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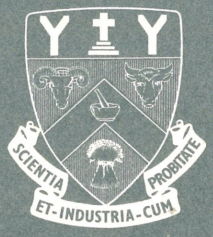

Lincoln College

PROFITABILITY OF IRRIGATION IN MID-CANTERBURY

by

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Publication No. 6

PROFITABILITY OF IRRIGATION IN MID CANTERBURY

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P R E F A C E

In the drier areas of New Zealand irrigation is one possible method of securing the increased volume of farm production which the country requires. But irrigation is costly and, however desirable it may be from the national viewpoint, it will only be adopted by farmers if it is profitable to them as individuals.

In a previous paper, Dr Stewart has shown that in one specific area of Mid-Canterbury, there was considerable doubt as to the profitability of irrigation compared with dry land systems of farming.

This conclusion is important enough to warrant further intensive farm management research which is now being pursued, and in this paper Dr Stewart and Mr Haslam present some preliminary first results from this research.

Lincoln College
12 August 1964

B. P. Philpott

PROFITABILITY OF IRRIGATION IN MID CANTERBURY

1. Introduction

During the summer of 1962/3, at the request of the Irrigation Development Association of the Ashburton-Lyndhurst Irrigation scheme, the Farm Management Department of Lincoln College undertook a survey of irrigation and dry land farming in Mid-Canterbury. The objective was to obtain information on the comparative profitability of irrigated and non-irrigated farms. This information was required by the Association as a basis for the negotiation of new contract rates for irrigation water, as the existing contracts were then due to expire at the end of the 1962/3 season.

Physical and financial data for the three production years 1959/60, 1960/61 and 1961/62 were obtained from 130 farms. Of these, 108 were on light land (Lismore series). This paper is concerned with these farms only, the remaining 22 being on better class cropping soils. Of the 108 farms, 65 were being irrigated from the Ashburton-Lyndhurst scheme, under varying levels of watering intensity. This was a comprehensive sample of irrigation farms over 200 acres. The remaining

43 farms which were non-irrigated were located outside the boundaries of the scheme, but under similar environmental conditions.

The results of the survey* have been fairly widely publicised. They gave quite clear indications that after due allowances had been made for different farm areas and for their correspondingly different levels of investment, irrigated farms were showing a margin of profit no wider than non-irrigated farms. There was in fact some indication that the opposite applied. We have been led to believe that opponents of irrigation in other districts, where the results do not necessarily apply, have used the survey to support their opposition. The survey has even been called a "national disaster". We know that there are quite a number of people who genuinely feel that further development of irrigation on the Canterbury Plains has been put back many years by the publication of the survey results.

We would share the concern of those who feel that the results have been interpreted too generally. But we could not have been more specific in designating

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* J.D. Stewart (1963) The Comparative Profitability and Productivity of a Sample of Irrigated and Non-Irrigated Farms in the Ashburton-Lyndhurst Area of Mid-Canterbury, New Zealand. Lincoln College Publication No.1.

the are to which the research applied, and in describing its physical environment. We were careful to point out in the conclusions to the survey, that they related to "the class of land and climate covered by the survey ... the type of farming generally practised ... and the existing technological conditions". Having taken this care we believed that it was our obligation to publish the facts which the research uncovered, even at the risk of unpopularity in some circles. It should also be emphasised that the research was specifically aimed at determining the capacity of irrigated farms to meet increased water charges. It was not primarily concerned with the wider aspects of irrigation economics.

This paper attempts firstly to explain the reasons behind the survey results and secondly, on the basis of management studies made of survey farms, to compare the profitability of two alternative management systems under irrigation.

2. Relative Profitability of Dry and Irrigated Farms

In an attempt to understand the survey results, we investigated the financial and physical structures of the 11 dry land and 13 medium irrigated farms of Table 1.

TABLE 1

FINANCIAL RESULTS ON LIGHT LAND FARMS

300-499 acres[1]

	(a) Non-Irrigators	(c) Medium[2] Irrigators
(1) Number of farms	11	13
(2) Average area in acres	425	374
(3) Average acre/feet water per acre	-	0.64
(4) Average total farms capital (£)	23,118	28,446
(5) Average Owner's Surplus (£)[3]	1,328	1,064

1. Stewart (op.cit.,) Table 5 p.10.

2. Farmers who used between 0.4 - 0.79 acre feet of water per acre of the farm, as an annual average over the three survey years.

3. Owner's surplus is the residual of income available to the farmer as a reward for management, after meeting all working expenses including depreciation, and interest at 6% on the total farm capital.

We aggregated and averaged the relevant data for these farms and the results are presented in Table 2. (Details of this table are given in appendix 1.)

TABLE 2

AVERAGE PHYSICAL AND FINANCIAL DATA

300-499 acre Farms

Dry and Medium Irrigated

Item	Average of 11 Dry-land Farms (with per acre averages in brackets)		Average of 13 Medium-irrigated Farms (with per acre averages in brackets)	
Area (acres)	425		374 (170 Border-dyked)	
Land Utilisation (% of Total area)				
(1) Cash Crops	10		9	
(2) Small Seeds	2		4	
(3) Winter feed	11		9	
(4) Lucerne	10		4	
(5) Grass	62		68	
Labour Units	1.4		1.3	
Capital (£)				
(1) Land U.V.	10,814	(25.4)	12,735	(34.0)
(2) Land V.I.	5,946	(14.0)	8,217	(22.0)
(3) Land C.V.	16,760	(39.4)	20,952	(56.0)
(4) Plant (Book Value)	1,666		1,861	
(5) Stock	2,924		3,748	
(6) Working Capital	1,766		1,884	
(7) Total Farm Capital	23,118	(54.4)	28,446	(76.0)
Stock (Numbers)				
(1) Breeding Ewes	1,085		1,100	
(2) Others	184		336	
(3) Cattle	5		20	
(4) Stock units/ available acre	3.3		3.9	

TABLE 2 (Cont'd)

Item	Average of 11 Dry-land Farms (with per acre averages in brackets)	Average of 13 Medium-irrigated Farms (with per acre averages in brackets)
Financial Performance (£)		
(1) Total farm income	5,413	5,830
(2) Total farm working expenses	2,698	3,059
(3) Interest on T.F.C.	1,387	1,707
(4) Owner's Surplus	1,328	1,064

Table 2 shows that, when compared with the average 300-499 acre dry land farm, the average 300-499 acre medium irrigated farm has heavier investment in land, stock and plant, with the result that total farm capital is some £5,000 greater. Secondly these irrigators are carrying only half a stock unit per available acre more than the dry land farmers. In particular, both these average farms carry the same number of breeding ewes and the extra half stock unit is composed of dry sheep and cattle.

Therefore it is not surprising to find that the total farm income is only £400 greater on these irrigated farms, while farm expenses are also greater.

The survey results showed that the average irrigation farmer was making at least no more profit than the average dry land farmer, and in fact indications were

that the opposite applied. Table 2 shows that the extra half a sheep per grazing acre carried by the irrigation farm is not sufficient to sustain the additional £5,000 capital investment.

However, we wish now to emphasize that we have never suggested that irrigation cannot be made to pay. Indeed there are clear indications that some irrigators are earning high rates of return on the additional capital they have invested in irrigation. On the other hand, very efficient dry land farmers are earning high rates of return on their properties. Some critics have been inclined to accept our results but to argue that irrigation farmers in general are not using the water efficiently. This may be so, but it may also be argued that dry land farmers in general are not using lucerne very effectively. (Only 10% of the area of the dry-land farms in the survey was in lucerne.) There seems to be no ground for arguing that a sample of irrigation farmers, as widely representative as our survey group, is any less competent than any other group of farmers. However, it is arguable that we have not yet seen advances in irrigation technique that will change the economics of irrigation farming. For example, recent work at Winchmore on the mechanics of border-dyke irrigation may lead to advances in the design of future irrigation schemes on the Canterbury Plains, possibly resulting in improved economic results.

In the meantime farmers in the Ashburton-Lyndhurst scheme are left with their own particular problem, of how to make the investment they have made in irrigation, and the long hours of tedious work involved in their conventional irrigation systems, pay off.

We have therefore carried our research a little further. We attempted to isolate those characteristics of the management of irrigation farms which appear to be associated with success. Our interest to this stage has been only in current management practices as revealed by the survey farms. We have not attempted to explore the economics of innovations, such as automatic irrigation, because of inadequate information.

3. The Pattern of Farming

The production possibilities under irrigation farming on the light soils are quite wide, even though these soils cannot be very heavily cropped. Our first interest was in the production patterns of the highest performance farms of our survey. We wished to see whether these farms exhibited a constant or even similar pattern of farming. Some of the principal characteristics of these farms are shown in Tables 3 and 4, Table 3 being for irrigated farms under 500 acres and Table 4 for irrigated farms over 500 acres. (Details of these tables are given in appendix 2.)

TABLE 3

PATTERN OF FARMING AND LEVEL OF STOCK

PRODUCTION OF SIX HIGH PERFORMANCE IRRIGATED FARMS

(Results from farms below 500 acres)

Farm	Area (Nearest 10 acres)	Owner's Surplus (£)	Index of Irrigation level	% Crop	Stock Units per available acre	Lamb meat per available acre (lbs)	Wool per available acre (lbs)
1	490	2,342	35	32	3.5	120	32
2	430	2,153	19	8	3.5	83	44
3	370	2,029	128	7	5.8	67	69
4	430	1,864	32	33	4.1	142	43
5	370	1,746	71	-	4.1	83	36
6	370	1,603	78	4	4.4	81	41

TABLE 4

PATTERN OF FARMING AND LEVEL OF STOCK

PRODUCTION OF FOUR HIGH PERFORMANCE IRRIGATED FARMS

(Results from farms 500 acres and above)

Farm	Area (Nearest 10 acres)	Owner's Surplus (£)	Index of Irrigation level	% Crop	Stock Units per available acre	Lamb meat per available acre (lbs)	Wool per available acre (lbs)
7	750	3,935	90	-	3.9	70	36
8	1,000	3,319	6	16	2.9	96	29
9	1,000	2,531	52	-	3.8	81	44
10	870	2,239	12	3	2.8	70	26

TABLE 5

ALTERNATIVE MANAGEMENT POLICIES OF SIX HIGH PERFORMANCE IRRIGATED FARMS

(Results from farms below 500 acres)

Farm	Area (Nearest 10 acres)	Owner's Surplus (£)	Index of Irrigation level	% Cash Crop	% Small Seeds	Beef Cattle per 100 Breeding Ewes	Dry Sheep per 100 Breeding Ewes	Bought in lambs per 100 lambs sold
1	490	2,342	35	32	-	-	-	14
2	430	2,153	19	3	5	-	47	25
3	370	2,029	128	7	-	1.4	44	-
4	430	1,864	32	30	3	-	8	39
5	370	1,746	71	-	-	4.8	30	13
6	370	1,603	78	4	-	1.6	29	12

TABLE 6

ALTERNATIVE MANAGEMENT POLICIES OF FOUR HIGH PERFORMANCE IRRIGATED FAMRS

(Results from farms 500 acres and above)

Farm	Area (Nearest 10 acres)	Owner's Surplus (£)	Index of Irrigation Level	% Cash Crop	% Small Seeds	Beef Cattle per 100 Breeding Ewes	Dry Sheep per 100 Breeding Ewes	Bought in lambs per 100 lambs sold
7	750	3,935	90	-	-	8.8	35	-
8	1,000	3,319	6	11	5	-	2	-
9	1,000	2,531	52	-	-	2.3	33	-
10	870	2,239	12	3	-	1	32	20

It is evident from these tables, and also from Tables 5 and 6 (details of which are given in appendix 3) which give additional information on the management policies of the same ten farms, that there is little consistency amongst them. For example, in the small farm group (Table 3) the range of owner's surplus is only £700, yet among the six there are two heavy croppers, three light croppers and one zero cropper; there are two farms carrying 3.5 ewe equivalents per acre and one carrying 5.8; and there is a farm using scarcely any water at all and one an intensive irrigator. Similarly there is a large range in lamb meat and wool production per available acre, and in the stock policies practised.

4. Case Farm Studies

Carrying the examination a little deeper we now give further details of the management of three of these ten farms, which in our view are of particular interest.

(i) Farm 1.

The area of this property was approximately 490 acres of which nearly two-thirds could be irrigated, one-half by border dykes, and the balance by wild flooding. Automatic irrigation was used and a man was not needed full time on watering. However, over the survey period the volume of irrigating was only 0.35 acre feet per acre of the farm. 1,100 Corriedale breeding ewes were

run, replacements were purchased, and an average of 160 acres of cash crop was grown each year. Two men worked the farm entirely, except for shearing by contract.

Stock:

The farm carried 3.5 stock units on the available grazing and produced 120 lbs of lamb meat and 32 lbs of wool per acre. The ewes lambed down 115% survival-to-sale, 50% of which were sold fat off the mother. Replacements were bought in as two-tooths and approximately 200 wether lambs were purchased, shorn, and fattened each year. The ewes were wintered on 80 acres of autumn saved pasture, 3,000 bales of lucerne and meadow hay, 80 acres of lupins and 10-15 acres of turnips.

Cropping:

The cash crops grown included principally 80-100 acres of wheat and 60-80 acres of barley. Linseed had also been grown in the past. All harvesting was in bulk, carried out by the farm labour.

The farm's high financial performance was ascribable to:-

(a) High gross output, 45% of which came from cash crops, 25% from wool and 25% from stock. Crop yields and stock performances were good.

(b) Low costs, especially on wages and contract work.

(ii) Farm 3.

This property of approximately 370 acres was one of the most heavily stocked in the survey. It carried 1,350-1,400 Romney ewes, plus replacements and 20 head of cattle. Over the 3 years, only 6% of the farm had been in cash crop. Two men worked the farm and contractors did all the normal contract work, including heading and baling, but not topdressing.

The ewes all went to the white faced ram and all ewe lambs were kept. Between 300 and 350 surplus two-tooths were sold annually. The farm was stocked at 5.8 stock units per available acre and produced 69 lb of wool and 67 lb of lamb meat per acre. The wool production figure was exceptional for the area, and the lamb meat figure good considering all ewe lambs were kept.

The ewes were wintered on 2,600 bales of hay, 180 acres of autumn saved grass and 15 acres of swedes. Lambing was quite good - 110%, and no lambs were sold off the mother. All lambs were shorn before drafting.

The property was one of the heaviest irrigated in the scheme and used 1.3 acre feet per acre each year. The entire farm could be watered.

The management features of this farm were:

(a) High stocking through heavy watering.

(b) Resultant high wool production per acre.

(c) A breeding replacement policy, involving the sale of surplus two-tooths.

(d) Late fattening and shearing of wether lambs.

The gross income was high, while low vehicle and machinery costs, together with moderate other expenses, conferred on this farm its high financial performance.

(iii) Farm 7.

The area of this very high performing farm was 760 acres. It carried 1,900 Romney breeding ewes, 600 ewe hoggets, 85 breeding cows and 80 yearlings. No crops were taken and no winter roots grown.

The labour complement, for the size of farm and the stock numbers, was low, two men doing all the work. However, there was no harvesting or cultivation work involved. Contractors were only employed for shearing and crutching.

The farmer was a heavy irrigator and used 0.9 acre feet of water per acre of the farm. Between one-quarter and one-third was bordered and a similar area could be wild flooded, so that almost one-half the farm was irrigated. This means that the level of watering on the irrigated portion was very heavy.

Stock:

The ewes averaged 115% lambing survival-to-sale, and one-third of the total lambs were sold off the mother. Only enough ewe lambs for replacements were

kept. Seventy pounds of lamb meat and thirty-six pounds of wool were produced per available acre. Including the cattle, 3.9 stock units per available acre were carried.

The property carried a relatively large number of cattle and was one of the few with breeding cows. The cattle were all Aberdeen Angus and the surplus heifers and all steers were sold fat as rising two year olds.

The property was an all-grass farm and the stock were wintered on approximately 10,000 bales of meadow hay and 600 acres of autumn saved grass, some of which was carried over into lambing. The cattle played a vital role in utilising lower quality meadow hay cut from irrigated grass.

The high performance of this farm was attributable to a low cost farming system, particularly with respect to labour and machinery. But output per acre was high, due to high carrying capacities on grass, and to the supplementation of income by cattle which fully utilised rough grazing and lower quality hay.

5. The Synthesis of Irrigation and Management Policies

If investment in irrigation is to be worthwhile, the irrigation farmer must outproduce in value terms his dry land equivalent by the extent of all the running costs associated with irrigation, plus interest on the extra capital invested in irrigation facilities. Our

survey indicated that this was not in fact the case. Indeed it appeared that many farmers adopted the now well-established principles of successful dry land farming. These involve early lambing and weaning, drafting at light weights and summer destocking. Irrigation on these farms becomes merely a drought insurance rather than an income earning investment.

The ten farms tabulated, of which three have been described in more detail, have quite different patterns of management, yet each is a highly successful financial unit. It might be concluded therefore that the pattern of management and production is not very relevant to variations in the level of financial success, and that what is really important is the level of managerial skill with which these various patterns are implemented. Management has three components, planning, execution and control. It appears that under irrigation farming wide differences in management plans may be possible, and that results will depend more heavily upon skilful execution.

But closer appraisal of the high performing farms indicates that they tend to have one factor in common. They have adjusted their pattern of output from conventional dry-land farming methods to suit the change in their environment conferred by irrigation. We are convinced

that profitable irrigation farming depends on their making this change. This pattern could conceivably involve the irrigation of crops, which is the basis of profitable use of irrigation in other countries. But the influence of water on mixed arable farming in Mid-Canterbury is not so clear. There are indications that farmers can achieve success with the irrigation of linseed, barley, cocksfoot and white clover seed. This appears to be the reason for high profits on some survey farms. On the other hand the survey results show that some very high performing farms have no crops at all. Nevertheless they have adapted their pattern of output to suit their changed environment.

A valid question would be "what form should summer utilisation of irrigation take?" We can suggest a number of alternatives for consideration. The list has been divided into two sections. Group A concerns products with a world-wide market and Group B includes alternatives with a local or New Zealand market only.

Group A - The World Market

(1) Increased wool production:

(a) Dry sheep with a high per acre production.

(b) Shearing of bought-in store lambs.

(c) White-faced lamb production, shearing all lambs not sold off the mother, and subsequent sale of

surplus stock as ewe lambs, ewe hoggets or two-tooths.

(2) Increased Meat Production:

(a) Purchase of store lambs for fattening.

(b) Late fattening of heavy weight lambs.

(c) Fat cattle production.

(3) Crop Production:

(a) White clover seed.

Group B - The Local Market

(1) Meat Production:

(a) Butchers' market for fat stock.

(2) Crop Production:

(a) Cocksfoot seed.

(b) Linseed.

(c) Barley.

Each of these alternatives to be successful, requires directly or indirectly, the continuous efficient use of irrigation water throughout the irrigation season. These are only some of the alternatives open to the irrigation farmer. We are at present investigating the relative profitability of these with the help of computer programming.

6. A Comparison of Two Management Systems under Irrigation

Finally, we have selected two management systems of irrigation farming and examined their relative profitability. These are (1) All-grass farming and (2) Mixed-arable farming. We selected these because they represent two opposed schools of thought prevalent in Mid-Canterbury. We established a hypothetical farm of 310 acres. The farm capital, the amount of border dyking, the carrying capacities and stock performances, and the crops grown and their yields, were based on information collected during the irrigation survey. They are therefore as accurate and faithful a representation of the actual situation practised in Mid-Canterbury, as we could interpret. We assumed that management efficiency was similar on the grassland farm and on the mixed cropping farm. The grassland farming system carries the stock for twelve months of the year on pasture and hay alone. No winter supplements are grown. We allowed a pasture life under irrigation of fourteen years with renewal through a summer fallow. In fact farmers practising this system consider that pasture life under prudent stock management, could be indefinite. On the cropping farm, we harvested linseed, wheat, barley, ryegrass and white clover seed, and grew forage crops for wintering the stock. The stock policy on the

grassland farm involved the use of white faced rams, rearing replacements, and the sale of surplus two-tooth ewes. On the mixed cropping farm, replacements were purchased as two-tooths and all ewes were put to the Down ram.

On the basis of these two programmes, we established the land utilisation, and using the carrying capacities experienced during the survey, we calculated the number of stock to be carried. We then budgeted the two alternatives, using 1963/4 prices and costs. A summary of the land utilisation and comparative budget is shown in Table 7. (Details of these are given in appendix 4.)

This table illustrates that, on the assumptions we made, a low cost system of grassland farming is more profitable than a more costly mixed cropping system. The essence of the former system is its low cost structure in relation to the total income. In particular wages, and vehicle and machinery expenses are very low. Moreover this system is utilising irrigation during the summer for the production of late fattened, shorn lambs, and to carry all ewe hoggets. Critics may argue that we have unduly penalised the mixed cropping system by using lower crop yields than one might expect. We can only remind them that these yields are based on information obtained from a large sample of farms during

TABLE 7

ALTERNATIVE MANAGEMENT SYSTEMS UNDER IRRIGATION

Land Utilisation and Comparative Budget for a grassland and a mixed arable farm

Area:

143	acres	Border dyked
52	"	wild flooded
105	"	dry-land
10	"	waste
310	acres	

Item	Grassland Farm		Mixed Arable Farm	
I. Land Utilisation (acres)				
(a) Spring-Summer				
(1) Irrigated Grass	182		40	
(2) Dry-land grass	72		48	
(3) Lucerne	21		24	
(4) Autumn saved grass			50	
(5) Cash crops			42	
(6) Small seeds			75	
(7) Winter feed			15	
(8) Fallow	22			
(9) Rape + new lucerne	3	300	6	300
(b) Winter				
(1) Winter forage			30	
(2) Cash crops			15	
(3) Small seeds			75	
(4) Autumn saved grass	48		55	
(5) Pasture	206		83	
(6) Lucerne	21		27	
(7) Fallow	3		3	
(8) New grass	22	300	12	300
II. Labour Units	1.0		1.5	
III. Capital (£)				
(1) Land and Buildings	16,740		16,740	
(2) Stock	3,629		2,619	
(3) Plant	1,300		4,765	
(4) Working Capital	1,083		1,206	
(5) Total farm capital	22,752		25,330	
IV. Stock (Numbers)				
(1) Breeding ewes	820		900	
(2) Others	467		18	
(3) Stock units per available acre	4.4		4.8	
V. Financial Performance (£)				
(1) Total farm income	4,978		6,568	
(2) Total farm working expenses	2,343		4,649	
(3) Interest on Total farm capital	1,365		1,520	
(4) Owner's Surplus	1,270		399	

our survey. While individuals may be obtaining much better performances we can only interpret those of the average farmer. Moreover it is equally arguable that we have penalised the grassland farmer by using lower carrying capacities than some people are achieving. Again we have interpreted the performance of the average farmer.

We hope to have illustrated that a mixed arable system involving high expenses, requires physical performances to be high, and probably better than the average irrigation farmer on Lismore soil can expect. On the other hand, a grassland farming system efficiently executed, with a low cost structure appears to be a very profitable one. Indeed, our experiences with farmers operating under this sytem have verified this.

7. Conclusion

This paper has been concerned with profitable methods of irrigation farming. The management policies and the physical and financial performances of several survey farms have been detailed and two alternative management systems have been compared. However, the results shown in this publication do not in any way invalidate the results from the irrigation survey, and the conclusions drawn from them. They aim however, to indicate possible channels for improved financial performance under irrigation.

APPENDIX 1

DETAILS OF TABLE 2

1. Capital

(a) Land and Buildings at the 1961 Government revaluation.

(b) Stock: The stock numbers were obtained at the field inspection. The values used were a standardised estimate of market values appropriate to the whole period. These values are listed below. Any wether lambs on hand at balance day were not valued, unless rearing of wether hoggets was practised. Stock bought in and fattened were ascribed a value proportionate to the length of time on the farm.

Breeding ewes	
(i) Romney mixed age	50/-
(ii) " 4 and 5 year	35/-
(iii) Corriedale mixed age	45/-
(iv) " 4 and 5 year	30/-
Ewe hoggets	
(i) Romney	50/-
(ii) Corriedale	45/-
Wethers	40/-
Wether hoggets	
A fraction of 40/- depending on the time on the property.	
Rams - all breeds	100/-
Stud sheep	
(i) Ewes	80/-
(ii) Ewe hoggets	60/-
(iii) Ram hoggets	100/-
(iv) Rams	160/-
Beef Breed cows	£25
Rising 2-year heifers	£20
Rising 1-year heifers	£15
Bullocks	£30
Rising 2-year steers	£20
Rising 1-year steers	£15
Bulls	£50

Dairy Cows	£25
Dairy heifers	£25
Dairy yearlings	£15
Sows	£12
Weaner pigs	£5

(c) Plant and Machinery: This was determined by taking the opening book valuations for 1959, 1960 and 1961 and the closing valuation for 1962 for all the plant and machinery, except the motor car, and averaging these entries. Depreciation was standardised at 20% per annum for motorised plant and 10% for non-motorised. No special depreciation was allowed. Where machinery was sold during the three-year period and the sale price differed from the book value, the sale price was taken as the book value, and the preceding valuations were recalculated from this. Hence any gain or loss on sale shown in the Profit and Loss Account was eliminated.

(d) Working Capital: An allowance for liquid cash necessary to run the farm. This was estimated as one-half the average annual sum of all cash expenses, excluding outlays on stock, rent, interest, development, and depreciation reserves, but including an allowance for owner-occupier drawings. (The latter was calculated as £675 plus 1% of the total capital involved in Land and Buildings, Stock and Plant.)

(e) Total Farm Capital: The sum of Land and Buildings, Stock, Plant and estimated Working Capital

2. Stock Units per available acre

The carrying capacities of the farms were calculated on the following basis:

Romney ewes	1 stock unit
Corriedale Ewes	0.9 " "
Hoggets	0.67 " "
Trading Stock	Part thereof - as per time on the farm.
Breeding Cattle	6 stock units
Cattle(rising 2 yr)	4 " "
Cattle(rising 1 yr)	3 " "

The figures for each farm were expressed as stock units per acre available for grazing or feeding. Where an area was available for grazing for part of the year only, as for example with white clover, allowances were made.

3. Total Farm Income

The sum of the average gross profits on sheep, cattle, wool, grain, seeds and produce, and any other farm income.

4. Total Farm Working Expenses

The sum of wages, vehicle and machinery expenses, contract and cartage, repairs and maintenance, farm purchases (including lime, fertiliser and seeds), overhead expenses (including rates), irrigating charges, and depreciation, but not including rent, interest paid, developmental expenses.

5. Interest on Total Farm Capital

Charged at 6%.

6. Owner's Surplus

(Total farming income) - (Farm working expenses + Interest on Total farm capital).

APPENDIX 2

DETAILS OF TABLES 3 AND 4

1. Owner's Surplus: See Appendix 1.

2. Index of Irrigation Level:

   Acre feet of water used per effective area of the farm; one acre foot per acre = 100.

3. % Crop:

   Percentage of the effective area of the farm in cash crops and small seeds.

4. Stock Units per Available Acre: See Appendix 1.

5. Lamb Meat per Available Acre:

   Only fat lambs were considered here. The total lamb meat produced (including an allowance for store lambs purchased for fattening) was divided by the area available for grazing.

6. Wool per Available Acre:

   Total wool clipped, including lambs' wool and crutchings, but not slipe wool, expressed per acre available for grazing.

APPENDIX 3

DETAILS OF TABLES 5 AND 6

1. Beef Cattle per 100 Breeding Ewes:

   Includes breeding cows, and fat cattle.

2. Dry Sheep per 100 Breeding Ewes:

   Includes ewe and wether hoggets carried through to the two-tooth stage, but does not include hoggets sold to the butchers' market in the winter and spring.

3. Bought in lambs per 100 lambs sold:

   Includes all lambs purchased for fattening as lambs or hoggets.

APPENDIX 4

DETAILS OF TABLE 7

A. Land Utilisation and Estimated Carrying Capacities: Grassland System

(1) Spring Summer			S.U.	(2) Winter			S.U.
182	acs	irrigated grass @ 5	910	206	acs	grass @ 1.25	258
72	"	dry land @ 3	216	48	"	autumn saved pasture @ 6	288
21	"	lucerne - for hay	-	22	"	new grass @ 7	154
22	"	fallow	-	21	"	lucerne @ 1	21
3	"	new lucerne	-	3	"	winter fallow	
10	"	waste		10	"	waste	
310			1,126	310			721
				Plus 1260 bales luc. hay @ 3/S.U.			420
							1,141

B. Land Utilisation and Estimated Carrying Capacities: Mixed Arable System

(1) Spring Summer			S.U.	(2) Winter			S.U.
15	acs	linseed	-	15	acs	turnips @ 15	225
15	"	wheat	-	15	"	turnips & Italian @ 12	180
30	"	→ turnips @ 5	150	15	"	wheat	-
15	"	ryegrass	-	60	"	White Cl.@ 2.5	150
30	"	2nd yr White Clover @ 3	90	15	"	new grass → ryegrass @ 2.5	38
30	"	1st year white clover @ 3	90	12	"	new grass→spring	-
10	"	irrigated grass @ 5	50	3	"	winter fallow → lucerne	-
15	"	turnips & Italian	-	27	"	lucerne @ 1.0	27
12	"	barley & new grass	-	50	"	Autumn Saved Past.→ Spring	-
3	"	rape	-	5	"	Autumn Saved Pasture @ 6	30
3	"	new lucerne	-	83	"	grass @ 1.25	104
36	"	dry land grass @ 3	108	10	"	waste	
12	"	lucerne grazing @ 4	48	310			754
12	"	lucerne hay	-	Plus 720 bales lucerne @ 3/S.U.			240
12	"	new grass @ 7	84				
50	"	Autumn Saved Pasture @ 7	350				
10	"	waste					
310			970				994

C. Capital details	Grassland Farm		Mixed Arable Farm	
(1) Land and Buildings				
310 acres @ £54 per acre				
(Buildings £4500)		£16,740		£16,740
(2) Stock	head		head	
Breeding ewes @ 55/-	820		900	
Ewe hoggets @ 55/-	450			
Rams @ £8	17		18	
		£3,629		£2,619
(3) Plant				
Motorised	£800		£3,600	
Non-Motorised	£500		£1,165	
		£1,300		£4,765
(4) Working Capital				
5% of fixed capital		£1,083		£1,206
(5) Total Farm Capital		£22,752		£25,330

D. Income				
(1) Lamb sales				
110% Survival-to-Sale	head		head	
45/- F.O.M.	135		990	
40/- F.O.F. shorn	315			
		£934		£2,228
(2) Ewes				
3% deaths + 5 lambs				
per ewe	head		head	
C.F.A.ewes @ 25/-	164		180	
2-tooth ewes @ 80/-	247			
		£1,193		£225
(3) Wool				
Lambs 3 lb				
Hoggets 7 lb				
Ewes 10 lb				
Rams-S.D. 8.5 lb				
Rom. 12 lb				
Av.price 50d net	13,683 lb		9,006 lb	
		£2,851		£1,876
(4) Crops				
White Clover 90 lb				
per ac. @ 3/- lb			3,600 lb	
White Clover 120 lb				
per ac. @ 3/- lb			2,700 lb	
Ryegrass 20 bu. per				
ac. @ 19/- bu.			300 bu.	

	Grassland Farm		Mixed Arable Farm	
Wheat 40 bu. per ac. @ 13/6 bu.			600 bu.	
Barley 50 bu. per ac. @ 8/10½ bu.			600 bu.	
Linseed 12 cwt per ac. @ £37.10.0 per ton			9 ton	
				£2,239
Total Farm Income		£4,978		£6,568

E. Expenditure

(1) Stock Purchases			head	
Two-tooths @ £4 per head			207	
Rams @ £15.15.0 per head	3 head		4	
		£47		£891
(2) Standing charges				
Insurances	£26		£48	
Rates and Land Tax	£175		£175	
Water charges	£40		£40	
		£241		£263
(3) Administration		£60		£60
(4) Working expenses				
(a) Wages				
Permanent @ £14 per week	days		weeks 26	
Casual @ £3 per day	20			
Shearing £7 per 100	head 2034		head 900	
Crutching £2/10 and £1/10	1650		1800	
		£235		£464
(b) Animal Health			head	
Dipping 6d p/head	1270		900	
Drenching 7d "	1585		900	
Vaccination 7½d per head	820		900	
Docking rings 1d each	900		1000	
Vet fee £5				
Foot rot @ £1 per 100	900		900	
		£121		£93

	Grassland Farm		Mixed Arable Farm	
(c) Crop Harvesting				
23" sacks @ 1/-			sacks 584	
48" sacks @ 1/3			80	
Twine				
Dressing -				
Ryegrass @ 4/- per bu.			300 bu.	
W.C.@ 6d p/lb			6,300 lb	
Wheat Board Levy @ 4/9 per 50 bu.			200 bu.	
Cartage @ 1/2 F.O.R.			sacks 665	
				£238
(d) Cultivation contracts @ £6 per acre	acres 25	£150		
(e) Freight		£25		£50
(f) Feed				
Baling @ 1/- per bale	bales 1300		bales 720	
Cartage @ 8d per bale	1300		720	
		£108		£60
(g) Fertilisers and Lime				
44/46 bagged @ £9.7.0 ex wks.	tons 2.5		tons 8.5	
44/46 bulk @ £8.13.0 ex wks.	13.5		10	
D.D.T. @ £15 ex works	7.5		3	
S/Ammonia @ £30 ex works			1¼	
Freight @ 38/- per ton	24		23	
Spreading @ 4/6 per ac.	acres 280		acres 200	
Lime @ 50/- sown	tons 28		tons 48	
		£425		£451

	Grassland Farm		Mixed Arable Farm	
(h) Crop seeds				
Turnips @ 4/6 lb			34 lb	
Italian Ryegrass @ 15/- per bu.			4 bu.	
Rape @ 2/6 lb			9 lb	
Linseed @ 7½d lb			225 lb	
Wheat @ 24/- per bu.			23 bu.	
Barley @ 15/- " "			24 bu.	
				£88
(i) Grass Seeds				
Perennial ryegrass @ 20/- per bu.	27 bu.		46 bu.	
White clover @ 5/- per lb	57 lb		159 lb	
Red clover @ 4/- per lb	27 lb		36 lb	
Coxsfoot @ 4/- per lb	40 lb		66 lb	
Timothy @ 2/6 lb	13 lb		30 lb	
Lucerne @ 5/- lb	36 lb		36 lb	
		£63		£117
(j) Weed & Pest Control				
Lucerne @ £2.10.0 per acre	21 acs		24 acs	
Barley grass @ £3.15.per ac.	10 acs		10 acs	
White clover @ 15/- per ac.			60 acs	
Linseed & wheat @ 8/6 ac.			30 acs	
Barley @ 34/- ac.			12 acs	
		£90		£174
(k) General Expenses				
1% of Cash Income		£50		£66
		£1,267		£1,801
(5) Vehicle Expenses				
Diesel tractor @ 3/- per hour	235 hours		545 hours	
Petrol @ 4/- per hr.			200	
Header @ 4/- " "			93	
Car @ 9d per mile	2000 miles		2000 miles	
		£111		£219
(6) Repairs and Maintenance				
Buildings @ 2½%	£4500		£4500	
Motorised Plant @ 2/6 per hour	235 hrs		838 hrs	
Plant @ 10%	£500		£1165	
Fences @ 2/6 chains	300 chs		300 chs	
		£219		£361

	Grassland Farm		Mixed Arable Farm	
(7) Reordering @ £2.10.p/ac.	10 acs	£25	22 acs	£55
(8) Depreciation				
Buildings @ 2½%	£4,500		£4,500	
Car @ ¼ of 20%	£1,000		£1,000	
Motorised Plant @ 20%	£800		£3,600	
Non-Motorised Plant @ 10%	£500		£1,165	
		£373		£999
(9) Total Expenditure		£2,343		£4,649
(10) Estimated Net Farm Profit		£2,635		£1,919
(11) Interest @ 6% on Total farm capital		£1,365		£1,520
(12) Owner's Surplus		£1,270		£399

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