Proceedings of the New Zealand Grassland Association 44: 108-l 19 (1983)

PRODUCTION POTENTIALS OF HILL COUNTRY IN THE NORTHERN SOUTH ISLAND

A.D.H.JOBLIN
Agricultural Research Division, MAF, Lincoln.

Abstract

Hill country, defined as land over 15° slope, comprises 51% of the agricultural land resource and 44% of the grassland in the Northern South Island. This steeper land is assessed as carrying 20% of the current grazing stock numbers, with an estimated capacity to expand by 13 million stock units to support 31% of the region's livestock. The ability to achieve this potential will be influenced by the profitability of farming the land more intensively. At present the South Island hill and high country is farmed much more extensively than North Island hill country with net incomes of $9 and $1.5/ha respectively compared with $53 and $30/ha for hill and hard hill country in the North Island. Production output figures show similar trends. The challenge to research workers, advisers and farmers is to develop farming systems that will lead to a profitable expansion of production to the South Island hill and high country's potential. These systems will need to recognise the crucial importance of summer drought as a limiting factor to these production increases.

Keywords: Hill country, slope, vegetation, production potentials, productivity, economic returns, costs, microsite pasture production, research requirements.

INTRODUCTION

Agriculture has a proven record as the major source of this country's export income (e.g. Joblin, 1980). All of us involved in agriculture have little doubt about the industry's latent capacity to expand production. What is needed is adequate access to development resources and a knowledge that the technology, industry and marketing structure exists to make this increased production profitable. Indeed for the Northern South Island, I submit that a doubling of the present values of production is the only sustainable development option capable of supporting an expanding regional economy. The alternative is a steadily escalating decline in the economic fortunes of the region.

The question for pastoral agriculture is, where should this expansion of production occur? Since the preparation of the NRAC Country Working Party report in 1977 it has become almost an "article of faith" that the prime area for the investment of resources in grassland research was into the hill country. Yet such is the shortage of research resources within this country, that the assumption of priority for hill country research needs to be questioned for each agricultural region. The high cost of obtaining reliable research data specific to hill country, makes the objective appraisal of the potential of hill country even more imperative.

Accordingly data have been drawn from the Ministry of Works New Zealand Land Resource Inventory, the Meat and Wool Board's Economic Service Surveys and our own regional research trials, to make an assessment of the potential for expanding production on this region's hill country, compared with that of the flatter areas. These data enable the land within the

region to be described according to its slope characteristics, predominant vegetation and estimated stock carrying capacity. There are no direct data on the relative profitability of achieving the production potentials described, but comparisons can be made of production levels, net incomes and costs between hill and high country farms in the South Island with those of hill country farms in the North Island.

LAND CHARACTERISTICS OF THE REGION

The Northern South Island region comprises the provincial districts of Canterbury, Marlborough, Nelson, Buller and the West Coast. These districts embrace 32% of the land available for agriculture within New Zealand. Although this area includes the intensively farmed areas of the Canterbury plains, it also includes some of the country's most extensive farming. Whereas 30% of the region's area comprises land of less than 3° slope carrying an average of 11.1 S.U./ha, an almost equal area (29%) consists of land greater than 25° slope carrying 1.7 S.U./ha.

The definition of hill country used in this paper is land over 15° slope. Although topographically precise, this definition cuts across conventional descriptions by excluding the flatter parts of hill and high country areas from the "hill country" classification. However, in this region MOWD Land Use Inventory maps show that the areas of flat land enclosed within hill country properties are relatively small.

Table 1: DISTRIBUTION OF OCCUPIED AREA ('000 ha) IN NORTHERN SOUTH ISLAND.

Degree Slope	Canterbury	Marlborough	Nelson	West Coast	Whole Region
o - 3	1055	59	54	301	1470
4 – 7	254	68	53	119	493
8 – 15	293	22	25	91	432
16 – 20	192	45	44	58	337
21 -25	362	167	113	136	779
25+	614	459	201	147	1421
o- 15	1602	149	132	511	2395
15+	1168	671	358	340	2538
Total	2771	821	490	850	4933

Over the region as a whole 51% of the occupied farming land is over 15° slope (Table 1). Within the region variation between provinces is large. In Canterbury and the West Coast approximately 40% of the potential agricultural land is hill country by this definition, but 73% of Nelson and 82% of Marlborough would be included in this category. Relating this to vegetative cover (Table 2), 44% of the region's grassland is on land over 15°. This

relative decline in the proportion of hill country in grassland occurs mainly on the West Coast and in Nelson where 1% and 17% respectively of this steeper land is predominantly in grassland, compared with 55% in Marlborough and 90% in Canterbury. Thus 1.4 m of the 1.5 m of grassland over 15" slope occurs in the eastern drier districts of Marlborough and Canterbury.

As would be expected reciprocal changes occur in the distribution of forests within these occupied lands. The only district with substantial amounts of land below 15" slope in forest is the West Coast with 24% of the region's forests on this class of land. Of the 460,000 ha of land in the region on which scrub is dominant, 38% occurs in the parts of Marlborough over 15° slope and 26% in similar land in Nelson. The remaining significant scrub areas are the flat land of Westland (14%) and the hill country of Canterbury (9%).

Stock Carrying Capacities

The MOWD Land Resources Inventory also recorded MAF Advisory Services Division staff estimates of the stock carrying capacities of average farmers, present day top producing farmers and what they believed would be the ultimate potential of each class of country. Although these advisers could call on their knowledge of actual production achievements for the first two estimates, the prediction of ultimate potential was much more speculative and variable between different advisory officers.

Table 2: NORTHERN SOUTH ISLAND DISTRICTS. DOMINANT VEGETATIVE COVER ('000 ha) RELATED TO LAND SLOPE

	Slope	Canterbury	Marlborough	Nelson	West Coast	Whole Region
Grassland	0 – 15°	1526	136	95	139	1897
	Over 15°	1050	372	62	4	1487
	Total	2576	508	156	142	3384
Forest	0 - 15°	39	5	20	243	307
	Over 15°	75	124	178	314	691
	Total	113	129	198	557	998
Scrub	0 - 15°	15	95	13	65	99
	Over 15"	43	175	119	22	359
	Total	59	181	132	87	458

In Table 3 the steps by which stock carrying capacity of land below 15° slope could be increased from the present 15 m S.U. to an estimated ultimate of 38 m S.U. are set out. The 4 m S.U. increase at present stocking rates from an expansion of irrigation allows, where appropriate, for the irrigation of land now occupied by scrub or forest. As would be anticipated districts vary widely in the relative importance of different development options for increasing stock numbers on this flatter land. For example, 95% of the increase in Canterbury would

Table 4: NORTHERN SOUTH ISLAND DISTRICTS. POTENTIAL TO INCREASE PRODUCTION ('000 S.U.) ON LAND OVER 15° SLOPE.

	Activity	Canterbury	Marlborough	Nelson	West Coast	Whole Region
At present stocking rates	Irrigation	16	-	-	-	16
	Scrub clearance	85	457	452	61	1055
	Forest clearance	140	216	633	725	1714
	SUB TOTAL	241	673	1085	786	2785
Additional Increase to tbp farmers stocking rate's		2053	1081	755	586	4475
	CUMULATIVE TOTAL	2294	1754	1840	1372	7260
Additional Increase to estimated potential carrying capacity		1624	2159	1029	1249	6060
	TOTAL POTENTIAL INCREASE	3918	3913	2869	2621	13319
S.U. carried at present		2275	1203	357	11	3847

Table 3: NORTHERN SOUTH ISLAND DISTRICTS. POTENTIAL TO INCREASE PRODUCTION ('000 S.U.) ON LAND OF 0 – 15" SLOPE.

	Activity	Canterbury	Marlborough	Nelson	West Coast	Whole Region
At present av. stocking rates	Irrigation	3780	138	105	–	4023
	Scrub clearance	36	29	114	480	659
	Forest clearance	166	34	155	1858	2214
	TOTAL	**3982**	**201**	**374**	**2338**	**6896**
Additional Increase to top farmers stocking rates		**4857**	**607**	**557**	**1699**	**7794**
	CUMULATIVE TOTAL	**8839**	808	931	4037	**14690**
Additional Increase to estimated potential carrying capacity		4868	933	582	2265	8664
	TOTAL POTENTIAL INCREASE	**13707**	**1741**	**1513**	**6302**	**23278**
Present carrying capacity		11392	990	987	1574	14960

come from irrigation development and 80% of that in the West Coast from forest clearance, Much of this latter development would be dependent on the decision to foster agricultural development on this land in preference to forestry. The district where scrub clearance would be of greatest significance is Nelson, where it accounts for 39% of the land development potential. Intensification of production, through bringing average production levels up to those of the best farmers of the district on similar types of land, is considered to be capable of increasing carrying capacity by 13% more than the total of all the land development options considered. In Marlborough and Nelson increasing intensification within existing land use patterns is of much greater significance than any proposed form of land development.

The situation for hill country is summarised in Table 4. On this land scrub clearance is believed to be able to increase carrying capacity in Marlborough and Nelson districts by a total of 900,000 S.U. Similarly forest clearance in Nelson and the West Coast could increase stock unit numbers by 1.3 million, provided land stability could be maintained on this cleared land. All class 8 land has already been excluded from these estimates. The potential for increasing intensification of land use through bringing farmers up to the achievements of the best farmers (4.5 million S.U.) or the estimated potential of the land (6.1 million S.U.) is greater for this hill country than it was for flatter land, when related to present carrying capacities.

The characteristics of the "top" farmers that enable them to intensify their production are not well quantified. This would be a major study in itself, as is being shown through the survey being initiated in the North Island. The advisers consulted believe that the farmers themselves are the key elements in the success that is being achieved, not the features of the land they are farming. The methods by which they achieve their success vary, but clearly effective pasture utilisation is vital. The stocking rates required to achieve the carrying capacities nominated, even for what could be called the "speculative potential", are not in most cases above what is already being achieved under experimental conditions (Table 5.)

In summary these data show that a doubling of the region's present stock carrying capacity is believed to be attainable through land development and the

Table 5: NORTHERN SOUTH ISLAND DISTRICTS. S.U./ha FOR DIFFERENT LEVELS OF PRODUCTION.

Degrees Slope		Canterbury	Marlborough	Nelson	West Coast	Whole Region
0-15	Average Farmer	7.5	7.3	10.4	11.3	7.9
	Top Farmer	12.8	12.3	15.0	12.6	12.8
	Estimated Potential	15.9	18.7	19.5	17.6	16.6
Over 15	Average Farmer	2.2	3.2	4.0	2.8	2.6
	Top Farmer	3.9	4.4	6.1	4.1	4.4
	Estimated Potential	5.3	7.6	9.0	7.7	6.8

intensification of production on developed land to what the best farmers are achieving today. 15 m of this increase is expected to take place on the land below 15° slope and 7 m on the steeper land. MAF advisers speculate that the ultimate potential for the region could be 16 m higher at 55 m S.U. compared to the present 19 m. Of this speculative increase, 6 m S.U. is ascribed to land over 15° slope.

Relative Profitability of South Island Hill Country Farming

The above estimates of the potential for increasing production from this region's steeper lands take little account of the potential profitability of such an expansion of production. Neither do they allow for the importance of pockets of "easy" country in the development strategies of hill and high country properties. Consequently it is useful to examine the results of the New Zealand Meat and Wool Boards' Economic Service Sheep and Beef Farm Surveys (1982) to obtain production figures and profitability estimates for South Island hill and high country farms. The data in these surveys are obtained from sample farms throughout the Island, with a variable proportion of these located specifically in the Northern South Island. Nevertheless they do establish some important facts in relation to the present productivity and profitability of South Island hill country properties relative to those of the North Island.

Table 6: NEW ZEALAND SHEEP INDUSTRY FARMING STRUCTURE

	Number of farms	Number of sheep (m)	Number of sheep per farm
South Island High Country	300	2.4	8,000
South Island Hill Country	900	5.0	5,550
North Island Hard Hill Country	1,700	7.2	4,250
North Island Hill Country	5,100	16.4	3,200
South Island "Flat/Rolling" Country	9,600	23.2	2,420
North Island "Flat/Rolling" Country	4,400	9.4	2,150

The overall sheep industry structure (Table 6) shows that the total carrying capacity of the South Island hill and high country is roughly equivalent to the hard hill country of the North Island, or less than half that of the North Island "easier" hill country. This balance is reversed in the "flat and rolling" country of both Islands, where the sheep numbers in the South Island are some 2% times those of the North Island.

Some reasons for the relatively small contribution of South Island hill country farms to national productivity can be drawn from the data in Table 7. These show that productivity/ha in South Island hill country is little more than one third of the so-called hard hill country of the North Island and about one quarter of that of the North Island hill country. High country productivity in the South Island is less than a quarter of that of its hill country. The dif-

Table 8: INCOME AND EXPENDITURE PATTERNS OF NEW ZEALAND HILL COUNTRY FARMS.

	Gross Income	Expenditure	Net Income	Gross Income as % of Expenditure	Expenditure on Fertiliser as % of net income
South Island High Country	7.70	6.10	1.55	125	58
South Island Hill Country	31.70	29.10	8.70	130	51
North Island Hard Hill Country	101.40	71.40	30.10	142	43
North Island Hill Country	143.80	90.40	52.60	158	26

From New Zealand Meat and Wool Boards' Economic Service Data (1982)
(Income and expenditure figures based on the mean of six years 1974/75 to 1979/80).

Table 7: PRODUCTION AND PROFITABILITY PARAMETERS OF NEW ZEALAND HILL COUNTRY FARMS

	Farm Area (ha)	S.U.	Production/ha Meat (kg)	Wool (kg)	Net Income Per Farm
South Island High Country	10,600	0.7	5.4	2.9	$16,380
South Island Hill Country	1,830	2.9	32.9	12.0	$15,930
North Island Hard Hill Country	625	8.4	89.5	32.2	$18,790
North Island Hill Country	360	14.1	124.9	47.2	$19,050

From New Zealand Meat and Wool Boards' Economic Service Data (1982)

(Income and expenditure figures based on the mean of six years 1974/5 to 1979/80).

ferences in net income per farm favour the North Island hill country properties by approximately 17%. despite the very much larger land areas of the South Island farms. The income and expenditure patterns in Table 8 show the same general trends for higher cash returns from North Island hill country farms.

Assessing the profitability of a farm as the ratio of gross income to expenditure incurred in generating that income, suggests that over the six years up to 1979/80, farming North Island hill country has been in the region of 18% more profitable than farming either hill or high country in the South Island. Even the traditionally difficult hard hill country farming areas of the North Island have been appreciably more profitable than South Island hill country over this period. A period which excludes the economically damaging effects of the dry 1980/81 and 81/82 years. Against this it also excludes the relatively high prices obtained for South Island fine wools in 1981/82.

The effects of these income constraints can be illustrated through the expenditure on fertiliser on these four classes of farms (Table 8). Fertiliser and lime application rates per stock unit on South Island high country are half those on hard hill country in the North Island. Further this fertiliser was applied to less than 5% of the effective area of the South Island high country compared with 60 to 70% of North Island hill country. Yet the expenditure on fertiliser, lime and seeds on South Island high country was equivalent to 58% of net income compared with 43% for the North Island hard hill country equivalent. Similarly, fertiliser and lime applied per S.U. on South Island hill country in 1979/80 was three quarters of that on North Island hill country and was applied to 28% as opposed to 80% of the effective land area. This lower rate of application still required almost double the level of expenditure, relative to the net incomes of the two classes of farms.

Given these calls on expenditure relative to available income, even in relatively prosperous years, is it reasonable to consider that these South Island

farmers lack the motivation to increase production on their properties? It seems more likely that they lack the cash surpluses from which to sustain a prolonged period of investment in farm productivity improvement.

It is not hard to ascribe reasons for the present lower profitability of South Island hill and high country farms. Cold winters and dry summers limit the pasture growing season and the distance from population centres inflates transport costs for goods, services and farm 'produce. Counterbalancing factors favouring profitability on an individual farm basis, if not per hectare, such as the historical availability of large farms with extensive areas of relatively clean grassland at a comparatively cheap cost per hectare are insufficient at present to overcome these basic problems.

Thus the challenge to the agriculturalist, be he a practical farmer, adviser or scientist, is to devise systems of improving South Island hill country profitability that will make possible the 7 to 13 million S.U. increase described in Table 4. All sections of the above groups will need to work very closely together if this is to be achieved, Greater commitment from all parties to the monitoring of the successes and failures of controlled grazing schemes on South Island hill country can be one means of generating this co-operative effort.

Methods of Improving Pasture and Stock Productivity

The problems in achieving highly profitable production from Northern South Island hill country relate not only to the relatively low levels of pasture production achieved, but also to the very brief period in the spring when pasture dry matter digestibility has been shown to be high (Radcliffe et *a/* 1977). These problems are compounded by high rates of pasture decay under the extensive management systems commonly practiced on South Island hill country.

Although progress can be made through oversowing of drought resistant species possibly including fodder trees, subdivision and rotational grazing, it needs to be established whether these methods alone can provide the economic basis for a change from the present extensive methods of farming South Island hill country.

Table 9: COOPERS CREEK — ANNUAL PASTURE ACCUMULATION ON HILL COUNTRY MICROSITES (tDM/ha)

Site	4 year average	Annual yield range
Whole Aspect		
North	5.3	3.5 — 6.6
South	6.0	3.7 — 7.4
Ridge s t		
North	5.0	2.9 — 5.8
South	7.5	4.4 — 9.8
Hummocky Spur Hollow		
North	8.6	6.6 — 10.7
South	7.0	4.9 — 8.1

A clue to a method of making this country more productive may lie in some very detailed work carried out at Coopers Creek in North Canterbury (Radcliffe 1982). On a continuously grazed measurement site averaging 25 slope, the North facing aspect was 12% less productive overall than the South aspect, reflecting the low growth rates on this aspect over the dry summer period (Table 9). Yet the most productive microsite on this whole area was not the high fertility and consequently high ryegrass stock camp area on the ridge crest, nor was it any of the moister but cooler sites on the South aspect. It was in the small hollows on the North aspect where surface water would be expected to accumulate.

This is strongly suggestive that we should be investigating cheap gravitational systems of water harvesting and water distribution on hill country that might be capable of extending the period of high quality pasture production in the spring and early summer. The technical problems in achieving this at an economic cost are immense and these would increase in the drier areas where the need was greatest. The rewards would also be high. An alternative approach being developed by the New Zealand Institute of Agricultural Engineering in the Hakataramea Valley is to use the hills as catchments for water subsequently used to irrigate flatter areas in the valley floors. These flatter areas are then integrated into the overall management of the property.

Whichever approach or combination of approaches is used in the long run, the improvement of the moisture status of hill country soils in the Canterbury, Marlborough and Nelson districts is likely to be an essential feature of farming them intensively and profitably in the future.

CONCLUSIONS

Although the production increase believed to be achievable on hill and high country in the Northern South Island is less than can be anticipated on the flatter land, it still represents a major opportunity to boost the regional economy. The projected increase of 7 to 13 million S.U. in the carrying capacity of land over 15° slope would be worth $200-400 m to the nation. The very difficult challenge is to make such an expansion in stock numbers profitable.

We must be prepared to be highly innovative in devising new methods of intensifying farming on this country in the face of both cold winters and dry summers. Although this conference is examining some promising leads towards methods of improving production on this country, I suggest that there is a need for much greater progress to be reported to subsequent meetings of this Association.

ACKNOWLEDGEMENTS

The assistance of S.D.Walsh of the Ministry of Works and Development Land Inventory Survey Team, the Economic Service of the N.Z. Meat and Wool Boards and Dr. J.E. Radcliffe of MAF in providing data for this paper is gratefully acknowledged, as is the assistance of Mrs A.J. Lister and S.A. Rogers in initial collation of the MOWD data.

REFERENCES

Joblin, A.D.H. 1980. N.Z. *Agric. Sci.*, *74* (4): 135-142.