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22 The role of grassland in sheep production

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THE CONTRIBUTION OF SHEEP TO THE AGRICULTURAL ECONOMY

At the June 1978 census of agriculture, there were nearly 30 million sheep and lambs on farms in the United Kingdom, more than one for every two persons in the population. In the agriculture of the mainland Celtic fringe, Scotland and Wales, sheep actually outnumbered the human population at this date; in June the sheep population is nearly at its greatest with all the lambs on farms, except for the half-million or so already sold for the early and Easter trades. Impressive as these figures appear, and important as sheep are in certain parts of UK farming, the statistics are fairly meaningless when considered in isolation. The aim in this section is to set the sheep statistics in perspective.

The breeding ewe population in the United Kingdom remained fairly steady in the mid-1970s, at just under 14 million, after declining towards the end of the previous decade (Table 1). At June 1978 the flock numbered 14.2 million and, in that year, sheep contributed 4.7% of total agricultural output in the form of lamb, mutton and clip wool (Table 2); this is much the same proportion as it was ten years earlier in 1968–1969. In the 1970s this percentage fluctuated between 4 and 5% so that, in the context of UK agriculture as a whole, sheep production is relatively unimportant.

The question 'how many sheep farmers are there in the UK?' cannot be precisely answered from official statistics but evidence on the distribution of sheep flocks can be obtained by reference to the number of holdings at the June agricultural census which records the presence of sheep of one type or another. These statistics will be a guide to the number of sheep farmers who

Table 1
Sheep numbers in the UK, 1968–1978 (thousand)

	1968	1970	1972	1974	1976	1978
Ewes	13 873	12 807	13 106	13 865	13 667	14 160
Total sheep and lambs	28 004	26 080	26 877	28 498	28 265	29 690

Sources: MAFF (1968–1972); MAFF (1973–1978).

Table 2
The contribution of sheep to the agricultural economy

Product	£ million		percentages	
	1968/69	1978	1968/69	1978
Fat sheep and lambs	87	300	4.3	4.2
Clip wool	15	33	0.7	0.5
Sub-total	102	333	5.0	4.7
Fat cattle and calves	312	1 257	15.2	17.6
Milk and milk products	442	1 621	21.5	22.7
Pigs, poultry and eggs	534	1 533	26.0	21.5
Other livestock	13	73	0.6	1.0
Crops and horticulture	642	2 255	31.2	31.5
Sundry output	11	70	0.5	1.0
Total output	2 056	7 142	100.0	100.0

Sources: MAFF (1968–1972); MAFF (1973–1978).

are, in the main, the ones with breeding flocks. The sheep farmer who buys store lambs in the August–November sales, for finishing, will not be recorded in the main June census. Table 3 gives information on this aspect of the importance of sheep in the agricultural economy: from it can be deduced that there were 80 000 agricultural holdings in 1975 on which sheep were kept.

Despite some unsatisfactory innate characteristics of the sheep as an animal, eg, its tendency to lie down and die and its ability to break out through weakened hedges, a flock of sheep is a very flexible entity such that

Table 3
The number of agricultural holdings with sheep in the UK, 1975

	Number of agricultural holdings (thousand)	% of holdings with sheep	Number of holdings with sheep (thousand)
England and Wales	206	28	57.2
Scotland	32	48	15.3
Northern Ireland	34	22	7.4
United Kingdom	272	29	79.9

Source: MAFF, DAFS & DANI (1977).

it can be fitted into many farming systems. Evidence of this flexibility is shown in the following Tables, which give the distribution of sheep flocks by type of farming. It can be seen that flocks of sheep of a different average size are kept on varying proportions of farms in each type group. In England and Wales (Table 4) sheep are mainly important on livestock-rearing farms, 77%

Table 4
The distribution of breeding ewes by type of farming, 1969 and 1975, England and Wales

Type of farming	% of holdings with breeding ewes		Average number of breeding ewes per holding		% of total breeding ewes	
	1969	1975	1969	1975	1969	1975
Dairy	29	27	68	85	12	10
Livestock	85	77	273	298	57	64
Pigs and poultry	11	12	73	94	1	1
Cropping	23	21	138	175	9	8
Horticulture	4	3	134	138	1	1
Mixed	55	51	129	170	11	7
Full-time[1]	36	35	166	207	89	92
Part-time[2]	17	18	48	51	11	8
All holdings	27	28	131	165	100	100

1 275 smd's and over. *2* Under 275 smd's. Source: MAFF, DAFS & DANI (1977).

having an average flock of 298 ewes, and on mixed farms, 51% with an average flock of 170 ewes. While, overall, the number of breeding ewes on pig and poultry holdings is insignificant (1%) the sheep, together with dairy and beef cattle, would use most of the 29 ha of crops and grass on these farms which are not required by the main intensive enterprises.

In Scotland (Table 5), the hill sheep and upland farms accounted for 36% of holdings but for 70% of all ewes, with average flocks of 976 and 278 ewes respectively. More than half the 'rearing with arable' farms (17% of holdings) had flocks averaging 151 ewes and about one-third of all dairy holdings kept nearly 200 ewes. On this type of farm the flock would play a cleaning-up role in the autumn, on pastures previously grazed by dairy cows (average number 71). 58% of the Northern Ireland ewe population were kept in small flocks (average 100 ewes) on the beef and sheep holdings (Table 6). Table 7 gives the total number of holdings in each country for comparison.

Table 5
The distribution of breeding ewes by type of farming, 1969 and 1975, Scotland

Type of farming	% of holdings with breeding ewes		Average number of breeding ewes per holding		% of total breeding ewes	
	1969	1975	1969	1975	1969	1975
Hill sheep	100	100	895	976	37	32
Upland	75	72	267	278	28	38
Rearing with arable	61	51	135	151	8	8
Rearing with intensive livestock	42	38	94	131	1	1
Arable rearing and feeding	46	46	105	127	2	2
Cropping	35	27	114	125	4	3
Dairy	34	32	111	196	6	5
Intensive	7	5	54	73	—	—
Full-time[1]	50	50	257	285	86	89
Part-time[2]	37	47	39	62	14	11
All holdings	42	48	143	202	100	100

1 250 smd's and over.

2 Under 250 smd's.

Source: MAFF, DAFS & DANI (1977).

Table 6

The distribution of breeding ewes by type of farming, 1969 and 1975, Northern Ireland

Type of farming	% of holdings with breeding ewes		Average number of breeding ewes per holding		% of total breeding ewes	
	1969	1975	1969	1975	1969	1975
Dairying	16	13	22	31	5	6
Dairying, pigs and poultry	24	21	24	37	4	1
Mixed	40	32	44	55	12	8
Beef and sheep	61	46	101	100	45	58
Beef, sheep and pigs	46	35	40	50	7	3
Pigs and poultry	14	9	35	46	1	1
Cropping	20	13	42	56	2	1
Full-time[1]	32	28	56	75	75	78
Part-time[2]	18	17	33	37	25	22
All holdings[3]	25	22	48	54	100	100

1 200 smd's and over.

2 50–199 smd's.

3 Over 50 smd's.

Source: MAFF, DAFS & DANI (1977).

Table 7

The number of holdings in 1969 and 1975 (thousand)

	England and Wales[1]	Scotland[1]	Northern Ireland[2]
1969	242.3	53.1	36.3
1975	203.0	30.6	33.2

1 Excludes non-crops and grass holdings.

2 Excludes holdings of less than 50 smd's and those consisting of rough grazings only.

Source: MAFF, DAFS & DANI (1977).

Table 8 provides statistics to show the two-fold changes in the structure of sheep production. First the number of producers, or more strictly 'holdings with sheep', is decreasing annually; in England and Wales this number fell by 15% over the period 1968 to 1975, in Scotland the drop was 33%. For the

Table 8

The distribution of holdings and breeding ewes by size of breeding flock (ewes)

Number of breeding ewes per holding	% of holdings		% of breeding ewes	
	1969	1975	1969	1975
England and Wales				
1– 99	60.7	53.0	19.4	13.7
100–499	35.2	40.3	55.0	52.3
500–999	3.4	5.2	17.0	21.1
1 000 and over	0.8	1.5	8.5	12.9
Totals	100.0	100.0	100.0	100.0
Number of holdings (thousand)	66.8	57.2		
Average number of ewes per holding	131	165		
Scotland				
1– 99	67.6	52.9	15.9	11.4
100–499	24.8	35.7	36.2	36.5
500–999	5.2	7.5	23.2	23.7
1 000 and over	2.4	3.9	24.7	28.4
Totals	100.0	100.0	100.0	100.0
Number of holdings (thousand)	22.8	15.3		
Average number of ewes per holding	152	214		

Note: This analysis is not available for Northern Ireland where sheep are relatively unimportant, as shown by the breeding flock of less than 0.5 million compared with 12.7 million in Great Britain in 1975.

Source: MAFF, DAFS & DANI (1977).

UK as a whole the 79 000 producers in 1978 represented a decrease of 24% in the ten-year period. As there has been very little change in the total population of breeding ewes, it follows that there is a growing concentration of ewes into bigger flocks.

The still very numerous small flocks (under 100 ewes) carried 13.7% of total ewes in England and Wales in 1975 as against 19.4% in 1968; in Scotland these figures are respectively 11.4 and 15.9%. Conversely, flocks of over 500 ewes accounted for 44% of all the breeding ewes in England and Wales in 1975 compared with 25.5% in 1968. The trend in Scotland is similar, but not so pronounced. While increasing size is not always a recipe for improved financial returns, the one main advantage of a large flock (over 500 ewes) is that it justifies the employment of a specialist shepherd, a type of worker who is, however, getting scarcer year by year.

Table 9 reveals the importance of sheep regionally in the United Kingdom and the competitive or complementary nature of the sheep and cattle enterprises. The contrast in this respect in England and Wales is between the relatively 'sheepless' eastern region, with only 8 sheep LU/100 ha of grassland, and the 'sheep country' of Northern England and Wales, with 32 and 49 sheep LUs per 100 ha of grass. In these areas, the ratio of sheep to cattle is narrowly in favour of cattle compared with the ratio of 1:8 in the east and west of England. With the exception of north-east of the country, Scotland shows up as a sheep-keeping area with high sheep stocking rates and a narrow ratio of sheep to cattle. In contrast, sheep are relatively unimportant in Northern Ireland; the stocking rate was seven sheep LUs per 100 ha of grassland and there is a wide differential in the sheep:cattle relationship.

In the agricultural economy of the hills and uplands, sheep remain a major enterprise, either alone or in association with cattle. Table 10 shows that 57% of the UK ewe flock is kept on hill and upland farms. In the lowlands, sheep must always compete on economic terms with other livestock and cropping enterprises and the success they have in this respect reflects back to the hill and upland sheep sector. This is because of the so-called stratification within the sheep industry by which culled breeding stock and store lambs from the hills come down to the lowlands for further breeding or for finishing.

THE CONTRIBUTION OF SHEEPMEAT TO NATIONAL CONSUMPTION AND EXPENDITURE

A fact that sheep farmers must always be aware of is that domestic consumption of lamb and mutton is declining; the trend is not a short-term one for it has been evident over the last decade. In the mid-1960s,

Table 9

The regional distribution of sheep, cattle and stocking rates, June 1978

	Number of breeding ewes (thousand)	Grassland[1]		Livestock units per 100 ha of grassland[2]		
		Area (thousand ha)	As % of crops and grass	Cattle	Sheep	Ratio of sheep:cattle
England						
Eastern	134.2	238.7	16.9	135	8	
South Eastern	640.9	563.5	48.7	120	16	
East Midlands	545.3	436.5	36.7	122	18	
East	1 320.4	1 238.7	33.0	124	15	1:8.3
West Midlands	914.5	703.3	63.8	141	19	
South Western	1 345.5	1 237.2	73.3	132	14	
West	2 260.0	1 940.5	69.5	135	16	1:8.4
Northern	1 907.9	688.4	67.5	120	36	
Yorks and Lancs	728.2	431.5	49.7	86	24	
North	2 636.1	1 119.9	59.3	107	32	1:3.0
Wales	2 967.3	945.6	89.8	96	49	1:2.0
Scotland						
North West	722.7	88.4	45.7	47	29	1:1.6
North East	189.3	137.7	35.1	193	20	1:9.7
South East	861.5	183.3	32.7	110	49	1:2.2
South West	1 271.3	297.2	56.5	151	42	1:2.8
Northern Ireland	498.0	766.4	90.1	115	7	1:16.4

1 Excluding rough grazings.

2 Including an allowance for rough grazings.

Sources: MAFF (1979); DAFS (1979); DANI (1979).

Table 10
Distribution of breeding ewes by elevation of farm, UK, 1978

	Percentage of total ewes			
	Lowland flocks	Upland flocks	Hill flocks	Totals
England	29.1	4.8	10.0	43.9
Wales	6.8	5.3	14.0	26.1
Scotland	6.0	4.9	15.6	26.5
Northern Ireland	1.1	0.6	1.8	3.5
UK	43.0	15.6	41.4	100.0

Source: MAFF – personal communication.

consumption of sheepmeat was relatively stable at about 10.7 kg per head per annum, in 1977 it was 7 kg.

Table 11 gives more information on this point, together with comparative statistics of expenditure on other meats, total food and household expenditures. It is important to remember, when considering domestic consumption and spending on lamb and mutton, that the UK sheep farmer supplies only about 60% of the country's sheepmeat requirements.

Summarising Table 11, the important features are that consumption of carcase meat (kg per week) declined marginally in the decade 1968–1978 (–2.9%) but the sheepmeat component decreased from 36 to 25%. Spending on sheepmeat, as a proportion of total food expenditure, dropped from 4.2 to 3.5% in this ten-year period. Small as these figures are, they are comparatively large when expenditure on sheepmeat is related to total household expenditure. In 1977 the latter was just under £72 per week, of which 49p was spent on mutton and lamb, or 0.7%, and some 40% of this was spent on imported lamb. This is the minimal share of the consumer's purse that sheep farmers receive from the home food market; it is bolstered by expenditure on sheepmeat outside the home in hotels, restaurants and canteens and by the relatively small wool contribution.

This discussion may seem far removed from grassland matters but, as is seen later in the paper, grass is the main component of the sheep's diet and it follows that farmers must manage their flocks, and consequently their grassland, in order that sheepmeat remains so competitively priced that it loses no more ground in the struggle for the consumers' choice.

While the factors outlined in the preceding paragraphs affect the total trade in sheepmeat, for the UK sheep farmer changes in the structure of that

Table 11

The contribution of sheepmeat to average food consumption and expenditure

Weekly, per person

Item	Weight – kg		Cost – p	
	1968	1978	1968	1978
Beef and veal	0.22	0.24	14.76	49.45
Mutton and lamb	0.16	0.11	7.89	19.51
Pork	0.07	0.09	4.08	16.55
Carcase meat	0.45	0.44	26.73	85.51
Bacon and ham	0.17	0.15	10.56	29.85
Poultry	0.14	0.17	6.32	19.35
Meat products	0.32	0.34	13.32	44.65
Total meat and meat products	1.08	1.10	56.93	179.36
All food			189	561
Sheepmeat as a percentage of:				
Carcase meat	35.7	25.2	29.5	22.8
Total meat and meat products	15.0	10.1	13.9	10.9
Expenditure on food			4.2	3.5

Weekly, per household

	1967–1969 (av)		1977	
	£	% of total	£	% of total
Total	24.87	—	71.84	—
On food	6.62	26.6	17.74	24.7
On meat and meat products	1.57	6.3	4.12	5.7
On mutton and lamb	0.21	0.8	0.49	0.7

Sources: MAFF (various); Department of Employment (various).

trade have cushioned the impact of falling consumer demand. These changes are set out in Table 12 which analyses the components of 'total new supply', ie, the current supply of sheepmeat and wool to the domestic market. These changes, some contingent on the UK entry into the European Community (EC), have been substantial over the last ten years. The major change is the decline in imports of lamb from New Zealand; these averaged 347 000 t in 1967–1969 but fell to 220 000 t in 1978 (forecast). As a result, UK self-sufficiency in sheepmeat was 58% in 1978, which represents a substantial increase in this ratio over the decade. In addition, the UK has developed a significant export of lamb to its European partners, despite the difficulties imposed on this trade by France. Table 12 shows that these exports increased five-fold over the past decade and now account for over 20% of home production. The outlook for UK sheep farmers is linked with the development of this trade by the introduction of a Common Market Policy for sheep, but there should be a reluctance on the trade to increase domestic prices for lamb with the consequent diminishing effects on consumption. There is little doubt that lamb is the poor relation in the meat trade, while sheep production is very important in the agriculture of certain areas of the UK whose grassland areas would deteriorate in the absence of grazing sheep.

Table 12
The contribution of UK agriculture to the total new supply of mutton and lamb and wool

	Mutton and lamb (thousand tonnes)		Wool (thousand tonnes)	
	1967–1969	1978	1967–1969	1978
Production	244	238	53	47
Imports from:				
the EC	7	1	12	15
third countries	347	226	227	144
Exports to:				
the EC	11	48	14	17
third countries	1	4	12	8
Total new supply	586	411	266	181
Production as % of new supply	42	58	20	26

Sources: MAFF (1962–1972); MAFF (1973–1978).

THE IMPORTANCE OF GRASSLAND IN THE SYSTEM OF SHEEP PRODUCTION

The main product of the sheep industry in the UK is lamb (meat) with wool being a secondary product and mutton from culled breeding stock a necessary but valuable by-product. In 1978 the value of new lamb (ie, born in 1978) accounted for 59% of the output of £300 million of sheepmeat (Table 2).

The start of the production cycle, which varies from about 8 to 15 months, can be taken as the date on which the rams are turned in with the ewes. This date, and consequently the lambing period, varies considerably; it is one of the main determinants of the sheep system practised and is, to an extent, itself determined by the location of the farm and, in particular, its elevation. Excluding those flocks, it is thought relatively few in number, which aim to produce three lamb-crops in two years, the date of tupping in the once-a-year lambing flocks spreads from July/August through into November/December. The summer matings will produce lambs before the turn of the year, or soon after, with the aim of finishing lambs for the highly valuable Easter trade. The later tuppings will take place in hill/mountain flocks and on the exposed Romney Marsh in Kent. The objective here is to lamb down in April, or later, when the weather is less hostile for the new lambs and when Spring grass is becoming available to sustain the ewes' milk production. For lowland sheep flocks, the chain of events, tupping-lambing-sale of carcase lambs, can be used as the basis of classification; for hill and upland there is less flexibility in the timing of these events and other criteria, such as the composition of output, can be used for classification purposes.

Integral to the sheep system is the feeding of ewes and lambs and the contribution which grass makes, to the feed requirements of the flock, varies with the system. For lowland flocks the following four broad systems can be demarcated but they are not distinct and in the systems practised on many flocks there will be an overlapping of these main ones.

(i) **Early lamb production** – lambs born late autumn/early winter, sheep often inwintered, except in milder areas of south west; lambs finished off ewes indoors or off ewes on early bite, green crops or swedes, lambs sold March–May at high prices. Lambs may have access to creep feed.

(ii) **Mid-season (or grass) lamb production** – lambs born February–March, ewes fed concentrates prelambing, may lamb indoors but not kept in for long periods, turned out to grass, maybe with concentrate feeding for a while, lambs finished off ewes or off grass and sold June–October.

(iii) **Late season (or forage) lamb production** – lambs born March–April, some prelambing concentrates for ewes, first lambs finished off grass (aftermaths) and sold October–December, but majority go on to specially-grown forage crops.

(iv) **Hogget production** – similar to (iii) but lambs kept on till after the turn of year and finished on forage crops, sales January–March in year after birth.

It should be borne in mind that the breeding and initial rearing of the lambs may take place on one farm; they are then sold as stores for finishing (feeding) to slaughter weight on another farm. This is more likely in the forage and hogget production systems, the store lambs being bought between August and October. The contribution of grass to the flock feed requirements is given in Table 13 and the composition of the diets will not be materially different wherever the lambs are finally fed.

Table 13
Contribution of grass to sheep feed requirements

Type of production	Contribution to total feed requirements (%)[1]				Concentrates kg per ewe
	Grass	Other forage	Other bulk feeds	Concentrates	
Early lamb	58	5	2	35	95
Mid-season (grass lamb)	86	2	2	10	50
Late lamb (forage lamb)	84	5	2	9	55
Hogget	82	7	2	9	60

1 Based on ME for ewe/lamb unit, the grass contribution is the residual after deducting the ME from other sources from the total requirement.

Source: Meat and Livestock Commission – unpublished.

With the exception of the early lamb flocks, often housed and always heavily concentrate-fed, grassland provides overwhelmingly the greatest part of lowland sheep feed. Whilst this is so for the three lowland systems outlined, the characteristic is also applicable to the lowland sheep industry generally; for, as shown in Table 14, it is estimated that the greater part of lamb sales came from farms practising these systems.

The figures in Table 14 could be used as weights to calculate from Table 9 an overall estimate of the grass contribution to the feed requirements of lowland sheep but this is not necessary as the value of grass has already been clearly demonstrated and is confirmed by further figures in Table 15. These also show that, for upland sheep, grass provides an even greater part of the feed requirements than for lowland sheep. It can be assumed that this would also be the position for hill sheep; for these the percentage could, in fact, be higher still, given the reluctance to eat trough-feed. In a study of hill

Table 14
Seasonality of liveweight sales of lambs and hoggets

System of production	% of sales			
	1975/76	1976/77	1977/78	3-year average
Early lamb	4	6	5	5
Mid-season (grass lamb)	58	52	51	53
Late-season (forage lamb)	16	19	18	18
Hogget	22	23	26	24
Total	100	100	100	100

Source: MLC (1978).

Table 15
Contribution of grass to sheep feed requirements

Type of farm	Contribution to total sheep feed requirements (%)				Concentrates kg per ewe
	Grass	Other forage	Other bulk feeds	Concentrates	
Lowland	84	3	2	11	55
Upland	90	2	<1	8	35

Source: Meat and Livestock Commission – unpublished.

flocks in Wales (Lloyd & Jones, 1978) the cost of purchased concentrates amounted to £3 to £4 per £100 of sheep output and no home-produced concentrates were fed.

It was shown earlier (Table 11) that the mid-season (grass lamb) flocks accounted for, on average, 53% of lamb sales and, within this broad section of the lowland sheep industry, there are differing subsystems. In the MLC analysis of feed requirements, three subsystems were demarcated, dependent on the use by the flocks of (i) leys, (ii) permanent pasture and (iii) grassland, mainly leys, with catch-crops (rape, stubble turnips) and arable by-products (vegetable residues, sugar-beet tops). The grassland contribution to feed requirement for (ii) was estimated to be above the average of 86% (Table 13) for the mid-season (grass lamb) flocks and slightly below this level

for the 'ley' flocks. For the grass/arable flocks the proportion of feed from grass was calculated as 68%, the 'arable' contribution at 15% and concentrates at 14%.

It follows from this close association of sheep and grassland that one of the components of a successfully run sheep flock is the management of the grassland which contributes so much of the sheep's feed. Some aspects of this are dealt with in the next section.

SHEEP AND GRASSLAND MANAGEMENT

Each sheep flock has its place on the farm, determined by the farmer as a result of many considerations. Where the flock is a major enterprise, its needs will take a higher priority in comparison with, for example, a scavenging flock 'cleaning-up' behind the dairy cows. On many lowland farms the limiting factor to the size of the flock, even its very existence on some farms, is the area of grassland available. At certain times of the year, such as the spring, this factor is critical; then housed cattle are being turned out, ewes will have lambs at foot and will require good grass to maintain milk yields while the farmer is also considering the date to 'shut-up' certain of his grass fields for conservation.

It follows from all these factors that the stocking rate of the sheep on grassland is crucial and the farmer's management in this matter is all-important. The individual sheep farmer's grassland management is a subject for a case-study and the results of the many separate decisions on stocking rates can only be shown in a general paper by the frequency distributions of stocking rates, as found in surveys of sheep production. Table 16 shows the results from the commercial flocks recorded annually by the MLC. The sample of 650 flocks is not random, nor statistically representative, but the figures indicate the wide variations in performance and the analysis of the variation between flocks provides valid information on the interrelationship between levels of performance and financial results. Of the lowland flocks, only a quarter achieved a year-round stocking rate of 15 or more ewes per ha, and a similar percentage of the upland flocks stocked at 11 or more ewes per ha. At the other extreme, in 44% of the lowland flocks the stocking was at the rate of 10 or fewer ewes per ha. In a smaller survey (Thomas, 1977), of carcase lamb flocks in four lowland areas of England, the stocking rates determined are given in Table 17.

Data for the MLC recorded flocks in 1977 showed that increasing stocking rates more than offset lower gross margins per ewe to produce greater margins per ha of land used by the sheep (Table 18).

Economic success in sheep production rests largely on twin foundations of a good lambing performance and a cheap feeding regime to get the lambs

Table 16
Frequency distributions of stocking rates of ewes per hectare

Overall stocking rate (ewes per ha)	Lowland flocks	Upland flocks
	Percentages	
Under 5.0	3.0	8.8
5.0– 7.4	11.0	14.9
7.5– 9.9	32.9	35.1
10.0–12.4	24.9	27.2
12.5–14.9	14.0	11.4
15.0–17.4	10.1	2.6
17.5 and over	14.1	—
Total	100.0	100.0
	Ewes per ha	
Average	10.4	9.2
Top third flocks[1]	12.7	10.3

1 Based on gross margin per ha.

Source: MLC (1979).

Table 17
Stocking rates and gross margins per ha in a sample of 103 lowland flocks (1976)

Ewes per ha	% of flocks	Gross margin (£ per ha)
Under 6.0	14	125
6– 7.9	24	151
8– 9.9	24	190
10–11.9	24	227
12 and over	14	277
Total	100	

Averages: Ewes per ha 8.9
Gross margin per ha £182

Source: Thomas (1977).

Table 18
Relationships of certain factors in sheep production with stocking rates, 1977

	Ewes per ha					
	6–7.9	8–9.9	10–11.9	12–13.9	14–15.9	16 and over
Lambs per 100 ewes	144	143	142	140	140	139
Lamb sales – £ per ewe	33.7	32.4	31.4	30.7	29.5	28.0
Gross margin – £ per ewe	21.6	20.6	20.1	19.6	18.7	17.8
Gross margin – £ per ha	151	183	220	259	286	301

Source: MLC (1979).

into a saleable condition. Stocking rate had no significant effect on lambing performance in the recorded flocks as shown by the difference of less than 3% in the number of lambs reared per 100 ewes between the lowest and highest stocked flocks. The difference in the gross margin per ha between these extremes was, however, nearly 100%, a very substantial bonus for the skill of the farmers in managing a year-round stocking of 16 or more ewes per ha. A similar result is seen in Table 17 from the survey of lowland flocks.

While the grassland makes a very large contribution to supporting the denser population of ewes and lambs, it does not do so entirely. Table 19 shows that more concentrates are used in the more intensively run flocks.

Table 19
Contribution of grass to sheep feed requirements and stocking rates

Ewes per ha	Contribution to total feed requirements (%)				Concentrates kg per ewe
	Grass	Other forage	Other bulk feeds	Concentrates	
Less than 8:					
Grass flocks	89	2	2	7	46
Grass/arable flocks	70	16	3	11	52
More than 8:					
Grass flocks	83	2	<1	15	53
Grass/arable flocks	66	12	2	20	61

Source: Meat and Livestock Commission – unpublished.

The importance of stocking sheep heavily on grassland has long been recognised as one of the keys to successful sheep production and the final section examines some of the technical developments which are leading to further improvements in this respect.

DEVELOPMENTS IN SHEEP PRODUCTION AND GRASSLAND USAGE

Since the relationship between sheep and grazed grass is a very close, almost symbiotic one, it follows that virtually any development in one will have a more or less direct bearing on the other. The first of the examples of technical progress in sheep production, considered in this final section, can be stated simply as:

> More fertiliser:higher stocking rate:greater sheep output per ha:greater gross margin per ha.

If it is assumed that, on the lowlands, land for sheep production is limited, then it can also be assumed that the farmer's objective is to achieve greater productivity per area of land allocated to sheep. Evidence of the effect of higher stocking rates on profitability per ha, as measured by gross margins, was given in Table 18.

Higher stocking rates necessitate heavier fertiliser applications, in particular of nitrogen, and Table 20 provides data, from MLC recorded flocks,

Table 20
Sheep stocking rates and usage of nitrogen

Nitrogen (kg per ha)	Stocking rates and ewes per ha			
	Lowland flocks		Upland flocks	
	Summer	Overall[1]	Summer	Overall[1]
Under 25	12.1	7.4	9.1	7.2
25– 49	12.8	8.6	10.1	8.4
50– 74	14.3	10.6	10.9	9.6
75– 99	15.0	12.4	12.4	10.6
100–124	16.3	13.1	—	—
125 and over	17.5	14.3	—	—

1 Overall stocking rate on grassland.

Source: MLC (1979).

on the relationship between stocking rate and the usage of nitrogen on lowland and upland farms. The figures in the Table are means and there was, in each class, a wide dispersion of results about the mean.

The economic implications of heavier stocking rates have been calculated and, over the past few years, the effects of increasing the stocking rate by one ewe per ha are as shown in Table 21. The cost of the extra fertiliser applied in obtaining the higher stocking rate is a variable cost and is deducted before deriving the gross margin.

Table 21

The effect, on gross margin, of increasing the stocking rate by one ewe per ha – current prices

Year	Increase in gross margin (£ per ha)
1974	21.40
1975	26.19
1976	20.20
1977	16.50
1978	18.90

Source: Meat and Livestock Commission – unpublished.

A further analysis, examining the reasons for the success of the top third flocks measured according to gross margins per ha, concluded that the major component of success was the stocking rate. It accounted for 53% of the difference between the top third and the average flock; the other major factor was the lambing performance of the ewes and these factors are mentioned elsewhere in this paper as the 'twin foundations' of successful sheep production. The full breakdown of the components of success is given in Table 22.

As critics of the gross margin concept are not reluctant to point out, it does not measure the full financial position of a farm enterprise for the fixed costs have still to be met. In this connection, a recent study by MLC of fixed costs in lowland sheep production showed that there was little correlation between fixed costs and stocking rate. Fixed costs averaging £150 per ha are, therefore, equal to £15 per ewe at 10 ewes per ha, or £10 at a stocking rate of 15 ewes, with the corresponding beneficial effect on the net margin.

Some of the variation in the stocking rates which have been mentioned may well be due to the different body weights of the ewes in the survey flocks.

Table 22
The components of success

Factor	% contribution to top third flock superiority
Stocking rate	53
Lambs reared per ewe	33
Lamb value	10
Feed and forage cost	2
Flock replacement	2
Total	100

Source: MLC (1979).

Because of the wide range in ewe body weights, there is some justification for measuring stocking rates, not in terms of number of sheep but in the total body weight of ewes carried per ha. From the economic point of view, what matters is the total sheepmeat produced, irrespective of whether this is from a greater number of lightweight hill ewe crosses or from fewer, but heavier, Down cross ewes carried on the same area of land.

Another development in sheep production which is gaining in popularity is the housing of the breeding flock during the winter months, eg, from January till lambing. The relevance of this to grassland is that, by freeing the pastures from stock during the wet winter period, they are rested and protected from poaching and denudation and are, therefore, given every chance to 'come away' as early as possible in the Spring. In this way higher stocking rates are possible when the sheep are turned out and throughout the grazing period. An equally, if not more important, reason for housing breeding ewes at the end of gestation and during lambing is that it facilitates shepherding at these vital times. Average increases of 10% in the number of lambs reared have been achieved by inwintering, as is shown in Table 23 which analyses MLC data over a five-year period. The increased value of the lamb-crop, however, does not permit a very high capital investment in housing. On economic grounds the housing must be fairly basic and inexpensive.

The trend towards the increasing concentration of the sheep production into fewer but larger flocks has already been noted in Table 8. This development has also been noted in the MLC sample of recorded flocks and has been accompanied by higher stocking rates and greater usage of fertiliser. These trends over a five-year period are summarised in Table 24.

Table 23
Results from inwintered and outwintered lowland flocks (five-year average)

	Inwintered flocks	Outwintered flocks
Per 100 ewes put to the ram		
Number of ewes lambed	94	92
Number of lambs reared	157	141
Concentrates kg/ewe	52	45
% contribution from grass to total feed requirements	84	86

Source: MLC (1979).

Table 24
Trends in flock size, stocking rate and fertiliser in an identical sample of 70 recorded flocks

	1970	1971	1972	1973	1974
Ewes put to ram	187	199	189	279	313
Ewes per ha	9.1	9.3	9.4	9.8	10.1
Nitrogen kg per ha	70	76	84	93	119

Source: Meat and Livestock Commission – unpublished.

By nature a ewe is endowed to suckle two lambs at any one time and, if average lambing percentages in lowland flocks were of the order of 200, there would be little need of the research and advisory expenditure into raising the prolificacy of ewes which is current today and which is the last development in sheep production considered in this paper. Average lambing performance in lowland flocks is well below 150% and for the whole national flock the lambing percentage was calculated at 106% (Howe, 1976). These figures are the justification for the work concerned with raising ewe productivity. The work proceeds along two lines, first by crossbreeding with high prolific breeds, eg, the Finnish Landrace, to increase the number of lambs reared per ewe in the traditional once-a-year lambing system. Second by developing systems of production based on lambing more than once a year, eg, three lamb-crops in two years. In a paper on sheep and grassland, it is not opportune to consider these matters in detail but the authors' opinion

is that the general run of lowland sheep farmers in this country would not be interested in litters of 3 or 4 lambs per ewe. However, they should be making more effort to raise lambing performance up to and above 150%, which means more multiple births than singles in the flock as a whole.

Table 25 shows that, from the point of view of sheep and grassland, raising ewe productivity involves a greater use of concentrates and a lowering of the grassland contribution to total feed requirements. This is because of the need for higher quality feed than grass for the additional lambs, and because of the seasonality problems with 'out-of-season' lambing. At the lowest level of productivity quoted, one lamb per ewe per year, which is a more appropriate target for upland and hill flocks, grass and other home-grown forage contribute 95% of feed requirements of the flock. At two lambs per ewe per year, a not unrealistic aim in lowland flocks, grass and forage meet 82% of requirements. For ewes lambing three times in two years, which is probably the most intensive system for commercial sheep production, and at 1.5 lambs per lambing, grassland and forage crops could only contribute 69% of total feed requirements. In this system, lambs would need to be weaned early on to concentrates to enable the ewes to regain condition to breed again. Sufficient grass would not be available after every lambing to maintain milk yields and trough-feeding for the ewes would also be necessary. This very intensive system, therefore, dissociates grass from sheep production, a singularly inappropriate subject to include in a paper devoted to emphasising the association between them. However, given the conservatism of sheep farmers as a whole, it is likely that the strong relationship between grass and sheep will remain and the aim for the future should be to continue to improve the management of both.

Table 25

The contribution of grass to total feed requirements and ewe productivity in lowland flocks

Lambing frequency	Lambs reared per ewe per lambing	Lambs sold per year	Ewes per ha	% contribution to total feed		
				Grass	Forage and bulk feeds	Concentrates
Once per year	1.0	1.0	15.5	90	5	5
	1.5	1.5	13.0	86	4	10
	2.0	2.0	11.5	78	4	18
Three times in	1.0	1.5	17.0	74	4	22
in two years	1.5	2.2	15.0	66	3	31

Source: Meat and Livestock Commission – unpublished.

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