

Cattle - Feeding



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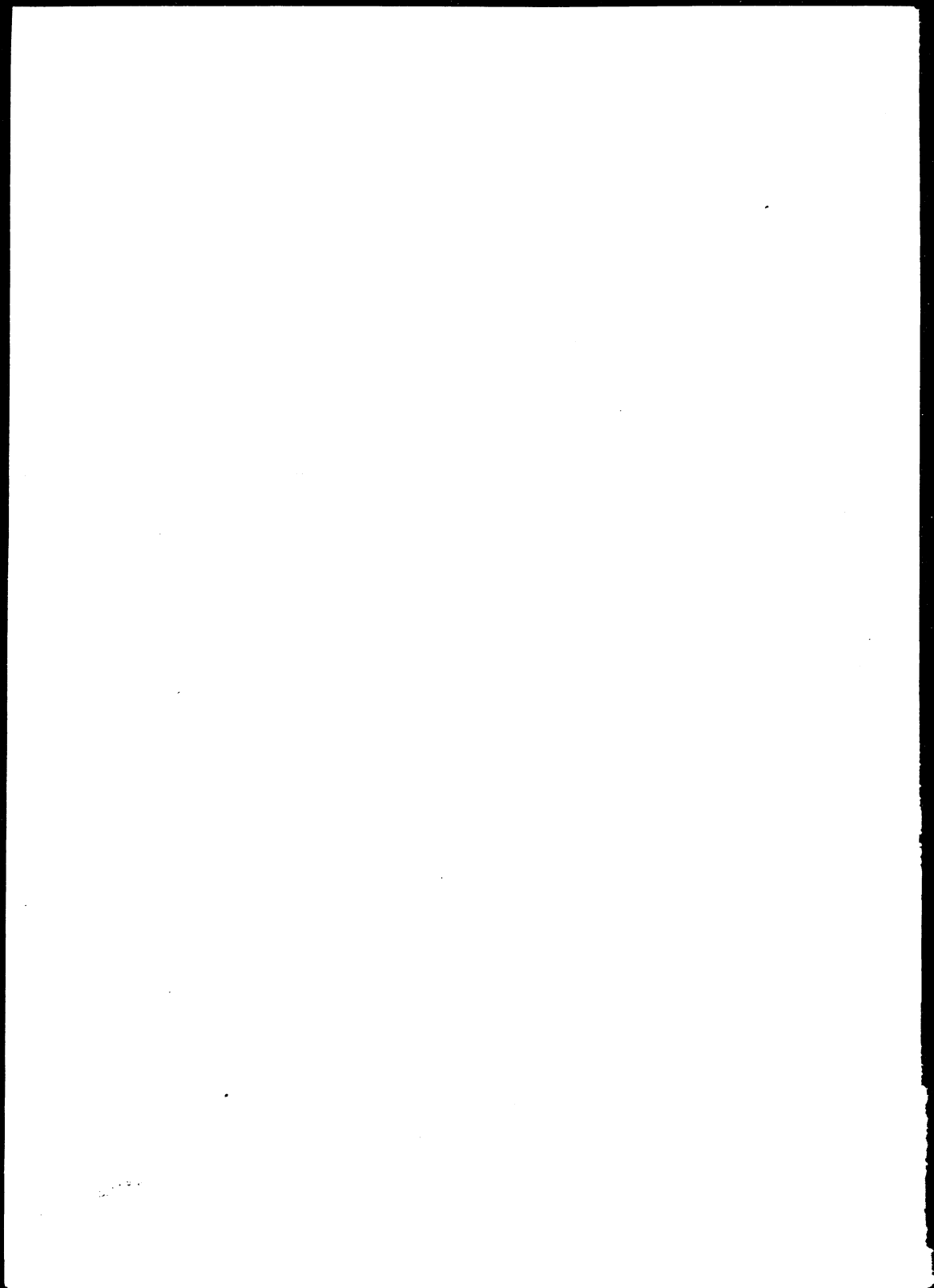
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*East of Scotland college of agriculture
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**STRAW AND CONCENTRATE DIETS FOR
INTENSIVE BEEF FINISHING**

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**STRAW AND
CONCENTRATE DIETS
FOR INTENSIVE BEEF FINISHING**

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SUMMARY

The object in introducing straw to dilute ad lib barley-based diets for fattening cattle was to cheapen the cost of the ration and leave a greater margin for profit. The experimental evidence shows that cheapening the cost per ton by introducing straw into the diet is only one factor when considering the complex inter-relationships between biological and financial functions related to intensive ad lib fattening systems.

Particle size is very important and there is a considerable difference in performance of the animals directly related to this. Grinding straw compared with chopped straw gives better results both from an animal performance and financial viewpoint.

Younger animals on diets including straw compare particularly unfavourably with animals on an all-concentrate diet and the system should only be considered for older animals of at least 5 cwt liveweight.

Comparison with animals fed on all-concentrate diets indicates that liveweight gain per day is progressively reduced when straw is included in the diet. Food conversion ratios and killing-out percentages are similarly affected.

The financial assessment in this bulletin is based on physical data obtained from experimental evidence from several sources, updated to current cost and price levels for a range of straw inclusion rates from 0 to 50 per cent, for comparison with an all-concentrate diet. The comparison also includes the effects of either grinding or chopping the straw. The evaluation is expressed in gross margin and net margin terms. This type of comparison although useful, is limited by the basic assumptions used and to overcome this, the effects on the comparative financial performance of variations in the price of barley and straw and changes in the buying and selling price are also considered.

The financial comparison indicates that there is no apparent advantage in introducing processed straw to the diets of beef cattle being finished on an ad lib concentrate system.

INTRODUCTION

The 'barley-beef' system of production was adopted on many farms because of certain inherent advantages over traditional methods. Land previously used for forage production could go into cash crops which together with the returns from barley beef could increase overall farm profitability. The system also lent itself to labour economies and the possibilities of both a more uniform product and a regular throughput.

Rising feed costs substantially reduced the profitability of this system, however, and this has stimulated research into possible ways of reducing these costs. The introduction of a cheaper food as part of the diet is an obvious method and in recent years a considerable amount of experimental work has been carried out on finishing cattle fed ad lib on complete diets of concentrates and processed straw. This work has been primarily concerned with the effect of:

- a) different treatments of straw (ground through $\frac{1}{4}$ in. - $\frac{1}{2}$ in. screens or chopped to lengths of 1 in. - 3 in.) and
- b) different rates of straw inclusion with concentrates in a complete diet.

The objective of this bulletin is to provide an economic evaluation of the performance of finishing cattle given various straw/concentrate diets ad libitum. The main biological results are also summarised.

The physical data which form the basis for the economic assessment are derived from results published by The Rowett Research Institute, The University of Nottingham and Queen's University, Belfast. These have been related to current costs and returns and the effects of possible changes have also been assessed.

There are problems associated with using published data if all the relevant information is not available. Comparisons can be complicated by breed differences, the undefined quality of the straw used, variation in particle size of processed straw, etc. Nevertheless these factors are unlikely to be of sufficient importance to invalidate the conclusions.

MAIN BIOLOGICAL EFFECTS OF FEEDING PROCESSED STRAW AND CONCENTRATES TO BEEF CATTLE

1) Influence of particle size of straw on digestion

Chopped straw offers no nutritional advantage over straw fed in the long form. The only difference due to chopping seems to be in a slightly increased intake, possibly due to reduction in waste by selection rather than any specific response by the animals.

Grinding alters the physical nature of the material to a greater extent, causing changes in the process of straw digestion. It results in reduced salivary secretion and less regular rumination, with more rapid fermentation and passage through the rumen. Dry matter intake is also increased. This causes a change in the quantity and nature of the end products of digestion, which consequently affects animal performance. The optimum particle size of straw is obtained by grinding using a $\frac{1}{4}$ " screen.

2) Effect of age on animal performance

a) Animals between 260 lb (120 kg) and 620 lb (280 kg) liveweight

Dry matter intake

As the proportion of ground straw in the diet increases to 50 per cent, the intake of dry matter also rises. The intake of dry matter is greater with diets containing ground rather than chopped straw.

Dry matter digestibility

The digestibility of the total dry matter in the diet decreases as the proportion of the straw rises, falling from around 80 per cent with an all-cereal diet to about 60 per cent for one containing 50 per cent chopped straw or 55 per cent with a similar inclusion of ground straw. However, the increased intake of the ground straw/concentrate diets more than compensates for the reduced digestibility and results in greater intakes of digestible dry matter.

Liveweight gains

Higher liveweight gains are obtained with the ground straw compared with the chopped straw diets at all levels of straw inclusion.

Killing-out percentages

These decrease substantially with increasing straw content and are greater with the chopped straw diet. These reductions are reflections of 'gut fill'.

Food conversion ratios¹

These deteriorate with increasing straw content, being greater for the chopped than the ground straw diet.

b) Animals from about 620 lb (280 kg) liveweight to slaughter

Composition of diets

The composition of the diets used differed slightly from centre to centre but were based on processed barley straw, barley or maize, molasses and adequate levels of protein (or urea substitute), plus minerals and vitamins. Although the crude protein content of the diets used for fattening cattle was 12 - 14 per cent, recent findings indicate that these levels are higher than necessary and suggest that levels of 10 - 11 per cent would be adequate. Furthermore, urea alone may be used to provide supplementary crude protein in such diets without loss of performance.

Dry matter intake

Barley based diets

The dry matter intakes of animals offered diets containing chopped straw remain relatively constant regardless of the straw content, whereas the dry matter intakes on ground straw diets tend to increase with straw inclusion up to 20 per cent and then decline up to 50 per cent inclusion.

Maize based diets

When ground straw is used in diets containing maize rather than barley as the main energy source, intake increases progressively until the ration contains around 30 per cent ground straw and then remains relatively constant up to 50 per cent straw inclusion.

Dry matter digestibility

The digestibility of dietary dry matter decreases progressively with increasing straw content. The decrease is similar for ground and chopped straw.

For each 10 per cent increase in straw content, the digestibility decreases by about 4 units until it reaches a low level of about 60 per cent for the 50 per cent straw ration. The digestibility of crude protein is variable but tends to decrease as straw content rises.

¹Food conversion ratio : food consumed per unit of liveweight gain (related to fresh food containing 85% dry matter).

Liveweight gain

Barley based diets

Daily liveweight gain on barley-based ground straw diets declines as straw inclusion increases; the decline becoming more pronounced at around the 20 per cent level and above.

When chopped straw is used the reduction in liveweight gain is also apparent at all levels of inclusion and the effect is greater than for the ground straw.

Maize based diets

Daily liveweight gains remain constant up to the 30 per cent inclusion level after which they also decline.

Food conversion ratios

These deteriorate progressively as the straw content of the diet rises, the increase being greater for the chopped straw diets. For each 10 per cent increment in ground straw, the food conversion ratio increases on average by about 0.53 and 0.65 units for the maize and barley-based diets respectively.

Killing-out percentage

Ground straw

Experimental evidence is inconclusive but suggests that killing-out percentage is reduced when the straw inclusion rate exceeds 20 - 30 per cent.

Chopped straw

Killing-out percentages show a progressive decline when the straw content inclusion rises above 5 per cent.

Conclusion

The lower feed conversion efficiency associated with feeding straw to younger animals results in inferior liveweight and carcass gains, comparing less favourably with the performance achieved with feeding similar diets to older animals. In consequence, diets containing straw compare unfavourably with all-concentrate rations for younger animals and have therefore been excluded from the economic evaluation which now follows.

ASSESSMENT OF FINISHING BEEF CATTLE ON STRAW AND CONCENTRATE DIETS

The physical data used as a basis for the financial comparisons are mean values from experiments at various centres. The factors to be considered are:—

- 1) liveweight gain,
- 2) food conversion and
- 3) killing-out percentage.

1) Liveweight gain

To allow comparison between treatments the same starting and finishing weights are used.

	mean weight:	
	cwt	kg
Average liveweight:		
at finish	8.21	418
at start	5.54	282
gain during feeding period	2.67	136

Table 1 shows the effect of various levels of straw inclusion and method of straw processing on:—

- a) liveweight gain and
- b) subsequent effect on duration of feeding period.

TABLE 1: Effect on liveweight gain of different rates of straw inclusion

	Percentage straw inclusion:					
	0	10	20	30	40	50
	Ground straw					
Liveweight gain per day: lb	2.30	2.20	2.10	1.95	1.75	1.65
Total liveweight gain: cwt	2.67	2.67	2.67	2.67	2.67	2.67
Feeding period: days	130	136	143	154	171	182
	Chopped straw					
Liveweight gain per day: lb	2.30	2.20	2.05	1.80	1.55	1.32
Total liveweight gain: cwt	2.67	2.67	2.67	2.67	2.67	2.67
Feeding period: days	130	136	147	167	193	227

Liveweight gain per day

This decreases in both straw treatments by 0.1 lb per day at the 10 per cent inclusion level, but above 20 per cent inclusion, the decrease for the cattle on the chopped straw diets becomes progressively more rapid.

Duration of feeding period

As a constant total liveweight gain has been used, the duration of the feeding period is directly related to the liveweight gain per day, varying from 130 days on the all-concentrate diet to 227 days on the diet containing 50 per cent chopped straw. This has a direct effect on the time period over which capital is required.

2) Food conversion

The effect of different rates of straw inclusion on food conversion and total food utilisation over the feeding periods are shown in Table 2.

TABLE 2: Effect on food utilisation of different rates of straw inclusion¹

	Percentage straw inclusion:					
	0	10	20	30	40	50
	Ground straw					
Food conversion ratio	7.4	8.1	8.7	9.4	10.0	10.7
Feed used/head (cwt):						
concentrates	19.8	19.5	18.7	17.6	16.0	14.4
straw	—	2.2	4.6	7.6	10.8	14.3
total	19.8	21.7	23.3	25.2	26.8	28.7
	Chopped straw					
Food conversion ratio	7.4	8.1	9.2	10.7	12.3	13.9
Feed used/head (cwt):						
concentrates	19.8	19.5	19.7	20.1	19.8	18.6
straw	—	2.2	4.9	8.6	13.1	18.6
total	19.8	21.7	24.6	28.7	32.9	37.2

Food conversion deteriorates as percentage straw increases. This effect is much greater with chopped straw compared with ground straw at the 20 per cent inclusion level and above.

Concentrate consumption

As a result of the increase in food conversion the saving of concentrates is not as significant as might have been expected. This is particularly true in the case of chopped straw where the savings are virtually nil until the 50 per cent straw inclusion level is reached.

Total food consumption

The deterioration in food conversion has a direct effect on total food consumption and consequently on straw processing and mixing costs.

¹ Both straw and concentrates assumed to be in natural state (85% D.M.).

3) Killing-out percentage

In commercial practice the comparison of killing-out percentages is of limited value unless the treatment of animals after leaving the farm and before slaughter is the same. If there is considerable variation in time from leaving the farm, when animals probably have a well-filled gut, and time of slaughter, inter-plot comparisons of killing-out percentage can lead to misleading conclusions. However, using experimental data, as in Table 3, avoids this source of error.

TABLE 3: Effect on carcass weight and value of different rates of straw inclusion

	Percentage straw inclusion:					
	0	10	20	30	40	50
	Ground straw					
Killing-out percentage	56.0	56.0	56.0	55.0	53.0	52.0
Total carcass weight: lb	515	515	515	506	488	478
* Value of carcass @ 32p/lb: £	164.8	164.8	164.8	161.9	156.2	153.0
	Chopped straw					
Killing-out percentage	56.0	55.5	54.3	53.0	51.7	50.5
Total carcass weight: lb	515	511	500	488	476	465
* Value of carcass @ 32p/lb: £	164.8	163.5	160.0	156.2	152.3	148.8

* 32p per lb deadweight is equivalent to approximately £20 per cwt liveweight at a killing-out percentage of 56.

Killing-out percentage drops off more rapidly when **chopped** straw is used.

Carcass weight

This is considerably affected by a lower killing-out percentage. The importance of this in economic terms has frequently been underestimated, as a lower carcass weight is a reflection of the killing-out percentage on the **total liveweight of the animal** and not just the liveweight gain over a feeding period. Comparisons of liveweight gain **alone** between treatments can lead to misleading

conclusions being drawn, as the real value of this gain should be in terms of saleable meat which relates to carcass weight and not to liveweight.

The values of carcasses from animals with the **same liveweight** but **different killing-out percentages**, are significantly different in financial terms. Comparing animals fed all-concentrate diets with those fed on rations containing 50 per cent chopped straw — the two extremes — the difference in carcass value amounts to £16 per animal.

FINANCIAL EVALUATION

1) Basis of assessment

In order to carry out a financial assessment of the various diets, certain assumptions have had to be made at the outset. These are detailed below.

a) Concentrates and straw mix

The following ingredients per ton of mix were assumed at the various levels of straw inclusion.

Ingredient	Cost/ ton	Percentage straw inclusion:					
		0	10	20	30	40	50
	£	cwt	cwt	cwt	cwt	cwt	cwt
Barley	45	17.7	15.2	12.7	10.2	7.5	5.0
Molasses	40	1.0	1.0	1.0	1.0	1.0	1.0
Protein concentrate ¹ (40% crude protein)	70	0.8	1.3	1.8	2.3	3.0	3.5
Minerals and vitamins	80	0.5	0.5	0.5	0.5	0.5	0.5
Straw ²	4	0.0	2.0	4.0	6.0	8.0	10.0
Percentage crude protein:							
concentrates		11	12	13	14	17	19
concentrates and straw		11	11	11	11	11	11

¹ 40% crude protein – 28% crude protein from urea.

² Assumed to be home produced. If it had to be purchased the cost could be considerably more. (See also page 15).

Cost per ton of concentrate fraction of mix

	Percentage straw inclusion:					
	0	10	20	30	40	50
	£	£	£	£	£	£
Cost per ton	46.6	47.5	48.6	50.0	52.3	55.0

The cost of the concentrate to supplement the straw in the diet increases as the percentage of straw rises, due to the increased protein supplementation required. This increase would obviously be greater if a protein concentrate had been used, which did not include urea.

b) Processing and mixing charges

Per ton

The costs used relate to contractors' charges. These increase as the proportion of straw is raised, for the following reasons:

- i) reduction in weight per batch mixed;
- ii) increased operating time per batch mixed;
- iii) greater wear and tear on machinery.

In addition, grinding is a slower job than chopping, a factor which has also been taken into account.

Per head

On a per head basis, costs are increased still further with higher rates of inclusion, as the quantity of feed required to achieve the same total liveweight gain also increases — the result of a deterioration in conversion efficiency.

Table 4 summarises these various factors. The figures used relate to contractors' charges, but it is appreciated that these may be on the low side for some areas, in view of the wide range in contractors' charges known to exist. No attempt has been made to calculate charges for home mixing as circumstances can vary so much from farm to farm.

TABLE 4: The effect on processing and mixing charges of different rates of straw inclusion

	Percentage straw inclusion:					
	0	10	20	30	40	50
	£	£	£	£	£	£
	Ground straw					
Cost: per ton	3.0	4.0	5.1	6.1	7.1	8.2
per head	3.0	4.3	5.9	7.7	9.5	11.8
Total feed consumed:	cwt	cwt	cwt	cwt	cwt	cwt
concentrates and straw — /head	19.8	21.7	23.3	25.2	26.8	28.7
	£	£	£	£	£	£
	Chopped straw					
Cost: per ton	3.0	3.7	4.5	5.3	5.9	6.7
per head	3.0	4.0	5.5	7.6	9.7	12.5
Total feed consumed:	cwt	cwt	cwt	cwt	cwt	cwt
concentrates and straw — /head	19.8	21.7	24.6	28.7	32.9	37.2

c) Buying price of store cattle

This is based on £20 per cwt.

d) Selling price of fat cattle

This is based on 32p per lb deadweight which is approximately equivalent to £20 per cwt liveweight at a killing-out percentage of 56.

2) Gross margin comparison

The effects of feeding the various diets can be compared, using the physical data — liveweight gain, feed conversion and killing-out percentage — discussed earlier. These are shown in Table 5 where the comparison is made on a gross margin basis.

TABLE 5: The effect on gross margin per head of feeding diets containing different rates of straw inclusion

	Percentage straw inclusion:					
	0	10	20	30	40	50
	£	£	£	£	£	£
	Ground straw					
Output:						
selling price	164.8	164.8	164.8	161.9	156.2	153.0
less buying price	110.8	110.8	110.8	110.8	110.8	110.8
total	54.0	54.0	54.0	51.1	45.4	42.2
Variable costs:						
concentrates	46.2	46.2	45.5	44.0	41.9	39.4
straw (incl. bedding)	1.0	1.5	1.9	2.5	3.2	3.9
processing and mixing	3.0	4.3	5.9	7.7	9.5	11.8
miscellaneous	0.5	0.5	0.5	0.5	0.5	0.5
total	50.7	52.5	53.8	54.7	55.1	55.6
Gross margin	3.3	1.5	0.2	-3.6	-9.7	-13.4
	Chopped straw					
Output:						
selling price	164.8	163.5	160.0	156.2	152.3	148.8
less buying price	110.8	110.8	110.8	110.8	110.8	110.8
total	54.0	52.7	49.2	45.4	41.5	38.0
Variable costs:						
concentrates	46.2	46.2	47.8	50.3	51.8	51.1
straw (incl. bedding)	1.0	1.5	2.0	2.7	3.6	4.7
processing and mixing	3.0	4.0	5.5	7.6	9.7	12.5
miscellaneous	0.5	0.5	0.5	0.5	0.5	0.5
total	50.7	52.2	55.8	61.1	65.6	68.8
Gross margin	3.3	0.5	-6.6	-15.7	-24.1	-30.8

Note: The gross margin does not take the fixed costs into account since these cannot normally be allocated to an individual unit of production.

3) Net margin comparison

The gross margin comparison does not take account of the cost of the different capital requirements due to variation in length of feeding period. The effect of this is shown in Table 6 where interest at 10 per cent per annum has been charged on average working capital, to arrive at comparative net margins.*

TABLE 6: The effect on net margin of different rates of straw inclusion

	Percentage straw inclusion:					
	0	10	20	30	40	50
	£	£	£	£	£	£
	Ground straw					
Gross margin	3.3	1.5	0.2	-3.6	-9.7	-13.4
less interest	4.8	5.1	5.4	5.8	6.5	6.9
Net margin	-1.5	-3.6	-5.2	-9.4	-16.2	-20.3
	Chopped straw					
Gross margin	3.3	0.5	-6.6	-15.7	-24.1	-30.8
less interest	4.8	5.1	5.6	6.5	7.6	9.0
Net margin	-1.5	-4.6	-12.2	-22.2	-31.7	-39.8

The net margins show that there is a loss per head with all treatments but the returns deteriorate significantly when straw is included at any level, particularly when it is in a chopped condition.

4) The effect of price changes on financial performance

The gross and net margins in Tables 5 and 6 show returns which would be unacceptable to commercial producers. The factor and product prices on which these are based are continually altering in practice. The significance of these changes is considered below.

a) Variation in the price of barley

A £5 ton variation in barley price has a significant effect on the net margin per head, although the comparative position between treatments is altered very little within these ranges.

* The cost of capital is discussed more fully in the Appendix. See Page 22.

TABLE 7 Net margins per head with variations in barley price

Barley price/ton	Percentage straw inclusion:					
	0	10	20	30	40	50
	£	£	£	£	£	£
	Ground straw					
£40	3.0	0.7	-1.6	-6.1	-13.6	-18.5
£45	-1.5	-3.6	-5.2	-9.4	-16.2	-20.3
£50	-5.8	-7.6	-10.0	-12.5	-18.6	-22.1
	Chopped straw					
£40	3.0	0.4	-8.4	-16.8	-28.6	-37.5
£45	-1.5	-4.6	-12.3	-22.2	-31.7	-39.8
£50	-5.8	-8.7	-16.2	-24.7	-29.3	-42.1

b) Variation in the price of feeding straw

So far, the price used for straw has been £4 per ton, which is a comparatively low figure, although realistic in many arable areas. If straw had to be purchased, e.g. for a large feed lot, then the cost of the straw could become a more significant factor.

If the price for straw were considerably higher than the £4 per ton used for the comparisons given in Tables 5, 6, 9 and 11 then the net margins would be adversely affected to a considerable degree, particularly at the higher levels of inclusion in diets. The figures in Table 8 do not take account of bedding straw, where price variation will have similar affects for all treatments.