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29 Potential changes in sheep output from grassland

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INTRODUCTION

The changes in the British sheep industry that occur in the next 20 years will occur as a result of economic forces. The rulings of the EC in Brussels on lamb price, entry to the French market, the share for New Zealand lamb and a continued subsidy to upland areas will have a greater impact than research and development. The price of oil, or the price of labour, may render the making of hay and silage a luxury in this country, and this would throw a greater emphasis on grazing management. Fortunately, no accurate prediction of the direction and magnitude of these changes, or accurate prediction of progress, has ever been made. The most sober and well-researched scenario is as likely to be wrong as one's wildest fantasy, so the scientist has very little guidance for the direction of long-term research, except perhaps his inclination and that of his paymaster. However, the adjective qualifying change in the title is potential and not probable and that removes the burden of picking the winner and inserts the easier task of naming the likely runners.

Implicit in the title is the fact that there will still be sheep, or, I suppose, animals at all for meat; it is probably worth considering the reasons why this country has a population of approximately 12 million breeding ewes. Traditionally, until the 18th century, wool was a more important advantage of the sheep than its meat, but this emphasis has changed and now the financial return from the lamb's meat is ten times that of the ewe's fleece. Although there has been some decline in the amount of lamb eaten per head of the population, we still eat more mutton and lamb (7.6 kg in 1974) than other European countries, and still only supply about 40% of the sheepmeat eaten in Britain, most of the remaining 60% being supplied by New Zealand. There is thus a large home market for sheepmeat that might well enlarge. There is also the possibility of increased trade with the EC, particularly France. Although the gross margin for sheep has improved recently, it is still not as profitable as milk production, but the return on capital is higher; furthermore, sheep production can easily be made independent of expensive concentrates. Finally, (with the exception of beef cattle) a great deal of the rougher grazings are not very suitable for other types of farm livestock.

AMOUNT OF GRASS GRAZED BY SHEEP

Green & Baker (1981) calculated that the ruminants in Britain consumed about 297 PJ of ME from grassland. A calculation of the amount of grass eaten by sheep, based on the annual requirements of hill, upland and lowland ewes, produced a figure of 71.2 PJ. This suggests that sheep consume 24% of the available grass in the country. Subdividing grass into rough grazing, permanent pasture and temporary grass (NEDO, 1974), a calculation has been made as to what proportion of grass in each category is grazed by sheep, using the assumptions listed in Table 1. In England the sheep graze 10% of the permanent pasture and 14% of the temporary grassland. This contrasts with Wales, where over a third of the available permanent pasture is used by sheep. Thus, relatively more grassland in Wales is devoted to sheep than in the other countries, and Northern Ireland has the least amount of good grassland used by sheep. Scotland has more rough grazing than the other three countries put together and this absorbs the largest amount of their sheep population. Taking Britain as a whole, about a sixth of the better grassland is used by sheep and this maintains nearly three-quarters of the British sheep flock of approximately 12 million ewes. Were the carrying capacity of rough grazing to be doubled and the national sheep flock stay the same size, then approximately 375 000 ha of better grassland would be released.

INCREASED ANNUAL PRODUCTION OF GRASS

Sheep output from grassland can be altered by increased production of grass or by the increased efficiency with which it is grazed. At present the number of sheep kept per ha, whether in the hills or on the lowland, is dependent on the amount of grass grown. If self-sufficiency for annual grass/silage consumption is the aim, then the number of sheep kept is limited by the grass grown during the grazing season, minus the amount needed for the

Table 1
Distribution of types of grassland (thousand ha) and their use by sheep (thousand)

	Rough grazing		Permanent pasture		Temporary grass	
England						
Area used by sheep	750	(60)	328	(10)	182	(14)
Number of sheep	600	(11)	2 715	(53)	1 887	(36)
Scotland						
Area used by sheep	2 705	(60)	97	(23)	39	(6)
Number of sheep	2 164	(66)	744	(23)	374	(11)
Wales						
Area used by sheep	369	(60)	287	(39)	55	(31)
Number of sheep	295	(10)	2 153	(72)	535	(18)
Northern Ireland						
Area used by sheep	138	(60)	32	(6)	13	(6)
Number of sheep	111	(23)	249	(51)	126	(26)
Total UK						
Area used by sheep	3 962	(60)	768	(15)	310	(12)
Number of sheep	3 170	(27)	5 861	(49)	2 922	(24)

Note: The figures in parentheses show percentage of total area of grassland of that type or percentage of the total number of sheep, as appropriate.

Assumptions

Of the rough grazing, 60% is available for hill sheep, stocked at 0.8 ewes/ha. The remaining hill sheep graze permanent pasture at 7.3 ewes/ha.

70% of the upland sheep graze permanent pasture at 7.3 ewes/ha; the remaining 30% graze temporary grass at 8.6 ewes/ha.

50% of the lowland ewes graze permanent pasture at 9.0 ewes/ha and 50% graze temporary grassland at 10.6 ewes/ha.

Source: Stocking rates from MLC (1978); Eadie (1974).

winter. The longer the winter, the more inroads are made into the grass available for grazing. Current annual stocking rates vary between 1.2 ha per sheep on the hills, where annual DM production may be 2.25 t/ha (Eadie, 1974) to 12.7 ewes per ha annually on the lowlands (MLC, 1978) where grass production may reach 14 t DM/ha (Newton, Young & Orr, 1976). On the hills, the grass only grows for six months and on the lowlands for seven to nine. A lengthening of this grazing season would make a two-fold difference as it would increase the amount of grass grown and decrease the amount needed for the winter, even though the stocking rate should increase as well. There are two ways this might occur; either a change in climate, a kind of reverse ice age, or by the breeding of a grass species that is more cold tolerant. Whichever is responsible for this lengthening of the grazing season, the consequences can be calculated.

LOWLAND SITUATION

If the annual DM requirement of a 70 kg ewe with 1.8 lambs is 650 kg, excluding concentrates (see Table 2), then the annual requirement of 12.7 ewes per ha (MLC, 1978) would be 8.25 t DM/ha. With an efficiency of grass utilisation of 70%, the amount required to be grown becomes 11.8 t DM/ha, which is not an impossible figure (Newton, Young & Orr, 1976). If one now assumes that a month is added to the grazing season, and that this increases the amount grown from 11.8 to 13 t DM/ha, then, without increasing the efficiency of utilisation and without, therefore, decreasing animal performance, the stocking rate can be increased to 14 ewes per ha. Assuming an energy concentration of 11.5 MJ/kg DM for the grass, then utilised ME is 105 GJ per ha. The increase in stocking rate

Table 2

The annual DM requirement of a 70 kg lowland ewe with 1.8 lambs

	DM requirement (kg)
Five months pregnancy	212
Five months lactation	303
Two months dry	61
Total for ewe	576
Requirement of 1.8 lambs	110
Total for ewe and lambs	686
Less DM provided in concentrates	36
DM from grass and grass products	650
– of which, conserved for three-months winter use	100

Calculated from: Joyce *et al.* (1976).

will result in an increase in lamb meat production from 366 kg to 403 kg, a 10% increase of 37 kg lamb meat per ha of lowland grass devoted to sheep keeping. This is an achievable figure: net carcase output per ha from a lowland grass sheep system has been 540, 460, 440, 440, 445 and 397 kg respectively in six successive years (Wilde, Young & Newton, 1980).

Increasing grass production, without a lengthening of the grazing season, would increase the requirement for conserved forage. The less the rate of grass growth and removal by the animal match, the more need there is for conservation or supplementation, if wastage and undernutrition are to be avoided.

The figure used for the efficiency of annual utilisation of grassland by the lowland ewe is 70%. This figure is derived by calculating how much has been eaten by the flock during the year and expressing this as a proportion of the amount of grass actually having been measured in the field as grown. It takes no account of how much might have been grown had grazing management been different (Noy-Meir, 1978). Higher figures than 70% of annual utilisation have been found (89–96%), for mixed grazing with sheep and cattle (Dickson, 1978), but such calculations start with the assumption that a certain amount of grass is ungrazeable. These high figures for annual utilisation have to be distinguished from the amount of herbage actually grazed by animals per paddock in a rotational grazing system during each rotation, which is normally much lower. This figure, utilisation per grazing period, is unlikely to be increased much without a reduction in animal performance. Rattray & Jagusch (1977), in a series of pasture allowance experiments, showed that percentage utilisation at a given allowance is controlled by the ewe's physiological state, as had Arnold and Dudzinski (1967) ten years earlier. Thus, a ewe suckling twins, offered 2 kg of DM per head per day in a rotational system, ate 77% of the herbage whereas a ewe in mid-pregnancy ate only 40% of the herbage present at the same allowance. In most cases, % utilisation was increased by decreasing the allowance (ie, by increasing the stocking rate) but when the allowance fell below a certain level, utilisation dropped rapidly. From their figures it would appear that there is no way that a dry ewe will ever eat more than 50% of the pasture available – it will die first. Interestingly enough though, for the ewe being flushed, utilisation was fairly constant at 27% for allowances ranging from 6.3 kg DM per head up to 10.7. Thus, actual intake doubled (1.4 to 2.9) when allowance was increased from 4.2 to 10.7. This has important consequences for grazing management, for from this it would appear that high intakes are only achievable at generous allowances of herbage.

The figure of 70% utilisation, on an annual basis, is unlikely to be improved without a marked decline in animal performance, or until a grass has been bred with a reduced rate of leaf senescence.

HILL SITUATION

Similar calculations can be made for the hills. If the annual DM requirement of a hill ewe (50 kg), producing 0.8 lambs to a liveweight of 24 kg, is 500 kg (Eadie, 1974), then the annual requirement of 0.8 ewes per ha is 0.4 t DM/ha. With an efficiency of grass utilisation of 20%, the amount required to be grown is 2 t DM/ha. Lengthening the growing season by a month would increase yield to 2.3 t DM/ha and, with the stocking rate raised to 0.91, the production of lamb liveweight per ha would go up from 15.4 kg to 17.5 kg, an increase of nearly 14%.

Eadie (1974) has shown how production on some hills can be doubled, by increasing ewe numbers and ewe output, both of which were made possible by better overall pasture utilisation. This better utilisation has been achieved by some fencing of the better quality, or more accessible, areas and the use of this during lactation and lamb growth, and by introducing feeding in late pregnancy so that ewes that have gone to the ram in better condition will receive adequate nourishment for the higher proportion of twins that they are carrying; increased lamb birthweight will decrease lamb mortality. A doubling of liveweight output on some areas of the hills, perhaps 25%, would not only increase the hill farmer's income but also increase the output of lamb from the hills. In 1972 (MLC, 1972) it was recorded that 6 896 000 hill ewes reared 5 681 000 lambs (82%), of which 29% were retained and 71% sold or slaughtered. A 32% increase in ewe carrying capacity of a quarter of the hills, plus an increase in selling % for all hill ewes from 82% to 95% due to better nutrition, would increase the number of lambs reared from 5 681 000 to 7 075 000, an improvement of 24%.

THE EFFECT OF GRAZING MANAGEMENT ON PASTURE PRODUCTION

The next aspect to consider is the virtually impossible one of by how much grass production, and sheep output therefrom, would increase if grazing management were changed. Underutilisation has been discussed in the previous section, but this one is concerned with the effect of overgrazing, either periodically, as in periods of drought, or consistently throughout the year. Brougham (1960), in New Zealand, demonstrated that, for a sward made up mainly of short rotation ryegrass but also containing cocksfoot and red and white clover, hard grazing in the summer reduced annual yield from 13.1 t to 9.8 t DM/ha, a reduction of 25%; hard grazing in the spring reduced the annual yield to 10.7 t, a reduction of 18%. Hard grazing here was defined as defoliation from 3 to 1 in. every time the sward height reached 3 in. Hard grazing in the autumn had no effect on yield. Carter & Day (1970), in Australia, showed a similar reduction of yield using high and low stocking rates of wethers on a pasture of perennial ryegrass and subterranean clover.

The mean annual yield, over three years, was 7.6 t at the low stocking rate and 6.5 t at the high stocking rate, a reduction of 15%. An experiment in England, comparing early with late lambing, gave yields of perennial ryegrass as shown in Table 3. Overall yield was lower in the late lambing system, where the most intensive defoliation came during the summer months, as with Brougham. The early lambing system yielded less grass than the late in the spring months, when grazing pressure was higher on the early system, and vice versa in the last four months. By this stage the ewes on the early system were dry, the lambs having been sold fat, whereas the ewes were lactating on the late system and the lambs were eating plenty of grass as well.

Table 3
Grass production and peak daily intake

	Grass production (t DM/ha)		Peak daily intake[1] (kg DM/ha)	
	Early lambing	Late lambing	Early lambing	Late lambing
March, April, May	6.25	7.25	300	192
June, July, Aug, Sept	4.65	2.85	156	300
Annual total	10.9	10.1		

1 16 ewes per ha plus lambs on one paddock in a six-paddock rotation.
Source: J E Newton, R J Orr, J E Betts & R M Wilde – unpublished.

Having shown that untimely overgrazing can lead to reduced yields within the year, what does the farmer do about it? It is much easier for the scientist to 'lose' his stock for six weeks, during a period of slow grass growth, than for a farmer – who may not have extra grass available. One solution is supplementation at pasture.

The supplement needs to be eaten in preference to grass because, otherwise, there will be no sward sparing effect, but it should also be as cheap as possible. If overgrazing leads to a 20% reduction in yield (11.6 reduced to 9.3 t DM/ha), then how much supplement needs to be injected into the system to make this saving and how can it be realised? We have shown, with weaned lambs, that the supplementation efficiency of barley or grass nuts for grass was 48% (Newton & Young, 1974). This means that for every 100 g of supplement eaten, the intake of grass will be reduced by 52 g. Ewes that were eating 1 250 g of grass per day, and that were offered 500 g of grass nuts, would reduce their intake of grass to 990 g, but their total intake of dry matter would increase to 1 490 g. Rattray (1977) showed that when ewes were offered chopped, wilted silage at pasture and ate 990 g of the silage, then pasture intake was reduced from 1 240 g to 840 g, a supplementation efficiency of 60%. The intake of the supplement is likely to alter with the digestibility and DM of the silage and with the quantity and quality of the pasture available. However, an example based on a 60% supplementation efficiency will show the effect on severity of defoliation and thus on annual grass production (Table 4). In the first example, the effect of offering the supplement is to reduce the severity of defoliation so that the outcut value rises from 905 to 1 097 kg DM/ha on a fixed rotation speed. (Outcut value is the amount of grass remaining when the sheep are moved out.) The second example, when the outcut value is fixed, is to increase the defoliation interval from 20 to 30 days. Increasing the defoliation interval has been shown by Frame & Hunt (1971) to increase herbage yield under grazing. Thus, if the period at risk is a drought period in the summer of six weeks, then 665 kg of silage per ha have been consumed. This has increased animal performance [total intake per ewe per day = 1.83 (suppl + pasture) v 1.24 (pasture alone)] and at the same time has encouraged the pasture to grow an extra 2.3 t DM/ha by reducing the severity of defoliation. The extra 2.3 t DM/ha should easily be conserved into the 0.665 t DM/ha required (plus a surplus) as the silage supplement, so that the only extra charge is the labour and equipment required to make and feed the silage. No account has been taken here of the effect of overgrazing in one year on subsequent sward composition and yield. Zero-grazing would prevent overgrazing by the animal but it has three drawbacks: first, wheel damage to the sward by the cutting machinery is likely; second, the labour costs of the sheep enterprise would increase sharply; third, the beneficial effect of nutrient recycling during grazing would be lost.

As in the example of the increased stocking rate from the hills by tactical supplementation, so the same situation can be made out for the lowlands or uplands. Instead of the stocking rate being pitched to allow sufficient silage or hay to be made for the winter, so a case can be made for increasing stocking rates and using more supplement during the periods of shortage in the grazing season, in the way described above, and also by the use of catch-crops such as rape or stubble turnips to extend the grazing season into the winter months.

RYEGRASS – WHITE CLOVER

If the price of nitrogen fertiliser increases disproportionately, there will be a

Table 4

The effect of a feed supplement on pasture defoliation

96 ewes rotating round six one-hectare paddocks: an overall stocking rate of 16 ewes per ha

Example 1 – The severity of defoliation on a set rotation of five days grazing per paddock (Defoliation interval 25 days)

(i) No supplement

Grass intake per ewe per day	=	1.24 kg DM
Grass intake by 96 ewes in five days	=	595 kg DM per ha
Initial amount of herbage	=	1 500 kg DM per ha
Amount remaining after five days	=	905 kg DM per ha

(ii) With supplement of 0.99 kg silage DM per ewe per day

Grass intake per ewe per day	=	0.84 kg DM
Grass intake by 96 ewes in five days	=	403 kg DM per ha
Initial amount of herbage	=	1 500 kg DM per ha
Amount remaining after five days	=	1 097 kg DM per ha

Example 2 – The effect on rotation speed of moving the ewes when the herbage remaining is 1 000 kg DM per ha

(i) No supplement

Grass intake by 96 ewes per day	=	119 kg DM per ha
Initial amount of herbage	=	1 500 kg DM per ha
Days in each paddock	=	4
Rotation length round six paddocks	=	24 days
Therefore defoliation interval	=	20 days

(ii) With supplement of 0.99 kg silage DM per ewe per day

Grass intake by 96 ewes per day	=	80.6 kg DM per ha
Initial amount of herbage	=	1 500 kg DM per ha
Days in each paddock	=	6
Rotation length round six paddocks	=	36 days
Therefore defoliation interval	=	30 days

reduction in the amount applied and, to prevent yields of DM per ha being halved, with a drastic reduction in the national population of livestock, much more reliance will be placed on white clover as a sward component. Experiments have shown that, under a cutting regime, swards of perennial ryegrass and white clover can yield between 8.4 and 9.4 t DM/ha per annum with no irrigation and no nitrogen (Morrison & Denehy, 1979). Of this yield the clover has contributed up to 60%. This compares reasonably with average yields of 10.5 t DM/ha for perennial ryegrass, with 200 kg N/ha, under a sheep grazing regime (J E Newton, R J Orr, J E Betts & R M Wilde – unpublished). But the problem with the ryegrass/white clover sward is that, under a grazing regime, particularly set stocking at ewe stocking rates of 12–16 per ha, the clover will be grazed preferentially, as sheep can and do, and that the clover plants will remain small with small leaves (Betts, Newton & Wilde, 1978). Under these circumstances the clover yield will be low, less than 10% of the dry matter, and N fixation and grass production will be correspondingly reduced. If the problem of managing ryegrass/white clover swards can be overcome successfully (evidence from Rosemaund, in the wetter western half of the country, has shown that stocking rates of 13 Welsh Halfbred ewes per ha can be carried successfully on a 50% ryegrass, 35% white clover pasture with no nitrogen) then it is well documented that sheep grow better on white clover than on grass (Thomson, 1979). On a perennial ryegrass/white clover mixture, the advantage in liveweight gain will be related to the proportion of clover in the mixture, but a mean advantage of 25% is claimed (Thomson, 1979). As has been shown by Ulyatt (1971), part of the advantage of feeding white clover comes from a higher intake and part from an increased efficiency of digestion.

Because of the problem of forecasting how much clover is likely to persist in pastures, if reasonably high stocking rates are used, and partly because no figure can be put on the increased efficiency of utilisation of white clover, it is not possible to calculate the impact of changing over from nitrogen fertiliser to clover dependence. However, a ryegrass/white clover sward with the average level of N for lowland sheep pastures (100 kg N per ha per annum) is likely to outyield and produce more sheepmeat than a grass sward with the same level of nitrogen: provided the white clover makes a significant contribution.

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