AGRICULTURAL
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Lincoln College

BUDGETING FURTHER DEVELOPMENT ON INTENSIVE SHEEP-FARMS IN SOUTHLAND

by

R. C. JENSEN and A. C. LEWIS

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THE AGRICULTURAL ECONOMICS RESEARCH UNIT

THE Unit was established in 1962 at Lincoln College with an annual grant from the Department of Scientific and Industrial Research. This general grant has been supplemented by grants from the Wool Research Organisation, the Nuffield Foundation and the New Zealand Forest Service for specific research projects.

The Unit has on hand a long-term programme of research in the fields of agricultural marketing and agricultural production, resource economics, and the relationship between agriculture and the general economy. The results of these research studies will be published as Unit reports from time to time as projects are completed. In addition, it is intended to produce other bulletins which may range from discussion papers outlining proposed studies to reprints of papers published or delivered elsewhere. All these publications will be available at a small charge. For list of publications see inside back cover.

P R E F A C E

This publication is the second report arising out of the Unit's research programme on fertiliser economics in New Zealand farming. The first report analysed actual farm output at the intensive margin in Southland; this report examines the problems of farmers who wish to intensify production still further. The authors base their calculations on a representative intensive sheep farm in the area and estimate how greater intensification would affect output and net farm income at different price levels. The results show that greater output per acre is consistently a paying proposition with our present-day knowledge of farming technology.

Such higher outputs depend very largely on the ability of farmers to control large numbers of sheep on a small area. Attention to correct fertiliser practices and grazing management in the form of autumn saved pasture is most important. It is estimated that fertiliser requirements in Southland will double if the high intensities of stocking budgeted are to be achieved.

We are grateful to the American Potash Institute Inc., Washington, D.C., for their financial support and continuing interest in this work. We also appreciate the continued access to data and the help given by the New Zealand Meat and Wool Boards' Economic Service.

Mr M.A. Monteath of the New Zealand Department of Agriculture has once again supplied basic data for the analysis and reviewed this manuscript. We are glad to acknowledge his help in this preface.

R.W.M. Johnson
Acting-Director

Lincoln College
November 1967

BUDGETING FURTHER DEVELOPMENT ON INTENSIVE SHEEP FARMS IN SOUTHLAND

INTRODUCTION

This paper compares the profitability of different rates of intensive development on a fairly heavily stocked sheep farm in Southland. It is the second of a series of reports on the economics of fertiliser use in New Zealand. The first paper (1) drew attention to the initial rôle that fertiliser played in increasing production on intensive sheep farms in Southland. It also established that fertiliser use, stocking rate and management skill, should be the main ingredients of further farm development that aims at increased production from a given area of land.

THE DEVELOPMENT PROCESS

The process of development refers here to the intensification of land use by the employment of more farm inputs on a given farm. It involves a programme of drainage, subdivision, increased fertiliser use and more stock and requires higher standards of management. For this particular study the authors have adopted the 'best' known methods for increasing meat and wool production on Southland intensive sheep farms, as recommended by extension officers. Such development may eventually result in greater net income, or it may alleviate the effect of the cost-price squeeze.

The specific aim of this paper is to estimate the profitability of the further development of a representative Southland intensive farm. It is usual to base the assessment of profitability on an actual farm development programme

that has already been carried out. The advantage of such a method is that the technological relationships are known, and it is assumed that these results can be applied, with modification, to other farms developing from a similar low level of production. In the previous analysis of Meat and Wool Boards' Economic Service data it was shown that intensive farms in Southland are already at a high level of production. The average stocking rate in 1964/65 was about 5.5 ewe equivalents per acre. Consequently development of farms at low levels of production has little relevance for intensive farmers in Southland. Furthermore, the benefits of developing these farms are obvious and have been demonstrated dramatically on many farms in Southland. However, it is not obvious that it is profitable to develop further from 5.5 ewe equivalents per acre; it is the intention of the authors to examine this question.

Southland's homogeneity of soil type, terrain and climate over much of the intensive sheep farming region, make it ideal for the exploration of this problem.

PROCEDURE AND METHOD

The profitability of different rates of development of a representative farm will be considered for three price situations:

Situation 1 - Increasing the carrying capacity of the farm from 5.5 ewe equivalents per acre to 8.0 ewe equivalents per acre when output is valued at 1966/67 prices. It is thus assumed that wool will be sold for 29.2 cents (26.7 cents net) and fat lambs will sell for 12.6 cents (12.2 cents net) per lb.

Situation 2 - Increasing the carrying capacity of the farm in the same way, but valuing outputs and inputs according to the actual price changes in the last 16 years.

Situation 3 - Increasing the carrying capacity of the farm using average product prices and average inputs for the period 1954/1965. This situation in effect suggests that past prices are normal and can be expected again in the future.

In general, the first situation anticipates that the present terms of exchange for farmers are fairly permanent and that farmers and advisers must plan accordingly. The second situation assumes product prices will fluctuate in a manner similar to recent years and that input prices will show a steady upward inflationary trend. The third situation assumes stable price levels similar to the average levels of recent years.

Within the three price situations, three further hypotheses with regard to the rate of development are examined.

Hypothesis 1 - It is assumed that the farmer wishes to reach the present accepted maximum carrying capacity (i.e. 8.0 ewe equivalents per acre) in the minimum time. This involves adding 150 ewe equivalents in each of four years to the total stock carried. It is assumed that lambing percentages and wool weights per sheep will decline in this period of rapid development, but will later recover to their former levels.

Hypothesis 2 - In this case the farmer will take twice as long to reach the target carrying capacity, i.e. eight years, but will also suffer some decline of stock performance at this rate of development.

Hypothesis 3 - The development programme to reach 8 ewe equivalents per acre will now be spread over 16 years, and stock performance will be maintained throughout the period.

The resulting estimates of gross farm profit over the appropriate periods of development are then analysed in present value terms. One useful measure of such comparisons is the constant (annual) annuity which could be paid out of the net incomes generated by the development programme. This is similar to a pension payment one can obtain by making continual investments during working life except that an annuity can start from the first year of development. Interest is assumed to be earned at the rate of 6½% per annum.

The three price situations for each development hypothesis can be compared in terms of the following (annual) annuities:

	Situation I 1966/67 Prices	Situation II Trend Prices	Situation III 1955-56 Prices
	$	$	$
Rapid	746	1002	1697
Medium	834	975	1676
Slow	770	853	1461

As might be expected, the projection of output at 1966/67 prices gives the lowest additional gross profits. With some fixed inputs like land and management and plant, there is always likely to be some profit in further intensive development unless stock performance declines more than budgeted in these examples. There is little to choose between the development hypotheses at this point.

Allowing for the effect of the converging trend between output prices and input prices in recent years gives a result intermediate between present prices and the average of past prices. Proceeding toward the desired objective reasonably quickly gives a greater net benefit.

The average prices of the last 14 years are more favourable than those of 1966/67, and farmers can expect an annual net benefit, on average, of $1500-1800. There is some slight advantage to the fast and medium development hypothesis even though some decline in stock performance is involved. Further details of these results are discussed later.

In general, the authors believe that further intensification of farming in Southland at the rates of development budgeted, is a paying proposition with present knowledge of husbandry, grazing management and farming skill. In the rest of this paper, the full details of calculations supporting this conclusion will be presented.

THE REPRESENTATIVE FARM

The budgets for different rates of development for the three price situations outlined above, were drawn up for a representative Southland intensive sheep farm. The farm is managed by the owner with no debt or mortgage encumbrances. A serious disadvantage of assuming 100% equity is that since no mortgage, rent or interest payments are deducted from gross returns, no measure of income available for development finance is calculated. Apart from this, the farm is representative of Southland intensive sheep farms in the Meat and Wool Boards' Economic Service sample.

It was assumed that the basic physical requirements for carrying on farming operations at the level of 5.5 ewe equivalents per acre existed on the farm. Except for drainage and subdivision these requirements are not important for the study. They might include a house, a set of yards, a shearing shed, a full range of implements and motive power etc., and a state of subdivision and drainage yet to be described.

Farm Size: The farm is 240 acres - approximately the modal size of the farms in the Meat and Wool Boards' Economic Service farms in Southland in 1964/65. Average farm size was about 300 acres in the sample.

Stock: All calculations for development are based on the input requirements considered necessary as stocking rate rises to 8.0 ewe equivalents per acre. The initial stocking rate was taken to be 5.5 ewe equivalents per acre which was the average stocking rate in 1964/65. The stock policy adopted was, as far as possible, one of breeding for replacements and for stock increases. In the real situation, some more flexible policy for increasing stock numbers would have been adopted. In all likelihood this would depend on the relative prices of two-tooths, old ewes and fat lambs in any particular year. No cattle are run, and if some other product mix is more profitable than lambs and Romney wool then it may well be so at all levels of development. Stock reconciliations were worked out for each situation and then built into the development budgets.

Fertiliser: Management apart, fertiliser is undoubtedly the most important single input.. High stocking rates result directly from higher fertiliser applications. Assuming that the recommended practice is the correct one, fertiliser accounts for 26 per cent of the extra annual cost involved in achieving the new level of production.

The recommendations* for fertiliser use at 8.0 ewe equivalents per acre, incorporated in the budgets were:-

4 cwt/acre 3:1 potassic serpentine superphosphate over the whole farm, excluding forage crop areas.

3 cwt/acre DDT serpentine superphosphate when sowing new grass.

4 cwt/acre serpentine superphosphate when sowing forage crop; half of this would be borated.

3 cwt/acre 2:1 potassic serpentine superphosphate on hay and silage areas.

(The use of serpentine superphosphate rather than 44/46 superphosphate is optional. Until recently serpentine superphosphate has been favoured in Southland.)

Crop and hay areas for each situation were calculated on the basis that 1000 ewes require 10 acres of swedes and 1500 bales of hay, or equivalent amount of silage, for winter feed. At 8.0 ewe equivalents per acre on a 240 acre farm, 54 tons of fertiliser should be applied:-

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* Recommendations from M.A. Monteath, Scientist, Invermay Agricultural Research Centre, Department of Agriculture, formerly farm advisory officer at Gore.

44.9 tons 3:1 potassic serpentine superphosphate
4.5 tons 2:1 potassic serpentine superphosphate
4.6 tons of serpentine super, some with DDT and boron.

At all development levels one ton of lime per acre is applied prior to sowing grass.

For the base year budget, fertiliser application was set at 2.26 cwt per acre, or 27 tons per annum over the whole farm. Over the period 1954-1964, applications on the intensive sample had varied about 1.86 cwt per acre on average, with carrying capacity rising from 4.5 to 5.5 ewe equivalents per acre. It was assumed that 0.40 cwt of fertiliser was required above the 10 year average to maintain carrying capacity at the 5.5 ewe equivalent level. The following calculation shows the details of its application:-

11 acres swedes at 4 cwt	=	44 cwt
21 acres hay at 3 cwt	=	63 cwt
11 acres new grass at 3 cwt	=	33 cwt
230 acres pasture at 1.7 cwt	=	400 cwt
		540 cwt

The hay and new grass get two dressings per year, and 540 cwt is equivalent to 2.26 cwt per acre. Average fertiliser use on Southland intensive sheep farms in 1964/65 was somewhat higher than this.

As the number of stock increases in the budget for each year, slightly more swedes, hay and new grass are required, and the area of pasture contracts slightly. But as the stocking rate increases, the fertiliser application on pastures rises steadily from 1.7 cwt per acre of 3:1 potassic serpentine superphosphate to 2 cwt at 6 e.e./acre, 3 cwt at 7 e.e./acre, and 4 cwt at 8 e.e./acre.

Subdivision: It was not possible to obtain an indication of the average number and size of paddocks in the area for the base year budget. It was therefore assumed that 12 paddocks were necessary for the convenient handling of 1,100 ewes at 5.5 ewe equivalents per acre and twenty 12 acre paddocks were necessary for 1,600 ewes at 8.0 ewe equivalents p/acre. The practice of autumn saved pasture requires that stock be grazed at up to 100 head to the acre immediately prior to closing up, and the subdivision programme is based on this assumption. The need for small paddocks for this purpose diminishes as stock numbers become greater but the need for small paddocks for convenience of management remains. 160 chains of new fence are required for this subdivision programme.

Autumn Saved Pasture: The management plan provides for 50-60 acres of dry ground for every 1000 ewes for autumn saved pasture. The only apparent cost of this management technique is the above requirements for subdivision. But in management terms, the paddock must be grazed bare before closing, and fed in the spring before lambing in a dry condition.

Drainage: For the base year budget the assumption is made that 80 acres of the farm have been drained before development starts. Some extension officers contend that there is a critical limit above which stocking rate cannot go without the farmer embarking on a comprehensive drainage programme. This limit depends on rainfall but varies from 4 ewe equivalents per acre to 6 ewe equivalents per acre - with most of Southland it appears to be about 5 ewe equivalents per acre. On this basis a further 160 acres must be drained with tiles and moles when developing to 8 ewe equivalents per acre. If this is carried out progressively during development, 40 acres must be drained for each increase of 150 ewe equivalents. It is likely that the full drainage and subdivision programme should have been completed at 7 ewe equivalents per acre. After this the major input requirements are fertiliser and management skill.

Labour for Development: As far as was possible all development work was charged for at contract rates. In addition the budgets include hired wages for additional labour in proportion to increased stock. No new housing was involved.

General Running Expenses: The breakdown of farm expenditure for the intensive farm sample over the ten year period from 1955/56 to 1964/65 is shown in Table 1. Each year's expenditure has been adjusted to 1966/67 prices of inputs. As already suggested in the first report in this series (1) the pattern of expenditure changed very little in the ten years shown. Since the representative farm is assumed to be debt free, interest and rent are deducted from the total shown in Table 1 to get total farm expenses.

In the course of these ten years, however, carrying capacity was raised from 4.5 E.E./acre to 5.5 E.E./acre. Total farm expenses were therefore raised from the average for the period by a factor of 1.058 to represent a slight upward trend associated with heavier stocking.

	$
Total expenditure	5638
Less interest & rent	485
Farm expenses	5153
Farm expenses @ 5.5 e.e. (5153 x 1.058)	5452

The base year budget at 1966/67 prices is shown in Table 2. Expenditure items which are normally included in stock accounts and which thus do not appear in running expenses were accounted for by adjustment of prices received for products. Ram replacements were added separately. Total expenditure is thus $5572, with gross income from fat lambs, cast-for-age ewes and wool of $9121, giving a gross profit of $3549. Out of this sum the farmer must meet actual interest payments, mortgage repayments, wages of management and income tax.

TABLE 1 Average Running Expenses - Southland Intensive Farms 1955/56 - 1964/65 (1966/67 Prices)

	$	Per Cent
Wages and Rations	942	16.7
Shearing	423	7.5
Farm Requisites	169	3.0
Fertiliser, Lime & Seeds	874	15.5
Truck, Tractor, Fuel & Power	536	9.5
Feed and Grazing	96	1.7
Contract Work	288	5.1
Repairs & Maintenance	631	11.2
Railage & Cartage	209	3.7
General Expenses	130	2.3
Insurance	62	1.1
Rates	231	4.1
Interest	366	6.5
Depreciation	564	10.0
Rent	118	2.1
	5638	100.0

TABLE 2 Base Year Budget for Representative Farm at 1966/67 Prices

	$	$
Income		
1120 lambs @ 33 lbs. @ 12.2 c. per lb.	4509	
154 c.f.a. ewes @ 55 lbs. @ 6.6 c.	559	
1320 ewe equivalents @ 11.5 lbs. wool @ 26.7 c.	4053	
Gross Income		9121
Expenditure		
Running expenses at 5.5 ewe equivalents	5452	
6 rams @ $20.00	120	
Total Expenditure		5572
Gross Profit		3549

In the development budgets, expenditure was divided into overhead items which would not increase with more stock and variable items which vary with stock numbers. Insurance, rates and depreciation were taken as fixed. Fuel and power, contract work and repairs and maintenance were assumed to increase by 33 per cent of stocking rate; these items in farm accounts include tax deductible development expenditure. Wages, shearing, farm requisites, railage and cartage and general expenses in direct proportion to stocking rate. Fertiliser, fencing and drainage are estimated separately.

Method: As long as the rate of development does not affect production levels, the faster a profitable development programme is carried out, the more profitable it will be. In this analysis some allowance is made for stock performance to suffer as rate of development increases. The gross profit generated for each farm for the seventeen years following the initiation of the development plan is compared to that from no development at all. This shows the amount of money that would have to be sacrificed in the early years of development. It also shows when and how much extra income is generated.

The development strategies for each situation were as follows:

(1) Rapid Development - defined as the most rapid rate of development known that can be contemplated under present technology. These apparently limit the speed of development to the rate defined as an increase of 150 ewe equivalents per year, i.e. development is completed by the end of the fourth year when stocking rate has increased from 5.5 ewe equivalents per acre to 8.0 ewe equivalents per acre. (0.63 e.e/acre/annum.) Lambing percentages decline from 120 per cent to 110 per cent and wool weights from 11½ lbs. of wool to 10½ lbs. of wool.

(2) Medium Rate Development - when the development programme provides for stock increases of 75 ewe equivalents per year, and hence stocking rate is increased from 5.5 ewe equivalents per acre to 8.0 ewe equivalents per acre by the end of the eighth

year. (0.31 e.e/acre/annum.) Stock performance declines to a smaller extent.

(3) Slow development - the development programme proceeds at a quarter of the rate of the "rapid" programme, i.e. stock numbers are increased by an average of 37.5 ewe equivalents annually, and the development plan is completed at the end of the 16th year. (0.16 e.e./acre/annum.) There is no decline of stock performance.

Clearly, profitability studies such as this tend to oversimplify the complex of factors which may inhibit or prevent production increases. It is necessary, for example, to assume that the farm operator is technically efficient, and has the management ability to follow recommended techniques of pasture improvement, and to take advantage of the increased volume of forage by efficient stock management. Similarly, it will be shown that the rapid development strategy requires large amounts of capital in the early years. Capital could quite feasibly impose a further limit on the rate of development. This could happen in two ways:-

(a) The bank or stock firm may be unable or unwilling to lend all the capital required.

(b) The farm owner, if he has limited liquid assets available, may be unwilling or unable to sacrifice income to finance the development.

It is not the purpose of this paper to comment on the best source of finance for development. For convenience, and to enable all costs to be amalgamated under one heading, it will be assumed that development is financed from income. The sacrificed income could equally be interpreted as the level of borrowing necessary to maintain income.

Criteria of Profitability: The profitability of the various development proposals is measured by the present value of the estimated annual increase in gross farm profit. An investment such as a development programme will require that income be sacrificed or foregone in earlier years in

order that it be at a higher level after development is completed. The faster rate of development will clearly require larger sacrifices in income (or perhaps borrowing) than slower development programmes, but will reach a high level of income much sooner. Present values convert different proposals to a common measure for comparative purposes.

Since the paper compares development programmes with the "no-development" or static situation, the only figures which need concern us are the additional expenditures (sacrificed income) or income which results from the development programme. Hence the following formula has been the basis of calculations of present value:-

$$PV = \sum_{n=1}^{N} \frac{A_n}{(1+i)^n} + \frac{A_F}{i(1+i)^{F-1}}$$

where PV = Present Value

A_n = Sacrificed income or additional income in year n. If income is sacrificed the sign of A is negative. If income is additional the sign is positive.

A_F = Income in year F

F = Year when development is complete, i.e. the $(N+1)^{th}$ year.

N = Period of development

i = Discount rate

The profit from development is defined as the cash difference between what the farmer undertaking a development programme receives and what he would have received had he not developed. The amount of profit is defined as the present value of this difference in successive years summed for all years. The present value is the discounted value

of a future income stream. It assumes that the earlier a given sum is received the more valuable it is, e.g. if $1,000 was received now and was invested at 6½%, the total in a year's time would be $1,065. The discount rate that has been used in this case is 6½% since this is the interest rate charged by most stock firms.

Another measure of profit is obtained by setting PV = 0 and calculating i. This is the Internal Rate of Return. The cash proceeds of a development programme are equivalent to those which could be obtained from an alternative investment at the internal rate of return.

PROFITABILITY OF FARM DEVELOPMENT

Situation 1 - 1966/67 prices: The basic method of analysis used is a comparison of the developing farm with a static or non-developing farm. The base year gross profit in Table 2 represents the starting point, and it is assumed that a non-developing farm would stay at this gross profit for the period of the analysis (except where the price squeeze is assumed to affect this farm also).

For each development hypothesis, the projected rate of stock expansion was used to calculate drainage, fencing, labour and fertiliser requirements; fuel and power, contract work and repairs and maintenance were increased at one third of the rate of increase of stocking and shearing costs, farm requisites, railage and cartage, wages & rations and general expenses in direct proportion to the increase in stocking rate. All these costs are at 1966/67 prices in situation 1.

Stock reconciliations were worked out for each rate of development assuming a breeding replacement policy where possible. Most ewes survive six lambings and a 5 per cent wastage rate from hoggets to old ewes was allowed.

The fast development hypothesis raises carrying capacity from 5.5 ewe equivalents per acre to 8.0 ewe equivalents per acre in four years. An additional 150

ewe equivalents would have to be added to the existing flock each year. At this rate of advance, farm advisers in the area do not think stock performance can be maintained at existing levels. The budgets therefore take into account a decline in wool weight per sheep from 11½ lbs. in the base year to 10½ lbs. in the fifth year, recovering again to 11½ lbs. by the 13th year. Over the same period, lambing will fall from 120 per cent to 110 per cent and then recover again.

The medium rate of development hypothesis requires the flock to be expanded by 75 ewe equivalents per year. Over this eight year period some decline in stock performance is anticipated, but probably not as much as for fast development. It was therefore assumed that wool production would fall from 11½ lbs. to 11 lbs. by the eighth year and returning to 11½ lbs. in the 13th year; and lambing percentage declines to 115 per cent over the same period.

The slow rate of development is calculated on the basis of an increase of 37½ ewe equivalents per annum. It takes 16 years to reach the target stocking capacity, and it is assumed that this can be achieved without sacrifices of lambing percentages or wool weights.

The actual weight of 11½ lbs. of wool per ewe equivalent is the average production for the sample of farms surveyed by the New Zealand Meat & Wool Boards' Economic Service, after an allowance of 2½ lb. wool sold with each prime lamb and ¾ lb. wool sold with old ewes is deducted.

Lamb meat production was calculated on the basis that all lambs not kept for replacement were sold prime at an average of 33 lb. dressed weight. Where two-tooths predominate among the young stock in the case of rapid development, a lambing percentage of 107 per cent for extra two-tooths was assumed. Mutton production was calculated on the weight of old ewes - 55 lbs. dressed weight.

Lamb prices are based on the South Island schedule price for prime lambs, February-March, <u>less</u> 0.4 cents per lb. to allow for an average of 30 miles transport to freezing works. Mutton prices are also the schedule price for the same period, with the same deduction. Wool

prices are based on the average Invercargill sale price for greasy wool, for the same period, less 2.5 cents per lb. for selling charges. The actual 1966/67 schedule of wool prices can be compared with the average prices from 1955 to 1966 as follows:

	1966/67	1955-65
	(cents per lb)	
Lamb	12.6	16.8
Mutton	7.0	5.6
Wool	29.2*	37.0

* N.Z. average

The resulting budgets for the three rates of development are summarised in Table 3. The negative sign indicates the extent to which gross profit was less than $3549 in the year stated. The positive sign indicates where gross profit started to improve over and above $3549, the level the farm already had before intensive development.

Rapid development implies that development expenditure is higher in each year. If no borrowing is assumed, gross profit must fall by the full amount of money re-invested in the farm. Thus the farmer who wishes to develop rapidly must make more sacrifice of income to achieve his objectives (or go further into debt). But at the same time, he reaches the high level of income sooner. The medium and slow developers must wait longer for their rewards, but they have made less sacrifice as well. Which of these courses of action farmers would actually prefer is probably a matter of personal preference. The following analysis of present values might help the adviser particularly, in setting out the choice to the farmer.

Table 4 shows how the three hypotheses may be compared. The present value calculations assume that the farmer discounts future income at 6½ per cent per year. The calculation for each rate of development measures how much the later gains from development compensate for the early sacrifices. The greater the sacrifice, the greater the later gain needed for compensation. Alternatively,

TABLE 3 Foregone and Additional Income Associated with Different Rates of Development at 1966/67 Prices

Base Profit = $3549

Season	Rapid $	Medium $	Slow $
1967/68	-3912	-1824	-1082
1968/69	-3384	-1608	- 784
1969/70	-3025	-1516	- 761
1970/71	-3017	-1239	- 496
1971/72	+1043	- 970	- 340
1972/73	+1188	- 707	- 179
1973/74	+1337	- 439	- 19
1974/75	+1481	- 210	+ 108
1975/76	+1626	+1626	+ 181
1976/77	+1774	+1774	+ 360
1977/78	+1919	+1919	+ 514
1978/79	+2064	+2064	+ 615
1979/80	+2212	+2212	+ 790
1980/81			+ 964
1981/82			+1140
1982/83			+1157
1983/84			+2212

TABLE 4 Present Value Analysis of Development at 1966/67 Prices

Rates of develop.	Period of develop.	Period of sacrifice	Largest sacrifice	Eventual extra gross profit	P.V. of sacrifice	P.V. of extra gross profit during develop.	P.V. of post-develop. extra gross profit	Total P.V.	Annual Equiv.	Int. Rate of Return
	Years	Years	$	$	$	$	$	$	$	%
Rapid	4	4	-3912	+2212	-11506	0	+23116	+11610	+746	11.2
Medium	8	8	-1824	+2212	- 6949	0	+19781	+12832	+834	13.3
Slow	16	7	-1082	+2212	- 3104	+2521	+12425	+11842	+770	14.9

Gross profit from base year budget $3549
Gross profit after development $5762
Total P.V. = P.V. of extra gross profit during development
+ P.V. of extra gross profit after development
- P.V. of sacrificed profit.
Rate of interest = 6.5%
Annual equivalent = Total P.V. x .065

the greater the sacrifice, the sooner the later gain will be needed for compensation. It can be seen that the medium rate of development comes out best from the comparison. Apparently, the gains are achieved soon enough to more than make up for the medium level of sacrifices involved.

But if the rate of time preference of farmers is around 6½ per cent, then there is little to choose between all three rates of development. The errors involved in budget calculations of this sort could well be greater than the differences between the total present values.

If borrowing is contemplated for the development programme, then the three methods of development will meet the cost of borrowing, i.e. at current overdraft or stock firm interest rates. The internal rate of return on each programme is highest for the slow programme and lowest for the fastest programme. The pattern of present values over different interest rates can be seen in the following comparison:

	Present Values		
	Fast	Medium	Slow
	$	$	$
at 5%	20817	21781	20092
10%	1762	3454	3601
15%	-3200	-1075	- 65
20%	-4949	-2579	-1187

Thus the fast developer is at a disadvantage at higher discount rates, as his later gains are neither high enough or soon enough to make his sacrifice worthwhile.

Situation 2 - Effect of Inflation: Situation 1 reflected the rather pessimistic view that 1966/67 prices were all farmers could expect in the next few years. No inflation of input prices was contemplated.

But if the past is any guide, New Zealand's export prices will continue to fluctuate against a background of rising input prices. This section of the bulletin examines

what would happen to gross profit on the representative farm if past price patterns were repeated.

The analysis commences from the same base year budget as shown in Table 2 and the three physical development programmes are carried out in the way already described. It is assumed that prices change after 1966/67 in the same manner as they did after 1951/52.

Price index numbers were drawn up with 1951/52 = 1000, for wool, lamb and mutton, and for price changes of inputs on fattening farms.* Thus the prices for the budget of the second year of development would bear the same relationship to 1966/67, as those of 1952/53 had to 1951/52. High price years following 1951/52 would thus increase gross revenue and low price years lower it. The costs of production in 1967/68 were also adjusted from 1966/67 in proportion to the change in input prices from 1951/52 to 1952/53. This process of adjustment built up the gross profit series shown in Table 5.

It is important to note that instead of a single base year budget, there is now a base farm or static budget for every year of development. The static farmer is subject to the same winds of change as the developing farmers. The high returns of year 6 and year 13 reflect the good seasons of 1956/57 and 1963/64. The low returns of year 11 and year 16 likewise reflect the sale prices of 1961/62 and 1966/67. The increase in the prices of farm inputs has been steadily eroding profits over the same period (see appendix for details). The final gross profit for year 17 is based on the average price relationships of the period from 1954 to 1965. The effect of the price squeeze is evident in the steady erosion of the gross profits of the non-developing farm.

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* New Zealand Meat and Wool Boards' Economic Service Cumulative Cost Index.

TABLE 5 Gross Profit of Representative Farm, Static Situation and Three Rates of Development

Season	Static $	Rapid $	Medium $	Slow $
1	3549	-363	1724	2467
2	5298	1864	3647	4507
3	5819	2925	4369	5089
4	6693	4207	5612	6321
5	6758	8819	6084	6634
6	7190	9619	7066	7393
7	4519	6202	4109	4565
8	3365	4790	2898	3349
9	3981	5809	5809	4141
10	3075	4718	4718	3250
11	2240	3696	3696	2326
12	2578	4331	4331	2826
13	5311	8459	8459	6575
14	5017	8054	8054	6367
15	3977	6563	6563	5169
16	1353	2769	2769	1481
17	3603	6041	6041	6041

Table 6 sets out the additional income that the developing farms obtain. It is important to note that these series are not derived from a fixed base year as in Table 3, but are the differences between the gross profit of the static farm and each of the developing situations.

The pattern of sacrifice and gain is similar to that shown in the pessimistic price situation, but the general level of profits is higher. As one would expect, the price relationships over this period were more favourable to farmers than those of 1966/67.

The present value analysis of these results is set out in Table 7. The change in prices has slightly favoured the fast developer at the expense of the medium developer, but the difference is not significant. The slow developer has not made sufficient later gains to compensate enough for the small decline in income foregone. As interest rates (discount rates) rise, the slow developer gains at the expense of the fast and medium developers as the following present value calculations show:

	Present Values		
	Fast	Medium	Slow
	$	$	$
5%	+25650	+24845	+22113
10%	+ 4334	+ 4656	+ 4199
15%	- 1436	- 387	+ 253
20%	- 3629	- 2115	- 960

TABLE 6 Foregone and Additional Income Associated with Different Rates of Development with Inflation of Input Prices and Fluctuating Product Prices

Season	Rapid $	Medium $	Slow $
1	-3912	-1824	-1082
2	-3433	-1650	- 791
3	-2893	-1449	- 729
4	-2486	-1080	- 371
5	+2060	- 674	- 124
6	+2429	- 123	+ 203
7	+1682	- 410	+ 46
8	+1425	- 466	- 16
9	+1828	+1828	+ 160
10	+1642	+1642	+ 175
11	+1456	+1456	+ 186
12	+1752	+1752	+ 247
13	+3147	+3147	+1264
14	+3037	+3037	+1350
15	+2585	+2585	+1191
16	+1416	+1416	+ 127
17	+2438	+2438	+2438

TABLE 7 Present Value Analysis of Development with Inflation

Rate	Period of dev.	Period of sacrifice	Largest sacrifice	Eventual extra gross profit at average prices	P.V. of sacrifice	P.V. of extra gross profit during 16 yrs	P.V. of extra gross profit after 16 yrs	Total P.V.	Annual Equiv.	Internal Rate of Return
	Years	Years	$	$	$	$	$	$	$	%
Rapid	4	4	-3912	+2438	-11027	+12754	+13692	+15410	+1002	13.7
Medium	8	8	-1824	+2438	- 6328	+ 7632	+13692	+14996	+.975	14.8
Slow	16	6	-1082	+2438	- 2705	+ 2139	+13692	+13126	+ 853	15.7

Situation 3 - Average Prices 1955-1965: The third price hypothesis is that farmers will experience output prices similar to the average of the period 1955-1965. Input prices are held at 1966/67 levels.

The base year profit is calculated the same way as in Table 2, but total receipts will be slightly higher.

Income	$
1120 lambs @ 16.4 c. per lb.	6062
154 c.f.a. ewes @ 5.2 c. per lb.	440
1320 ewe equivalents, wool @ 34.5 c. per lb.	5237
	11739
Total Expenditure	5572
Gross Profit	6167

The three rates of development will have the same physical coefficients as before. The resulting outputs will be valued in all years by the prices used to calculate total income above. The appropriate level of expenditure in each case is deducted to obtain the gross profit series. Additional gross profit over and above the base year gross profit is then calculated. These results are shown in Table 8.

The pattern of profit recovery is the same as in the previous two situations, but the ultimate level of income at the end of the development period is higher.

	Base Profit	Ultimate Additional Profit
	$	$
1. 1966/67 Prices	3549	+2212
2. 1955/65 Prices	6167	+3402

TABLE 8 Foregone and Additional Income Associated with Different Rates of Development at 1954-1965 Output Prices

Base Profit = $6167

Season	Fast $	Medium $	Slow $
1967/70	-3869	-1740	-1070
1968/69	-3174	-1515	- 827
1969/70	-2517	-1391	- 710
1970/71	-2127	- 983	- 332
1971/72	+1857	- 562	- 81
1972/73	+2048	- 154	+ 169
1973/74	+2245	+ 286	+ 419
1974/75	+2436	+ 692	+ 601
1975/76	+2627	+2627	+ 658
1976/77	+2823	+2823	+ 987
1977/78	+3014	+3014	+1189
1978/79	+3205	+3205	+1326
1979/80	+3402	+3402	+1584
1980/81			+1852
1981/82			+2141
1982/83			+2302
1983/84			+3404

Converting the data in Table 8 to present value terms gives generally higher levels of total present value of cash development programme. These are set out in Table 9. The annual equivalents of the total present values are nearly twice as high as those estimated at 1966/67 output prices. The fast and medium rates of development again give very similar answers, and pay better than slow development at 6½ per cent interest rates. The previous pattern of results follows in the internal rate of return calculations, which favour the slow development hypothesis. The disadvantages of fast development at higher discount rates can be seen in the following analysis of the extra gross profit flows:

	Present Values		
	Fast	Medium	Slow
5%	+40605	+39938	+35609
10%	+10234	+10603	+ 8987
15%	+ 1744	+ 2782	+ 2560
20%	- 1647	- 180	+ 314
25%	- 3191	- 1456	- 599

TABLE 9 Present Value Analysis at Average Output Prices

Rates of Devel.	Period of Devel.	Period of Sacrifice	Largest Sacrifice	Eventual Extra Gross Profit	P.V. of Sacrifice	P.V. of extra Gross Profit during Devel.	P.V. of post-dev. Extra Gross Profit	Total P.V.	Annual Equiv.	Internal Rate of Return
	Years	Years	$	$	$	$	$	$	$	%
Rapid	4	4	-3869	+3402	-10168	0	+36268	+26100	+1697	17.0
Medium	8	6	-1740	+3402	- 5401	+ 602	+30591	+25792	+1676	19.5
Slow	16	5	-1070	+3402	- 2639	+5926	+19189	+22476	+1461	21.3

Gross profit from base year budget = $6167

Gross profit after development = $9569

CONCLUSIONS

The objectives of this paper were to examine the following questions:

1. Does further intensive development of sheep farms in Southland pay?

2. What management techniques are important in this stage of development?

3. What are the fertiliser requirements of the programme?

4. Do different speeds of development alter profitability?

5. Are different speeds of development compatible with maintaining stock performance?

6. What is the influence of present price levels on profitability?

Without a doubt, intensive development programmes do pay. Satisfactory extra gross profits were generated at all price levels. It is always likely that intensification of this type will be a paying proposition as long as some fixed costs can be spread over a larger and larger output. Diminishing returns can set in because the cost of increasing stock numbers rises progressively or because individual stock performance declines. There is no evidence that variable costs are increasing rapidly, although it must be noted that the fertiliser requirements of extra stock are much higher. Declining stock performance has been incorporated in the calculations already set out.

The new levels of stocking capacity are based on higher management skills. The experience of farmers with high stocking rates is increasing all the time, and further intensification methods are yet to be discovered. The

main benefit of intensification so far has been to increase the number of stock a single owner-occupier can control from day to day.

Fertiliser requirements double when the stocking rate is increased by 50 per cent, i.e. from 5.5 e.e. to 8.0 e.e. Analysis of the herbage and soils, and the offtake of meat and bone suggests that potassic superphosphate must be the main fertiliser. If intensive farms expand stock at the medium rate of development, their fertiliser requirements will double in a period of eight years.

The results on speed of development do not suggest marked gains to very rapid development. But both rapid and medium speed of development improve incomes more than slow development. It is suggested that the farmer himself has to judge at what speed to go and this must be related to family commitments, schooling needs and borrowing power. Some farmers have personalities which like to see results quickly; others like to consolidate as they go along.

The evidence for declining performance under rapid development is not complete. Extension officers feel that some loss is involved at present. The budgets have tried to quantify this loss as accurately as possible.

The final over-riding question is whether intensive development pays at 1966/67 prices? Evidence on prices paid for products in 1967/68 is not complete yet. The lamb schedule has opened at 11.9 cents and wool is subsidised at 25 cents per lb. It seems likely that 1967/68 profits will be similar to 1966/67 profits.

But intensive development at 1966/67 prices still adds to gross profits in the long run. The farmer has an extra $2000 to meet his obligations of mortgages, interest and income tax. Some farmers may not like to develop at present because it may be difficult to finance the development programme out of income. They may not wish to borrow. It seems that liquidity may be more

important to farmers at the present time than increasing income at some future date.

If product prices do improve, then the gains from development increase proportionately. More income can be set aside for re-investment, and development can be accelerated again. Present farm management knowledge suggests that 8 ewe equivalents per acre can be achieved in all grass farming in Southland, and that it can be done profitably.

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(5) N.Z. Wool Board Annual Reports.

A P P E N D I X

Prices Used in Analysis

Year	Wool $/lb a	Wool Index	Lamb $/lb b	Lamb Index	Mutton $/lb c	Mutton Index	Input Price Index 1951/2 = 1000 d	Input Price Index 1951/2 = 1000 e
1951/52	.312	1000	.136	1000	.050	1000	1000	1000
1952/53	.395	1266	.158	1162	.052	1040	1015	1069
1953/54	.419	1343	.166	1221	.060	1200	1042	1074
1954/55	.418	1340	.200	1471	.056	1120	1078	1121
1955/56	.395	1266	.212	1559	.062	1240	1096	1149
1956/57	.477	1529	.196	1441	.066	1320	1123	1179
1957/58	.333	1067	.180	1324	.054	1080	1148	1221
1958/59	.310	994	.162	1191	.044[f]	880	1175	1235
1959/60	.374	1199	.156	1147	.044[f]	880	1178	1252
1960/61	.343	1099	.144	1059	.044[f]	880	1197	1275
1961/62	.329	1054	.126[f]	926	.048[f]	960	1215	1292
1962/63	.349	1119	.130	956	.048[f]	960	1226	1312
1963/64	.467	1497	.166	1221	.048[f]	960	1225	1319
1964/65	.351	1125	.196	1441	.082	1640	1254	1344
1965/66	.338	1083	.178	1309	.076	1520	1292	
1966/67	.292[g]	936	.126[g]	926	.070[g]	1400	1335	

[a] Average wool price, Invercargill sales - Dept.of Statistics(4)

[b] January average woolly lambs 36/u. (3)

[c] February and March average price for ewes.(3)

[d] N.Z. Meat & Wool Boards' Economic Service Cumulation Index of Cost Movements (5)

[e] Estimates of Farm Income & Productivity (2)

[f] Deficiency payments.

[g] Provisional.

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