep per acre, the more cattle grazing is needed to achieve the same degree of pasture control. The cattle have also served to reduce the incidence of coarse weeds such as toetoe (Arundo conspicua), carex species and rushes.

Although cattle were intended to be supplementary to sheep with respect to grazing, it has been noticed that initially they compete with sheep for the shorter feed. Only when this has been cleaned up do they graze the roughage which the sheep tend to avoid at all times.

The production levels achieved with different stocking policies are given in Table 2.1.

2.26. The Fifty-Acre Paddock

The 50-acre paddock has been used as an example of how the management practices developed on the rest of the trial area, can be applied on a paddock which is more representative of the size and topography of a typical farm paddock. From 1949 to 1955 this area was not under experimental management and during this time it was not topdressed and was estimated to be carrying about 3 ewe equivalents per acre. Since 1955 the paddock has been annually topdressed at 2 cwt. per acre with an extra 4 cwt. per acre in 1959 and 1960. The stock have consisted of ewes and hoggets under set stocking, with cattle as required. The carrying capacity of this paddock, and the rate of increase, are estimated to be similar to what a commercial farmer could achieve without undue risks and worry.

TABLE 2.2

CARRYING CAPACITY OF THE 50-ACRE PADDOCK

Year	Ewe equivalents/acre
1955-56	4.6
1956-57	4.8
1957-58	5.1
1958-59	5.3
1959-60	5.9
1960-61	6.1
1961-62	5.5

The decrease in carrying capacity in 1961-62 can be largely explained by the fact that therewas a drought for portion of the year and sufficient cattle couldn't be obtained when required. For the last four years ewe numbers have remained constant at 5 per acre and the surplus has been taken up by cattle. 30 hoggets have been run since 1961.

2.3 Difficulties in Economic Analysis of Te Awa

Unfortunately it was not possible to examine the economics of development at Te Awa, as much of the information that would be necessary for a full economic analysis was not available. This was largely due to the fact that the research programme at Te Awa was designed to study the physical aspects of pasture and animal behaviour on hill country under different management systems. At no stage was the research effort intended to be part of an economic research programme.

Even if the necessary information was available for Te Awa, a full economic analysis would be difficult and of limited value, as in many respects Te Awa is not representative of hill country farming.

The research unit is a lease of part of a larger farm which serves as a pool for the supply and disposal of stock and produce. Management is thus greatly

simplified in that there are no marketing problems, but on the other hand several aspects of management, particularly seasonal stock operations, are under the control of the owner of the property and not the research workers.

The majority of the Te Awa ewe flock are of the same age group, in contrast to the normal hill country flock of mixed age ewes. The trial area is stocked up with young ewes, usually two or four tooth ewes, which are ultimately disposed of as five or six year olds. Thus there is virtually a complete turnover of ewes every three to five years, whereas on a normal farm a portion of the flock is culled and replaced each year. Part of the between year differences in performance may be due to the different composition of the ewe flock in those years. Also the ewes are part of a stud breeding flock and their genetic merit is likely to be higher than the average hill country ewe. All lambs are removed at weaning and no replacement stock are reared whereas normal hill country management is to rear replacement ewes on the farm. Ram lambs are not castrated and it is likely that they thrive better than do wether lambs until weaning.

At Te Awa the breeding ewe is used as the basic stocking unit, as the productivity of an area is more conveniently measured with sheep than with cattle. Cattle are used primarily to keep the pasture in suitable condition for the sheep and the numbers fluctuate considerably during the year. The average hill country farmer could only achieve a similar fluctuation in cattle numbers, by an active policy of buying and selling cattle. 1/

There has been no measure of the labour requirements of the different treatments. The labour input at Te Awa has been high, mainly due to the large amount of recording work, and it is very difficult to differentiate between the input for management and the input for experimental work.

1/ The economics of such a policy are not likely to be very attractive, as the farmer will tend to be buying on a rising market and selling on a falling market.

The question arises as to whether Te Awa should have been made part of an economic research programme. Experience with both physical and economic aspects of a research programme indicates that the two are very difficult to combine satisfactorily, mainly due to the problem of representativeness. 8/

The author believes that the main objective of such research units should be to provide the technical information which farmers and advisory workers need to evaluate the economic merits of a proposed change in management on a particular farm. In order to obtain the necessary information the physical scientist and farm economist will need to collaborate in the design and conduct of the research programme. A feature of most technical research in New Zealand at present is that the economic aspects of adoption are virtually ignored.

The research work at Te Awa has shown that one particular class of unploughable hill country can be developed to a carrying capacity of seven ewe equivalents per acre. Te Awa is not, however, truly representative of hill country farming, particularly with respect to stock policies. Thus it was essential to conduct a farm survey to augment the information available from Te Awa.

8/ The limitations and contributions of pilot farms, management units or experimental units in an economic research programme, have been discussed in a report of the Management Unit Subcommittee of the Southern Farm Management Research Committee, North Carolina State College of Agriculture and Engineering, 1951.

CHAPTER III

THE FARM SURVEY

As discussed in Chapter I, it was decided that a farm survey of the interview type was the best means of investigating development at the farm level. The basic hypothesis used in the survey, "that development of unploughable hill country was profitable", was formulated on the results of a budgeting study of the data available from Te Awa.

A major difficulty encountered in planning and conducting the survey, was that no surveys of this nature had been previously used in New Zealand. Thus in a sense this study was also an exploratory investigation of the use of farm surveys for problems of this nature. For this reason the survey is described in rather more detail than would have been the case if relevant documented information on the use of farm surveys in New Zealand had been available.

3.1 Definition of the Survey Area

Ideally the survey would have been restricted to hill country which was similar to the Te Awa research station with respect to soils, climate and topography. This area has been estimated at about 34,000 acres, [1] involving some 65-70 holdings. A preliminary investigation showed that few of these farms were being developed along Te Awa lines in spite of their proximity to the research area. Most of those farmers who were attempting to increase production, were relying on cultivation and regrassing. The majority of unploughable hill country in this region was being improved very slowly if at all, and no farmers had reached carrying capacities comparable with Te Awa.

It was felt that a survey of this area would have provided little apart from a description of the farming of the region, and the reasons given by

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1/ Suckling, F.E.T. 1954. op. cit. p. 238.

farmers for not adopting the practices evolved at Te Awa. Little information would have been obtained on the results and problems of development.

Consequently it was decided to extend the survey to cover hill country on which the Te Awa practices have been, or probably could be, applied successfully After consultation with Mr. Suckling of D.S.I.R. this area was defined as all North Island hill country with a fairly evenly distributed rainfall of 35 inches per year or more, and without any climatic extremes. Soil type was not considered to be a major restriction, as the Te Awa practices have been successfully used on quite a wide range of soil types. 2/ The potential survey area thus consisted of most of the hill country on the West Coast of the North Island. Geographical considerations in the form of travelling expenses delimited the area to what can be broadly classified as the Wanganui-Rangitikei-Manawatu hill country region. (See Fig. 3.1)

By enlarging the area of interest, a greater number of farmers undertaking development became eligible for inclusion in the survey, and the application of results was more general. A disadvantage, however, was that the conditions encountered were more heterogenous and the influence of factors such as soil type and climate on the results became more pronounced.

3.2 Selection of Farms

Two groups of farms were selected for inclusion in the survey; eight randomly selected farms, to provide some information on what was happening on the "average" farm, and 25 farms selected on the basis that they had been, or were being developed to relatively high levels of production.

Ideally the randomly selected farms would have been selected from a register of all hill country farms in the survey area. However, as no such register

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2/ F.E.T. Suckling, pers. comm., 1962.

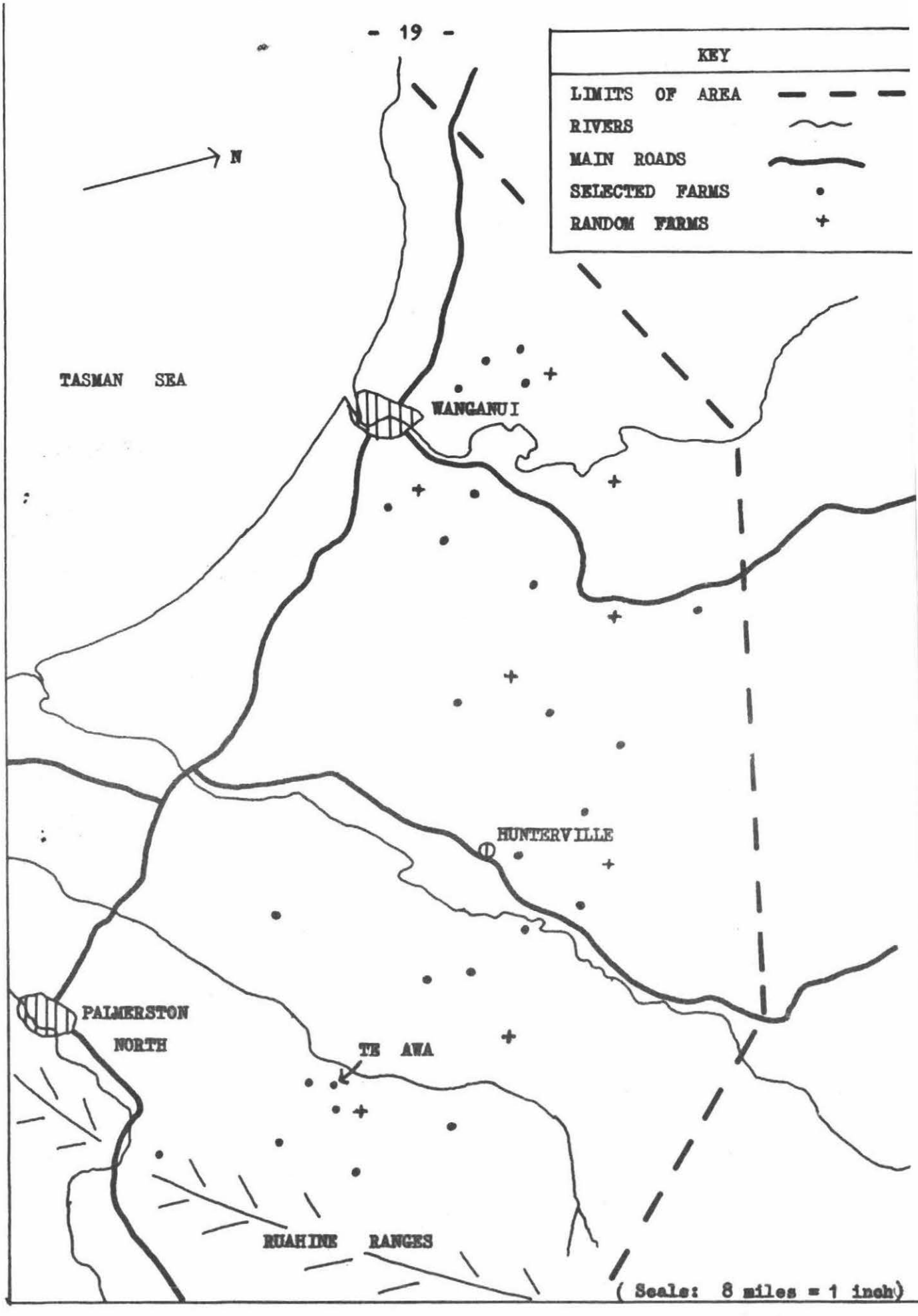

Fig 3.1 Map of Survey Area

existed, an alternative method had to be used. Numbers were taken from a table of random numbers and these were used to identify farms while travelling through the survey area. If the random number was 8, for example, then the eighth farm from, say, a bridge or crossroads would be taken. In the advent of a farm being unsuitable, e.g. if it was not hill country, the owner was absent or uncooperative, the nearest suitable farm was taken.

A similar difficulty arose with the selection of the second group of farms in that there was no means of identifying farms that were being developed. Selection of these farms was done mainly on the recommendation of people connected with hill country development, mostly in an advisory capacity. The following organisations were approached for this purpose:-

Grasslands Division, D.S.I.R.

Department of Agriculture,

Farm Improvement Clubs,

State Advances Corporation,

Lands and Survey Department,

Manawatu and Rangitikei Catchment Boards.

The selected farms constitute essentially a census of the suitable farms in the area. Undoubtedly a number of interesting farms have been missed, but this was unavoidable in the absence of a register of developing farmers. Although some of the farmers interviewed considered themselves to have no more than average management ability and resources, it is believed that they constituted a fair cross section of the more progressive hill country farmers.

3.3 Interview Procedure

Two methods of making the first approach to likely farmers were tried. The first was by means of a letter setting out the aims of the project, the type of information required and asking for their cooperation. They were then

contacted by 'phone and a visit to the farm was arranged. This method worked extremely well and there were no instances of farmers refusing to cooperate.

The second method tried, was making the initial contact by 'phone. This did not prove very satisfactory, mainly because the farmers were not prepared to commit themselves at such short notice. In all cases a letter of explanation was necessary before the farmers became fully cooperative. This method was discontinued after several attempts.

It was found to be very difficult to arrange visits to more than three or four farms in succession. This was because each interview took from three to eight hours and had to take place when the farmer was not occupied with normal seasonal work. This prolonged the survey work but would seem to be unavoidable if the full value is to be obtained from each visit. An advantage was that it enabled development to be inspected at different times of the year and seasonal effects to be evaluated.

Whenever possible, the first stage of the interview was an inspection of the farm with the owner and/or manager. The farm inspection was regarded as being essential if the full implications of the methods and problems of development were to be evaluated. It was also an ideal time and method of getting some insight into the farmer's ability and of gaining his confidence.

It was found that it was not always possible, or indeed advisable, to follow a fixed order of questions. The first necessity was to get the farmer talking freely, and often the best means of achieving this was to spend some time discussing a subject in which the farmer had a particular interest. The breeding, management, and performance of stock, was frequently a useful subject for such discussions, as the majority of farmers regard themselves as good stockmen.

Some farmers were rather reticent at first and sensitive of any implied criticism of their management. It was found that the best way to obtain

information in such cases was to maintain a conversant but unbiased attitude towards development, and to refrain from anything more than mild argument. It often helped to give the farmer the impression, that the interviewer had come especially to him to learn about development.

The most satisfactory farmers to interview were those who welcomed criticism and encouraged a two-way flow of information. As these farmers tend to provide the most valuable information, it is very desirable for the interviewer to have a wide knowledge of the subject prior to the survey. 3/ The initial theoretical study was of assistance in this respect as was a familiarity with the research work at Te Awa.

As a rule the questionnaire was not produced until near the end of the interview, as it was found that many farmers tended to talk more freely when their replies were not being recorded. In many cases, completion of the questionnaire merely involved summarising the discussion that had been held on the farm, and this could often be done after the visit. This method of conducting the interview helped to avoid getting answers tailored to suit the questions, as the farmer had generally committed himself before the questionnaire was filled in. Whenever it was judged that incorrect replies were given, either due to unawareness or unwillingness on the part of the farmer, the interviewer's opinion of the correct reply was also recorded. The recording of financial and physical data (when available), was found to be a time consuming task and whenever possible the farmers records were borrowed and returned after a copy had been taken.

The procedure outlined above proved very satisfactory. The main danger lay in trying to adopt too tight a schedule of visits. In a survey of this nature it would appear to be unwise to try and visit more than one farm

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3/ It is doubtful whether this type of survey can be conducted by anyone but a trained agriculturist, with some prior knowledge of the problem. Obviously, the research worker will be learning more about various aspects of farming during the survey. It is likely, however, that much useful information will be missed if the worker has to gain <u>all</u> his knowledge from the survey.

in a day. This should enable a complete summary of each farm to be done before tackling another farm.

3.4 Design of the Questionnaire

The questionnaire (see Appendix A), consisted of two sections. The first of these was to record a description of the farm and its management at the time of the interview. The design of this section posed no great problems as there are many such forms in common use at present.

The second section was to record details of the development programme, and was intended to provide both a description and an evaluation of the programme since its initiation. In the absence of any suitable literature on similar investigations in New Zealand, (or indeed anything really relevant from overseas), the design of this section was largely empirical. The theoretical study was of considerable assistance in this respect.

It became apparent as the survey progressed, that the design of this section was not entirely satisfactory, as the scope of some of the questions was too broad. There is, however, a need for broad questions in exploratory surveys of this nature, as many farmers may have unique experiences which should be related in full. Particularly when farmers are, in effect, experimenting with various aspects of development, it is important to know not only what a farmer did, but why he did it, and what results he obtained.

In view of the above considerations it is unlikely that a suitable, detailed questionnaire can be designed prior to the survey. As the interview proceeds, the interviewer will have to decide which points are worth following up. The extent and accuracy of the information obtained will largely depend on the ability of the interviewer.

In this survey, the original questionnaire was used as a guide, and as new information came to hand, it was used to modify the line of questioning pursued during the interview. As the interviewer became more conversant with

the methods and problems of development, the interviews became easier to handle, and there was an accompanying improvement in the information obtained. After each interview, the questionnaire was reviewed to check that all aspects of the development programme covered in the rather "free form" interview, had been recorded.

Both the amount of physical and financial data, and the form in which it was available, varied considerably. Ordinary data paper was used to record this, rather than a specially prepared table.

3.5 Reports to Farmers

During the course of the study two reports were prepared for distribution to the people who had assisted with the work. The first of these was prepared after the completion of the field work, and consisted of a brief review of some of the results and impressions that had been obtained during the survey. 4/ The second report was a summary of the completed study. 5/

There were two reasons for preparing these reports. Firstly, many of the people approached in connection with the study had displayed considerable interest, and had expressed a wish to be kept informed of the progress and results of the work. This applied particularly to farmers who were in the process of developing their proper ties.

Secondly, it was felt that as some of the conclusions were based on the overall impressions gained from the survey, it would be useful to have a check on the veracity of these conclusions. Accordingly, comments and criticism of the material in the first report was invited.

4/ A. Wright, "A Progress Report on a Study of The Development of Unploughable Hill Country", Discussion Paper No. 2. Department of Agricultural Economics and Farm Management, Massey University of Manawatu, 1962.

5/ Forthcoming.

The replies received following distribution of the first report, in general, supported these conclusions, and in addition, brought up several aspects of development which had been overlooked or insufficiently emphasised.

The preparation of an interim report after the field work has been completed means that the research worker has to review his whole problem and put it into perspective. It is a useful prelude to the rather detailed analysis which has to be done before the final report on the study.

CHAPTER IV

DESCRIPTION OF THE SURVEY AREA

This chapter contains a brief description of the region in which the survey was conducted. Some background information on the area is necessary to give an indication of the environment in which development is being carried out. Unfortunately, there is a marked lack of published statistical and descriptive material. Much of the information that would be desirable in order to give a comprehensive description of the area was unavailable.

The climate and soils of the region are discussed, together with a brief history of farming, and finally, some details of the survey farms are presented.

4.1 Climate

The climate of the area is one of mild winters and warm summers, with a relatively small mean annual range of temperature. 1/ The average annual rainfall on the hill country, ranges from about 40 inches, to over 60 inches near the Ruahine Ranges. The annual rainfall is fairly evenly spread, with a maximum in winter and a minimum in summer or autumn. February is generally the driest month, although there are occasional dry periods in the spring. There are two peaks of pasture production, one in the spring and the other in the autumn. Improved pastures generally produce throughout the year, and make possible an all grass system of farming, even under high stocking rates.

The whole area slopes towards the west, and is exposed to the prevailing winds from that quarter. Storms and gales, however, usually come

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1/ B.J. Garnier, "The Climate of New Zealand", Edward Arnold Ltd., (London), p. 53.

from the south and south west. Practically all the country lies below 1500 ft.

4.2 Soils

It is estimated that there are about 1200 square miles, or 768,000 acres of hill country in the survey area. This estimate was based on an assessment of the area of hill country soils as shown on the soil maps. 2/ There are 13 major hill soils in the region, ten of which were encountered on the survey farms. (see Table 4.1) There has been no detailed survey work done on these soils and consequently relatively little is known about their characteristics. 3/

4.21. Atua - Taihape Soils (29H and 114a)

The Atua - Taihape soils are formed from bluish-grey mudstones (papa) of Tertiary age. They have developed under a broadleaf-podocarp forest, with an average rainfall of 40-60 inches. The Atua soils include the hilly slopes (12-30°) and the Taihape soils are the related soils on steep slopes (greater than 30°). These soils are of medium natural fertility, the main deficiency being phosphate. There is some slipping, especially on the Taihape steepland soils, but these tend to heal fairly rapidly.

4.22 Kumeroa - Whangaehu Soils (29fH and 114)

These soils are formed from sandy mudstones of Tertiary age, and are fairly coarse textured. They have developed under similar conditions to the previous group, but the natural fertility is lower. The Whangaehu steepland soils are subject to slipping, and these heal less rapidly than on the Taihape soils.

2/ "General Survey of the Soils of North Island, New Zealand", Soil Bureau Bulletin No. 5, Department of Scientific and Industrial Research.

3/ The author is indebted to Mr. D. Cowie of the Soil Bureau for information on hill soils.

TABLE 4.1

MAJOR HILL SOILS IN SURVEY AREA

NAME	REFERENCE NO.
Atua silt loam, hill soil.	29H
Taihape silt loam.	114a
Kumeroa silt loam, hill soil.	29fH
Whangaehu loam.	114
*Turakina silt loam.	114b
Raumai sandy loam, hill soil.	11H
Kiwitea loam, hill soil.	76aH
Pohangina sandy loam.	118a
Matamau heavy silt loam, hill soil.	77bH
Halcombe silt loam, hill soil.	13bH
Westmere silt loam, hill soil.	66dH
*Mokau sandy loam.	117c
*Moumaki sandy loam.	117

*Not encountered on survey farms.

The reference numbers are standard for New Zealand soil maps.

4.23. Turakina Silt Loam (114 b)

This soil is formed from bluish-grey calcareous mudstone, under broadleaf forests. It occurs on steep hill country in the lower rainfall areas (35-40 inches). It has a high natural fertility, and slips heal readily.

4.24. Raumai-Kiwitea-Pohangina Soils (11H, 76aH and 118a)

This group of soils is formed from loose unconsolidated sands of late Tertiary to early Pleistocene age. The Raumai and Kiwitea soils are formed on hilly slopes, and the Pohangina soils on steep and very steep slopes.

The Raumai soils are formed under fairly low rainfalls (less than 45 inches), and are of medium fertility. Slips heal readily but this soil is liable to severe gully erosion. The Kiwitea hill soils are similar to the Raumai soils, but occur under a higher rainfall, and slipping and gullying is less frequent. The Pohangina steepland soils are very subject to slipping and severe gullying. They are of medium natural fertility.

4.25. Matamau Hill Soils (77bH)

These include soils on moderately steep land formed from sandy mudstones and siltstones of Tertiary age. They are of medium natural fertility and are subject to slips which heal fairly rapidly. Areas mapped as Matamau soils, also include areas of Makutuku hill soils, formed from sandstones. Profiles are sandier, natural fertility is lower, and slips heal less rapidly than on the Matamau soils.

4.26. Halcombe Silt Loam, Hill Soil (13bH)

This is formed from sandy mudstone on moderately steep country, but under a lower rainfall (less than 40 inches) than the Matamau soils. A very compact subsoil slows drainage and this soil tends to lie wet in the winter. Natural fertility is medium, and there is some slipping and gullying.

4.27. Westmere Silt Loam, Hill Soil (66dH)

This soil occurs mainly north of Wanganui, and is formed on mixed parent

material of andesitic volcanic ash, and Pleistocene sands. It is formed under a broadleaf - podocarp forest with a rainfall of 40-45 inches. It is of medium natural fertility and erosion is not a great problem.

4.28. Mokau Sandy Loam (117c)

Mokau sandy loam is formed from early Tertiary sandstones, under a broadleaf-podocarp forest with a rainfall of 50-80 inches. It is found on steep slopes and the soil is shallow and sandy. Slips are numerous and these heal slowly. Natural fertility is low.

4.29. Moumahaki Steepland Soils (117)

These soils are similar to the Mokau sandy loam, but are formed under beech forest. The natural fertility of these soils is very low.

4.3 History of Farming

Most of the hill country in the survey area was developed from the original native forest between 1880 and 1910. Initially, development was confined to fringe areas, and to country adjoining the main access routes, but from 1900-1910, large inland areas were cleared and sown to pastures. The bush was usually burnt standing, and seeds mixtures were hand sown on the ashes. Pasture establishment and production after the burn was relatively good, but once the natural fertility of the soil had been exhausted, pastures began to deteriorate. At this time there was no means of replenishing fertility, and as the pastures weakened, reversion and erosion became major problems, and stocking rates declined.

After about 1920, the deterioration of the poorer hill country became widespread, and over much of the region, only extensive farming involving low stocking rates and large areas was possible. Many of the original settlers were forced to abandon their farms, particularly in areas north-west of the Wanganui river. Much of this abandoned country is still unproductive at the present time.

The innovation that contributed most towards the improvement of hill country was aerial topdressing. After about 1948, large areas of unploughable

Fig. 4.1. Typical Unploughable Hill Country in the Survey Area.

(Photo. F.E.T. Suckling)

hill country were oversown and topdressed, by air. The high wool prices of the early 1950's also helped to increase the rate of hill country development. The advent of the crawler tractor, also in the 1940's, resulted in considerable areas of the easier hill country being cultivated and sown to improved pastures.

Initially, the main products of the hill country were wool and tallow, but with the advent of refridgerated shipping, the hills became important as a source of store stock for fattening on lowland farms. Wool and store stock are still the major products, but there is an increasing amount of fat stock production. As a result of pasture improvement, many farms are now able to fatten both sheep and cattle. Although the Romney is the predominant sheep breed on hill country, there is a trend on improved farms to use a fat lamb sire such as the Southdown, over portion of the ewe flock.

4.4. The Survey Farms

Some details of the survey farms not included elsewhere in the text, are presented in Table 4.2.

The survey farms covered a total area of 27,155 acres, which is 3½% of the estimated 768,000 acres in the survey area. It is unlikely that the number of random farms was sufficient to give a true indication of average carrying capacities in the region. A considerable portion of the hill country is farmed extensively in blocks of up to 8,000 acres. None of these large blocks were included in the survey, and their carrying capacity is thought to be less than 2 ewe equivalents per acre. When this extensively farmed land, and the unproductive land is taken into account, the average carrying capacity over all the hill country in the survey area is probably only about 2 ewe equivalents per acre.

The carrying capacity on all the random farms had increased in the last ten years. On seven farms there was no definite development programme and the rate of increase was very slow. The only farmer actively developing, had nearly doubled his carrying capacity in the last five years.

TABLE 4.2

SURVEY FARM DATA

	Selected Farms	Random Sample
Number of farms	25	8
Total area occupied (acres)	19388	7767
Average farm size (")	775	971
Range in farm size (")	220 - 2100	600 - 1600
Average carrying capacity (ewe equivalents per acre)*	3.4	2.8
Range in carrying capacity	2.1 - 6.2	2.0 - 3.3
Number of farms cropping	18	6
Farms with one labour unit	17	6
Farms purchased since 1950	15	5

*See appendix B for details of the stock conversion factors used.

It was estimated that the physical potential of all the farms visited was at least 5 ewe equivalents per acre, although only two farmers had reached this level of stocking. As the survey farms included all but three of the major hill soils, it is likely that most of the survey area could be developed to a carrying capacity of 5 ewe equivalents per acre.

Nearly 75% of the farmers in the survey grew a winter crop, usually choumoellier. Cropping was generally limited to small areas of flats or easy slopes. Most of the farmers who did not crop would have done so, if they had accessible areas that could be cultivated. A winter crop, however, did not appear to be an essential factor in achieving high stocking rates.

The main feature of the hill country in the survey area, is the potential for increased production with existing technology. Conservative estimates of average and potential carrying capacities, suggest that there is scope for hill country production to be increased by about 100%, in terms of carrying capacity. The technical aspects of such development are reviewed in Chapter V.

CHAPTER V

TECHNICAL ASPECTS OF DEVELOPMENT

The term "development", generally refers to the operations or changes in management, which enable production to be increased. The breaking in of non-productive land, the improvement of low producing pastures, and the better utilisation of existing pastures, are all forms of development. Development proper, in the sense of felling standing bush, had already been carried out on the survey area in the late 19th and early 20th century.

For the purposes of this study, then, development can be regarded as involving some or all of the operations of clearing secondary growth, subdivision, topdressing, oversowing, and increased stocking, with consequently more intensive grazing management.

In this chapter the technical aspects of these operations are reviewed, and on the basis of farmers' experiences and of impressions gained during the survey, some of the common reasons for success and failure are discussed.

5.1 Secondary Growth

Many hill country farms tend to represent a balance between reversion and development. Hence, most development programmes are, at some stage, concerned with the problems of secondary growth. "Secondary growth", is a general term used to describe the plant species which appear as the initial stages of reversion to original vegetative cover. The three major forms of secondary growth encountered in the survey were manuka, gorse and bracken fern. On all the survey farms, initial development involved areas which either had reverted, or were in the process of reverting to one or more of these weeds.

5.11. Manuka (Leptospermum spp.)

Manuka scrub was the most common form of secondary growth encountered

on the survey farms. It was present on all but two of the farms, and was the major weed on 60% of the farms.

Successful development of manuka country is still based on the manual cutting of the scrub. For a time, Manuka blight, [1] which was introduced to the North Island about 1947, showed some promise of eradicating manuka. Unfortunately, a parasitic fungus has seriously reduced the effectiveness of the blight and it very rarely kills the plant entirely.

The common method of developing manuka country at present is to cut the scrub manually, and burn it in February or March. [2] [3] The time of cutting largely depends on the age of the plant, and scrub that is more than 10 years old usually has to be cut during the winter to have it sufficiently dry for burning in the autumn. The regrowth in the first two years can generally be controlled by heavy stocking with both sheep and cattle, however, once the plants reach a height of 12-18 inches, they become unpalatable to stock. In most cases scattered regrowth has to be cut by hand two or three years after the initial clearing.

The best means of suppressing regrowth is to establish as quickly as possible a dense, vigorous pasture. This inhibits seedling establishment, and high stocking rates then ensure the constant grazing and subsequent mortality of any seedlings that do become established.

High stocking rates and dense, vigorous pastures cannot be achieved independently. The rate of pasture improvement largely depends on the farmer's knowledge of the relationship between stock and pastures, and his management ability. Failure to achieve and maintain a satisfactory pasture usually results

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1/ C.J. Hamblyn, "Manuka Blight", N.Z. Journal of Agriculture, Vol. 99, No. 2, 1959. p. 119.

2/ K.R. Marshall, "Manuka to Grass", Massey College Sheepfarming Annual, 1962, p. 115.

3/ C.J. Hamblyn, "Clearing Manuka from Hill Country", N.Z. Journal of Agriculture, Vol. 77, No. 3, 1948, p. 290.

in gradual reinfestation of manuka (and other weeds), which in 10-20 years can present another major development problem. Much of the current "development" of hill country is in fact "redevelopment" of areas that have reverted in this manner.

The majority of scrub on the survey farms was cut on a contract basis, and the costs varied considerably depending on the degree of infestation and the age of the scrub. The range of scrubcutting costs was from £1.10. 0. per acre for light, scattered scrub, to about £12. 0. 0. per acre, for dense, heavy scrub.

5.12. Gorse (Ulex europaeus)

Unlike fern and manuka, gorse is an introduced plant. Its spread had been comparatively unhindered on hill country until the advent of hormone sprays. Some control had been achieved, but only by laborious manual operations.

Gorse occured on 52% of the survey farms, and was the major problem on 24% of the farms, these being in the Wanganui district. It was apparent from the survey that there was no accepted method of controlling gorse. Farmers had varying opinions as to the best method of developing gorse country, and there were several variations in technique being used. The three most common methods are described in detail below:-

Method A: The gorse is burnt in the autumn and sown and topdressed immediately after. There is some risk of not getting a uniform and complete burn on shady faces and where the gorse is relatively young and sparse. In such cases there may be considerable surface debris and some difficulty in getting uniform grazing over the area. Regrowth is sprayed about 18 months after burning.

Method B: The gorse is sprayed with 2,4.5-T about October-November either with a ground spray outfit or more commonly by helicopter, or fixed wing 'plane. The gorse can be burnt in the following autumn although some farmers prefer to wait until the second autumn. Killing the gorse before burning ensures a hot fire with a minimum amount of surface debris remaining.

Method C: The gorse is sprayed as before, but with a much lighter rate of application. The aim is to "brown off" the gorse, rather than completely kill it, before burning. There is less risk of a poor burn than with Method A.

An attempt has been made to estimate the cash outlay for each method. [4] The costs are based on farm costs (where available) and on experimental results. [5] They cover the period from initial treatment, to the stage where the land is carrying three ewes per acre. Fencing is assumed to consist of one chain of Hunter fence per acre, and topdressing to be 9 cwt. per acre in three applications over eighteen months. Carrying capacity is estimated to be 2 ewes per acre one year after sowing, and 3 ewes per acre after two years. It is assumed that extra stock have to be purchased. The costs for the three methods are presented in Table 5.1.

The cost of spot spraying for all three methods may be higher than quoted, and may be spread over a number of years. This will occur if the initial seedling growth is not rigorously controlled, and if the establishment of a dense pasture is unsuccessful. If extensive respraying is required, it is likely that additional oversowing, particularly of clovers, will be necessary.

It has been stated [6] that the aim in developing gorse country should be to get a slow, hot fire to reduce to a minimum the amount of surface debris, and to render permeable a maximum amount of gorse seed, so that it will germinate in the following spring. This means that the gorse must be dense, and if an initial spraying is to be eliminated, must be at least four years old, and have been closed to stock for some months to accumulate dry undergrowth. The initial growth after burning will contain a large proportion of gorse

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[4] It was not possible to obtain the necessary information to enable complete budgeting for each method of development.

[5] J.D. Currie, "Gorse Control on Unploughable Hill Country", Proceedings of the N.Z. Weed Control Conference, 1959, p. 65.

[6] G.R. Moss, "The Gorse Seed Problem", Ibid., p. 59.

TABLE 5.1

COSTS OF GORSE DEVELOPMENT (£'s/acre)

	Year*	1	2	3
Method A	Fertiliser	2.25	4.50	maintenance
	Seed and sowing	6.00	0	0
	Fencing	6.50	0	0
	Spot spraying	0	0	4.78
	Stock @ £2/ewe	2.00	2.00	2.00
	Total	16.75	6.50	6.78
Method B	Initial spraying	12.83	0	0
	Fertiliser	2.25	4.50	maintenance
	Seed and sowing	6.00	0	0
	Fencing	6.50	0	0
	Spot spraying	0	0	4.25
	Stock	2.00	2.00	2.00
	Total	29.58	6.50	6.25
Method C	Initial spraying	1.75	0	0
	Fertiliser	2.25	4.50	maintenance
	Seed and sowing	6.00	0	0
	Fencing	6.50	0	0
	Spot spraying	0	0	4.78
	Stock	2.00	2.00	2.00
	Total	18.50	6.50	6.78

* Based on July-June farming year.

seedlings, and these should be first grazed when 2-3 inches high. At this stage they are relatively palatable to stock. Sheep are preferable for the initial grazing as they provide some consolidation and do not open up the ground surface as much as cattle. Heavy stocking rates are essential for the first grazings although definitions of "heavy" range from 30 to 300 sheep per acre for periods of one to four weeks at a time. Surviving regrowth should be easily controlled by spot spraying.

Method B was the most popular on the survey farms in spite of the high cost. The impression gained from the survey was that too much emphasis was being placed on the initial use of hormone sprays, and that Method A, if properly carried out, should prove to be the cheapest and most effective means of controlling gorse.

The majority of the survey farmers who were developing gorse country considered that experimental work on gorse control was urgently needed. The real problem, however, appeared to be largely one of extension. While there is scope for further research into gorse control, it is possible that what is most urgently required in the survey area, is a demonstration farm to compare the different methods under similar conditions. The main value of such a unit would be as a means of extension.

5.13. Fern

Three types of fern were encountered in the survey area. These were bracken fern (Pteridium aquilinium var. esculentum), hard fern or ring fern (Paesia scaberula), and water fern (Histiopteris incisa). Fern was not the major form of secondary growth on any of the survey farms. All three types were generally found in association with manuka, bracken fern being predominant. Bracken fern can, however, present the major development problem in more northern areas, such as the King Country.

Although the following discussion pertains to the control of bracken

fern, the same methods of control are generally effective for the other types of fern.

The complete eradication of bracken fern is often a long process due to the extensive underground rhizome system, which may survive beneath pastures for many years. The development of fern country is based on the removal of surface vegetation, and the suppression of subsequent regrowth by means of heavy stocking and the establishment of dense vigorous pastures. 1/

If the fern is sufficiently dense it is best cleared by burning in the autumn, followed by oversowing and topdressing. The regrowth, (from November to May), is usually prolific, but until the young fern fronds reach a height of 6-8 inches they are soft and palatable and can be destroyed by high stock concentrations. It is unlikely that all regrowth in the first year will be destroyed by stock, and once the young fern has reached the woody and unpalatable stage it is probably best left alone, unless it is thick enough to be reburnt. This surviving regrowth will die off naturally during the winter and a fresh attack can be made the following spring.

As the pastures improve and the stocking rate is increased, the amount and vigour of regrowth will be reduced each year until it is no longer a serious problem. If deprived of the vegetative phase, the plant will eventually die.

When the fern has been too sparse to be burnt, a policy of oversowing, topdressing and heavy stocking has been successful in gradually bringing the land under control. Isolated patches of fern can often be eradicated by feeding out hay on them. The stock generally trample out the fern sufficiently to allow a pasture to become established from the hay seed.

5.14. Variegated Thistle (Silybum marianum)

One of the added problems of development for about 30% of the survey

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1/ E.A. Clarke, "Fern Control", Proceedings of the Ruakura Farmers' Conference, 1960, p. 62.

farmers, particularly in the Wanganui area, was the presence of variegated thistles. After the secondary growth had been cleared pasture establishment was often very difficult due to the dense infestation of these thistles. They are large and unpalatable to stock, and if allowed to grow unchecked can smother out considerable areas of pasture. They can be controlled by spraying at a cost of about 30/- per acre, but they are likely to grow just as thickly in succeeding years. A dense pasture will help to reduce infestation, but if the ground becomes bare at any stage due to slips or stock movements, the growth of thistles may become prolific.

5.2 Subdivision

The research at Te Awa, discussed in Chapter II, indicated that increased subdivision alone, could enable carrying capacity to be increased due to improved pasture utilisation. Subdivision to the degree found at Te Awa, however, would be uneconomic on most farms.

The aim in planning subdivision should be firstly, to separate different classes of land (subject to water supplies and convenience of stock movements), and secondly, to have paddocks of such a size that they can be evenly grazed rather than patch grazed. The size of each block to be developed should largely be determined by the number of stock available for pasture control. A farmer contemplating developing 100 acres of gorse, for example, must take into account the necessity for having a stocking rate of, say, 30 sheep per acre, to control seedling growth in the spring. This will involve about 3,000 sheep, and if the farmer has not got access to this number, he would be unwise to attempt to develop the whole 100 acre block in one year.

The impression gained from the survey was that the majority of farmers were developing areas too large to be handled by the number of available stock. Many of them did not fully appreciate the role that heavy stocking could play in pasture improvement. This failure to apply sufficient grazing pressure was

usually associated with increased regrowth problems and a slow rate of pasture improvement.

Much of the subdivision necessary to obtain proper grazing control in the initial stages of pasture improvement need only be temporary. Once a dense vigorous pasture has been established, satisfactory control can be achieved with a reduced amount of subdivision, provided that relatively high stocking rates are maintained.

There was a definite tendency for farmers to think in terms of permanent rather than temporary fencing. By far the most common fence used on the survey farms was the conventional post and wire type. This type of fence is no doubt the most reliable and attractive, but it does not compare favourably with other types of fences in terms of cost. Few farmers were able to give a detailed breakdown of fencing costs, but their estimates of total costs were very similar to those obtained by Hewitt [8] on which the following table is largely based:

TABLE 5.2

ESTIMATES OF FENCING COSTS

	Conventional	Hunter	Electric	Hurricane
Materials	£6.18. 9.	£4. 0. 5.	£1. 5. 8.	£4.11. 6.
Cartage	16. 4.	2. 9.	7.	3. 0.
Laying	11. 5.	5. 7.	1. 2.	6. 0.
Bulldozing	-	4. 0.	5. 0.	5. 0.
Erection	3.15. 0.	1.15. 0.	6.10.	1.15. 0.
	£12. 1. 6.	£6. 7. 9.	£1.19. 3.	£7. 0. 6.
Cost per mile including gates	£1,000	£546	£232	£597

These costs are very dependant on cartage costs, difficulties of erection,

[8] W.R. Hewitt, "Comparative Costs of Ordinary, Hunter Chain, and Electric Fences," Massey College Sheep Farming Annual, 1958, p. 104.

and variations in construction.

The Hurricane netting fence had not proved entirely satisfactory under high stocking rates, but there were too few examples to indicate whether this was due to the design of the fence, or to faulty erection. At Te Awa, this type of fence has proved quite satisfactory. The electric fence is still on trial as an effective permanent fence on hill country, but it would appear to have a considerable potential for temporary fencing.

The advantages of the conventional fence do not seem sufficient to warrant the extra cost of £400-£500 per mile. Farmers could consider the possibilities of cheaper types of fence, particularly when finance is limited. If necessary, these could be gradually replaced with conventional fencing when the farmer is in a sound financial position.

It would seem that there is a need for some research on hill country fencing in view of the importance of adequate subdivision, and the relatively high cost of fencing. To date, the majority of innovations in fencing, with the exception of electric fences, have been produced by farmers and commercial firms.

5.3 Topdressing

Apart from the Te Awa work, the author is unaware of any published research on the effects of different rates of topdressing on hill country. In view of this general lack of knowledge, it was not surprising to find that there was a considerable variation in topdressing practices among the survey farms. These ranged from maintenance rates of 1 cwt. per acre every second year, to development rates of 15 cwt. per acre in three dressings over 18 months. Much of this variation was also due no doubt, to the fact that topdressing is one of the most easily adjusted items of expenditure. Thus a financial crisis may result in the amount of fertiliser being markedly reduced, even to the extent of omitting topdressing entirely. This situation is very likely to occur if the farmer

has not budgeted his development programme.

Research at Te Awa has indicated that the rate of pasture improvement can be increased by heavy applications of fertiliser at the beginning of a pasture improvement programme. (Refer to Chapter II). Most farmers were aware of this principle, either from familiarity with the Te Awa results, or from their own experiences. Their ideas of "heavy", however, ranged from 2 to 10 cwt. per acre annually.

The Te Awa results have also indicated that to obtain the maximum pasture response from heavy topdressing, it is necessary to maintain a high grazing pressure. In this respect, it seemed likely that on most farms, the fertiliser that had been applied, would have supported a faster rate of pasture improvement if higher stocking rates had been used. Many farmers were aware of this but were unwilling to accept the loss in "stock quality" that would have resulted from higher stocking rates.

The most common topdressing policy during development, was to apply 3 cwt. of phosphatic fertiliser in the autumn when oversowing, 3 cwt. per acre in the spring and 3 cwt. per acre in the following autumn. It would appear from farmer experience, and the Te Awa results that an adequate maintenance rate is 2 cwt. per acre, even for pastures that are carrying five or more sheep per acre. 2/

One fact to arise from survey was the importance of maintaining topdressing during development. It was noticed that when annual topdressing had been markedly reduced or omitted during the early stages of pasture establishment, the result was always to prolong development, and this generally led to increased regrowth problems.

Research into both the physical and economic aspects of hill country topdressing is urgently needed, particularly as the rate of topdressing is one

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2/ This situation may not hold for some soil types not encountered in the survey.

of the major factors governing the rate of pasture improvement. The topdressing policies in use at present are largely derived from farmer experience. Further additions to knowledge under this situation are likely to be limited, as the farmer cannot afford to experiment to any great degree.

5.4 Oversowing

Oversowing, defined as the sowing of seed on the ground surface, is used at two stages of development. Either to sow a seed mixture after a burn, or to introduce improved pasture species into existing pastures.

It was generally recognised that manual oversowing gave the best results due to even seed distribution, but owing to the labour involved this was seldom done except on small areas. The majority of oversowing on the survey farms was done by air, the seed often being applied with the topdressing. Aerial oversowing has given good results, the main requirements for success being, a skilled pilot, suitable air conditions at the time of sowing and application of the seed from two or more directions. The cost of aerial oversowing was about 4d. a lb. of seed.

It has been found that heavy stocking for a short period, immediately after oversowing markedly improves pasture establishment. In the case of burns this is due primarily to the consolidation of the ground surface which is usually very flocculent and unstable after a fire. When oversowing pastures, the heavy stocking ensures that the majority of the seed is trampled into the soil rather than left suspended in the plant foliage. This method has been used with considerable success by the Wanganui Farm Improvement Club. 10/

There was a considerable variation in the composition of seed mixtures used for oversowing. These ranged from 5-6lbs. per acre of clovers alone, to a full pasture mixture of 25-30lbs. per acre, for both burns and pastures. Much of this variation can be explained by the fact that many farmers are still

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10/ G.F. Frengley, pers. comm., 1962.

experimenting to find a seeds mixture most suited to their conditions. In the past it was usual to oversow both grasses and clovers at a rate of 25-35lbs. per acre, however, many farmers now believe that the value of grasses for oversowing has been over-emphasised. The greatest need is for clovers to help build up fertility, and it has been found that if high fertility grasses such as ryegrass and cocksfoot are sown initially, they frequently die out within a year or two to be replaced by naturally introduced species and weeds. It has been noted that as the fertility improves, the high fertility grasses tend to become increasingly dominant on their own accord, and it is likely that a process of natural selection under high stocking rates will result in the evolution of a pasture most suited to the conditions. This process can be speeded up slightly by the artificial introduction of the high fertility species at the appropriate stages.

Farmers have found that in many cases oversowing with clovers alone has given results as good, if not better, than oversowing with a full pasture mixture containing grasses and clovers. In addition the cost of seed may be halved. (About £2.10. 0. per acre as compared with £5-£6 per acre for a conventional pasture mixture.)

All farmers were oversowing in the autumn as this allowed the young plants to become established before grazing was required in the spring to combat regrowth. In cases where the young pasture was badly damaged in attempting to control regrowth, oversowing was often repeated in the following autumn. About 30% of the farmers attempted to spell oversown pastures in order to allow clover reseeding, but because of varying feed supplies it was seldom possible to make this a regular practice, particularly under high stocking rates.

The most common faults noted with respect to oversowing were, failure to maintain topdressing of oversown pastures, and a failure to appreciate the importance of reducing surface vegetation to a minimum prior to oversowing an established pasture.

5.5. Increased Stocking and Grazing Management

Increased stocking and the associated problems of grazing management are discussed in terms of grazing method, stocking rate, (both theoretical considerations and practical observations), and finally type of stock.

5.51. Grazing Method

The majority of farmers in the survey used a method of grazing similar to that evolved at Te Awa, consisting essentially of set stocking from mid-winter to weaning, followed by mob stocking. High levels of physical production per acre have been achieved not only with this system of grazing, but also with set stocking and with rotational grazing. This indicates that the important factor is stocking rate rather than the method of grazing. It is of interest to compare this with relatively recent views on hill country farming, as illustrated by the following quotation:-

> "Set stocking, whatever the ration (cattle to sheep), is less likely to succeed, than rotational mobgrazing, be it with all cattle, all sheep, or with a high or low cattle-to-sheep ratio.
>
> The despoilers of the hills are the hard, set-sheep graziers...."[11/]

5.521. Stocking Rate - Some Theoretical Considerations

The optimum stocking rate can be considered from either a technical or economic point of view.

Technical efficiency is measured in terms of a physical ratio of output of product to input of factor. There are thus two ratios that can be used to evaluate stocking rate. The first is output per unit of the fixed factor, or production per acre, and the second is output per unit of the variable factor, or production per animal.

These two ratios are illustrated in Figure 5.1 which represents a hypothetical example of the effect of stocking rate on per acre wool production.

11/ Sir Bruce Levy, "Grasslands of New Zealand," N.Z. Government Printer, (Wellington), 1955, p. 214.

(For the purposes of this discussion, it has been assumed that wool is the only product.) It can be seen that maximum wool production per acre is achieved with a stocking rate of five sheep per acre. At this point the marginal productivity of the variable factor is zero. Per sheep production, on the other hand, is a maximum at a stocking rate of one sheep per acre (or less).

It is obvious that both these stocking rates cannot be optimum at the same time. Farmers are generally trying to maximise profits, and this implies that profit maximisation should be the criterion with which to evaluate stocking rate.

To determine profits it is necessary to introduce prices, and to construct a budget line such as A, or B, in Figure 5.1. The slope of the budget line is given by the factor/product price ratio. If the price of wool is 5/- per lb. and the variable costs of running an extra sheep are £3, then twelve pounds of wool are equivalent in value to one sheep. Thus the budget line has a slope of 12:1. (Line A in Figure 5.1).

Profits are maximised when the factor/product price ratio is equal to the marginal productivity of the resource. As the slope of the production function at any point represents the marginal product of the resource, then the input which gives maximum profits is denoted by tangency between the budget line and the production function.

With the price of wool at 5/- per pound, and the variable costs of an extra sheep at £3, profits are maximised at a stocking rate of one sheep per acre. If the variable costs fall to £1 per sheep, the price ratio becomes 4:1, (giving budget line B), and a stocking rate of four sheep per acre will maximise profits. Maximum physical production per acre, will only maximise profits when sheep can be obtained and run at no cost. Farmers who refuse to increase stock numbers because of the effect on "stock quality", are in effect, trying to maximise the technical ratio of wool production per sheep. In the above example the appropriate stocking

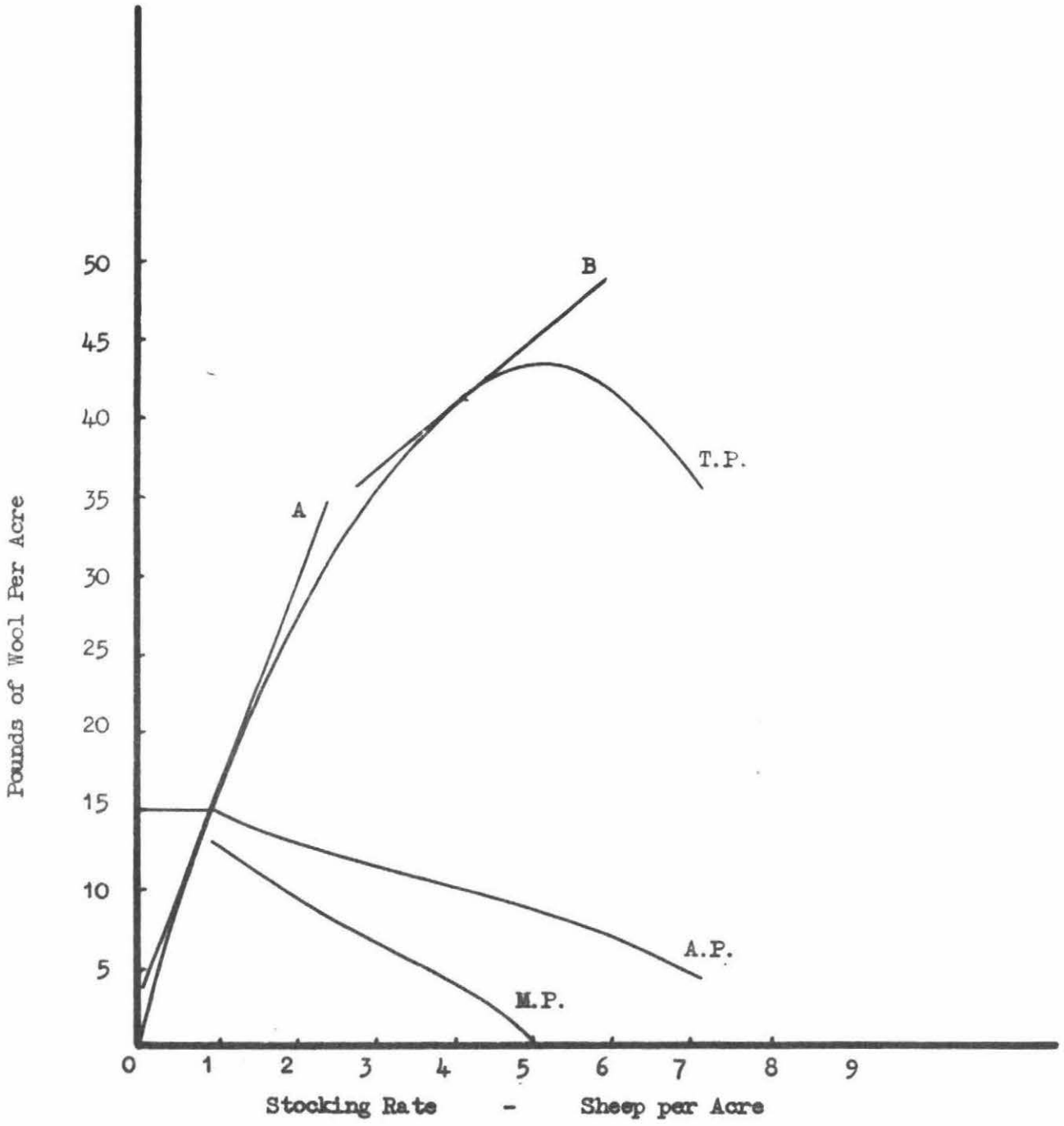

Fig. 5.1 Relationship Between Stocking Rate and Wool Output per Acre

rate would be one sheep per acre. 12/

Much agricultural research in New Zealand is concerned with technical efficiency, in particular with maximising physical production per acre. Frequently, the implication behind the design of such research and the presentation of results, is that increased physical production per acre leads to increased profits. As shown above, this is not necessarily true. 13/ If the concepts of production functions and marginal products were fully recognised in physical research, it would be possible to determine the technical information necessary for profits to be maximised, for any price ratios.

Several farmers and advisory workers contacted during the survey, were dubious of the merits of aiming for quantity rather than quality of animal products. Although there is no conclusive evidence to support this, it is of interest to note that a recent Australian experiment, 14/ investigating the effect of stocking rate on the efficiency of fat lamb production, found that a high stocking rate was not the most profitable. It was found that over a three month period, a stocking rate of 4.5 ewes per acre was more profitable than either 1.0 or 9.0 ewes per acre. The experiment did not attempt to find the most profitable stocking rate.

5.522. Stocking Rate - Practical Observations

High stocking rates are necessary, both to achieve a maximum rate of pasture improvement, and to fully utilise the production of improved pasture. It

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12/ A full treatment of this topic is contained in E.O. Heady, "Economics of Agricultural Production and Resource Use," Prentice-Hall, Inc. (New Jersey), Chapter 13.

13/ This conflict between maximising technical efficiency and maximising profits, is known as the "technologists dilemma." See W.V. Candler and D. Sargent, "Farm Standards and the Theory of Production Economics," Journal of Agricultural Economics, Vol. XV, No. 2, 1962, p. 282.

14/ D.E. Tribe and A.G. Lloyd, "Effect of Stocking Rate on the Efficiency of Fat Lamb Production", Journal of the Australian Institute of Agricultural Science, Vol. 28, No. 4, 1962, p. 274.

is usual to find, however, that at high stocking rates, per animal productivity declines, although per acre production may increase markedly. This is illustrated by the Te Awa results presented in Table 2.1. (Page 12). The decline in stock productivity may be accentuated when stock are being "worked" during development. Experience at Te Awa, however, suggests that some of this loss will be recovered once pastures have become established.

It was evident that few farmers were using sufficiently high stocking rates to achieve either a maximum rate of pasture improvement, or maximum utilisation of pasture. The main reason for this is probably that most farmers tend to be animal husbandmen rather than pasture husbandmen. Their management is orientated towards producing "high quality" stock, and the decline in per animal production resulting from heavy stocking is generally unacceptable. As a result, the rate of pasture improvement tends to be slower than would be possible with a more intensive appraoch, and once a carrying capacity of 3-4 ewe equivalents per acre had been reached, farmers usually began to concentrate on improving stock quality with little, if any, further increases in stocking rate. Farmers commonly used the quality of their stock as comparative measures of success, rather than physical and financial returns per acre.

Farmers considered that another disadvantage of high stocking rates was the risk of increased losses due to more favourable conditions for the spread of disease, and to inadequate nutrition in adverse seasons. There does not seem to be any real foundation for this belief as at both Te Awa and Ruakura, where high stocking rates have been used for a number of years, the proportionate losses are lower than on many less heavily stocked farms. This has been largely due to the greater total production and spread of production from improved pastures, and to the intelligent use of preventative measures against diseases.

One of the difficulties of development is estimating the carrying capacity of a pasture at any particular stage of improvement. Stocking rate is usually calculated on the basis of winter carrying capacity, as the period just

prior to lambing is generally the most critical time of the year. Farms stocked up to estimated winter carrying capacity in the late autumn, have little flexibility for subsequent adjustment of stock numbers until the following spring. Fear of "over-stocking" tends to result in a rather conservative approach to stock increases.

There is no generally accepted method by which farmers can measure the adequacy of their stocking rate. The majority of them rely on subjective measures of animal thrift and tend to favour their stock at the expense of a slower rate of pasture improvement. More objective measures of stocking rate that have been used are discussed below.

(i) The "optimum" stocking rate is defined as that which enables a breeding ewe to produce, say, 10lbs. of fleece wool per year. A higher wool production indicates that stocking rate could be increased. Lower wool production would indicate that the stocking rate was too high. A similar method uses a figure derived by dividing total wool production by the number of ewes, thus taking into account the wool production of hoggets and lambs. The "optimum" stocking rate in this case is defined as that which gives a figure of 15lbs of wool per ewe. These methods do have the advantage of implicitly recognising that per animal production can be too high. The selection of 10lbs. per ewe or 15lbs. per ewe as being optimum is, however, fairly arbitrary.

(ii) The body weight of ewes can be used to evaluate the stocking rate. With this method, an "optimum" body weight is defined , and occasional weighings will indicate how well stock numbers have been equated to feed supplies. The work at Te Awa (see Table 2.1) suggests that average body weight can be reduced to about 110lbs. before there is any serious decline in per animal productivity. This method enables stocking rate to be measured at any time. Disadvantages are the need for weighing facilities, the time involved in weighing and the fact that, as yet, there is insufficient information to define optimum body weight.

(iii) The incidence of sleepy sickness has been suggested as a measure of

stocking rate, but this is a measure of fluctuating planes of nutrition rather than stocking rate. Sleepy sickness can be a problem even on farms that are obviously understocked.

5.53. Type of Stock

The present system of hill country farming in the survey area is based primarily on breeding ewes. The ewes are replaced as five year olds and replacements are usually reared on the farm. Wether lambs are fattened if possible, but otherwise are sold as stores. Cattle policies vary considerably and depend primarily on the preferences and resources of individual farmers.

Under this system of farming the only stock available for pasture control throughout the year are breeding ewes, ewe hoggets and cattle of varying classes and ages. Breeding ewes cannot be "worked" for more than about six months of the year without seriously affecting their productivity. The safe periods are from weaning until 3-4 weeks before tupping, and from after tupping until 6-7 weeks before lambing. Hoggets cannot be worked at all if well grown replacement sheep are to be reared. The same restrictions apply to breeding cows and young cattle.

In most cases successful development has been achieved with the above system of stocking, provided that the farmer has been prepared to accept some decline in per animal production as a result of working the stock. The ideal stock to use for pasture control during development would be mature wethers and steers, as these can be worked at any time of the year and will stand much more rigorous treatment than will breeding and young stock. Financially, however, this stock policy is not as attractive as a breeding policy. This point is illustrated in the discussion of Case Farm B in Chapter VI.

The role of cattle on hill country once pastures have been established is largely undefined at the present time. The opinion of farmers in the survey indicated that the relation between sheep and cattle could take three possible forms:-

(a) Competitive - when sheep and cattle are competing for the same pasture.

(b) Supplementary - when cattle are used to consume feed which is surplus to sheep requirements.

(c) Complementary - when the thrift of sheep is improved in some undefined way by running them in association with cattle.

Observations of grazing behaviour indicate that when sheep and cattle are grazed together the initial grazing relationship is purely competitive. Once the "sheep feed" is too short for the cattle to graze they then take up the supplementary role of grazing the long pasture which the sheep tend to avoid.

The existence of the complementary relationship is in some doubt. In theory the improved thrift of sheep that are run in association with cattle can be explained by the fact that the cattle, by acting in a supplementary role, are ensuring that the pastures remain in the best condition for sheep grazing, i.e., they remain relatively short and evenly grazed.

It is quite common belief amongst farmers, that cattle play a part in reducing the incidence of internal parasites in sheep. As yet, there is no scientific evidence to support this belief.

At Te Awa, cattle are primarily used in a supplementary role. The improvement in sheep thrift, compared with no cattle grazing is illustrated in Table 2.1. In addition, cattle have controlled the incidence of coarse weeds, as discussed in Chapter II.

The main factors determining the cattle policies used on the survey farms were, labour resources, profitability and personal preferences. The farmers were generally agreed that a breeding policy was the most profitable, although this belief was usually intuitive rather than the result of detailed budgeting. This breeding policy also involves the greatest input of labour and management. As stock numbers increase and labour becomes fully extended there is a tendency to move out of breeding into a straight grazing policy, usually with steers.

5.6 Farm Development

In this chapter, the technical aspects of the individual operations which comprise hill country development have been discussed. The development programme for a farm, varies in form depending on, the physical state of the farm prior to development, the resources that are available and the objectives and ability of the individual farmer. Due to the wide variation between farms and farmers, there is no really "standard" development programme.

Regardless of what form development takes, the objective is normally to increase profits. The majority of revenue on a hill country farm is obtained from animal production. Hence if development is to increase profits, the operations of clearing secondary growth, topdressing, oversowing and subdivision, must result in an increase in the quantity and/or quality of animal products. It has been shown, however, that technical success in terms of maximising physical production, does not necessarily maximise profits.

The profitability of hill country development is discussed in the next chapter, firstly on a theoretical basis, and secondly, with reference to actual development programmes.

CHAPTER VI

THE PROFITABILITY OF DEVELOPMENT

As outlined in the introductory chapter, increased profits are likely to be the main incentive for farmers to adopt new techniques. The results of hill country development can be very impressive in terms of increased physical production, but it has been shown in the previous chapter, that maximising physical production does not necessarily maximise profits. Hence an examination of profitability is an essential part of an adoption study.

Profitability is frequently measured by the rate of return on capital. It would appear, however, from the few New Zealand studies that have attempted to measure the profitability of development, [1] that there is no generally accepted method of deriving this figure. Consequently the method used in this study is given in detail.

In this chapter the problems of assessing the profitability of development are discussed, and the concept of discounting, used to overcome the problem of time, is explained. The method of analysis is outlined with reference to a hypothetical development programme, and finally, two of the survey farms are analysed.

6.1 Problems of Assessing Profitability

There are two main difficulties of assessing the profitability of hill country development. These are firstly, the wide range of physical and economic conditions that have to be taken into account, and secondly, the fact, that the costs and returns of development occur as sequences through time. [2]

1/ See for example, P.R. Barrer and R.C. Stuart, "Results on a Banks Peninsular Demonstration Farm," N.Z.Journal of Agriculture, Vol.101,No.3, 1960, p. 234; and R.H. Scott "Some Economic Aspects of Developing Hill Country", Proceedings of the N.Z. Grasslands Association Conference, 1954, p. 140.

2/ These problems have been referred to by F.H. Gruen and R.A. Pearse, "Aerial Pasture Improvement," New South Wales Department of Agriculture, 1959, p.33.

6.11. Physical and Economic Variation

As indicated in the previous chapter, the development of hill country can take many forms. A development programme may involve improving low producing pastures, establishing pastures on non-productive land, or merely increasing the stocking rate on existing pastures. In addition the results of development vary depending on the soil type, the climatic conditions and the management ability of the farmer.

The financial position of farmers commencing development varies, as does their ability to obtain credit. Differences also occur in committments for family living and education. Finally the objectives of the individual farmer must be taken into account.

This variation means that each calculation of the profitability of development is, in a sense, unique for a particular farm and farmer. The results give an indication of what the position might be on other farms, but a number of such case studies are necessary before the general pattern of the profitability of hill country development can be obtained.

6.12. Problems of Time

A feature of farm development is that the associated costs and returns are spread over a number of years. It may take some time, before production reaches the level where income would be stable if prices and seasonal conditions were constant.

Profitability is frequently measured by comparing the "static" situations before and after development. The difference between the profits obtained in each situation is then expressed as a percentage of the total capital cost of development. This method ignores the time taken to obtain this extra profit. In effect, it assumes instantaneous development.

Money earned at some time in the future, however, has less value than money held at present. This is illustrated by the following example. The sum

of £100 earned in three years' time has a lower value than £100 held at present, as the current £100 can be invested at the market rate of interest. If the rate of interest is 6%, then the value of the current £100 after three years, is £119.10. The extra £19.10. is made up of interest payments of £6, £6.36 and £6.74 in the first, second and third years respectively. This procedure can be reversed to find the "present value" of future earnings. Thus the present value of £100 earned in three years' time, is the sum of money, which, if invested now at the market rate of interest, would yield £100 at the end of the third year.

The present value, P.V., of future revenue, R, earned at the end of t years in the future, is given by the following equation:-

$$P.V. = \frac{R}{(1 + r)^t} \qquad -(1)$$

where r is the market rate of interest. If the rate of interest is 6% then the present value of £100 earned in three years' time is given by:-

$$\frac{100}{(1 + 0.06)^3} \qquad -(2)$$

i.e. £83.96

If income occurs as a sequence of payments over a number of years, then equation (1) can be expanded to:-

$$P.V. = \frac{R_1}{1 + r} + \frac{R_2}{(1 + r)^2} + \frac{R_3}{(1 + r)^3} + - - - + \frac{R_n}{(1 + r)^n} \qquad -(3)$$

where R_1, R_2, R_3, and R_n represent incomes in the first, second, third and nth years. Thus the present value of £100 earnt in each of three years is given by:-

$$\frac{100}{1 + 0.06} + \frac{100}{(1 + 0.06)^2} + \frac{100}{(1 + 0.06)^3} \qquad -(4)$$

i.e. £267.30

This process of converting future incomes to present value is known as discounting.

6.2 Method of Analysis

The method of analysis used to calculate profitability can best be explained by reference to a simple, hypothetical development programme. The essential data for this programme is given in the main body of Table 6.1. Development involves the expenditure of £3,040 spread over five years, and it is assumed that all development costs are financed out of income. Gross income reaches a maximum in the sixth year and stays at that level thereafter. Thus we have a finite stream of development costs, and an infinite stream of profits.

At this stage it is necessary to define the term "profit". Two types of profit are referred to in this discussion. Firstly, "apparent profit", which is defined as gross cash income less total expenditure, and secondly, "net profit", which is defined as gross cash income, less maintenance expenditure, less taxation, less a labour and management reward. Apparent profit is thus the actual cash surplus obtained at the end of each year. It does not, however, take into account income that has been invested in development during the year. This is included in the calculation of net profit, so that net profit equals apparent profit plus development expenditure.

In Table 6.1, the apparent profit for the first years' operation, is a "deficit" of £344. During the year, however, £400 has been invested in development, and adding this to the apparent profit, gives a net profit for the year of £56. In a year when there is no development, net profit and apparent profit will be the same. "Added profits" refer to the difference between profits actually received, and profits that would have been obtained if there had been no development.

The streams of development costs and added profits in Table 6.1 can now be converted to present values by using equation (3). This gives:-

P.V.C. - present value of costs

P.V.R. - present value of added apparent profits

P.V.R. - present value of added net profits

TABLE 6.1

A HYPOTHETICAL DEVELOPMENT PROGRAMME

FINANCED FROM REVENUE*

	Prior to develop.	Years from commencement of development					After development
		1	2	3	4	5	
Gross income	3700	3500	3650	3900	4460	4720	5100
Maintenance expenditure	2300	2380	2500	2650	2880	3150	3210
Labour and Management reward	1000	1000	1000	1000	1000	1000	1000
Taxation	194	64	41	19	138	204	359
Development expenditure	0	400	700	1200	560	180	0
Total expenditure	3494	3844	4241	4869	4578	4534	4569
Apparent profit	206	-344	-591	-118	186	531	531
Difference from pre-development	-	-550	-797	-1175	-324	-20	325
Net profit	206	56	109	231	442	366	531
Difference from pre-development	-	-150	-97	25	236	160	325

P.V.C. = £2,585.97**

P.V.R. = £1,561.81 = £93.71/year

P.V.R. = £4,147.78 = £248.87/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 9.6\%$$

$$\frac{\text{Added surplus}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 10.7\%$$

* All figures are in £'s unless otherwise indicated.

** Expressing results to two places of decimals gives a check on the accuracy of the calculations. It is not a reflection of the accuracy of the data.

P.V.R. for example, is given by.

$$-\frac{150}{1+r} - \frac{97}{(1+r)^2} + \frac{25}{(1+r)^3} + \frac{236}{(1+r)^4} + \frac{160}{(1+r)^5} + \frac{325}{r(1+r)^5} \quad -(5)$$

In the last term of equation (5), the additional net profit for the sixth year has been capitalised to give the sum, which if invested at the beginning of the sixth year, would give an annual return of £325 at the end of the sixth and every subsequent year. The last two terms are discounted at the same rate, as the fifth term represents a payment at the end of the fifth year, and the sixth term represents a payment at the beginning of the sixth year.

It is not really necessary to calculate P.V.R.′ in that this does not take into account income that is invested in development. However, as the following equality should hold,

$$\text{P.V.R.} = \text{P.V.C.} + \text{P.V.R.}' \qquad -(6)$$

the calculation of P.V.R.′ provides a useful means of checking the accuracy of the calculations.

If an interest rate of 6% is used in equation (5) the present value of added net profits becomes £4,147.78. This represents the sum of money which could be accepted as an alternative to development. This sum invested at 6%, would yield an annuity of £248.87, which is, in effect, the average annual increase in net profits obtained from development.

The profitability of development is obtained by expressing this average annual increase in net profits, as a percentage of the present value of development costs.

$$\text{i.e.} \quad \frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} \qquad -(7)$$

This gives a profitability figure of 9.62% for the example in table 6.1. Although this represents the profitability of development for the farmer, it is not a true return on capital which can be compared with the returns offered by alternative investment opportunities.

A return of 6%, offered by investment in Government Stock for example,

is a return before taxation. The profitability figure calculated above is a return after taxation. To obtain a figure which can be compared with alternative investment opportunities it is necessary to calculate the return on money invested in development, before taxation has been deducted. This has been done in Table 6.2, to give a return on capital of 13.4%.

This return to capital can now be compared with the returns offered by alternative investment opportunities. The rate at which money for development can be borrowed from trading banks, insurance companies, and stock firms is 6%. It is thus reasonable to assume that this is the return which could be obtained from investments other than development, e.g. holding a first mortgage. For this reason, an interest rate of 6% has been used in the above, and all subsequent calculations.

In the hypothetical example above, development has given a 13.4% return on capital, which is 7.4% better than the assumed opportunity cost of 6% for the farmer's money. After allowing for taxation the profitability to the farmer is 9.6%.

Figures for profitability, and return on capital, have also been calculated using the simple method of comparing the situations before and after development, referred to in section 6.12. This method, which assumes instantaneous development, has over-estimated profitability by 1.1% (Table 6.1), and return on capital by 2.7% (Table 6.2).

To further illustrate the use of the above method of analysis, figures for profitability and return on capital, have been calculated for the same development programme, in the following situations:-

(a) Development financed by borrowing, with debts serviced; Tables 6.3 and 6.4.

(b) Development financed by borrowing, with repayment of debts; Tables 6.5 and 6.6.

TABLE 6.2

DEVELOPMENT FINANCED FROM REVENUE

NO TAXATION

	Prior to develop.	Years from commencement of development					After develop.
		1	2	3	4	5	
Gross income	3700	3500	3650	3900	4460	4720	5100
Maintenance expenditure	2300	2380	2500	2650	2880	3150	3210
Labour and management reward	1000	1000	1000	1000	1000	1000	1000
Development expenditure	0	400	700	1200	560	180	0
Total expenditure	3300	3780	4200	4850	4440	4330	4210
Apparent profit	400	-280	-550	-950	20	390	890
Difference from pre-development	-	-680	-950	-1350	-380	-10	490
Net profit	400	120	150	250	580	570	890
Difference from pre-development	-	-280	-250	-150	180	170	490

P.V.C. = £2,585.97

P.V.R. = £3,173.51 = £190.41/year

P.V.R. = £5,759.48 = £345.57/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 13.4\%$$

$$\frac{\text{Added surplus}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 16.1\%$$

In Tables 6.3 and 6.4, it is assumed that development costs are met by borrowing at 6%. The cost of development in this case is the cost of using the borrowed money, i.e. the interest payments. In Tables 6.5 and 6.6, apparent profits in each year are used to reduce debts. The total development costs consist of these repayments plus interest payments.

The profitability of development is greatest (11.2%) when debts are serviced only. This is due to the fact that interest payments are a tax deductable item of expenditure. Principal repayments, however, are not tax deductable, and when these are taken into account as in Table 6.5, profitability is very similar to when development is financed out of revenue. The slight difference is due to the different times taken to reach an equilibrium position. The return to capital is greatest when development is financed out of revenue, as no interest payments are included in the cost of development.

An advantage of using the above method of analysis for evaluating farm development, is that it necessitates a close examination of the whole of a proposed development programme. The possibilities of a physical or financial crisis during development are unlikely to be overlooked. A simple before and after comparison, may well hide such crises.

6.3 Limitations to Practical Application

The application of this method of analysis to actual cases of development, was severely handicapped by the lack of physical and financial information available for the survey farms. The major problem was the paucity of farm records, as few farmers had kept full details of farm operations. As a rule the only records available were the annual balance sheets and statement of accounts. These are compiled solely for taxation purposes, and usually are of little help in determining accurate input-output data.

For this reason, detailed case studies had to be limited to those

TABLE 6.3

DEVELOPMENT FINANCED BY BORROWING

DEBTS SERVICED

	Prior to develop.	Years from commencement of development					After Develop.
		1	2	3	4	5	
Gross income	3700	3500	3650	3900	4460	4720	5100
Maintenance expenditure	2300	2380	2500	2650	2880	3150	3210
Labour and management reward	1000	1000	1000	1000	1000	1000	1000
Taxation	194	60	34	8	100	158	287
Interest	0	24	66	138	172	182	182
Development expenditure	0	400	700	1200	560	180	0
Total expenditure	3494	3864	4300	4996	4712	4670	4679
Apparent profit	206	36	50	104	308	230	421
Difference from pre-development	0	-170	-156	-102	102	24	215
Net profit	206	60	116	242	480	412	603
Difference from pre-development		-146	-90	36	274	206	397

P.V.C. = £2,736.06

P.V.R. = £2,391.45 = £143.49/year

P.V.R. = £5,127.51 = £307.65/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 11.2\%$$

TABLE 6.4

DEVELOPMENT FINANCED BY BORROWING

DEBTS SERVICED - NO TAXATION

	Prior to develop.	Years from commencement of development					After Develop.
		1	2	3	4	5	
Gross income	3700	3500	3650	3900	4460	4720	5100
Maintenance expenditure	2300	2380	2500	2650	2880	3150	3210
Labour and management reward	1000	1000	1000	1000	1000	1000	1000
Interest	0	24	66	138	172	182	182
Development expenditure	0	400	700	1200	560	180	0
Total expenditure	3300	3804	4266	4988	4612	4512	4392
Apparent profit	400	96	84	112	408	388	708
Difference from pre-development	0	-304	-316	-288	8	-12	308
Net profit	400	120	150	250	580	570	890
Difference from pre-development		-280	-250	-150	180	170	490

P.V.C. = £2,736.06

P.V.R. = £3,023.42 = £181.41/year

P.V.R. = £5,759.48 = £345.57/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 12.6\%$$

TABLE 6.5

DEVELOPMENT FINANCED BY BORROWING

DEBTS REPAID

	Prior to develop.	Years from commencement of development										After develo
		1	2	3	4	5	6	7	8	9	10	
Gross income	3700	3500	3650	3900	4460	4720	5100	5100	5100	5100	5100	5100
Maintenance expenditure	2300	2380	2500	2650	2880	3150	3210	3210	3210	3210	3210	3210
Labour and management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Taxation	194	60	35	9	103	166	311	320	330	340	350	359
Interest	0	24	64	133	160	152	136	110	82	54	24	0
Development expenditure	0	400	700	1200	560	180	0	0	0	0	0	0
Total expenditure	3494	3864	4299	4992	4703	4648	4657	4640	4622	4604	4584	4567
Repayments	0	36	51	108	317	252	443	460	478	496	399	0
Total debt.	0	400	1064	2213	2665	2528	2276	1833	1373	895	399	0
Apparent profit	206	0	0	0	0	0	0	0	0	0	117	531
Difference from pre-development	-	-206	-206	-206	-206	-206	-206	-206	-206	-206	-89	325
Net Profit	206	60	115	241	477	404	579	570	560	550	540	531
Difference from pre-development	-	-146	-91	35	271	198	373	364	354	344	334	325

Debt is paid off in the 10th year.

P.V.C. = £2,741.44

P.V.R. = £1,573.98 = £94.44/year

P.V.R. = £4,315.42 = £258.93/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 9.5\%$$

TABLE 6.6

DEVELOPMENT FINANCED BY BORROWING

DEBTS REPAID - NO TAXATION

	Prior to develop.	Years from commencement of development								After develop.
		1	2	3	4	5	6	7	8	
Gross income	3700	3500	3650	3900	4460	4720	5100	5100	5100	5100
Maintenance expenditure	2300	2380	2500	2650	2880	3150	3210	3210	3210	3210
Labour and management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Interest	0	24	60	127	153	138	112	66	16	0
Development expenditure	0	400	700	1200	560	180	0	0	0	0
Total expenditure	3300	3804	4260	4977	4593	4468	4322	4276	4226	4210
Repayments	0	96	90	123	427	432	778	824	270	0
Total debt	0	400	1004	2114	2551	2304	1872	1094	270	0
Apparent profit	400	0	0	0	0	0	0	0	604	890
Difference from pre-development	-	-400	-400	-400	-400	-400	-400	-400	204	490
Net profit	400	120	150	250	580	570	890	890	890	890
Difference from pre-development	-	-280	-250	-150	180	170	490	490	490	490

Debt is paid off in the 8th year.

P.V.C. = £2,740.81

P.V.R. = £3,018.97 = £181.14/year

P.V.R. = £5,759.78 = £345.59/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 12.6\%$$

farmers who had kept sufficient records to enable a reasonably accurate examination of development to be made. Several interesting farms could not be analysed because of a lack of data on past operations. This is likely to be a problem in all studies of this nature, as it appears that few farmers have the time or the incentive to keep the detailed records that research work requires.

It was necessary to draw up a complete budget for each year of development in order to determine the farmer's cash position for that year. The balance sheets and statement of accounts were used as a guide for this, but because of the aggregation of income and expenditure items in these accounts, the figures used in the budgets were often merely best estimates.

As none of the farmers in the survey had completed their development programmes, it was necessary to compile budgets for the remaining years of the programme. The management decisions for these years were discussed with the farmer, and the budgets were based on the costs and prices ruling in the 1961/62 season. 3/ A separate accounting was necessary to estimate taxable income, and taxation estimates were based on the 1962 rates. The farmers' labour and management reward was taken as £1,000 per year.

It was only possible to do a complete analysis of two of the selected group of farmers. Apart from the major problem of insufficient records, other reasons for rejecting farms for analysis were:-

(a) The farmer was unwilling to disclose confidential information,(two farms).

(b) The farm was run in conjunction with one or more farms, (five farms).

(c) The financial structure of the farm, and the financing of development was too complex to be examined within the time available for the study, (three farms).

(d) The development was not typical of hill country. Development had been

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3/ "Guide to Current Rural Costs and Prices," Department of Agricultural Economics and Farm Management, Massey University of Manawatu.

confined to the easier portions of the farm, and there had been no significant development of the unploughable country, (four farms).

6.5 Case Farm A

This farm is 547 acres in area, of which approximately 500 acres are grazeable, and is predominantly moderately steep to steep hill country with only 50 acres of flats. It lies at an altitude of 800 to 1000 feet a.s.l. and has a fairly evenly distributed rainfall of 40 to 45 inches. The district is subject to fairly cold winters. The soil type is described as an Atua silt loam hill soil, of medium natural fertility. At present the farm is run by the owner, and contract or casual labour is used for the main seasonal operations such as shearing and topdressing.

6.51. Original Condition of the Farm

The farm was originally part of a Lands and Survey block, and was taken over by the present owner in 1953. About 430 acres were infested with manuka and the pastures were only fair, containing little clover. The boundary fences were good but subdivisional fencing was virtually non-existent. Winter carrying capacity was 800 ewes and 100 two and three year old steers. The owner was financed into the property but has had to rely on surplus revenue to finance development.

6.52. The Development Programme

The immediate problems at the commencement of development were to subdivide to enable controlled grazing, and to build up sufficient ewe hoggets for replacement purposes. These were given priority and it was not until four years after purchase, that development of the manuka infested areas was commenced. From then on, a block of scrub was cut, burnt, oversown and topdressed each year, the most heavily infested areas being left until last. The final block of 72 acres was sown down in the autumn of 1962, leaving approximately 500 acres of grazeable land. Scrubcutting costs varied from £3 to £6 per acre, indicating

that the scrub was fairly light.

The topdressing policy has varied, but over recent years has consisted of an initial 9 cwt. of superphosphate per acre in three applications over 18 months, followed by annual dressings of 2 cwt. per acre. While this policy has given satisfactory results, the farmer is not certain whether it is the optimum policy for development.

Approximately 500 chains of fencing have been erected (i.e., 1 chain per acre), practically all as subdivisional fencing. Both Hunter and electric fences have been used, and while the longevity of the electric fence is relatively uncertain, it has proved a cheap and reasonably effective type of fence. The average cost of fencing has been about £7 per chain.

Stock increases in the initial four years consisted mainly of ewe hoggets, which were increased to 290. The extra carrying capacity over this period was made possible by improved grazing control. Once manuka eradication commenced both ewe and hogget numbers were gradually increased up to the present level of 1,030 ewes and 450 ewe hoggets. Over the same period, cattle numbers have been reduced to 65. An all steer policy has been maintained because of the flexibility it affords.

A feature of the grazing management has been the use of detailed paddock grazing records. [4] While such records are by no means infallible, they have been valuable in assessing the production and responses of individual paddocks. In the past, the stock have been "worked" fairly hard to suppress secondary growth and to develop dense pastures. With these objectives now largely achieved, it is intended to pay more attention to stock quality in the future.

The physical aspects of the development programme are summarised in

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[4] R.H. Scott, "Farm Production Records", N.Z. Journal Agriculture, Vol. 97, No. 4, 1958, p. 353.

Table 6.7, and the itemised costs are presented in Table 6.8.

The general financial policy during development has been to spend all surplus income, firstly on development, and secondly, on reducing the debts incurred in purchasing the farm. In addition to the £8,217 spent on development to date, £2,963 has gone towards reducing loans, (over and above annual mortgage committments).

6.53. Future Development

At the present time, all major development expenditure has been completed with the possible exception of a new woolshed. Further increases in production are expected as the pastures improve and the farmer's immediate objective is a carrying capacity of 4-5 ewe equivalents per acre with a wool production of about 40 lb per acre. It is hoped to achieve this in about four years time, the only extra cost being for the increased stock. The farmer considers the potential production of this farm to be 6 ewe equivalents per acre or more with wool production at about 60 lbs per acre. However, development to this level would raise labour problems, and would probably necessitate the application of lime. (An expensive practice on hill country).

6.54. Limiting Factors to Development

The farmer considers the only major limiting factor to have been lack of finance, particularly in the early years, when large amounts of fencing were necessary before any intensive pasture improvement could be attempted. As a result of his experience the farmer considers that the best way to develop a similar property, would be to do it as fast as possible, borrowing money if necessary, (and if possible.) He considered that the optimum rate of development would depend on the farmer's ability to keep a close personal contact with development. This is regarded as essential for efficient development, and is an intangible quality, varying for each individual.

6.55. The Profitability of Development

The data used for calculating the profitability of development are

TABLE 6.7

PHYSICAL ASPECTS OF DEVELOPMENT - CASE FARM A

(Based on 500 productive acres)

	Prior to develop.	1953/54	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	After develop.
Acres cleared of scrub and oversown	0	0	0	0	24.5	95.5	62	70	105	72	0	0	0	0	0	0
Chains of fencing erected	0			300		0	0	92	44	44	0	0	0	0	0	0
Total fertiliser application (tons)	20	20	20	24	30	30	20	30	51	54	65	50	50	50	50	50
Ewe equivalents per acre	2.8	2.8	2.8	3.0	3.1	3.0	3.1	2.8	3.0	3.3	3.4	3.7	3.8	4.0	4.3	4.6
Total wool production (lbs)	11090	10463	11120	12190	12168	12157	13286*	12434	12830	14128	16354	17002	18504	20043	21748	23220
Wool production per acre (lbs)	22.2	20.9	22.2	24.4	24.3	24.3	26.5	24.8	25.6	28.2	32.7	34.0	37.0	40.0	43.5	46.4
Lambing percentage	95	89	95	94	88.5	95	89	94	94	95	96	95	95	95	95	95

*Second shearing of two tooth ewes commenced in this year.

TABLE 6.8

DEVELOPMENT EXPENDITURE (£'s)

	1953/54	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	Totals
Capital fertiliser *	0	0	60	45	143	77	105	150	150	225	0	0	0	0	955
Scrubcutting	0	0	0	86	260	260	260	396	430	0	0	0	0	0	1692
Oversowing	0	0	0	66	258	167	175	262	175	0	0	0	0	0	1103
Fencing	690	690	690	690	0	0	452	194	225	0	0	0	0	0	3631
Gorse eradication			235			0	0	0	0	0	0	0	0	0	235
Bulldozing					720					112	0	0	0	0	832
Yards	0	0	0	0	106	0	0	0	0	0	0	0	0	0	106
Value of increased stock **	0	331	21	72	0	53	0	100	217	415	0	154	178	0	1541
Total expenditure	817	1148	898	1086	894	637	1072	1182	1277	752	0	154	178	0	10095

* Estimated cost of fertiliser over and above maintenance requirements.

** Stock were valued at.

Ewes	£2/head
Hoggets	£1/head
Rams	£5/head
Cattle	£20/head

presented in Table 6.9. The analysis for the return on capital after taxation has been deducted is shown in Table 6.10.

In the hypothetical example used earlier in this chapter, additional profits in each year were calculated as differences from a base year prior to development. This method is only valid when the budgets for each year are based on constant costs and prices. In a real example, such as Case Farm A, there will be changing costs and prices, and the above method of calculating profits is not suitable.

To overcome this difficulty, a budget for the predevelopment level of production was prepared using 1961/62 costs and prices. This budget was then modified for each year of the development programme. Income was recalculated using the actual prices received in each year, and expenditure was modified by using an index of cost movements. This was constructed from an index of cost movements for North Island hill country. 5/ This index used 1952 as a base year, and the only change necessary was to recalculate the index using 1962 as a base year.

The resultant surplus for each year was thus an estimate of what profits would have been if the farm had remained undeveloped. Additional profit for each year was then the difference between profits actually received, and estimated profits if there had been no development.

Development of Case Farm A has given a total return to capital of 6.01% (Table 6.9). It has been assumed that the opportunity cost for the farmer's money is 6% (page 63). Hence investment in development has given a return equivalent to alternative investment opportunities. When taxation is included (Table 6.10), the return is reduced to 5.97%. In this situation, P.V.C. is slightly greater than P.V.R., indicating that development is not as profitable

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5/ "Annual Review of the Sheep Industry", N.Z. Meat and Wool Boards' Economic Service, Publication No. 318, 1962, p. 6.

TABLE 6.9

THE PROFITABILITY OF DEVELOPMENT - CASE FARM A

BEFORE TAXATION

	Prior to develop.	1953/54	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	After develop
Gross income	4472	4343	5345	5284	5484	3971	4720	4617	4328	4367	5152	5410	5319	5560	6099	6179
Maintenance expenditure	2843	2477	2460	3095	2747	2678	2304	1983	2198	1901	3327	3403	3386	3361	3608	3720
Labour and Management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Development expenditure	0	817	817	877	1014	894	584	1072	1082	1060	337	0	0	0	0	0
Total Expenditure	3843	4294	4277	4972	3761	3572	3888	4055	4280	3961	4664	4403	4386	4361	4608	4720
Apparent profit	629	49	1068	312	723	-601	832	562	48	406	488	1007	933	1199	1491	1459
Profit if no development		1688	1737	1804	1765	1043	398	1932	1300	629	629	629	629	629	629	629
		-1639	-669	-1492	-1042	-1644	434	-1370	-1252	-223	-141	378	304	570	862	830
Net profit		866	2216	1210	1809	293	1469	1634	1230	1683	1240	1007	1087	1377	1491	1459
Profit if no development		1688	1737	1804	1765	1043	398	1932	1300	629	629	629	629	629	629	629
Difference		0882	479	-594	44	-750	1071	-298	-70	1054	611	378	458	748	862	830

P.V.C. = £7314.16

P.V.R. = £67.33 = £4.04/year

P.V.R. = £7381.49 = £442.89/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 6.01\%$$

$$\frac{\text{Added profit}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 8.2\%$$

TABLE 6.10

THE PROFITABILITY OF DEVELOPMENT - CASE FARM A

AFTER TAXATION

	Prior to develop.	1953/54	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	After develop
Gross income	4472	4343	5345	5284	5484	3971	4720	4617	4328	4367	5152	5410	5319	5560	6099	6179
Maintenance expenditure	2843	2477	2460	3095	2747	2678	2304	1983	2198	1901	3327	3403	3386	3361	3608	3720
Labour and Management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Taxation	211	100	350	120	220	45	45	290	136	30	179	331	188	407	558	513
Development expenditure	0	817	817	877	1014	894	584	1072	1082	1060	337	0	0	0	0	0
Total expenditure	4054	4394	4627	5092	4981	4617	3933	4345	4416	3991	4843	4734	4574	4768	5166	5233
Apparent profit	418	-51	718	192	503	-646	787	272	-88	376	309	676	745	792	933	946
Profit if no development		1079	1132	1143	1122	688	239	1213	850	418	418	418	418	418	418	418
Difference		-1130	-414	-951	-619	-1334	548	-941	-938	-42	-109	258	327	374	515	528
Net Profit	418	766	1866	1090	1589	248	1424	1344	1094	1653	1061	676	899	970	933	946
Profit if no development		1079	1132	1143	1122	688	239	1213	850	418	418	418	418	418	418	418
Difference		-313	734	-53	467	-440	1185	131	244	1235	643	258	481	552	515	528
Value of stock increases		0	331	21	72	0	53	0	100	217	415	0	154	178	0	0

P.V.C. = £7314.16

P.V.R. = -£40.13

P.V.R. = £7274.03 = £436.44/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 5.97\%$$

$$\frac{\text{Added profit}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 5.2\%$$

as other investments yielding a return of 6% after taxation.

The overall impact of taxation on development has not been great, as it has only reduced the return by 0.04%.

Although the above analysis has shown development to be equivalent to alternative investments, the position will be adversely affected by:-

(a) failure to reach anticipated levels of production,

(b) a fall in prices for farm produce, or an increase in costs,

(c) any further non-productive capital expenditure, for example a wool shed.

The occurrence of any or all of these, could reduce the return on capital to the stage where development compares unfavourably with other investments.

Alternatively, profitability would be increased, if there was a rise in prices and/or a reduction in costs, or if higher levels of production could be attained without further capital expenditure. Higher carrying capacities, however, would involve the cost of obtaining and housing an extra permanent labour unit. Development to the potential of about 5.5 ewe equivalents per acre, would only involve an extra 400 ewes and 150 hoggets. It is likely that this increase would take some time as the farmer would be feeling his way. An alternative scheme would be to maintain the ewe flock at a level that could be handled by the farmer, and to increase the carrying capacity by means of wethers.

Figures for return on capital were also calculated by simply expressing additional net profit as a percentage of the total capital invested in development. It can be seen from Tables 6.9 and 6.10 that this method has overestimated total return by 1.19% and underestimated the return after taxation by 0.77%.

With the development programme set out as in Tables 6.7, 6.8 and 6.10, it is possible to look for ways in which profitability could have been increased. The most significant feature is that for the first eight years of development there was very little overall increase in carrying capacity. Although sheep numbers increased during this period, this was offset by the decline in cattle numbers.

It is probable that carrying capacity could have been increased at a faster rate, if the basic fencing and pasture improvement programme had been largely completed in the first few years. With the farmer having to rely on surplus income, expenditure has been spread over ten years and it will have taken 15 years to achieve the planned level of stocking.

6.6 Case Farm B

Case Farm B, comprises 1454 acres of steep hill country, including approximately 100 acres of flats, and 150 acres of non productive land, mainly gorges. The farm lies at an altitude of 500-1100 feet a.s.l. and has an annual rainfall of about 42 inches. Internal access is rather poor, as the farm is trisected by gorges which can only be crossed at isolated points. Water is supplied mainly by natural sources, but is not well distributed.

There are two main soil types. Whangaehu loam, and Taihape silt loam, both of medium natural fertility. The country is subject to a moderate degree of gully erosion and slipping, with some sheet erosion on the sunny faces. The farm is run by the owner and a permanent married man.

6.61. Original Condition of the Farm

The farm was taken over by the present owner in 1960, and at that time was in a fairly run down condition. About 1100 acres were infested with manuka, and the pastures contained little clover. When taken over, the farm was running 1800 ewes, 800 ewe hoggets and 103 head of cattle, giving a carrying capacity of 2.2 ewe equivalents per acre. It was thought that the farm was overstocked at this carrying capacity, as the stock were of very poor quality. It was believed that a more realistic carrying capacity at this stage would have been about 1.9 ewe equivalents per acre.

6.62. The Development Programme

In comparison with Case Farm A, there are three main features of the

development programme for this farm. These are:-

(1) Development is being carried out as quickly as possible, and if the anticipated rate of progress is achieved, carrying capacity will have nearly trebled in ten years.

(2) In order to develop at this rate, the maximum amount of credit has been used, together with reinvestment of large amounts of surplus income.

(3) At the present time, only three years of development have been completed. This has enabled alternative courses of action in the future, to be evaluated. The results can be used to aid the farmer in his future management decisions. The development programme for Case Farm A was largely historic and there was relatively little scope for alternative plans.

To date, all but 120 acres of scrub has been cleared and sown to pasture, and the future oversowing policy will be to gradually improve the original pastures. Three cwt. of superphosphate is applied with the seed, and 1.5 cwt. the following autumn. Subsequent maintenance topdressing is planned to be about 1 cwt. per acre annually, but it may prove necessary to increase this if high carrying capacities are to be maintained.

Fencing has consisted mainly of electric and netting fences, and these have proved cheap and reasonably effective. Fencing has been necessary to retire areas from grazing particularly around the gorges. The local Catchment Board has provided some assistance with this, and with tree planting to combat erosion.

There was relatively little increase in carrying capacity for the first three years, partly due to the need to improve stock quality, and partly due to lack of finance for additional stock. The future stock policy is to increase sheep numbers as rapidly as possible, and it is this aspect of development that offers alternative courses of action.

The farm is currently running 1500 ewes, 650 mixed sex hoggets, 300 wethers, 71 breeding cows and 63 other cattle. The present intention is to maintain a basic ewe flock and to increase carrying capacity by means of wethers. When fully developed the farm would be carrying about 1600 ewes, 1400 hoggets, 3700 wethers, 50 breeding cows and replacements, to give an overall carrying capacity of 5.2 ewe equivalents per acre. The physical aspects of this development programme, and the associated costs, are presented in Tables 6.11 and 6.12 respectively.

As an alternative, the ewe flock could be increased to the maximum number that the two labour units (owner and married man) could handle, with a reduced number of wethers. Development to a similar carrying capacity as before would result in say, 2500 ewes, 1600 hoggets, 2860 wethers and the same number of cattle.

The general financial policy has been to use as much credit as possible, to enable a rapid rate of development. Credit has been obtained from the Bank and a Stock firm by way of overdrafts, and from a Marginal Lands Board grant. After the 1963/64 season, it is expected that all development expenditure will be met from surplus revenue.

6.63. The Profitability of Development

Profitability analyses were done for the two alternative situations referred to above. It was assumed that debts were repaid, as this results in a more realistic figure than if debts were serviced only. 6/

When the farm is developed to carry a basic ewe flock and a maximum number of wethers, the return on capital is 19.3% (Table 6.13). This is 13.3% better than the assumed 6% return offered by alternative investments. Thus, as an investment, development appears to be very attractive.

When taxation is taken into account (Table 6.14), the return is reduced

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6/ Refer to discussion on Tables 6.3 and 6.5

TABLE 6.11

PHYSICAL ASPECTS OF DEVELOPMENT - CASE FARM B

(Based on 1300 productive acres)

	Prior to develop.	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	After develop.
Acres cleared of scrub	0	245	350	386	120	0	0	0	0	0	0
Acres oversown	0	245	402	359	197	225	428	359	156	-	0
Total fertiliser application (tons)		52	88	88	54	49	67	88	71	66	62
Chains of fencing erected	0	0	100	173	60	42	28	30	0	0	0
Total wool production (lbs)	22758	19100	25492	26302	38125	48939	55645	64264	68726	72250	72688
Wool production per acre (lbs)	17.5	14.7	19.6	20.2	29.3	37.6	42.8	49.4	52.9	55.6	55.9
Ewe equivalents per acre	1.9	1.9	1.9	2.3	3.1	3.7	4.1	4.6	4.9	5.1	5.2

TABLE 6.12

DEVELOPMENT EXPENDITURE (£'s)

	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	Totals
Scrubcutting	638	1865	2055	720	0	0	0	0	0	5278
Oversowing	240	844	718	402	472	899	754	328	0	4657
Fencing	300	775	315	220	147	157	0	0	0	1914
Capital fertiliser	672	844	755	325	211	300	251	109	0	3467
Cost of stock purchased	0	0	1261	285	0	142	0	0	0	1688
Value of natural increase *	1247	1425	1935	2200	1010	921	757	594	108	10197
Total expenditure	3097	5753	7039	4152	1840	2419	1762	1031	108	27201

*Stock valued at:

Ewes	£2.25	Breeding cows	£30
Hoggets	£2	R. 1 year cattle	£18
Wethers	£2	R. 2 year cattle	£20
Rams	£5		

TABLE 6.13

THE PROFITABILITY OF DEVELOPMENT - CASE FARM B

BEFORE TAXATION

	Prior to develop.	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	After develop.
Gross income	6151	4519	4913	5587	7727	9522	10681	12064	12898	13912	13927
Maintenance expenditure	4404	5034	2715	4266	5248	5474	5756	6235	6107	6322	6342
Labour and management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Interest	400	600	787	1035	1113	1113	1051	967	805	532	400
Development expenditure	0	1550	3853	5564	2047	903	1488	1162	437	0	0
Total expenditure	5804	8184	8355	11865	9408	8490	9295	9364	8349	7854	7742
Surplus	347	-3365	-3442	-6278	-1681	1032	1386	2700	4549	6058	6185
Borrowed capital for development		3350	3100	4130	1295	0	0	0	0	0	0
Cumulative debt		3350	6450	10580	11875	11875	10843	9457	6757	2208	0
Repayments		0	0	0	0	1032	1386	2700	4549	2208	0
Interest		200	387	635	713	713	651	567	405	132	0
Development from Revenue		0	753	1434	752	903	1488	1162	437	0	0
Increase in stock values		1247	1425	1935	2200	1010	921	757	594	108	0
Apparent profit *		-315	-342	-2148	-386	0	0	0	0	3850	6185
Profit if no development		933	347	347	347	347	347	347	347	347	347
Difference		-1248	-689	-2495	-733	-347	-347	-347	-347	3503	5838
Net profit**		1132	2223	1856	3279	3658	4446	5186	5985	6298	6185
Profit if no development		933	347	347	347	347	347	347	347	347	347
Difference		199	1876	1509	2932	3311	4099	4839	5638	5951	5838

P.V.C. = £24,433.98

P.V.R. = £54,246.86 = £3254.81

P.V.R. = £78,680.84 = £4720.85

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 19.3\%$$

$$\frac{\text{Added surplus}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 21.5\%$$

* Apparent profit = Surplus + borrowings - repayments.

** Net profit = Apparent profit + development from revenue + interest + value of stock increases + repayments.

TABLE 6.14

THE PROFITABILITY OF DEVELOPMENT - CASE FARM B

AFTER TAXATION

	Prior to develop.	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	After develop.
Gross income	6151	4519	4913	5587	7727	9522	10681	12064	12898	13912	13927	13927	13927
Maintenance expenditure	4404	5034	2715	4266	5248	5474	5756	6235	6107	6322	6342	6342	6342
Labour and management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Taxation	191	0	0	0	0	0	222	1659	2730	3304	3329	3433	3509
Interest	400	300	787	1035	1113	1113	1051	981	919	817	669	514	400
Development expenditure	0	1550	3853	5564	2047	903	1488	1162	437	0	0	0	0
Total expenditure	5995	8184	8355	11865	9408	8490	9517	11037	11193	11443	11340	11289	11251
Surplus	156	-3665	-3422	-6278	-1681	1032	1164	1027	1705	2469	2587	2638	2676
Borrowed capital		3350	3100	4130	1295	0	0	0	0	0	0	0	0
Cumulative debt		3350	6450	10580	11875	11875	10843	9679	8652	6947	4478	1891	0
Repayments		0	0	0	0	1032	1164	1027	1705	2469	2587	1891	0
Interest		200	387	635	713	713	651	581	519	417	269	113	0
Development from revenue		0	753	1434	752	903	1488	1162	437	0	0	0	0
Increase in stock values		1247	1425	1935	2200	1010	921	757	594	108	0	0	0
Apparent profit *		-315	-342	-2148	-386	0	0	0	0	0	0	747	2676
Profit if no development		462	156	156	156	156	156	156	156	156	156	156	156
Difference		-777	-498	-2304	-542	-156	-156	-156	-156	-156	-156	591	2520
Net profit **		1132	2223	1856	3279	3658	4224	3527	3255	2994	2856	2751	2676
Profit if no development		462	156	156	156	156	156	156	156	156	156	156	156
Difference		670	2067	1700	3123	3502	4068	3371	3099	2838	2700	2595	2520

P.V.C. = £24,434.94

P.V.R. = £18,289.30 = £1097.36/year

P.V.R. = £42,724.24 = £2563.45/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 10.5\%$$

$$\frac{\text{Additional profit}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 9.3\%$$

* Apparent profit = Surplus + borrowings - repayments.

** Net profit = Apparent profit + development from revenue + interest + value of stock increases + repayments.

to 10.5%. Although development is still reasonably attractive, taxation has reduced the returns to the farmer by about 45%. If taxation is regarded as an infinite stream of additional payments, then the present value of taxation is £36,221, which is equivalent to an average annual increase in taxation of £2173. In other words, this is the benefit that the Inland Revenue Department obtains from the development of this farm, at no initial cost to the Department.

Any reductions in taxation levels would have the effect of increasing the overall returns to the farmer. It is likely that the most profitable "investment" the farmer can make in the future, will be to acquire the best possible advice on ways of reducing taxation.

The profitability of developing the farm to carry a maximum number of ewes is evaluated in Table 6.15. The return of 11.7%, is 1.2% better than the return for the previous situation. This serves to confirm the general impression gained from visiting this property, that ewes would be more profitable than wethers. It is possible, however, that running wethers would enable the overall carrying capacity to be increased, and would thus reduce the margin of superiority.

As with Case Farm A, returns have also been calculated by expressing additional net profit as a percentage of the capital invested in development. This method has under estimated returns aftertaxation, (Tables 6.14 and 6.15), and has over estimated returns before taxation (Table 6.13).

Two factors which could reduce the realised profitability, are firstly, a fall in prices and/or an increase in costs, and secondly, failure to achieve the anticipated development programme.

Over the last decade, the general trend has been one of falling prices and rising costs, and this has been a significant factor in reducing profitability for Case Farm A. If this trend continues, the development of Case Farm B will be similarly affected. While there is no evidence that the trend will continue, there is equally no reason to expect a significant rise in prices and/or a fall

TABLE 6.15

THE PROFITABILITY OF DEVELOPMENT - CASE FARM B

AFTER TAXATION

(Based on maximum ewe numbers)

	Prior to develop.	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	After develop.
Gross income	6151	4519	4913	5587	7457	9147	10826	11532	13590	15141	15645	15645	15645
Maintenance expenditure	4404	5034	2715	4266	5301	5500	5884	6390	6382	6581	6648	6648	6648
Labour and management reward	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Taxation	191	0	0	0	0	0	85	1496	3071	3940	4268	4391	4462
Interest	400	600	787	1035	1113	1113	1075	988	959	854	688	506	400
Development expenditure	0	1550	3853	5564	1762	903	1346	1162	437	0	0	0	0
Total expenditure	5995	8184	8355	11865	9176	8516	9390	11036	11849	12375	12604	12545	12510
Surplus	156	-3665	-3442	-6278	-1719	631	1436	496	1741	2766	3041	3100	3135
Borrowed capital		3350	3100	4130	1295	0	0	0	0	0	0	0	0
Cumulative debt		3350	6450	10580	11875	11875	11244	9808	9312	7571	4805	1764	0
Repayments		0	0	0	0	631	1436	496	1741	2766	3041	1764	0
Interest		200	387	635	713	713	675	588	559	454	288	106	0
Development from revenue		0	753	1434	467	903	1346	1162	437	0	0	0	0
Increase in stock values		1247	1425	1935	1342	1433	760	1202	652	36	0	0	0
Apparent profit		-315	-342	-2148	-424	0	0	0	0	0	0	1336	3135
Profit if no development		462	156	156	156	156	156	156	156	156	156	156	156
Difference		-777	-498	-2304	-580	-156	-156	-156	-156	-156	-156	1180	2979
Net Profit		1132	2223	1856	2098	3680	4217	3448	3389	3256	3329	3206	3135
Profit if no development		462	156	156	156	156	156	156	156	156	156	156	156
Difference		670	2067	1700	1942	3524	4061	3292	3233	3100	3173	3050	2979

P.V.C. = £23921.21

P.V.R. = £22599.51 = £1355.97/year

P.V.R. = £46520.72 = £2791.24/year

$$\frac{\text{P.V.R. as an annuity}}{\text{P.V.C.}} \cdot \frac{100}{1} = 11.7\%$$

$$\frac{\text{Additional profit}}{\text{Capital invested in development}} \cdot \frac{100}{1} = 11.2\%$$

in costs.

It is not unusual to find that progress becomes rather slow once a carrying capacity of about 4 ewe equivalents per acre is reached. The anticipated rates of development for this farm are fairly optimistic, and it may not be possible to achieve maximum carrying capacity by 1970. Spreading development over a greater period of time will reduce profitability, as future incomes will be discounted at a greater rate.

6.64. Interpretation of Results

The above analysis of two case farms, allows only a very tentative hypothesis to be formulated. It is, that with present methods, hill country development to the level of about 5 ewe equivalents per acre, is likely to be only slightly more profitable than alternative investments yielding 6%.

This hypothesis is based, in part, on the impression that farms A and B were two of the most impressive of the farms visited, particularly with respect to the farmer's knowledge of the technical aspects of development. Also, more weight should perhaps be placed on the profitability analysis of Case Farm A, as this development programme is largely historic. In addition to the development programme for Case Farm B being mainly in the future, it is rather unique in that the farmer has not had to depend entirely on farm income for living expenses, and has been able to borrow well in excess of the equity actually afforded by the farm.

CHAPTER VII

FACTORS LIMITING OR PREVENTING DEVELOPMENT

The analysis of the two case farms in the previous chapter, indicated that development was only marginally profitable. It is thus reasonable to assume that the lack of a strong financial motivation is a major reason for the relatively slow rate of hill country development.

Some attention was also given to the economic and non-economic factors affecting development. This portion of the study was largely exploratory, and as suggested in the text, several of the problems encountered in the survey could themselves be the subject of a major study. For some of the problems, a training in sociology and psychology could well be as important as a training in agricultural economics.

This chapter deals with taxation, credit facilities, labour, death duties and farmer knowledge.

7.1 Taxation

Little work has been done to investigate the impact of taxation on development, apart from isolated case studies. Scott, [1] in one such study, reported that taxation need not restrict the farmer's ability to carry out development. Prior to the survey, however, the general impression gained from contact with hill country farmers, was that taxation, if not a limiting factor, was at least a major disincentive to development.

In this section of the chapter, the impact of taxation on development is discussed in terms of the survey results, and an improved scheme of farm taxation is suggested.

1/ R.H. Scott, op. cit, 1954.

7.11. The Impact of Taxation on Development

To fully evaluate the impact of taxation it was necessary to consider two aspects of the situation:-

(a) Taxation during development;

(b) Taxation after completion of development.

Only 8% of the farmers in the survey considered that taxation had been a serious handicap, thus confirming Scott's conclusions. It could in fact be argued, that the present system of taxation acts as an incentive to development, by encouraging the use of surplus income for non-taxable development expenditure, rather than taxable consumption expenditure. There is, however, the possibility that this will lead to expenditure on dubious improvements for the sake of reducing taxation. This is most likely to occur once the basic development costs have been met.

In spite of the lack of real concern about taxation during development, the impression was gained that many farmers were paying more taxes than necessary. This was due to the fact that few farmers seemed to appreciate the advantages of having their affairs handled by a skilled accountant. In general, contacts with accountants were limited to the period when the annual accounts were being drawn up, and even then, little attempt was made to seek advice on the financial management of the farm.

The results of the theoretical study suggested that from an overall point of view, taxation could justifiably be regarded as a major disincentive to development. This took into account the large increases in taxation after completion of development, when money that was previously channelled into tax deductable expenditure, became taxable income. Case Farm B is an example of this situation. At the present time no taxes are being paid, but in a matter of six years, taxation could rise to about £3500. The overall effect of taxation for Case Farm B, is to reduce the return on capital from 19.3% to 10.5%.

Co-operation with an accountant, may make it possible to devise means of reducing the ultimate level of taxation; by forming a farm company for example. In such cases the extra cost of getting the best possible advice, may well be trivial when compared to the potential savings in taxation. Many farmers fail to take precautionary measures against taxation, until they are actually assessed for large amounts of tax. This situation is not likely to arise when the proposed development programme has been budgeted, as for Case Farm B.

7.12. Suggested Improvements to Farm Taxation

As a general observation, it would appear that the present taxation system is not an effective means of encouraging increased production. Rather, it penalises increased production.

It is suggested that a more effective system of taxation, would be a land tax based on the physical productivity of the various land classes. With this system, there would be a basic tax determined by average levels of production for each land class. This basic tax would be levied regardless of the production of the individual farm. Thus farmers would not increase their tax liability by increasing production, and farmers below average levels of production would eventually be forced either to raise production, or to sell their properties.

The land tax for the class of land of which Case Farm B is representative, might be for example, £1 per productive acre. This would result in an annual tax of £1300. When Case Farm B was fully developed, the net profit would then be £4885 as compared with the estimated £2676 net profit and £3509 taxation in Table 6.14.

Although the Inland Revenue Department would receive less tax from the individual fully developed farm, it is probable that a land tax would increase the total amount in taxation from farms on this land class. In addition, the nation would benefit from the increased volume of farm production, as farmers would have both the stimulus and the incentive to develop. A detailed study of various land classes would be needed to fully evaluate the impact of a land tax. Such a study would need to consider the likely benefits to both the individual farmer,

and the nation.

While this is possibly the optimum system of farm taxation, implementation and administration would raise many difficulties at present. A major problem would be the definition of land classes and of average production levels for these. A similar, and possibly a more workable system of taxation at present, has been suggested by Sears. 2/ With this system, taxation rates would be based on the total capital value of each farm.

7.2 Credit Facilities

To the author's knowledge, there have been no detailed surveys of the use of rural credit in New Zealand. Although it was realised that credit was likely to be a problem for farmers undertaking development, the scope and magnitude of the problem did not become apparent until the survey was in progress. This section reviews the problem of development credit, based on both survey results and research conducted after the survey. Specific investigations of rural credit would undoubtedly provide more complete information. The possible direction of such work is suggested as a conclusion to this section.

7.21. The Use of Credit for Development

The implementation of a development programme requires the use of capital which has to be obtained either from surplus income or by borrowing. The survey showed that only 10% of the farmers were using borrowed capital to finance development, yet 90% considered lack of capital to be a major limiting factor.

The reluctance of farmers to use credit facilities has been studied by Lewis 3/ in Australia. Several of the causes suggested in this study, were observed among the survey farmers. These were:-

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2/ P.D. Sears, "Cyclic Patterns Within New Zealand Grassland Farming", Massey College Sheep Farming Annual, 1963. In Press.

3/ J.N. Lewis, "Credit Facilities for Agriculture", Quarterly Review of Agricultural Economics, Vol. VIII, No. 4, 1955, p.99.

(a) The farmer placed a high value on freedom from debt, even though this meant that he was unable to fully exploit the income earning capacity of his farm. This attitude was more prevalent amongst the older generation of farmers, and was no doubt partly due to their memories of depression years. If this attitude exists among a large proportion of the farming population, then extra credit facilities are not going to be of great use.

(b) The farmer did not fully appreciate the part that an intelligent use of credit could play in development.

(c) The farmer was unable to offer sufficient security to obtain the required finance.

(d) The terms of borrowing were unacceptable, particularly with respect to the terms of repayment, and in some cases, the conditions imposed on farming operations by the lender.

(e) There was some uncertainty as to the technical success of the proposed development. Often farmers preferred to "feel their way", rather than attempt large and ambitious changes.

7.22. Features of Development Out of Revenue

The main stimulus to development amongst farmers in the survey seemed to be the feeling that their initial level of production did not provide adequate economic security. Indeed, 75% of the farmers interviewed, began development because they considered their farms to be uneconomic. When farmers in this situation rely on surplus income to finance development, a number of related problems generally arise.

(a) The initial rate of development is slow, as there is little money available in the early years.

(b) As development is competing with family expenditure, it is often only possible to make significant advances by lowering the standard of living.

(c) The farmer may not have the finance to develop at the time when he is physically and mentally most capable of handling the work.

(d) Once development of a block has been started, the farmer may be unable to finance the necessary follow-up treatment at the time when it is required.

(e) The rate of development becomes very sensitive to fluctuation in the prices received for farm produce.

The general result is, that in many cases, development out of income tends to be a long and relatively inefficient process.

7.23. Credit Requirements for Development

It would appear that if there is to be any significant increase in the productivity of hill country, there will need to be a greater use of credit for development. At the present time, farmers appear to be quite willing to use long term credit for farm purchase, and few seem to have much difficulty in financing day to day operations. It is intermediate term credit for development which farmers are reluctant to use, partly because such credit is often not administered with any real appreciation of the farmers' needs.

The significant features of a development programme with respect to the provision of credit are firstly, the long production process, and secondly the uncertainty involved.

Once a farmer commences development, he is committed to an initial period of heavy expenditure, while income does not increase markedly until several years later. This is particularly true for the development of land out of secondary growth, when the major portion of expenditure is incurred in the first eighteen months, while returns may not reach a maximum for five years or more. Case Farm A is an example of this situation. If a fast rate of development is to be achieved, it is necessary that during this period the farmer should be able to initiate development of other blocks. However, annual committments for

servicing loans during the initial years of development, can be a major financial handicap, and can retard the rate of development. 4/

It is desirable that a farmer should be allowed to consolidate his physical and financial position, before taking on the full burden of repaying loans. In many cases, this would involve allowing the farmers' debt to increase continuously for five or six years (subject to satisfactory progress), and at this stage to have the debt consolidated into a table mortgage, with repayment over, say ten or fifteen years.

The second feature of development is the uncertainty. This may take the form of uncertainty as to technical success and the rates of development that can be achieved, or more commonly, uncertainty due to climatic conditions. Adverse weather conditions when sowing down a block of newly cleared land, can result in the need for complete resowing and topdressing. Unless the farmer is able to finance such salvage operations, much of the potential benefit of the initial expenditure will be lost. Again, it is desirable that a farmer be guaranteed the right to borrow further to cover such circumstances.

7.24. Existing Credit Facilities

The policies of the recognised rural credit institutions are discussed below in relation to the provision of credit for development. The majority of the information was gained from discussions with the staff of the various institutions.

7.241. Trading Banks

Provision of rural credit by trading banks is generally limited to short term tide-over finance, and as such, covers mainly seasonal working expenses for credit worthy clients. Assistance with medium term finance for development has recently been provided by the introduction of term loans. 5/

4/ These annual committments in early years would not matter so much, providing the farmer was guaranteed the right to borrow further to cover such circumstances.

5/ Term loans were introduced in March, 1963.

The purpose of such loans is to enable increases in production, and they involve a degree of lending on productivity rather than security. They are amortized loans, with fixed repayments, and higher interest rates determined partly by the risk involved. The farmer is expected to have some equity and to put forward portion of the finance for the proposed development plan. The conditions of each loan are drawn up to suit the individual case. As yet, it is too early to evaluate the demand for, and the effectiveness of this particular service. It is, however, a move towards improving the credit services of the trading banks to the farming community.

7.242. Insurance Companies

These tend to deal almost entirely in long term credit with maximum security, i.e., first mortgage. In addition, the applicant is also required to take out substantial sums of life insurance with the company. Provided that the security is not endangered there is little apparent interest in the progress of the farmer, although some companies, such as A.M.P., do have field officers who check on husbandry. The amounts lent are dependent entirely on the security that can be provided.

7.243. Stock Firms

Stock firms deal quite extensively in short term credit for seasonal working expenses. Advances are generally limited to what can safely be covered by the farmer's expected income in the succeeding year. The farmer is usually required to conduct the majority of his business through the firm, and in theory, this has the advantage that the firm is in intimate contact with the farmer's management. In practice, several farmers considered that firms occasionally imposed controls on trading operations, that were not to the best advantage of the farmer.

A limited amount of intermediate term credit for development is provided by some of the firms, with Wright Stephenson and Company appearing to

be the most active in this field. With this credit service, both the farmer and the proposed development programme have to be approved, and development is guided to some extent by the firm. All available security is taken, but in some cases the initial security is only the farmer's ability and integrity.

While this is an attractive scheme for financing development, its effectiveness is limited by the fact that it is largely confined to one firm, and total lending is governed by the financial position of the firm.

7.244. State Advances Corporation

The State Advances Corporation is the largest source of rural credit at present, although it deals mainly with long term credit for farm purchase. First mortgage must be provided as security and interest rates are slightly lower than those of other lending institutions. Supervised lending based on budget control is also provided, but this service is generally restricted to Rehabilitation farmers, and to farmers who have run into difficulties in servicing their original loan for farm purchase. In these situations, principal, and occasionally interest "holidays" can be arranged. Otherwise credit is on a table mortgage basis.

The credit policy of the State Advances Corporation is controlled by Government policy, and the recent tendency has been for a decreasing proportion of rural lending. The figures for 1961, were 19.7% in rural advances and 80.3% in urban advances, the actual amounts being £8,161,092, and £41,506,426 respectively. 6/

7.245. Marginal Lands

The Marginal Lands Board was set up in 1951 as a result of recommendations put forward by the 1948 Royal Commission on the Sheep Industry. It represented the first real attempt to alleviate the financial difficulties of farmers, developing marginal land. 7/

6/ H.M. Caselberg, "Farm Finance", Massey College Sheep Farming Annual, 1963. In Press.

7/ Marginal land was defined as any land not fully developed, or declining in productivity.

The main policy points of the Board are:- [8]

(a) The applicant and the proposed development programme must be approved by a committee representing the Board.

(b) The applicant must be unable to get finance elsewhere.

(c) The loan is advanced progressively and security is taken as it becomes available. Ultimately the loan is converted into an instalment mortgage.

(d) The Board can make remissions of interest and principal.

(e) The Board reserves the right to say how an advance should be spent, and if necessary, how a particular farm should be stocked.

This policy makes Marginal Lands potentially, the most favourable source of credit for development, although (b) tends to result in the Board handling only the most difficult cases of development. The farmer who can offer security for credit is forced to use other facilities.

In recent years, Marginal Lands has lent on average only about £350,000 per annum to less than 100 farmers per annum. This would suggest that either there is relatively little demand for this service, or that the amount of finance available for distribution by Marginal Lands is limited. It has been asserted, however, that no suitable applicants have been turned down for lack of finance. [2]

7.25. The Need for Qualified Advisors

All of the above lending institutions could be criticised on the grounds that they were not sufficiently conversant with the technological and economic aspects of development. Even on farms under supervision, it was evident that full use was not being made of all available knowledge. It was noticed, for example, that credit was often being used to erect fences costing £800 or more per mile.

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[8] "Powers and Functions of the Marginal Lands Board", New Zealand Valuer, Vol. 11, No. 3 1953, p. 23.

[2] H.M. Caselberg, op. cit. 1963.

In most cases, greater increases in production could have been achieved if cheaper fencing had been used, and if the money saved in this manner had been spent on fertiliser, seed and stock.

This situation is no doubt partly due to the high cost of providing suitably qualified advisors. It is likely, however, that the cost of using credit inefficiently is much greater than the cost of obtaining really sound advice.

7.26. Needed Improvements to Credit Facilities

The most needed improvement in the credit facilities for development can be summarised as follows:-

(a) Lending on productivity rather than on security, so that the competent farmer undertaking development would not be unduly restricted by the security he could offer. Security would of course, be taken as it became available.

(b) Recognition of the long production process involved in development. This would entail provision for witholding principal and interest payments until the farmer was in a position of economic stability. Complete budgeting of proposed development programmes would be necessary to plan the pattern of repayments.

(c) Recognition of the uncertainty involved in development. In particular this would require that the farmer was guaranteed the right to borrow further, in order to obtain as much value as possible from previous expenditure.

(d) The institution of supervised lending. In view of the general lack of knowledge of farmers discussed in a later section, it seems that supervised lending will be necessary to ensure an efficient use of credit. This is likely to be more expensive than unsupervised lending, and to be acceptable to farmers, will require highly competent advisors, and a cooperative, rather than a dictatorial approach to supervision.

7.27 The Scope for Further Investigation of Rural Credit

It is obvious at this stage that there is considerable scope for further work investigating rural credit facilities. In particular it is suggested that more comprehensive studies are needed:-

(a) to investigate the use of credit by farmers,

(b) to estimate credit needs to enable a given rate of increased production to be achieved,

(c) to determine the policy changes that would be needed to promote a greater use of credit,

(d) to suggest how these policy changes could be adopted with respect to existing credit institutions.

It must be remembered, however, that credit only becomes a problem when profitable investment opportunities are being forgone. This may not be so on hill country if development is only marginally profitable. The relatively high profitability of development for Case Farm B, as compared with Case Farm A, suggests that the use of credit in the initial stages of development, may be a significant factor affecting profitability. Further detailed studies would be needed to confirm this hypothesis. 10/

7.3 Labour

Labour was considered to be a limiting factor by 32% of the farmers visited in the survey. It was evident, however, that as development progressed, many more farmers would be confronted by labour problems.

10/ Although not specifically referred to in the text, the following references were of considerable help in formulating the material presented in this section:

E.J. Waring, "Rural Credit", Farm Policy, Vol. 2, No. 3, 1962, p.81.
P.C. Druce, "Credit Policy for Rural Development", Review of Marketing and Agricultural Economics, Vol. 24, No. 4, 1956, p. 181.
W.D. McDonald, "The Role of the Development Bank in Rural Credit", Australian Journal of Agricultural Economics, Vol. 4, No. 2, 1960, p.97.

7.31 The Labour Problem on Hill Country

The labour problem on hill country farms is basically one of obtaining suitable permanent employees. There appeared to be an adequate supply of labour for the major development operations such as scrubcutting and fencing, which are generally done on a contract basis. The main difficulty with this type of casual labour is to obtain reliable workers needing a minimum of supervision.

The major labour problem arises when the carrying capacity of the farm reaches the stage where it is beyond the capacity of the existing labour force to handle routine work. Frequently, development stops at this stage, either due to inability to obtain and hold satisfactory labour, or to the farm being too small to warrant an extra labour unit, even when fully developed.

In general, the farmer's requirements, for permanent labour is a married man, skilled in most aspects of hill country farming, needing little supervision and capable of taking complete control of the farm if necessary. Single workers were considered to be too unstable as permanent employees.

7.32. Reasons for the Shortage of Labour

The inability (or unwillingness), of farmers to compete with other employers in terms of wages, has been suggested as the reason for being unable to obtain labour. This was often the case with farmers on small units developing out of income, where the payment of competitive wages for permanent labour would leave little or no money available for development. In addition there may be some difficulty in obtaining credit for housing, particularly if all available securities are already mortgaged. This did not seem to be the whole problem, however, as even the offer of good housing and high wages often failed to produce suitable applicants. 11/

11/ There were instances of farmers being prepared to pay £20 or more per week, for a suitable permanent employee.

The main reasons for the shortage of suitably qualified permanent labour appeared to be:-

(i) The desire of most rural workers to eventually get their own farms. The result is that some employees leave as soon as they can finance themselves into a farm. One way to reduce this loss of labour may be to allow workers to have a financial interest in the management of the farms, as an incentive for permanent employment.

(ii) The lack of arrangements to provide for workers' security when they are physically incapable of farm work. It was suggested by a few farmers that the possibilities of a rural superannuation scheme should be investigated.

(iii) The lack of social amenities in the country.

(iv) The lack of educational facilities. This was a very real problem for both farmers and employees. Primary schooling is reasonably well provided for in the country and the constantly fluctuating numbers of school children make it difficult to envisage any improvements to transport arrangements and siting of schools.

The low population density in country areas necessitates secondary schools being sited in the towns, and transport and boarding costs, particularly for large and isolated families, can be considerable. There were instances of farm workers leaving to take up employment in or near towns in order to provide adequate secondary education for their children, even when the farmer had offered some financial assistance. For the farmer, education costs of up to £300 per child per year, can drastically reduce the amount of money available for development.

Improvements that were suggested by the farmers were:-

(a) Substantial increases in boarding facilities and boarding allowances for country children,

(b) Treating educational costs (within reason) as a cost of farming, similar to topdressing,

(c) Better transport facilities.

Andrews [12] has put forward two proposals designed to alleviate the farm labour problem. The first of these is a Rural Farm Settlement Plan, which envisages small farm settlements or villages being set up throughout country areas. It is hoped that each village would be able to offer many of the facilities found in small suburban areas....."This is designed for the man of limited ambition, who wants a secure job, to own his own home, be provided with a pension in later life and enjoy the benefits of an urban community in a rural setting."

The second proposal is for a Farm Bursary, designed to assist those who have the aim and ability for farm ownership, but not the necessary capital. The plan provides for a combined training and saving scheme, with the ultimate objective of helping suitable applicants to acquire farms. During the training period, labour could be channelled into areas, where there is a labour problem.

There is scope for a specific research project investigating both the labour problem as it is at present, and as it is likely to be if there is a general move to develop farms to high levels of production. It is possible that such a study would find that a major reason for many farms having only one labour unit, was the unwillingness or inability of the farmer to manage extra labour.

7.4. Death Duties

None of the farms in the survey had been recently affected by death duties. Consequently, this section is mainly concerned with farmer attitudes towards death duties, and to indicate how these are affecting the extent of farm development.

12/ J.C. Andrews,"Some Thoughts on Farm Labour Problems in New Zealand," Massey College Sheep Farming Annual, 1962, p. 57.

7.41. Farmer Attitudes

Many farmers were of the opinion that too many of the benefits of development would ultimately go to the Government, to make complete development worthwhile. They felt that death duties could result in a highly developed property becoming a burden, rather than an asset, to the next generation. The general feeling was that if death duties were greatly reduced, or preferably abolished, there would be more incentive to undertake full development of farms. Without detailed information on the actual impact of death duties, it is not possible at this stage to comment on the justification for these beliefs. There is scope for a separate research project to evaluate the impact of death duties on farm development. Such a study would need to investigate farms on which death duties had been recently levied.

7.42. The Reduction of Death Duties

While the ultimate level of duties can be reduced over a long period, by the use of gifts or gradual purchases between generations, an unexpected death can be financially embarrassing to surviving family members. A number of farmers were considering arrangements such as the formation of trusts and companies within the family, with the aim of reducing taxation and death duties. There appeared to be scope for a more widespread adoption of such measures, but comments on the preliminary report suggested that farmers often entered into such arrangements without fully understanding their implications. Again, a skilled accountant is essential, if such schemes are to be effective in minimising the total tax liability. 13/

7.5 Farmer Knowledge

During the survey it was noticed that there was a considerable lack

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13/ See, P. Nevill, "How to Minimise Death Duties", Published by Rydge's Business Journal, Wellington, (N.Z.), 1961.

of knowledge amongst farmers, about many aspects of development. It is possible that this constitutes the greatest limitation to the success of development at present. A lack of knowledge can take two forms. Either the problem has not been solved, for example, the optimum topdressing rates for development, or more commonly, the farmer is unaware of much of the available information on the subject.

7.51. Problems of Inadequate Knowledge

It was evident from the survey that the greatest overall lack of information was in the field of economics. Few farmers are capable of making more than a cursory evaluation of proposed plans, and the advice they receive from advisory workers is usually limited in extent. Such advice is generally concerned with the technical aspects of a specific problem, and often fails to relate this to the management of the farm as a whole. For example, a farmer may be advised to apply heavy rate of fertiliser to bring his soil fertility up to "recommended" levels. The possibility that this money could be more productively spent on other aspects of development, say on extra stock, is often overlooked.

While there is a need for more research devoted to the problems of hill country farming, there is considerable scope for greater effort on the part of the farmer, to obtain the relevant information. In many instances, development would have been more successful if the farmer had attempted to improve his knowledge both prior to and during development. Many farmers were, in effect, progressing by a process of trial and error, and the same mistakes had been made on a number of farms. Many of these mistakes could have been avoided, (together with the financial loss), by taking note of the experience of other farmers, and of the results of research. The main thing is for the farmer to develop an inquiring mind, and to realise the savings that can be made with improved knowledge.

7.52. The Spread of Knowledge

In practice, a farmer is seldom able to provide himself with all the necessary information. He will need to rely to a large extent on advisory services, such as the Advisory Division of the Department of Agriculture. Such organisations should collect, evaluate and circulate available knowledge, and the farmer should not have to go past his local advisory officer for the information he requires.

At the present time advisory services are not of sufficient quality or quantity to ensure that all farmers are aware of available knowledge, and to assist farmers in problems of evaluation and adoption. Nevertheless, there is scope for farmers to make a greater use of advisory services than they are doing at present. The greater the demands made on the service, the more likely it is that needed improvements will be made.

Of the advisory services encountered in the survey, the Farm Improvement Club stood out as being potentially of great benefit to farmers. 14/ An advisor, usually a trained agriculturist, takes over much of the responsibility of collecting and evaluating information for the farmer, and if required, will advise on the application of this knowledge. The cost of membership, in the region of £50 per year, was considered by some farmers to be high, but in many cases it would have been small relevant to the savings that could have been made with improved knowledge.

In addition, the discussion groups organised by several of the advisory services, impressed the author as a means whereby farmers could exchange ideas, and benefit from each other's experiences.

14/ For a description and evaluation of the Farm Improvement Club movement, see, A.H. Hughes, "Farm Improvement Clubs in New Zealand", Proceedings of the Australian Agricultural Extension Conference, 1962.

CHAPTER VIII

CONCLUSION - THE POTENTIAL FOR INCREASED PRODUCTION

In this chapter, the main points arising from the material presented in earlier chapters, are collated in a discussion on the potential for increased production from unploughable hill country. While only a relatively small area of hill country has been studied, it is likely that these comments are pertinent for much of the hill country in the North Island of New Zealand.

It has been estimated that the potential carrying capacity of much of the hill country in the survey area is at least 5 ewe equivalents per acre, while the average carrying capacity is probably less than 2.5 ewe equivalents per acre. There is thus a potential for about a 100% increase in carrying capacity. Taking into account the decline in productivity per animal with increasing stocking rates, this could result in an increase of about 75% in the combined output of wool, mutton and beef. The majority of this increase would be in mutton and wool, as increases in stock numbers are likely to consist mainly of sheep.

To achieve this increase would require development of land that was non-productive or declining in production, and this would entail clearing considerable areas of secondary growth. Increased production on many farms, however, could be achieved merely by improving existing pastures with seed and fertiliser, and by fully utilising pasture production with increased stocking rates.

If farmers are going to undertake development, they must have the knowledge of the techniques involved, they must have the incentive to adopt them and they must have the necessary resources such as capital and labour.

The techniques necessary for development do exist, and have come from experimental work, of which the Te Awa research station is the principal source, and from "farmer" research. Nevertheless, there is still scope for further

research into the methods and problems of developing hill country. In particular, more information on topdressing rates would be desirable.

The situation with respect to the farmers' knowledge of these techniques, however, is not so satisfactory. There is scope for an improvement in the quantity and quality of extension services, although improvements are only likely to be effected when the farmers have the incentive to develop, and are demanding expert advice. In addition to improved extension services, the establishment of combined research and demonstration farms would be of considerable value. It is believed that the establishment of such a unit to investigate and publicise methods of developing gorse country, would have a significant effect on the amount and success of gorse development in the survey area.

The results of this study suggest that a major reason for the relatively small amount of hill country development, is that development is only marginally profitable to the individual farmer. At the present time, however, there is an increasing amount of attention being given to the need to increase primary productic in New Zealand. With development only marginally profitable, there is thus a conflict between the aims of the nation, and the aims of the hill country farmer. To achieve the national objective of increasing production, development must be made an attractive propostion for the individual farmer.

It has been suggested that an effective means of providing an incentive for development, would be to abolish the present system of taxation in favour of a land tax based on productivity. This is likely to give a greater impetus to production than any other form of taxation. The incentive would take the form of knowing that all production above some average level would be tax free, and that failure to achieve or maintain this level of production would eventually force poor farmers to make way for more efficient farmers.

Having the incentive to develop, is in itself not sufficient. It will still be necessary to ensure that farmers have the resources for development,

particularly credit and labour.

The main improvements needed in credit facilities are firstly, more emphasis on lending on productivity, and secondly, adjustment of the terms of lending to take into account the long production process and the uncertainty involved in development. It is likely that credit lent on productivity rather than security, would require some supervision, and hence in a real sense would be more expensive. In order to protect its investment, the lending institution would need to ensure that the money is spent to best advantage. This would necessitate budgeting of proposed development programmes, and the planning of expenditure and loan repayments. Supervision could be provided by field officers of the lending institution, in which case they would need to be fully qualified for this work. Alternatively, use could be made of the present advisory services. Further investigations into rural credit are necessary if credit facilities are to be improved.

Labour problems will arise on many farms as carrying capacity is increased. In many cases farm size will be the major limiting factor, and potential production will be determined by the capabilities of the existing labour units, rather than the physical potential per acre. On other farms the problem will be to obtain and hold suitable permanent labour. This problem appears to be largely due to the lack of social amenities, the high cost of education and the lack of arrangements for workers' security. Improvements that can be made in this direction are likely to help overcome the farm labour problem.

If a significant proportion of the existing potential of hill country is to be obtained, it will be necessary for those responsible for policy decisions to be fully aware of the problems of farmers developing hill country. Further detailed investigation of these problems will be required if needed improvements are to be effected.

As technology is constantly changing, it is likely that the future will

provide knowledge which will extend the ultimate physical potential, and which will enable the technical and economic efficiency of development to be improved. Even under the most favourable conditions for hill country development, it would take about ten years to breed sufficient stock to double carrying capacities. With the present lack of incentives, knowledge and resources, it is unlikely that the natural increase in stock numbers will ever be the main factor limiting the overall rate of development.

REFERENCES

Andrews, J.C. "Some Thoughts on Farm Labour Problems in New Zealand," Massey College Sheep Farming Annual, 1962, p. 57.

Barrer, P.R. and R.C. Stuart, "Results on a Banks Peninsular Demonstration Farm," N.Z. Journal of Agriculture, Vol. 101, No. 3, 1960, p. 234.

Candler, W.V. "Production Economics and Problems of Animal Production," Proceedings of the N.Z. Society of Animal Production, 1962, p. 142.

Candler, W.V. and D. Sargent, "Farm Standards and the Theory of Production Economics," Journal of Agricultural Economics, Vol. XV, No. 2, 1962, p. 282.

Caselberg, H.M. "Farm Finance," Massey College Sheepfarming Annual, 1963, In Press.

Clarke, E.A. "Fern Control", Proceedings of the Ruakura Farmers' Conference, 1960, p. 62.

Currie, J.D. "Gorse Control on Unploughable Hill Country", Proceedings of the N.Z. Weed Control Conference, 1959, p. 65.

Druce, P.C. "Credit Policy for Rural Development", Review of Marketing and Agricultural Economics, Vol. 24, No. 4, 1956, p. 181.

Garnier, B.J. "The Climate of New Zealand", Edward Arnold Ltd., (London), p.53.

Griliches, Z. "Hybrid Corn: An Investigation Into The Economics of Technological Change", Econometrica, Vol. 25, 1957, p. 501.

Gruen, F.H. and R.A. Pearse, "Aerial Pasture Improvement", New South Wales Department of Agriculture, 1959, p. 33.

Hamblyn, C.J. "Clearing Manuka from Hill Country", N.Z. Journal of Agriculture, Vol. 77, No. 3, 1948, p. 290.

Hamblyn, C.J. "Manuka Blight", N.Z. Journal of Agriculture, Vol. 99, No. 2, 1959, p. 119.

Heady, E.O. "Economics of Agricultural Production and Resource Use", Prentice-Hall, Inc. (New Jersey), Chapter 13.

Hewitt, W.R. "Comparative Costs of Ordinary, Hunter Chain, and Electric Fences," Massey College Sheep Farming Annual, 1958, p. 104.

Hockey, P.R. "The Awareness, Use and Acceptance of the Extension Services by Suppliers of the Tokomaru Dairy Factory," Unpublished Dissertation for Dipl. Agr. Sc., Massey University of Manawatu, 1962.

Hughes, A.H. "Farm Improvement Clubs in New Zealand," Proceedings of the Australian Extension Conference, 1962.

Hutton, J.B. "A Study of Dairy Farm Management in the Waipa County," Unpublished Thesis for M.Agr.Sc., Massey Agricultural College, 1953, p. 18.

Levy, Sir Bruce. "Grasslands of New Zealand", N.Z. Government Printer, (Wellington), 1955, p. 214.

Lewis, J.N. "Credit Facilities for Agriculture", Quarterly Review of Agricultural Economics, Vol. VIII, No. 4, 1955, p.99.

Marshall, K.R. "Manuka to Grass", Massey College Sheep Farming Annual, 1962, p.115.

McDonald, W.D. "The Role of the Development Bank in Rural Credit", Australian Journal of Agricultural Economics, Vol. 4, No. 2, 1960, p. 97.

McMillan, M.B. "The Sources of Information and Factors Which Influence Farmers in Adopting Recommended Practices in Two N.Z. Counties", Canterbury Agricultural College, Technical Publication No. 19, 1960.

Ministry of Works, "Pohangina Conservation Survey", 1951, Unpublished.

Moss, G.R. "The Gorse Seed Problem", Proceedings of the N.Z. Weed Control Conference, 1959, p. 65.

Nevill, P. "How to Minimise Death Duties", Rydge's Business Journal, Wellington, N.Z., 1961.

Sears, P.D. "Cyclic Patterns Within New Zealand Grassland Farming," Massey College Sheep Farming Annual, 1963, In Press.

Schapper, H.P. "Uses and Limitations of Farm Surveys", Review of Marketing and Agricultural Economics", Vol. 25, Nos. 1 - 2, 1957, p. 51.

Scott, R.H. "Some Economic Aspects of Developing Hill Country", Proceedings of the N.Z. Grasslands Association Conference, 1954, p. 140.

Scott, R.H. "Farm Production Records", N.Z. Journal of Agriculture, Vol. 97, No. 4, 1958, p. 353.

Scott, R.H. "Farm Management Advice and Recording Scheme", N.Z. Journal of Agriculture, Vol. 104, No. 3, 1962, p. 203.

Soil Bureau, "General Survey of the Soils of North Island, New Zealand", Soil Bureau Bulletin No. 5, Department of Scientific and Industrial Research.

Suckling, F.E.T. "Te Awa Soil Conservation Experimental Area", A Report Presented to the Soil Conservation and Rivers Control Council, 1950.

Suckling, F.E.T. "Pasture Management Trials on Unploughable Hill Country at Te Awa", N.Z. Journal of Science and Technology, Vol. 36 (A), No. 3, 1954, p. 237.

Suckling, F.E.T. "Pasture Management Trials on Unploughable Hill Country," N.Z. Journal of Agricultural Research, Vol. 2, No. 3, 1959, p. 488.

Suckling, F.E.T. "Recent Trials at the Te Awa Hill Pasture Research Station", Massey College Sheep Farming Annual, 1962, p. 181.

Tribe, D.E. and A.G. Lloyd, "Effect of Stocking Rate on the Efficiency of Fat Lamb Production", Journal of the Australian Institute of Agricultural Science, Vol. 28, No. 4, 1962, p. 274.

Waring, E.J. "Rural Credit", Farm Policy, Vol. 2, No. 3, 1962, p. 81.

Wright, A. "A Progress Report on a Study of the Development of Unploughable Hill Country", Discussion Paper No. 2, Department of Agricultural Economics and Farm Management, Massey University of Manawatu, 1962.

"Annual Review of the Sheep Industry," Meat and Wool Boards' Economic Service, Publication no. 318, 1962, p. 6.

"Guide to Current Rural Costs and Prices", Department of Agricultural Economics and Farm Management, Massey University of Manawatu.

"Powers and Functions of the Marginal Lands Board", New Zealand Valuer, Vol. 11, No. 3, 1953, p. 23.

"The Limitations and Contributions of Pilot Farms, Management Units or Experimental Units in an Economic Research Programme," A Report of the Management Unit Subcommittee of the Southern Farm Management Research Committee, North Carolina State College of Agriculture and Engineering, 1954.

APPENDIX A

DETAILS OF QUESTIONNAIRE

SECTION I DESCRIPTION OF THE FARM

Reference No:

Location:

Area: Tenure: Date of possession:

Altitude: Rainfall: Aspect:

Climate:

Land and Condition:

	Area	Productive area	Unproductive capable of dev.	Waste	Soil type
Flat/rolling					
Moderately steep					
Steep					
Total					

Water supply:

Erosion and reversion:

Weeds and pests:

Subdivision:

Internal access:

Labour:

Buildings and plant (main items):

Valuation:

Grazing and stock management:

Topdressing, oversowing and cropping programme:

Management problems peculiar to the farm:

SECTION II DETAILS OF DEVELOPMENT

Reference No:

Date of Possession:

Details of purchase:

Condition of the farm when purchased:

Was development started at once? If not, for what reason, and when was it started?

Original plan and method of development.

Why was this particular policy used in preference to any other?

Has the policy been changed during development. If so, for what reason, and what was the new policy?

Was it necessary to borrow money at any stage of development?

What level of production is aimed for, and when is it hoped to achieve this?

Is this considered to be the maximum production the farm is capable of?

Has development been limited by factors beyond your control?

How would the farm be developed if it had to be done again?

APPENDIX B

STOCK CONVERSION FACTORS

To obtain a comparative measure of the carrying capacity of the survey farms, it was necessary to express all classes of stock in terms of a common grazing unit, the ewe equivalent.

Estimations of conversion factors have been made by Hutton, [1] and the Department of Agriculture. [2] These estimations were based on both the estimated feed requirements of the different classes of stock, and on subjective opinions.

As these factors were calculated for conditions of lowland farming and stall feeding, it was felt that they would be inaccurate for use on hill country farms. Hence they were modified by the author to give a set of conversion factors which it was believed were more representative of hill country conditions. The factors used in this study, together with those calculated by Hutton and the Department of Agriculture, are presented in the following table.

It should be noted, however, that the use of conversion factors assumes all classes of stock to be perfect substitutes for grazing. This is not truly representative of actual conditions, especially on hill country undergoing development.

1/ J.B. Hutton, "A Study of Dairy Farm Management in the Waipa County", Unpublished thesis for M.Agr.Sc., Massey Agricultural College, 1953, p.18.

2/ R.H. Scott, "Farm Management Advice and Recording Scheme", Journal of Agriculture, Vol. 104, No. 3, 1962, p.203.

ESTIMATES OF CONVERSION FACTORS

Class of stock	Author's	Dept. of Agr.	Hutton
Ewes	1.0	1.0	1.0
Hoggets	0.75	0.5	0.5
Wethers	1.0	1.0	0.7
Rams	1.0	1.0	0.75
Breeding cows	5.0	7.0	5.5
Dry cows	5.0	6.0	5.5
Rising 1 yr. cattle	3.0	4.0	2.0
Rising 2 yr. cattle	4.0	5.0	4.0
Bullocks	5.0	6.0	5.5
Bulls	5.0	6.0	4.5