

AGRICULTURAL
ECONOMICS
RESEARCH UNIT



Lincoln College

AN ECONOMIC ANALYSIS OF
SOIL CONSERVATION
AND LAND RETIREMENT
ON SOUTH ISLAND
HIGH COUNTRY

by

R. W. M. JOHNSON



Research Report No. 62

1970

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P R E F A C E

This report is concerned with examining the economics of land retirement as a means of improved soil conservation in the higher altitude tussock grassland of the South Island of New Zealand. Dr Johnson sets out the detailed proposals for retirement of some 15,000 acres on an extensive property of 40,000 acres in size, and then goes on to show how present arrangements for the sharing of costs tends to fall rather heavily on the individual property owner.

This research project was commissioned by the Tussock Grasslands and Mountain Lands Institute and the actual costs of the investigation were met by them. A degree student, Mr David Shepherd, carried out field work, and officers of the above Institute, the Lands Department, and of the North Canterbury Catchment Board, gave generous assistance in the project. Final thanks go to the property owner, Mr David McLeod, for making his records available and extending hospitality to Mr Shepherd and Dr Johnson on visits to the property.

B. P. Philpott

Lincoln College,
May, 1970

AN ECONOMIC ANALYSIS OF SOIL CONSERVATION AND LAND
RETIREMENT ON SOUTH ISLAND HIGH COUNTRY

Introduction

In this paper, the soil conservation plan for Grasmere Station, Cass, is examined from the economic point of view. The conservation plan was drawn up in 1964 by the North Canterbury Catchment Board, and was to cover the 7 seasons from 1964/65 to 1970/71. Various modifications have been made to the original plan up to the present time and details of these are set out in the appropriate place. Details of costs and returns for the remaining two years of the plan have been estimated as closely as possible so as to obtain a reasonably clear picture of results for the whole period. Technical details of the plan are discussed first, then the costs of the plan are examined, including the cost-sharing basis that is employed in such planning, and finally an assessment is made of the benefits, both monetary and non-monetary, which should result from carrying out the plan.

The Basis of Soil Conservation Administration in New Zealand

The Soil Conservation and Rivers Control Act (1941), is the basis of government-assisted soil conservation work in New Zealand. The provisions of the Act are administered by Catchment Boards throughout the country, and Board officers prepare an overall plan of the necessary work required to qualify for assistance. This plan is submitted to the Soil Conservation Council in Wellington for approval.

and then the individual board is responsible for administering the adopted plan. Technical proposals on land retirement schemes for tussock grass-land properties are known as "run plans", and include a survey of the property from the point of view of location, area, tenure, altitude, climate, soils and vegetation, soil erosion, and the proposals for soil conservation.

In the case of the present report, the proposals are concerned with the removal of domestic grazing animals from 15,500 acres of exposed mountain land at altitudes from 3000' to 5000'. A 100% subsidy is available for a boundary fence on such an area, i. e. a retirement fence. To assist in providing grazing for sheep from the retired lands, certain subsidies are available, e. g. a 50% subsidy on materials only for fencing to subdivide grazing lands. Windbreak tree planting, firebreak access tracks, a 40% subsidy on soil conservation fencing to enable differential grazing of tussock country with different degrees of soil erosion and certain other practices are eligible for subsidies. A small deduction - on cost - is made from the subsidy by the Catchment Boards to cover direct expenses.

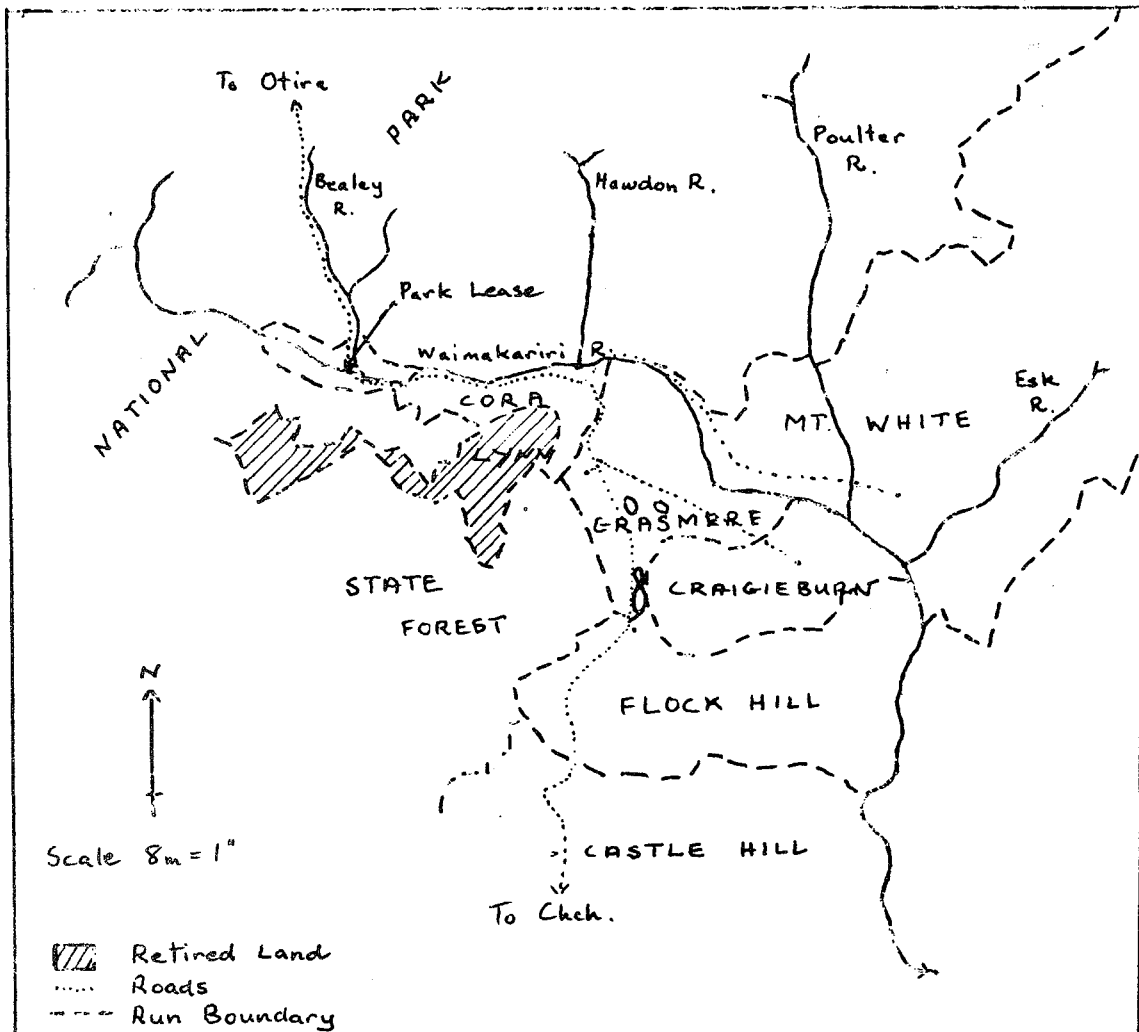
The Property

In this section, a brief description of the physical features of Grasmere Station is given. Many of the details are taken from the run plan proposed by the North Canterbury Catchment Board; this document is, of course, the basis of the economic study on which the present report is based, and further work could not proceed without it.

Grasmere Station actually consists of two leasehold runs in the Canterbury Land District, "Grasmere" and "Cora Lynn". Grasmere consists of a freehold area of 954 acres and a leasehold area of 13,419 acres. Cora Lynn has a freehold area of 387 acres and a leasehold area of 24,775 acres. The total area involved is 39,535 acres (1965 data).

The two runs are situated in the headwaters of the Waimakariri River, and follow the south bank of the river for roughly 25 miles. The altitude of the homestead and main flats is 2000', and a considerable area of the run acreage is situated at altitudes over 4000'. This is reflected in the land inventory of the property where approximately 25,000 acres of the 39,500 acres is classified as Class VII or Class VIII - land with severe limitations for grazing or not suitable for stock grazing at all.

Headwater Runs of the Waimakariri River



The leasehold area of Grasmere is University of Canterbury endowment land and the present lease is for 21 years, from February 1958. There are five separate leasehold areas on Cora Lynn, the higher and western-most of the runs. The Lands & Survey Department holds a pastoral lease over 13,100 acres for 21 years from 1944, and an occupational licence over 1,300 acres for seven years from 1959. The Arthurs Pass National Park Board has granted a long-term lease of 21 years from 1958 over 4,100 acres, and a further 3,500 acres is let on annual lease. Finally, the N. Z. Forest Service leased out 2,240 acres for a five year term from 1960.

As can be seen, three of the Cora Lynn leases expired in 1965, and the stated intention of the lessors is not to renew the leases subject to suitable arrangements being made for the grazing of stock thus affected. The run plan is designed to bring about this adjustment and by its conclusion in 1972, the property will only retain 5,053 acres under Crown Lease and 4,125 acres under National Park Lease on Cora Lynn. Some 15,600 acres on the Cora Lynn run will thus be permanently retired from domestic grazing stock. Details of the actual use of this land in recent years are given below.

Rainfall averages 50" at Grasmere and rises to 70" on Cora Lynn. The area is subject to strong winds from a north-west quarter, and pastures can dry out considerably in spring, summer or autumn. Snow is common in winter and may lie for weeks on the flats. The high summer grazing country is usually under snow for several months of the winter. Frosts are frequent for five months of the year and effective pasture growth is halted from May until mid-September.

The basic topography of the area was determined by glacial action in the remote past. Since the glacial age, the Waimakariri River has cut a broad swath through this glaciated landscape to form a number of wide terraces on the north-eastern boundary of the run. Other grazing country lies on the fans of the detritus which have formed over

the centuries, and on the more easily contoured mountain basins left by the glaciers.

The soils are suitable for cultivation on the lower fans, but most of the grazing area can only be improved by oversowing and top-dressing from the air.

The vegetation of the fans, river terraces and downs is Fescue tussock with the associated native species. Sweet vernal and browntop are the main introduced species. Towards the head of the watershed, beech forest is the dominant vegetative type, but on most of the steep intermediate country repeated burning in the last century has produced a wide mixture of various woody species, such as mata-gouri and manuka, which are probably slowly regenerating to a full forest cover. In the meantime, such areas are difficult to work and graze due to the lack of access. On hill country away from the divide, when rainfall is lower and evaporation higher, Fescue tussock predominates, interspersed with the remnants of a former covering of snow tussock.

The identification of the various land capability classes has been determined by Ministry of Works Soil Conservators. Details of the areas concerned for the two runs are as follows:-

	<u>Grasmere</u>	<u>Cora Lynn</u>
Class I	-	-
Class II	-	-
Class III	1100 acres	-
Class IV	1450 "	600 acres
Class V	-	-
Class VI	6610 "	1800 "
Class VII	1850 "	5400 "
Class VIII	3420 "	14200 "
Riverbed	-	4500 "
	<hr/>	<hr/>
	14430 "	26500 "
	<hr/>	<hr/>

These areas were determined off the land use map and do not exactly agree with the survey areas given elsewhere.

Management practices are discussed next. Historic records show that up to 23,000 sheep were grazed on the two runs in the 1890's. Stock losses and purchases for replacement over these years are not recorded but could be considerable. From 1900 to 1940 sheep numbers appear to have stabilised at about 12,000, but since 1945 only 9,000 have been grazed. There have been a number of adjustments to the grazing leases in the past, and the run plan shows that 39,400 acres were leased on Cora Lynn in 1947 compared with 25,000 acres still leased in 1965. Even with this reduction in the grazing area available, it appears that there has also been some decline in stocking rates per acre over the same period.

In 1964 there were 8,600 sheep wintered and 180 head of cattle. About 450 acres was in sown pastures or cultivation with some 75 acres sown to turnips each year. Breeding stock were wintered on paddocks, or on the low country surrounding the flats. During the summer and autumn, it was the custom to graze over 3000 wethers and dry ewes on the high country on the Cora Lynn run. In this way, some 10,350 grazing-months were obtained from the summer country. For a sheep flock of 8,600, this is 10 per cent of all sheep grazing months required.

The run plan and the lessors required that this proportion of the grazing requirements of the property be found elsewhere. As the run plan states "It will be a major task to adjust the management of this property to graze economically about 8,500 sheep on the remaining portions of Cora Lynn run and the Grasmere run".

The Retirement Plan as Proposed in 1964

It is useful to distinguish between the retirement proposals laid down in the run plan and other capital works concurrently entered into by the run-holder. Both can affect the disposition of livestock during the period affected by the run plan. In addition,

part of the run plan proposals carry subsidy and part do not. A proportional fee for soil conservation planning is added to the total costs of all subsidised work.

Taking the run plan proposals first, it was proposed to cultivate for turnips, hay and pasture a further 225 acres of previously uncultivated land in native cover. Turnips would be sown in the first and second years and new pasture sown in the third year. Only work on each block cultivated in the first and third years would be eligible for subsidy, and the runholder would have to undertake the complementary work of the second year at his own expense. Some fencing required to make cultivation blocks was also eligible for subsidy.

One 40 chain belt of shelter trees were proposed and subsidised together with half a mile of protective fencing.

A major fence of $4\frac{1}{2}$ miles was proposed to subdivide the sunny and shady sides of the 2,350 acre hill block for ewes.

It was proposed to subsidise the top-dressing and oversowing of 1,450 acres on the uncultivable fan country and on part of the hill ewe block. A total of 5 cwt of superphosphate was to be spread, 2 cwt in the first year a block was treated, $1\frac{1}{2}$ cwt of sulphur superphosphate in the third year and again in the fifth year. Thereafter, maintenance dressing would be the full responsibility of the runholder.

The objective of cultivating a further 225 acres and oversowing 1,450 acres was to be achieved in 7 years from 1964/65. Taking into account the actual blocks of land that were available, the physical development programme set out in the run plan could be summarised as follows:

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
New cultivation (ac.)	25	75	60	65			
Second turnips "		25	75	60	65		
New pasture "			25	75	60	65	
Chains of fencing	80	415	40				
Chains of treeplanting	40						
Area oversown (ac.)	300	200	950				
Area maintenance t.d.(ac.)			300	200	1250	200	950

The whole question of stock allocation is discussed in detail later, but it can be briefly noted at this point that the annual acreage of sown turnips was increased to about 130 acres from 75 acres, and that sown pasture available was increased to about 540 acres from 375 acres. By the end of the plan some 1,450 acres of hill country would have been oversown and regularly topdressed. The sheep displaced from the retired summer country would be found grazing on the more extensive hill country below 4000' and the stock formerly grazed on this country would in turn be accommodated on improved hill country and cultivated land. Since the medium hill country and cultivated land would have less spelling in summer under the plan, autumn and particularly winter grazing would also be affected by retirement of summer country and the increased area in turnips was designed to compensate for this.

Cultivation work, oversowing and topdressing, and tree planting were estimated to carry a 1:1 subsidy on job cost, while fencing a 2:3 subsidy on cost. The soil conservation planning fee in these initial proposals is simply assessed at 6 per cent of job cost. Unit costs of development work were assessed at 1964 price levels, and the plan costed for the whole seven year period. The financial implications for the Catchment Board of the proposed retirement plan can be seen in the following summary of the estimated plan costings:

<u>Year</u>	<u>Job Costs</u>	<u>Fees</u>	<u>"Total Cost"</u>	<u>Subsidy</u>	<u>"Local Share"</u>
1	\$ 3,004	180	3,184	1,540	1,644
2	8,108	488	8,596	3,696	4,900
3	7,656	462	8,118	4,006	4,112
4	3,136	190	3,326	1,662	1,664
5	4,518	270	4,788	2,394	2,394
6	1,720	104	1,824	912	912
7	2,612	156	2,768	1,384	1,384
Totals	\$ 30,754	1,850	32,604	15,594	17,010

Owing to the 2/5th fencing subsidy, the "local share" is a slightly higher proportion of the "total costs" of the run plan than the subsidy amount which is received by the Board. In effect the fee for planning work is deducted from this subsidy amount before the balance is paid to the runholder.

Modification of the Proposed Retirement Programme

Owing to the knowledge accumulated as the development plan was carried out, several modifications have been made in the works that are eligible for subsidy by mutual agreement of the parties concerned.

In 1967, it was decided to delay oversowing and topdressing the hill block of 950 acres and explore the possibilities of sub-division of the hill-block. The 4th year of the plan was therefore altered to include 50 chains of fencing on the hill-block, and another 200 acres of fan country was oversown and topdressed. At this stage it was planned to oversow 400 acres of the hill-block in the 5th and 7th years, and to put a second topdressing on the new fan block (Ritchies) in the 6th year.

During 1968, the oversowing of the hill-block was postponed indefinitely in favour of more fencing and some new cultivation. Thus the 5th year was to include 120 chains of fencing on another hill block (Long Hill) and the cultivation for turnips of a further 80 acres of native tussock on the better fan country. This 80 acres would come up for subsidy again in the 7th year when it was sown to permanent pasture.

Late in 1968, a further proposal was agreed whereby 380 chains of additional fencing was to be subsidised to enable cattle proofing to be carried out on most of the oversown areas.

At the time of writing (mid 1969) the physical plan of development can now be re-written as follows:

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
New cultivation (ac.)	25	75	70	60	84		
Second turnips		25	75	70	60	84	
New Pasture "			25	75	70	60	84
Chains of fencing	75	46	410	41	96	236	84
Chains of treeplanting	40						
Area oversown (ac.)	300	200		200			
Area maintenance t. d. (ac.)			300	200	300	400	

Using the unit costs already used above and adding the 6 per cent planning fee, the estimated costings of the modified plan, from the Board's point of view, are set out next.

Thus the estimated total cost of the proposed programme has now risen to \$35,777 compared with \$32,604 before modification. From the runholder's point of view the job cost of \$33,754 is most important, plus the proportion of the total subsidy he will actually receive. This is usually 50 per cent of job cost in the case of a 1:1 subsidy less 4 per cent.

<u>Year</u>	<u>Job Cost</u>	<u>Fees</u>	<u>"Total Cost"</u>	<u>Subsidy</u>	<u>"Local Share"</u>
1	\$ 3,004	180	3,184	1,498	1,686
2	2,978	179	3,157	1,488	1,669
3	8,338	499	8,837	3,594	5,243
4	4,624	277	4,901	2,252	2,649
5	5,048	303	5,351	2,388	2,963
6	5,542	332	5,874	2,434	3,440
7	4,220	253	4,473	1,440	3,033
Totals	\$ 33,754	2,023	35,777	15,094	20,683

Actual Cultivation and Improvement work since 1964

The following analysis lists the whole cultivation and improvement programme undertaken since 1964, and proposed up to 1971/72, dividing the improvements according to whether they were specifically mentioned in the run plan or not. It should be noted that the second crop of turnips in the cultivation sequence is henceforth considered part of the plan. All cultivation and topdressing work is included at this stage. Some acreages change with paddock size and some work was delayed from one year to the next.

	<u>Run Plan</u>	<u>Other Cultivation & Improvements</u>
(i) 1964/65	25 ac. to turnips 300 ac. oversown 40 ch. tree planting 75 ch. fencing	96 ac. to turnips 61 ac. to new grass 17 tons maint. super 105 tons lime 80 ch. fencing.
(ii) 1965/66	75 ac. to turnips 25 ac. second turnips 200 ac. oversown 46 ch. fencing	7 ac. to oats 53 ac. second turnips 36 ac. new grass 45 tons maint. super-aerial 30 tons initial super -aerial 52 tons lime 5 tons sulphate of ammonia 55 ch. fencing

(iii)	1966/67	70 ac. to turnips 30 ton maint. super 410 ch. fencing 25 ac. new grass 75 ac. second turnips	27 ac. first turnips 40 tons maint. super-aerial 10 tons maint. super-paddocks 164 tons lime 4½ tons Sulphate of Ammonia
(iv)	1967/68	60 ac. to turnips 75 ac. to new grass 70 ac. second turnips 200 ac. oversown 200 ac. maint. Super 41 ch. fencing	15 ac. to turnips 27 ac. second turnips 60 ac. new grass (from 65/66) - paddocks 9 tons super 75 tons lime 6 tons Sulphate of Ammonia 80 ch. fencing
(v)	1968/69	84 ac. to turnips 60 ac. second turnips 70 ac. new grass 30 tons Super 96 ch. fencing	25 ac. to turnips 42 ac. new grass 55 tons Super - aerial 11 tons Super - paddocks 150 tons lime 3 tons Sulphate of Ammonia
(vi)	1969/70	84 ac. second turnips 60 ac. new grass 46 ch. fencing 190 ch. fencing 400 ac. maint. Super	48 ac. to turnips 110 ac. second turnips 20 tons Super 30 tons lime
(vii)	1970/71	84 ac. new grass 190 ch. fencing	102 ac. to turnips 48 ac. second turnips 42 tons Super - aerial 20 tons Super - paddocks 55 tons lime
(viii)	1971/72	(status quo)	75 ac. to turnips 75 ac. second turnips 75 ac. new grass 42 tons aerial Super 20 tons paddock Super 37 tons lime (½ new grass)

This detailed outline shows how the subsidised improvements fitted into all cultivation and development work on the property, and shows how the subsidised works were first phased into the overall development plan and then phased out. The data shown for 1971/72 represents a

normal or status quo year which the runholder can achieve if no further capital improvements are envisaged. All quantities shown for this year would therefore be the more or less exact requirements of maintaining the new pastures and winter feed position at the 1970/71 level of productivity and carrying capacity. The stock carrying capacity for 1970/71 is assessed in a later section.

Total Cost of Cultivation & Improvement Work 1964/65 - 1970/71

Details of actual unit costs in each year to date are set out as an appendix to this report. In this section, total expenditure on cultivation and development is based on the actual cost to 1968/69 and budgeted costs for 1969/70 and 1970/71. Throughout this analysis a unit cost approach based on actual costs has been adopted for costing purposes, and any variations in farm overheads from year to year have been ignored. Total costs of the whole cultivation and improvement programme are worked out first, and then the cost of maintaining the pre-development situation is deducted from these costs to give the additional costs of the plan to the runholder before subsidy. It is the additional costs which will form the basis of any conclusions which can be drawn on the ultimate cost of the retirement plan.

The following table shows total expenditure on all cultivation and improvement work for the five years from 1964/65 to 1968/69 and estimates for 1969/70 and 1970/71.

The figures at the foot of the table show actual subsidies received by the runholder from 1964/65 to 1967/68, and estimated value of subsidies that will be received from 1968/69 to 1970/71.

\$	<u>64/65</u>	<u>65/66</u>	<u>66/67</u>	<u>67/68</u>	<u>68/69</u>	<u>69/70</u>	<u>70/71</u>
1st turnips)		1,317	1,702	1,393	1,864		
2nd turnips)	2,130	827	795	1,028	636	1,796	1,845
New Grass	1,128	667	627	2,496	2,207	1,150	2,035
O.S./T.D.	1,830	2,350		1,680			
Aerial T.D.		1,127	2,630	811	3,239	1,589	1,589
Paddock T.D.	450	397	265	238	291	530	530
S/Ammonia		250	225	300	150		
Lime	650	323	1,020	465	868	186	341
Fencing	1,849	1,311	5,816	1,090	1,262	1,429	1,051
Trees	31						
Oats		87					
Expenditure	\$ 8,068	8,656	13,080	9,501	10,517	6,680	7,391
Subsidy	\$ 1,358	1,375	3,429	2,530	2,257	1,739	1,065
Net Expenditure	\$ 6,710	7,281	7,651	6,971	8,260	4,941	6,326

Total Expenditure \$63,893

Total Subsidy \$13,753

Total Net Expenditure \$50,140

Thus all work on cultivation and improvements in the seven year period will cost \$63,893 but \$13,753 of this is paid for each year in the form of a subsidy by central government.

Estimated Cost of Cultivation without Run Plan

Clearly, some of the above expenditure would have been incurred whether the retirement plan was needed or not. It is thus necessary to estimate how much annual expenditure would have been needed to finance a cultivation programme involving about 38 acres of new grass, 75 acres of turnips, 138 tons of lime and 22 tons of maintenance fertiliser. It is assumed that no capital work was required to enable the property to be managed in the same way as it was in 1964/65.

The estimates of these base year costs are as follows:

	\$
38 ac. of 1st year turnips at \$17.50	665
37 ac. of 2nd year turnips at \$10.60	392
38 ac. of new grass at \$18.50	703
138 tons lime at \$6.20	856
7 tons fertiliser at \$26.50	185
15 tons aerial fertiliser at \$37.58	564
	<hr/>
	\$3,365
	<hr/>

It is important to understand that these are the costs of maintaining the cultivation programme as it was. This cost is to be deducted from development costs each year to obtain the extra expenditure associated with the retirement plan. In effect it is assumed that the labour requirements of the property remain the same as before and that overhead expenses remain unchanged. A bigger tractor was in fact bought at the beginning of the expanded cultivation programme. Replacement of machinery is fully allowed for in the unit charges.

Additional Costs Incurred with the Run Plan

The following analysis shows the derivation of these costs together with the actual subsidy as before:

	<u>Development Expenditure</u>	<u>Subsidy Received</u>	<u>Runholder's Extra Expenditure</u>
1964/65	4,703	1,358	3,345
1965/66	5,291	1,375	3,916
1966/67	9,715	3,429	6,286
1967/68	6,136	2,530	3,606
1968/69	7,152	2,257	4,895
1969/70	3,315	1,739	1,576
1970/71	4,026	1,065	2,961
	<u>40,338</u>	<u>13,753</u>	<u>26,585</u>

The extra costs involved will therefore total \$40,338 by 1970/71 of which \$13,753 will have been paid through subsidy. On this basis, 35 per cent of the retirement plan is paid by subsidy. The cost to the property owner is \$26,585.

The Catchment Board's Viewpoint

The subsidised development work in the run plan includes items from base year expenditure and items of development expenditure. Thus, the run plan allows a subsidy on the first crop of turnips out of new land, when probably half of this work would have been required in any case.

The following analysis shows all cultivation and top-dressing expenditure from 1964/65 to 1968/69 compared with total job costs on the run plan submitted to the Board.

	<u>Actual</u> <u>Expenditure</u>)	<u>Run Plan</u> <u>Estimates</u>
1964/65	\$ 8,068)	6,198
1965/66)	
1966/67	13,080)	8,584
1967/68	9,501		5,636
1968/69	10,517		4,906
	<hr/> 49,822		<hr/> 25,949
Less subsidy to runholder	10,949		10,949
	<hr/> \$ 38,873		<hr/> \$ 14,375

This comparison shows that the on-going cultivation and improvement programme has cost about twice as much as the subsidised components of the run plan. On this basis, only about 20 per cent of all expenditure is covered by the Catchment Board's subsidy.

From the procedural point of view, the subsidy system should perhaps be based on additional costs of the cultivation and improvement programme definitely associated with the retirement plans. Thus the subsidy would be based on costs over and above those which would have been incurred in the normal running of the station, as broadly indicated on page 16.

Benefits Generated by the Retirement Plan

There are two kinds of benefit generated in a retirement plan of the kind discussed here. Firstly, there is the physical change in the land which is removed from the grazing animal, and secondly, there are financial returns which can result from better land improvement, better stock and easier management. This section

therefore discusses the determination of the physical area of land which should benefit from the removal of stock and the nature of the physical benefit that is achieved; the next section will deal with the cost and returns from the re-location of sheep implied in the plan, and a third section deals with other financial benefits which arise during such a development programme.

On the Cora Lynn Run, the following areas will still be held by the runholder in 1971:

Cora Lynn freehold	387 acres
Crown Lease	5,053 "
National Park Lease	4,165 "
	<hr/>
	9,565

Since the area, leasehold and freehold in 1965, was 25,162 acres, the total area removed from domestic grazing animals is 15,597 acres.

On the Grasmere run, there were 529 acres in improved grasses (including the homestead area) and 450 acres in cultivation in 1965. Some 360 acres easy fan country will have been developed by 1971, bringing the total area of sown pastures to 890 acres.

On the more difficult fan country and rolling hill country some 700 acres will be oversown and topdressed under the new plan, and a further 600 acres had been oversown by the runholder independently of the run plan. In addition to this 1300 acres, some 4700 acres of moderate hill country has been affected by new fence lines, which enable closer grazing control to be achieved. This includes the front face of the ewe block of 900 acres, which is still open to the riverbed and cannot be regarded as fully enclosed as yet. This leaves 7,485 acres on the Grasmere run which is still grazed under the pre-1965 management pattern as it has not benefited from oversowing or fencing control improvements.

The position in 1971 will therefore summarise as follows:

i.	Area of land fully retired :		
	Cora Lynn	15,597	acres
ii.	Area of land grazed but unimproved :		
	Cora Lynn	9,565	"
	Grasmere	7,485	"
iii.	Area of land improved by fencing & oversowing:		
	Grasmere	6,000	"
iv.	Area of land improved by cultivation :		
	Grasmere	889	"
		<hr/>	
	Total area of 2 runs	39,536	"
		<hr/>	

The effective grazing holding in 1971 will therefore consist of 890 acres of cultivated pasture, 6,000 acres of semi-improved hill country, and 17,050 acres of natural grazing, a total of 23,940 acres out of the 39,536 acres held in 1965. Further subdivision on Grasmere particularly, could take some of the remaining Class VII country out of domestic use in future years if thought necessary.

As will be shown in the next section, the re-location of sheep grazing caused by this retirement of 15,600 acres has been achieved with considerable difficulty and at some cost. The benefits of this part of the plan are related entirely to the change in the soil conservation status of the country over 4,000' on Cora Lynn run. Clearly, undomesticated animals will also have to be kept to a minimum to achieve the full conservation objective, and it would greatly assist in this type of analysis if some measure of vegetative recovery or reduction of soil loss could also be demonstrated. With the present lack of knowledge of the physical changes which take place after full retirement, it is seldom possible to put a dollar value on the benefits to be derived.

On the 1,300 acres of oversown and topdressed hill country there is a definite improvement in surface cover. The following data on vegetative cover on Ribbonwood Fan, where oversowing and topdressing was initiated in 1956, is indicative:

		<u>'57</u>	<u>'58</u>	<u>'59</u>	<u>'60</u>	<u>'61</u>	<u>'62</u>	<u>'63</u>	<u>'64</u>	<u>'65</u>
Living										
Vegetation	%	62.4	92.5	77.7	82.7	79.8	87.5	88.4	95.4	99.0
Dead										
Vegetation	%	12.2	2.5	7.1	5.0	13.5	5.8	8.9	3.3	1.0
Bare										
Vegetation	%	25.4	5.0	15.2	12.3	6.5	6.7	2.7	1.2	0.0

Other sites surveyed show similar improvement in cover, together with the marked fall in 1958/59 due to porina damage. Browntop and sweet vernal are the main grasses which contribute to the increased cover, while clovers have gradually recovered each year to levels which were achieved immediately after oversowing.

Turning to retirement land, the Waimakariri Report² quotes further records of cover on enclosed and unfenced plots from the North Canterbury Catchment Board. In two sites out of four, there is a distinct improvement of cover in the enclosed plots.

In the same report,³ Wraight concludes his discussion of trends in the upper montane and alpine grasslands as follows:

¹ North Canterbury Catchment Board, Ms. Report on Grasmere Block, 18 May 1965.

² J.A. Hayward, The Waimakariri Catchment, Tussock Grasslands and Mountain Lands Institute Special Publication No. 5, 1967, p. 70.

³ Op. cit, p. 76.

"In the north west part of the (Waimakariri) catchment, the control of grazing animals (deer and chamois but not hares) that is being achieved is having a favourable effect on the condition and trends of the alpine grasslands. The response of the alpine grassland swards to this animal control has been good in some places, moderate only in others and lacking to date in others. But, equally importantly, large scale deterioration is no longer commencing."

In forest areas, adjacent to or within Grasmere Station, an intensive programme of deer control has been administered since 1957. In the Waimakariri Report, Holloway states that in 1956/57, trends in forest condition were considered to be uniformly downward, with the exception of Craigieburn Forest. By 1962/63, there had been a sharp drop in animal numbers as evidenced by droppings on measured plots but little indication of overall vegetation response. He concludes:

"It is not known for how long animal numbers must be held at their present low levels for the full resotation of satisfactory cover conditions, nor, in fact, whether full recovery is possible on all sites as a consequence of animal control alone. The example of Craigieburn Forest suggests that a minimum period of at least 15-20 years must elapse before the reversal of downward trends in strongly depleted high altitude forest becomes evident...."¹

It would greatly assist the analysis in this paper if the Forest Department could be asked to justify, in writing, the benefits they think will accrue on that part of the Cora Lynn leasehold that has been retained by them.

¹ Op. cit. p. 80

The Re-location & Displacement of Sheep Grazing under the Plan

The corollary of the land retirement proposal is the movement of the sheep off the high summer country. As suggested at an earlier point in this report the loss of the summer grazing sets in progress a process of displacement, whereby the dry sheep formerly grazed on the tops come down to the middle country, and the ewes and hoggets are in turn displaced to lower country and so on. In addition, there is heavier pressure on medium and low country grazing in the summer period which affects the carryover of feed into the winter period.

The runholder of Grasmere has kept records of sheep movements from the period before the run plan was implemented, and has recently brought these records up to date for the 1968/69 season. These records therefore allow the analysis of the before and after situation for sheep grazing to be determined quite accurately. It should be noted that this section only refers to the first five years of the run plan, and as indicated later, the final disposition of stock in 1971 is based on estimate only.

To bring all stock classes to standard units a high country ewe equivalent system has been adopted in what follows.¹

¹ <u>Classes of Stock</u>	<u>March-May</u>	<u>June-Sept.</u>	<u>Oct. -Feb.</u>
Ewes	0.75	1.00	1.00
Wethers	0.75	0.75	0.75
Hoggets	0.75	0.85	-
Two-tooths	-	-	1.00
Cows	6.00	6.00	6.00
Heifers	6.00	-	6.00
Steers	5.00	-	5.00
Yearlings	4.00	4.00	4.00
Weaners	3.50	3.50	-
Dairy Stock	5.00	5.00	5.00

The grazing records are analysed according to the three main high country seasons shown opposite and to bring out the displacement effects of the retirement policy, the records are also classified by the following land classes:

1. Retirement Land	- 15,500 acres
2. Extensive grazing land	- 17,000 acres
3. Improved grazing land	- 6,000 acres
4. Cultivated land	- 900 acres

Changes in Grazing Patterns 1964-69, Grasmere Station
(Ewe equivalent months)

<u>Season</u>	<u>Land Class</u>	<u>Before</u>	<u>After</u>	<u>Change</u>
March - May	1. Retirement	2,600	900	-1,700
	2. Extensive	8,458	8,426	- 32
	3. Improved	5,231	7,746	+2,515
	4. Cultivated	5,649	6,675	+1,026
		21,938	23,747	+1,709
June - Sept.	1. Retirement	-	-	-
	2. Extensive	11,970	9,476	-2,494
	3. Improved	6,968	9,262	+2,294
	4. Cultivated	15,700	18,480	+2,780
		34,638	37,218	2,580
Oct. - Feb.	1. Retirement	5,500	900	-4,600
	2. Extensive	19,370	13,878	-5,492
	3. Improved	13,921	18,756	+4,835
	4. Cultivated	5,593	12,635	+7,042
		44,384	46,169	1,785

It should be noted that the totals will not check exactly because of the ewe equivalent system and certain arbitrariness in the size of mobs on different blocks. There were also more cattle on hand at the end of the period than at the beginning.

The 900 grazing months still shown on the retirement plan country in summer and autumn is a small mob of wethers on Burnt Face in 1968/69. By 1970, this grazing will be no longer utilised.

In the autumn period, the loss of grazing on the retired block is mostly made up on the improved hill country. On the extensive blocks there is also a considerable movement out of sheep and an increase in cattle (see next table).

In the winter period a marked decline in stocking on the extensive country has taken place. A large number of sheep have been moved off these blocks in winter, and more cattle cannot be put in their place at existing standards of fencing. Instead, the improved grazing country has taken increased numbers of cattle, where the fencing is adequate, and ewes have been almost completely wintered on cultivated pastures and winter feed.

In the summer period there is a marked decline in both the retirement blocks and the extensive blocks. The movement of sheep off the extensive blocks is greater than shown, as cattle have increased slightly on these areas. In general, there is a great deal of summer feed available on the cultivated pastures and improved tussock, and there does not appear to be a need to push the sheep out on to the hills as much as formerly. The runholder is not in favour of allowing the grass on the improved country to "get away" in the autumn as grass grub and porina can be serious. In turn this means that the developed grazing areas do not have a greatly expanded contribution to make to winter feed.

The cattle do not graze the retirement block at all. As indicated above they have taken an important place in the management of this country by replacing sheep on extensive grazing land. The extent of this substitution process can be seen in the following figures showing the proportion of grazing months supplied by cattle instead of sheep.

Proportion of Total Grazing Used by Cattle

<u>Season</u>	<u>Land Class</u>	<u>Before</u>	<u>After</u>
March - May	2. Extensive	21.5%	28.2%
	3. Improved	19.6	20.6
	4. Cultivated	7.0	8.7
June - Sept.	2. Extensive	16.1	23.0
	3. Improved	26.8	48.1
	4. Cultivated	1.4	1.0
Oct. - Feb.	2. Extensive	9.8	18.3
	3. Improved	17.5	20.0
	4. Cultivated	1.3	0.9

Total sheep numbers have remained unchanged over the period of the analysis. The pattern of grazing of sheep has, of course, changed considerably. With the consolidation of the grazing area and the increased attention to winter feed, the main benefits have been in lower hogget and ewe mortality, less winter stress, and better quality surplus stock. As the following figures show, lambing percentages and wool weights have not shown a significant increase in recent years, and the revenue from the better quality surplus stock has not increased since 1966 due to lower market values.

Trends in Physical and Financial Productivity
Grasmere Station 1960-1969

<u>Year</u>	<u>Sheep Shorn</u>	<u>Sheep Sold</u>	<u>Wool/ Head</u>	<u>Lambing</u>	<u>Sales/ Head Sold</u>
1959/60	9,247	3,114	7.3 lb	88.0%	\$3.18
1960/61	9,165	3,483	7.0	86.0	3.95
1961/62	8,852	3,330	7.5	86.0	2.89
1962/63	8,662	3,140	7.0	87.0	3.56
1963/64	8,575	2,947	6.6	80.0	4.12
1964/65	8,705	3,075	6.4	85.3	4.80
1965/66	8,700	2,952	6.4	86.0	5.50
1966/67	8,671	3,194	6.8	91.0	4.10
1967/68	8,766	2,750	7.3	84.7	4.34
1968/69	8,448	2,468	7.2	80.2	4.96

The Gains from Increased Cattle

During the course of the run plan, it has been possible to increase cattle numbers, and by the end of the 7 year period a doubling of cattle numbers will have been achieved. At the autumn tally of 1964, there were 189 head of cattle and this has increased to 203, 223, 238, 261 and 323 in the years to 1969. It is estimated that numbers will be 350 in 1970, 377 in 1971 and 400 in 1972.

Natural increase has been relied on in the past to increase numbers, but in autumn 1969, 49 in-calf heifers were bought in. No other purchases except bulls are contemplated. Sales of cattle have steadily increased with a definite policy change from producing steers to producing weaners as the following data shows.

Cattle Sales - Grasmere Station 1961-72

<u>Year</u>	<u>Steers Sold</u>	<u>Cows Sold</u>	<u>Calves Sold</u>	<u>Total Sales</u>	<u>Value</u>
1960/61	21	17	-	38	\$2,723
1961/62	16	19	24	59	2,208
1962/63	17	16	35	48	2,712
1963/64	29	1	29	59	2,820
1964/65	21	13	35	69	3,552
1965/66	21	2	49	72	4,295
1966/67	16	1	62	79	3,440
1967/68	8	16	52	76	4,072
1968/69	23	20	65	108	5,237
<u>Projected</u>					
1969/70	37	20	91	148	7,316
1970/71	21 (heifers)	23	118	162	7,170
1971/72	23 (heifers)	26	141	190	8,320

The value of sales for the 3 projection years have been estimated from unit values of steers and heifers of \$80, cows at \$54, and weaners at \$36, with a 85% calving rate.

Taking into account purchases of bulls the gross profit from cattle should eventually approach \$8,000 per annum. Since gross profit in the early 1960's had just about reached \$3,000, the increase in revenue from cattle will be of the order of \$5,000 per annum.

Relative Costs of Development -Over sowing & Fencing versus Cultivation

The estimates given of increased carrying capacity can be next utilised to estimate the cost of development per ewe equivalent increase in carrying capacity on hill country and on cultivated country. These figures are derived from additional costs of cultivation and development as presented earlier. The cost is calculated in terms of carrying capacity as the exact acreages of the grazing country affected are not known with sufficient accuracy.

By allocating the expenditure items to the appropriate area and deducting appropriate base year costs, the extra development expenditure can be allocated to cultivated country and hill country as follows:

	<u>Cultivated Area</u>	<u>Hill Area</u>	<u>Total</u>
1964/65	\$ 3,437	1,266	4,703
1965/66	2,378	2,913	5,291
1966/67	2,453	7,262	9,715
1967/68	3,119	3,017	6,136
1968/69	3,215	3,937	7,152
	<u>14,602</u>	<u>18,395</u>	<u>32,997</u>

The following increases in carrying capacity have taken place on the respective classes of land:

	<u>Cultivated</u>	<u>Hill</u>
March-May	1,026	2,515
June-Sept.	2,780	2,294
Oct. - Feb.	7,042	4,835
	<u>10,848</u>	<u>9,644</u>

These are ewe equivalent grazing months. On a yearly basis there has been an increase of 904 EE on the cultivated land, and an increase of 804 EE on the hill, a total of 1708 EE.

It can be calculated that subsidies on cultivation development amount to \$5,225 and on hill development \$5,724. With all these figures, the following relative costs of high country development can be derived:

	<u>Cultivated</u>	<u>Hill</u>
Without Subsidy	\$ 16.18/EE	\$22.85
With Subsidy	10.41	15.76

	<u>All Development</u>
Without Subsidy	19.35
With Subsidy	12.90

Under these circumstances, the cultivated areas have proved more economic to improve. The hill country has not been brought up to its full potential, however, and greater investment in improvements is probably needed. More investment in fencing, for example, could greatly increase the carrying capacity at fairly low cost. It should also be noted at this point that 1,293 EE of the 1708 EE increase in these areas represents the re-location of sheep on the property and not a true increase in stock carried.

Summary & Conclusions

1. Out of a total area of approximately 40,000 acres, some 15,500 acres were to be retired from grazing.

2. This retired area was supporting about 10 per cent of the sheep flock at the introduction of the retirement plan.

3. The cost of altering the management of the property over a period of 7 years is of the order of \$40,000.

4. The benefits of the scheme are represented by the greater surface cover on the retirement area. It is difficult to get physical measurements of this benefit, not to mention dollar values for it.

5. Part of the cost of the soil conservation measures are met by central government subsidy, namely \$13,753 or 35 per cent.

6. The private cost to the individual runholder will be \$26,500 on the budgeting basis used.

7. Against this, the runholder will receive little extra revenue from sheep, but will, as a result of increasing cattle numbers, expect about \$5,000 more revenue annually than he had previously.

8. This run plan has been drawn up and administered according to the directives issued by the Soil Conservation Council. The plan has quite strictly re-located the former summer grazing on lower country without any alteration of sheep numbers.

9. The final results of the analysis indicate that the runholder has to bear a disproportionately large burden of the costs of land retirement. This is a value judgement on the writer's part and requires justification.

The view taken here is that land retirement is a watershed matter and the benefits of better vegetative cover on this land accrue to the people who benefit from better control of water in the watershed. The runholder would appear to be a very minor beneficiary in this case. It appears, in fact, that the benefits are entirely social returns in the sense that they accrue to the community at large, whereas the private return to the landholder is minimal.

The writer would therefore argue that the cost of retirement should be largely, if not completely, met by the community, and that the runholder should not have to 'share' in the cost of this essentially social decision by the community.

These remarks do not apply to any stock increases that occur during the re-location period. Clearly, if the re-location of 10,000 grazing months of sheep grazing should be fully subsidised, then any extra sheep or cattle that can be grazed should not be subsidised at all.

10. If the increase in expected cattle revenue is taken into account, then the runholder will maintain his income position at a level similar to what it was before retirement. It can be shown (see Appendix 2) that the extra cost of operating the property will be about \$2,500 per annum after the plan is completed, but that extra revenue from the cattle enterprise could approach \$5,000 per annum. Taking into account the 7 years of capital development, the extra \$2,500 per year is a fairly small improvement in the farmer's income position and represents a return of approximately 10 per cent on his share of the extra outlay, by the internal rate of return principle.

It is concluded, therefore, that the income position of this runholder has been protected by an increase in stock numbers. Conservation plans can protect the runholder in this way by either

an increase in cattle numbers up to a point where income is maintained, or by an increase in sheep numbers. Since careful budgeting of the sort represented here is beyond the time resources of local authority officers, the Soil Conservation Council could perhaps indicate a few working rules which would be acceptable for those charged with drawing up the original plans.

APPENDIX IUnit Costs of Cultivation & Development
(based on subsidy claims made)First Turnip Crop

	\$
Cultivation	10.25
Seed & Manure	<u>7.25</u>
Total	17.50

Second Turnip Crop

Cultivation	7.75
Seed & Manure	<u>2.85</u>
Total	10.60

<u>Oats</u>	Cultivation & Manure	Total	12.35
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Lime

Cost per ton	2.00
Spreading per ton	.80
Cartage	<u>3.40</u>
Total	6.20

Superphosphate

Bulk Price per ton	23.90
Transport	2.50
Spreading	<u>0.10</u>
Total	26.50

Ammoniated Super

Cost per ton	47.35
Transport & Spreading	<u>2.60</u>
Total	49.95

Oversowing & Topdressing

As per Fishermans Block 1964/65 (Pearson Block 1967/68 \$42.00)	46.00 per ton
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Aerial Topdressing

	\$
As per Fishermans Block 1966/67	37.58 per ton
(Pearson Block 1967/68 \$40.50)	

Sowing down of Pasture

As per Kidds Flat & Old Killer 1967/68	18.50 per acre
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Fencing

1964/65 Cass Paddock/Kangaroo & Kangaroo Plantation	11.85 per chain
Water race/Old Killer (paddocks)	12.50
1965/66 Kidds Flat/Fishermans (fans)	13.00
1966/67 Ewe country top fence	15.20
South Pole/New Paddock	11.50
1967/68 Magog/Cassidys Hill Block	15.20
1968/69 Long Hill - hill block	13.05

APPENDIX IIRunholder's Investment and Returns

The post-development expenditure situation is calculated as follows:

		\$
75 acres first year turnips	@ \$17.50	1,312
75 acres second year turnips	@ \$10.60	795
75 acres new grass	@ \$18.50	1,387
37 tons lime	@ \$ 6.20	229
20 tons super (paddocks)	@ \$26.50	530
42 tons aerial super	@ \$37.85	<u>1,589</u>
	Total	\$5,842
	Before Development	<u>3,365</u>
	Net	\$2,477

Combining the development costs from section 9, with the above budget, and including the gross profit from cattle, the following table of the investment and returns involved can be set out:

	<u>Net Costs of Development</u>	<u>Gross Profit of Cattle</u>	<u>Net Capital Cost</u>
1964/65	-3,345	+ 368	-2,977
1965/66	-3,916	+ 910	-3,006
1966/67	-6,286	+ 39	-6,247
1967/68	-3,606	+ 306	-3,300
1968/69	-4,895	+1,415	-3,480
1969/70	-1,576	+4,000	+2,424
1970/71	-2,961	+3,900	+ 939
	<u> </u>	<u> </u>	<u> </u>
Level off	-2,477	+4,900	+2,423

If the sum of \$2,423 is capitalised in perpetuity, the internal rate of return on the last column is 9.8 per cent.

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