FATTENING BEEF WEANERS ON CROPS
1. A THEORETICAL ECONOMIC APPRAISAL

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ABSTRACT

The theoretical profitability of a crop grazing system carrying 6.8 beef weaners per hectare is compared with that of an all-grass system carrying 3.9 beef weaners per hectare. Details are given of the crop system which consisted essentially of kale and oats alternating as winter and summer feeds on the same area of land each year and similarly, maize and kale alternating with oats as autumn and spring feeds.

Compared with the all-grass system, the crop system theoretically produced a 43, 51, 51 and 37% higher net income per hectare in the first, second, third and subsequent years after pasture respectively. The higher costs in the crop system were more than compensated for by the returns from its higher stocking rate. The weaner gross margin was shown to have a major effect on the relative profitability between the two systems.

The crop grazing system has the advantage over a 'cut and carry' system because of its lower capital costs and over a pasture grazing system because of its higher animal production and income returns per hectare. Possible improvements and problems involved in the crop grazing system are discussed.

INTRODUCTION

Economic studies comparing intensive forage cropping with pasture systems for animal production (Kearton and Shepherd, 1970; Philpott, Greigg and Wright, 1972) concluded that 'cut and carry' cropping systems (Mitchell, 1966, 1969) generate higher profits than do pasture grazing systems. However the cropping systems were considered uneconomic compared with pasture systems, in terms of the return on capital, due to the costs involved in the harvesting, storage and feeding out of the crops.

As a means of reducing the high capital costs involved in the 'cut and carry' system Stephen (1975a) suggested that the crops could be grazed **in situ** by animals. In an economic appraisal of forage farming systems for beef and dairy production Stephen *et al.*, (1974) reported that a crop system involving grazing was more profitable than a pasture grazing system although both were less profitable than a storage system. However, both the crop and pasture grazing systems were similar in terms of return on capital and in this sense much more economic compared with the 'cut and carry' crop storage system (Bell, 1975).

The aim of the present paper was to make a theoretical comparison of the costs and profitability of a crop system on which beef weaners are grazed with those of an all-grass system.

SYSTEMS

1. Crop system

Selection of the crops and predictions of dry matter production were based on data derived from purely agronomic short-term trials carried out at the Invermay Agricultural Research Centre. The crops included:

Mapua oats for spring (unpub. data) and summer (Stephen *et al.*, 1977) feed.
PX610 maize for autumn feed (unpub. data).
Medium-stemmed marrowstem kale for winter and autumn feed (Stephen, 1974, 1975b, 1976).

Details of the incorporation of these crops into a theoretical system are given in Table 1 which shows also the sowing times, dates of utilisation and average total dry matter yields for the periods of utilisation. The kale and spring-sown oats alternate on the same land in one year and similarly maize and kale alternate with autumn-sown oats on another area of land. All crops would be drilled in 15 cm rows.

This crop system theoretically produced sufficient dry matter to carry 6.8 beef weaners/ha with liveweight gains from 170 to 425 kg over a 12 month period. An 80-85% utilisation of each crop was allowed for. The target liveweight of 425 kg was chosen to ensure that the carcass would be graded in the PI top category.

The dry matter requirements of the animals (Table 2) were calculated from N.R.C. tables (1970) based on a 70% digestible ration. Digestibility and energy values differ for crops and for different stages of growth of a crop and therefore an average digestibility of 70% for each crop was assumed.

The crops would be strip-grazed using electric fences and, where regrowth was likely, back fencing would be required. In this paper the dry matter accumulated during regrowth was not included in the assessments of available dry matter and hence was surplus. This procedure was adopted as a means of 'making up' any deficit if crop yields were lower than expected as might happen through climatic adversities in any year.

2. Pasture system

There is a surprising paucity of information on the annual dry matter production of pasture under cattle grazing in Otago and Southland. Pasture production under dairy cow grazing over a 4 year period on a flat fertile South Otago soil ranged from 9800-11300 kg DM/ha in the absence of applied nitrogen (Cossens, pers. comm.). In this study an annual yield of 12000 kg DM/ha was adopted with an average utilisation of 80% and a pasture digestibility of 70% throughout

the year. This level of pasture production should support a stocking rate of 3.9 animals/ha giving the same liveweight gains of 170-425 kg/animal/year as postulated for the crop system.

TABLE 1: A rotation for grazing 5.8 beef weaners on 1 ha.

Areas 0.25 ha	Half Year	Half Year
1	**KALE** (Dec 8)* Use 21 Apr - 16 Jul at 11200** + hay	**OATS** (early Sep) 2/3 as hay on Dec 5 at 10500 Use 27 Nov - 18 Dec at 10700
2	**KALE** (Dec 20) Use 17 Jul - 15 Aug at 13200 (mid Jan) Use 16 Aug - 10 Sep at 9500	(mid Sep) Use 19 Dec - 14 Jan at 12400
3	**OATS** (early Mar) Use 11 Sep - 9 Oct at 8000	½ **MAIZE** (end Oct) + ½ **KALE** (early Oct) Use 15 Jan - 20 Feb at 9900
4	**OATS** (late Mar) Use 10 Oct - 10 Nov at 13400 (end Apr) Use 11 Nov - 26 Nov at 11800	½ **MAIZE** (end Nov) + ½ **KALE** (mid Nov) Use 21 Feb - 20 Apr at 14000 (M) + 11000 (K) + hay

Total DM utilized	= 18480 kg/ha
Total DM required	= 16830
Surplus	= 1650

* Sowing date

** Dry matter production in kg/ha

COST ASSUMPTIONS

1. Crop system

Cultivation costs were a major item in the crop system and were assessed at $8.55 per hour (Appendix A). This rate was based on conventional cultivation and included fixed costs such as tractor and machinery depreciation using current replacement prices and a labour charge of $2.50 per hour as well as variable costs such as fuel.

Current seed and fertilizer costs have been used and in the case of the cereals these were feed grain costs. Fertilizer applications of 188 kg superphosphate for maize and oats and 188 kg reverted superphosphate for kale/ha have been allowed for; these rates give an annual rate of application of 375 kg/ha. Application of nitrogen was not considered necessary during the first 3 years of the system out of pasture; it was assumed that, with the build-up of the nitrogen fertility under the previous pasture and the relatively uniform return of dung and urine during the strip grazing by animals, there would be sufficient at least for the first three years of crops.

For the fourth and subsequent years an application of 40 kg N/ha as sulphate of ammonia (S/A) was allowed for each crop. This contributed an additional cost for the 381 kg S/A/ha required annually amounting to $77.49 per tonne allowing for 32 km cartage.

A cost of 60 cents/bale was put on the oaten hay used in the system. More hay was made than the

TABLE 2: Assumed beef liveweight gains and dry matter requirements

Period	Growth rate (kg/day)	Animal weight (kg)	Animal* DM reqd (kg/day)	DM reqd for 6.8 animals over period
Apr 16		170		
	0.5		4.3	1345
May 31		193		
	0.5		4.6	2877
Aug 31		239		
	1.0		8.1	5012
Nov 30		330		
	1.0		9.3	1960
Dec 31		361		
	0.7		8.2	3290
Feb 28		402		
	0.5		7.5	2346
Apr 15		425		

Mean growth rate = 0.7 kg/day. Total DM required = 16830 kg.
* N. R. C. (1970)

system required and was intended as 'insurance'; this has not been included in the costs as it was assumed that the surplus hay would be sold at cost.

2. Pasture system

The cost and application of maintenance fertilizer at 312 kg superphosphate/ha/annum and the cost of 15 bales of hay/animal for wintering were the main costs involved in the all-grass system. No regrassing costs have been included as costs in this paper were based on a short term period.

3. Beef Weaner Gross Margin

A gross margin of $64.28 per animal has been used; its formulation, which is shown in Appendix B, is based on estimates of 53 cents per kg for beef at the works and $45 per weaner at the saleyards. These values are based on average prices over the 1976 and 1977 season. The effects of other weaner gross margins on the profitability of the crop and grass systems were also looked at.

RESULTS

The costs and returns of the crop system in the first, second, third and subsequent years after pasture are compared in Table 3 with those of the all-grass system.

In each of the first four years after pasture the crop system, with its higher stocking rate, had a higher net income/ha compared with the all-grass system; over this period the increase in net income averaged 46%, despite the higher costs involved in the crop system. The second and third years of the crop system were the most profitable. Increases in net income in the first year were lower because of the higher costs of cultivation out of pasture and in the fourth and subsequent years because of the requirement for nitrogen.

Table 4 shows the large effect that the weaner gross margin has on the profitability of the crop and grass systems. As expected the crop system becomes relatively more profitable as the weaner gross margin increases.

TABLE 3: Summary of profitability of grazing beef on crops and pasture

	$/ha			% increase in net income of crop over grass system
	Total Costs	Gross Income	Net Income	
A. **CROP SYSTEM** (6.8 animals/ha)				
First year (Appendix C)	149	437	288	+43%
Second year (Appendix D)	132	437	305	+51%
Third year (Appendix D)	132	437	305	+51%
Fourth and subsequent years (Appendix D)	161	437	276	+37%
B. **ALL-GRASS SYSTEM** (3.9 animals/ha)				
(Appendix E)	49	251	202	0

TABLE 4: Effect of Weaner Gross Margin on the Profitability of the Crop over the Grass Systems

Weaner Gross Margin ($)	Average Net Income ($) in first 4 yrs of Crop System	Grass System	% increase in net income of crop over grass system
40.00	128	107	+ 20%
50.00	196	146	+ 34%
60.00	264	185	+ 43%
64.28*	294	202	+ 46%
70.00	332	224	+ 48%

* As in Table 3

DISCUSSION

Calculation of returns on capital for the systems in this paper was impractical since the crop system would need to be incorporated into a total farm situation. The proportion of a farm on which such a crop system might operate has not been considered. It is possible that areas involving crop grazing might have to be returned to pasture after a time to restore fertility and possibly improve soil structure and hence part of the farm might need to be in crops and part in pasture at any one time. However, Bell (1975) showed that both a pasture and a part crop grazing system were superior to the 'cut and carry' system in terms of the returns on capital. Even if there were little difference in returns on capital between the crop and pasture grazing systems discussed in this paper, the crop system has a superior animal production and net income per hectare.

Compared with Mitchell's (1966) 'cut and carry' system the dry matter production of the crop system discussed in this paper is much lower; whereas in the 'cut and carry' system the crops are harvested at or near their maximum production, in the crop grazing system the crops are grazed from a relatively early growth stage to a more mature stage. The crop system presented here would therefore have a lower animal production and return per unit land area compared with the 'cut and carry' system; however, the savings in capital costs probably more than compensate for this.

The crop grazing system presented is not necessarily the best system available. There are several areas in which improvements can be foreseen. Firstly the use of the no-tillage direct drilling technique instead of conventional cultivation would reduce fuel, labour and capital equipment costs. Secondly it might be possible to introduce higher dry matter producing crops; for example, part of the area allocated to autumn-sown oats could be used for ryecorn whose dry matter production in the early spring is higher than that of oats. Thirdly the introduction of legumes into the crop system, such as lucerne sown on a separate area and the hay fed off on other areas or peas sown with the oat crop, might reduce or even do away with the need for nitrogen fertilizer application and hence reduce costs. With improvements such as these and others it is possible that the stocking rate might be increased with consequent effects on the net income.

It is only fair to point out, however, that improved grazing management and/or inclusion of more productive pasture species could increase the carrying capacity of an all-grass system and hence the profitability. Even so, however, the authors consider that the advantages of a crop grazing system, improved in the ways outlined above, could well outweigh the gains on an all-grass system.

There are also several uncertainties associated with the crop grazing system. These include questions concerning the reliability of crop yields from year to year, the utilisation percentage that can be obtained from the crops especially in relation to maintenance or weight-gain requirements of animals and the effect of crops on stock health. The crop system presented here is currently being examined under field conditions and it is hoped to obtain the answers to some of these questions.

Whilst it is acknowledged that much research is required before a crop grazing system for beef weaners can be accepted, the increased net income associated with this system more than justifies such work.

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APPENDIX A: Cultivation costs per hour

						$/hour
TRACTOR VARIABLE COSTS:						
Fuel: 13.5 1/hr at 16.5 c/l				= 2.23/hr		
Repairs and maintenance				= 0.40		2.63
LABOUR						
Extra labour for cultivation						2.50
TRACTOR FIXED COSTS:						
(Assume 50-60 H.P. tractor costing $9,000)						
Interest at 9%				= 810		
Depreciation over six years (if salvage value = $2500)				= 1080		
Registration				= 10		
Insurance and sundry				= 50		
				$1950		
If assume 800 hours/year						2.44
MACHINERY FIXED COSTS:						
(a) Depreciation over ten years						
(b) Depreciation over twenty years						
(a) drill	= 2000		(b) plough	= 750		
rotary hoe	= 1000		discs	= 650		
	$3000		harrows	= 150		
			roller	= 250		
				$1800		
salvage value	= 300			= 100		
Cost	2700			$1700		
Interest at 9%	= 270			= 162		
Depreciation (10 yrs)	= 270			= 85		
per year	$ 540			$ 247		
				+ $ 540		
			TOTAL:	$ 787		
If assume 800 hours use/year						0.98
TOTAL CULTIVATION COST PER HOUR						$8.55

APPENDIX B: Gross margin for finishing weaners
Assuming: Liveweight gain is 170 to 425 kg = 255 kg
Management from mid April to mid April

		$/head
GROSS REVENUE		
230 kg carcass weight at 53 cents/kg*		121.90
DIRECT COSTS		
Purchase price (170 kg weaner)*	= 45.00	
Losses 1%	= 1.22	
Interest 9% of $45.00	= 4.05	
Animal health – 3 drenches at 50 cents	= 1.50	
Lice control	= 0.50	
Cartage (32 km)		
1 weaner in at $1.89	= 1.89	
0.99 fat cattle out at $3.50	= 3.46	- 57.62
GROSS MARGIN PER WEANER		$ 64.28

* Based on current prices in 1976 and 1977

APPENDIX C: First year's net income from 100% crop system at 6.8 beef animals/ha
(Assume system begins in late April on kale)

			$/ha Costs	Gross Income
GROSS REVENUE (per ha)				
6.8 animals at $64.28 per head				437.10
COSTS (per ha)				
Kale (0.75 ha)				
Cultivation –	0.5 ha out of grass			
	6 hrs/ha at $8.55/hr	= 25.65		
	0.25 ha after oats			
	4 hrs/ha at $8.55/hr	= 8.55		
Seed –	3 kg/ha at $3/kg	= 6.75		
Fertilizer –	188 kg/ha at $40/tonne	= 5.64	46.59	
Oats (0.5 ha)				
Cultivation –	out of grass 6hrs/ha			
	at $8.55/ha	= 25.65		
Seed –	(Feed) 112 kg/ha			
	at 15 cents/kg	= 8.40		
Fertilizer –	188 kg/ha at $40/tonne	= 3.76	37.81	
Oats (0.5 ha)				
Cultivation –	(after kale) 4 hrs/ha			
	at $8.55/hr	= 17.10		
Seed –	(Feed) 112 kg/ha			
	at 15 cents/kg	= 8.40		
Fertilizer –	188 kg/ha at $40/tonne	= 3.76	29.26	
Maize (0.25 ha)				
Cultivation –	(after oats) 4 hrs/ha			
	at $8.55/hr	= 8.55		
Seed –	(F2) 180 kg/ha			
	at 26 cents/tonne	= 11.70		
Fertilizer –	188 kg/ha at $40/tonne	= 1.88	22.13	
Hay				
540 kg (from rotation) at 25 kg/bale				
22 bales/ha at 60 cents/bale		= 13.20	13.20	
	Total costs		148.99	- 148.99
	NET INCOME/HA			$ 288.11

APPENDIX D: Second and subsequent year's net income from 100% crop system running 6.8 beef animals/ha

			$/ha Costs	$/ha Gross Income
GROSS REVENUE (per ha)				
6.8 animals at $64.28/head				437.10
COSTS (per ha)				
Kale (0.75 ha)				
Cultivation –	(after oats)			
	4 hrs at $8.55/hr	= 25.65		
Seed –	3 kg/ha at $3/kg	= 6.75		
Fertilizer –	188 kg/ha at $40/tonne	= 5.64	38.04	
Oats (1.0 ha)				
Cultivation –	(after maize and kale)			
	4 hrs at $8.55/hr	= 34.20		
Seed –	(Feed) 112 kg/ha			
	at 15 cents/kg	= 16.80		
Fertilizer –	188 kg/ha at $40/tonne	= 7.52	58.52	
Maize (0.25 ha)				
Cultivation –	(after oats)			
	4 hrs at $8.55/hr	= 8.55		
Seed –	(F2) 180 kg/ha			
	at 26 cents/kg	= 11.70		
Fertilizer –	188 kg/ha at $40/tonne	= 1.88	22.13	
Hay				
540 kg (from beef rotation) at 25 kg/bale				
at 60 cents/bale for 22 bales per ha		= 13.20	13.20	
NITROGEN (Fourth and subsequent years)				
381 kg Sulphate of NH 4/ha/annum				
at $77.49/tonne			29.52	
Total costs second and third years			$ 131.89	
Total costs fourth and subsequent years			$ 161.41	
NET INCOME/HA SECOND AND THIRD YEARS				$ 305.21
NET INCOME/HA FOURTH AND SUBSEQUENT YEARS				$ 275.69

APPENDIX E: Net income from an all grass system carrying 3.9 beef animals/ha

	$/ha Costs	$/ha Gross Income
GROSS REVENUE (per ha)		
3.9 weaners at $64.28/head (see Appendix B)		250.69
COSTS (per ha)		
312 kg/ha superphosphate/year at $45/tonne	14.04	
15 bales hay/animal = 58.5 bales at 60 cents/bale	35.10	
NET INCOME =	$ 49.14	$ 201.55