The Economic Utilisation of Grassland

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Recent experimental work has brought to notice the remarkable yield potential of Irish grassland. In experiments at Johnstown Castle on poor soils, yields of about 40 cwts. of starch equivalent (S.E.) per acre were obtained (8). It is now agreed that the problem of increasing output of grass is not very difficult and that it should be quite possible with a moderate programme of pasture improvement to raise the average output of pasture to 25 cwts. (S.E.) per acre which is about double the present output.

When the utilisation of this increased output is considered the problem is not so simple. Yet it is obviously of great national importance that the most economic and efficient use be made of improved grasslands. One must begin by recognising that there can be no once-for-all determination of the most economic pattern. Even if the human and physical factors were constant, no stability can be expected in prices or markets. The best use to make of grasslands is, therefore, a matter to be constantly re-assessed in the light of changing circumstances and particularly the long-term outlook for prices and markets. It would be inappropriate to attempt to decide the question by assuming concentration on one type of utilisation of grasslands, e.g. beef production, to the exclusion of others since this could not in reality occur. Moreover, although this paper deals primarily with the micro-economic problem, a distinction must be drawn between relative profitability to the individual farmer and to the nation as a whole. If the disposal of the increased output from grasslands requires State subsidisation in any form, it is only the unsupported value of the additional output that represents a national gain; the subsidy element represents a transfer of income to producers from other sections of the community. Accordingly, where it is clear that increased production must be disposed of on export markets, the gain to the community is to be assessed by valuing it, not at supported home prices but at the prices realisable, apart from temporary fluctuation, on the export markets.

Even though many qualifications may attach to the estimates it seems desirable to try to establish a method of assessing—on specific assumptions which can be altered according as circumstances require—the relative profitability, in a national sense, of the various forms of utilisation of the increased output from grasslands which are technically within reach. Such estimates, however, tentative, may help in determining which particular forms of utilisation should from time to time, in the light of price and other trends, receive the greatest emphasis.

The alternative forms of utilisation of grassland which will be considered in this paper are milk production, the raising of dry cattle, single suckling of calves and sheep raising. It must not be overlooked, however, that milk and beef are joint products rather than alternatives; if cattle output is to grow there must be an increase in milch cow numbers and with this an increase in milk production.

The traditional type of farm records does not provide sufficiently useful information to make a proper assessment of the relative economics of different enterprises at any given time. Indeed, as far as can be seen from a perusal of the literature, very little experimental work on the economics of pasture utilisation has been done in Europe Some work has been done in New Zealand (7) but since conditions in that country differ substantially from ours, valid comparisons cannot be made. The difficulty in any event with the traditional farm records is that a number of enterprises are confounded and it is impossible to get separate figures for each. A proper study of this problem can only be made from controlled experiments on self-contained units. In popular articles on farming it has been usual to quote the Johnstown Castle experiments referred to above to show the profitability of beef production under conditions of good grassland management. This approach is not altogether correct because this trial did not stimulate real farm conditions. Under the conditions of the Johnstown Castle experiment there were holding pastures from which cattle could be moved to and from the area under test. This meant that there was almost perfect utilisation of the grass grown on the trial area. On the ordinary farm there is no such reservoir of land and cattle, with the result that animals may be on short fare for parts of the year or grass may be wasted in periods of flush growth. A further point is that under normal farm conditions part of the grass grown has to be conserved for winter use with a loss of feed nutrients of anything from one-quarter to one-half of those present in the original grass. Furthermore the pricing of beef produced under summer grazing conditions is not simply a question of valuing the live weight increase at the sale price per live cwt. received. There is usually a seasonal drop of about 20/- per cwt. in cattle prices between April and October (See Table XVI, Appendix) and this must be taken into account in valuing the Summer Production.

Since sufficient experimental data on which to base this study are not available the problem has to be tackled by a theoretical approach, i.e., by taking a given output of nutrients such as Starch Equivalent from a given area of land and by estimating the amounts of milk, beef, mutton and wool which can be produced by these nutrients under given conditions. This method has its limitations also since the exact nutrient requirement for different classes of stock is the subject of some controversy at present. Obviously until reliable scientific results are available, the theoretical approach can yield only a tentative basis for economic decisions.

The original experiments to determine the nutrient requirements of livestock for maintenance and production were carried out by

Kellner many years ago. Since then very little similar experimentation has been done and whatever work has been carried out reveals certain limitations in Kellner's figures for grazing animals (his work was done under stall feeding conditions). Wallace of New Zealand (12) working with grazing animals has found that the maintenance requirements for dairy cows on pasture were higher than those in use in this country, which are based on Kellner's experiments. Wallace's figures are, however, not generally accepted either (1) and so in spite of their limitations it was felt safer to work with the Kellner figures in common use in Ireland and Great Britain. Accordingly the feed requirements (which are based on Kellner's experiments) recommended by Professor Sheehy in his book, Animal Nutrition (11), have been used as far as applicable and supplemented wherever necessary by figures recommended by the British Grassland Society (10) based on Woodman (13). The Sheehy and Woodman figures are very similar. In cases where recent experimental results suggested that it might be safer to use other figures the sources of these figures are given.

The details of making the calculations are given in the Appendix. Outputs are given in terms of pence per lb. of Starch Equivalent (S.E.) from roughage and in £s per acre for different animals. Roughage is defined as Pasture, hay and grass silage (grass products). The animals are considered as being fed on grass products to the maximum extent. In the case of cows and older dry cattle the full feed requirements can be supplied by grass products. Calves in the first few months of life have to be given milk and meals as well. An adjustment is made for such feeds in calculating the output from grass products. The non roughage feeds which are taken as fed to all calves are 35 gals. whole milk; 105 gals. skim milk and 1½ cwt. meals.

In calculating outputs per acre, outputs per lb. S.E. are first calculated and then outputs per acre are obtained by assuming certain levels of utilised S.E. per acre for the different animals and multiplying the per lb. figures by these. In making the assumptions regarding the utilised S.E. per acre separate account must be taken of the amount required for winter feed since there is a loss in converting grass into hay and silage. The amount of this loss varies depending on the weather and the skill of the farmer. Sheehy states (Animal Nutrition P.215) that with untreated silage the loss of nutrients is about 25% and with hay about 40%. The treatment of losses however is complicated by the fact that there is also a loss of nutrients when pastures are eaten by grazing animals. Under conditions of grazing, a certain proportion of the pasture is tramped into the ground, is covered by dung or grows into stemmy indigestible material and is not eaten. The relative losses of nutrients grown are therefore not zero for grazing animals and 25 per cent. or 40 per cent. respectively for average hay or silage. Indeed the relative recovery of nutrients from pasture by grazing animals and as conserved grass is not a settled question at all and it is difficult to get any firm figures for it.

After due consideration it has been decided for the purposes of this paper to group hay and silage together and to assume that if the recovery of nutrients by the grazing animal is 100 that the

recovery as conserved grass is 75. Consequently the initial assumption is not that say 25 cwt. of S.E. per acre is produced by the pasture but that this amount of utilisable S.E. can be obtained per acre by grazing animals during the season. On this assumption and if 12 cwts. of S.E. were required for winter keep, then the net utilisable nutrients from this area would be 21 cwts. viz :

12 cwts. S.E. in conserved grass requires $\frac{12 \times 100}{75}$ = 16 cwts. S.E. in grazed pasture.

Amount remaining for grazing is 25 - 16 = 9 cwts. S.E.

Total utilized S.E. therefore equals 12 + 9 = 21 cwts.

The method of making the per acre calculations for the different animals is shown in the Appendix in Tables V, IX, XII and XV.

Returns from Dairy Cows

In estimating the returns given by dairy cows calculations have been made on the basis of 10½ cwt. liveweight animals (Sheehy (11) pp. 401-402) replaced on the average by 2½ year old heifers (see Tables I, II and III Appendix). Under conditions of creamery milk production it is usually not possible to have heifers calving at 2½ years of age since practically all calves are born in the Spring. For the purpose of this paper it was assumed that half the replacements would be by 2 year old heifers and half by three year olds. The calculations were made on these bases and the average of the results taken.

Other assumptions are :—

(1) Cows calve in Spring and produce milk for manufacturing purposes on Summer grass. Production for liquid milk from Autumn calvers is not considered since it is deemed that this market is now saturated. The possibility of finding markets for manufactured milk products is discussed.

(2) The average working life of a cow is taken as six lactations in six years. The figure for number of lactations is taken from Harnett's paper read to the Statistical and Social Inquiry Society in 1956 (5). A lactation every year may appear high but under conditions of creamery milk production with cows calving in Spring it is not as difficult to get cows in calf as it is with Autumn calvers. Furthermore, under those conditions a cow which does not produce a calf each Spring is a loss and has to be culled. This culling is taken care of in the average figure of six lactations.

(3) Calves, other than replacements, are sold at birth. The National Farm Survey shows that mortality of calves in creamery districts is about 8 per cent. in the first year of life. Since calves in this instance are considered as sold in the first few days of life it is assumed that 4 per cent. of the calves die on the farms where born and the remaining 4 per cent.

die on the purchasers farm*. A herd of six cows will produce six calves in any one year. Of these calves 0·24 will die on the farm where produced and of the remainder one will be used to replace a cow and 4·76 will be sold.

(4) In estimating the amount of feed required by replacements the heifer calving at 2 years old is fed according to Sheehy's table for animals sold fat at the age of 2½ years, and for three year old replacements the heifers are fed according to Sheehy's tables for animals sold fat at 3½ years old (Animal Nutrition pages 331 and 332). For details see Table II Appendix. The replacement heifer is considered as being brought to her maximum weight either before or during her first lactation and kept at this weight until culled. The milking cow is therefore considered as producing only milk in any one year and not as putting on weight as well. Cows normally put on weight in Summer, which requires extra feed, but it is assumed that any excess weight put on in Summer is lost in Winter with a corresponding saving in Winter feed. The average weight of the cow is thus the same over the year. The process of putting on weight in Summer and losing it in Winter is usually considered as being wasteful of feed but when one considers that there is a fairly considerable loss of nutrients in converting grass into silage and hay the loss due to a small weight decrease in Winter and subsequent gain may probably be neglected. Indeed under conditions of bad haymaking it may be more economical to conserve excess Summer grass as beef rather than as bad hay. In calculating the feed requirements of the milking cow a figure based on Sheehy of 6·625 lbs. S.E. per day for maintenance has been used. The average figure usually used in practical farm feeding of 2·5 lb. S.E. for each gallon of milk has not been used since it is generally agreed that the S.E. requirements per gallon of milk vary, depending on the yield. Figures given by Jawetz (6) based on British and U.S. studies which allow for diminishing returns to feed, have been used. These figures are shown in Table I Appendix.

In estimating the hay or silage requirements of the dairy cow it has been assumed that she is maintained for 150 days on conserved grass at the rate of 6·625 lbs. S.E. per day. It is assumed that the feed required for any milk produced during this period comes from late or early grazing. Since the hay or silage only supplies maintenance requirements, heavy and light yielders get the same amount of conserved feed, viz. 994 lbs. The allocation of the feed between grazing and hay or silage is shown in Table I Appendix. The hay

*Since this paper was written calculations from the National Farm Survey have been made which show that mortality of calves born in the creamery districts is at its highest at about 3 weeks after birth. This means that the assumption of half the calves dying on the producers' farms is not strictly correct. Altering the assumption would however make little material difference in the final results even if it were assumed that all calves die on the purchasers' farms.

requirements of the replacement heifers are shown in Tables II and III Appendix. These requirements are based on Sheehy.

(5) It is a somewhat difficult question to settle a reasonable range of prices per gallon for milk to be taken in this connection. The prices in question relate not to whole milk sold as such but to milk sold under the condition that the separated milk is returned to the farmer. The prices chosen for the calculation under this condition are 9d., 12d. and 15d. per gallon. The lowest price in this range is roughly the same as the unsubsidised price (of 9·4d. per gallon) which could have been paid for creamery milk exported as butter in 1958. The highest price in the range is about the average price, in that year, of creamery milk sold by farmers, net of cartage and levy. A constant value of 4d. per gallon has been taken for separated milk in all cases. This is approximately the present feeding value of the skim milk in relation to the current prices of substitute feeds. Similarly a constant price of 32/- per cwt. for meal fed to calves has been used throughout. The amount of separated milk returned to farmers by the creameries has been taken as four-fifths of the whole milk delivered.

In making the calculations, calves sold have been valued at £15 each and cull cows at £42 each. These were about the average prices for such animals in creamery districts in 1958. £1 has been deducted from the output of each cow to allow for bull service fee. The amounts of whole and separated milk fed to replacements have been deducted before estimating the value of whole milk sold and skim milk returned from the creamery. The value of meals fed to replacements has been deducted from the value of the separated milk also.

The Feed requirements obtained from these calculations compare well with results obtained in British and Danish progeny testing stations taking account of weights of animals and yield levels. (2) (4).

Results

Table 2 summarizes the value of the output of milk and by-products for 10½ cwt. cows of different yields at different prices of milk. It is seen that at a price of 15d. per gallon the output per lb. S.E. from milk and by-products varies from 3·08d. for 700 gallon cows to 2·68d. for 450 gallon cows. At 9d. per gallon for milk the total output varies from 2·31d. to 2·10d. per lb. S.E. for different yield levels. Reference to Table IV of Appendix shows that at 1/3d. per gallon for milk the output of by-products (i.e. calves and cull cows) varies from about 25 per cent. to 35 per cent. of total output depending on yield. At 9d. per gallon output of by-products varies from 34 per cent. to about 45 per cent. of total output.

The method of estimating output per acre is shown in Table V of the Appendix. Reference to this table shows that the carrying capacity of an acre yielding 25 cwt. of utilisable S.E. from grazing

varies from 0·473 cow units per acre (cow and replacements) for 700 gallon cows to 0·556 units for 450 gallon cows. Put another way this means that a 700 gallon cow unit requires about 2·1 acres and a 450 gallon cow about 1·8 acres. As shown in Table 2, output per acre in £'s varies from about £33 for 700 gallon cows at 1/3d. per gal. to about £22 per acre for 450 gallon cows at 9d. per gallon.

Returns from single suckling

As the name implies single suckling is an enterprise in which the calf suckles on its mother and takes the total of her milk. Cows for single suckling usually calve down in Spring, are carried on hay or silage until the Spring grass and on pasture during the remainder of the year. The calves are usually sold in October at the age of about 8 months and weighing about 3½ to 4 cwts. live weight. There is an export market in Great Britain for these single suckled calves and most of the calves sold at the special single suckled auction in Dublin in October 1958 were exported. The finishing of single suckled calves above the age of 8 months is not considered in this paper since this is an enterprise which has to be based on the feeding of concentrates and not of grassland products.

It would appear at first appearance that single suckling is a wasteful process since the total milk of a cow is fed to one calf but since the prices obtainable for the single suckled calves are high it is considered by some farmers a more profitable enterprise than ordinary dry cattle rearing. Indeed if the returns from single suckling were to compare favourably with dairying the surplus milk problem would be immediately solved. The average price paid for single suckled calves at the 1958 Dublin Auctions was £35-£32 for heifers and £38 for bullocks. This represented an average price of about 190/- per cwt. live weight.

In estimating the output per lb. S.E. from single suckling the following assumptions have been made: (1) The weight of the cow is considered as being 10 cwt. and it is assumed (3) that her working life is 8 lactations. (2) Replacement is by a 2½ years old heifer. Single suckled calves are not used for replacement. It is considered that the replacement cow is purchased as a dropped calf and pail fed in exactly the same way as the dairy cow replacement calf. The purchase price of the replacement calf is assumed to be £12, i.e. sale price of dairy heifer calves in 1958. It is assumed that mortality rate of purchased heifer calves is 4 per cent. and that all deaths take place in the first few days after purchase. (3) It is assumed that the single suckled calf is born in February or March and sold the following Autumn at 8 months of age weighing 3½ to 4 cwts. Mortality rate is 1 per cent. The feed requirements of the cow and calf are maintenance requirements of cow during dry period and 1·8 maintenance requirements during the suckling period of the calf (10).* The method of estimating feed requirements and of calculating output per lb. S.E. and per acre is shown in Tables VI, VII, VIII and IX of the Appendix.

*Professor Sheehy does not give figures for single suckling.

Results

Outputs based on three different prices for single suckled calves are given in Table 2, viz. £35, £38 and £40 each. At £35 which was the average price of such calves in 1958, the returns are 2·01d. per lb. S.E. and £22·04 per acre. At a price of £40 the returns are 2·30d. per lb. S.E. and £25·06 per acre.

Multiple suckling

In this enterprise a number of calves are suckled on a cow. It is a fairly popular enterprise in Britain. It is a very highly skilled operation, however, and is not widely carried on in this country although a variation of it, i.e. pail feeding several calves on a cow's milk, is fairly popular in the West of Ireland. Multiple suckling or pail feeding has not been considered in this paper because it is not a method of either increasing the calf population or of finishing animals for export. The multiple suckled calves have to be finished either on the same or some other farm and excess profits if any made on the enterprise are at the expense of later feeders.

Dry Cattle Rearing

Dry cattle rearing is the main enterprise on a high proportion of Irish farms. As normally carried on the cattle are kept for a short period on many farms before being finally exported or slaughtered. Some of the people who handle the beef animal in its passage from the south of Ireland via the west to the east undoubtedly make good profits by astute buying and selling but these profits, while they enter into national income, do not represent a net gain to the agricultural industry. Rather are they a redistribution of income within the industry since excess gains by one farmer must be at the expense of another. This is best appreciated by an example. Suppose a dairy farmer in Limerick sells a calf in his local market for £15 and that this animal is eventually sold for export at £65. The maximum gain to the dry cattle industry of this animal can be no more than £50 (i.e. £65-£15) and may be very much less depending on the amount of transport costs, market tolls, auction fees and dealers' margins which leave the system. A study of market returns shows that on an average prices of young calves in the month of April are about £2. 10s. each higher in Connacht and Leinster than in Munster. If we assume that this £2. 10s. differential represents the transport and dealers' margin for bringing the calf from the south to the west or east, then this is the first slice of the £50 margin which leaves Agriculture. At each subsequent change of hands a further amount leaves the industry in marketing expenses.

Because of the impossibility of estimating the amount of the added value of a beast which leaves Agriculture in the form of marketing and transport expenses we have assumed in this study that the calf is purchased at birth from a dairy farmer and is brought to the export or slaughter stage on a single farm. The output or gross profit given here therefore represents, on the assumption made, the whole return obtained from a single beast.

In calculating the output from dry cattle rearing the following other assumptions have been made:

(1) The animal is considered as being fed as outlined by Prof. Sheehy for animals sold fat at 2½ years old. (Animal Nutrition pp. 320-364).

(2) Because of the variation in cattle prices, output at 1957 and 1958 prices as well as at the average of the two years' prices are used.

(3) The animal is considered as being sold at one or the other of two stages (*a*) as a store beast in June at the age of 26 months and (*b*) as a fat animal in October at the age of 2½ years.

Prices per cwt. of cattle are practically always higher in June than in October (see Table XVI Appendix) and farmers who can grow early grass often consider it more profitable to sell in June rather than in October, the grass not consumed during the remaining Summer months being made into silage. The methods of estimating feed requirements and of calculating output per lb. S.E. and per acre for dry cattle are shown in Tables X, XI and XII of the Appendix.

Results

Outputs per lb. S.E. and per acre are given in Table 2. It can be seen that in 1958, sale of store cattle in June was more profitable than sale of fat cattle in October whereas in 1957 the opposite was the case. When prices are considered over a number of years the gross profit per acre and per unit of S.E. are on an average higher for June sales. The net profit may, however, not be higher since cost per acre of providing the early grass and of ensiling the uneaten Summer's grass, may outweigh the extra profit per acre from June sales. This is a matter which would require further study in field trials.

A point which should be kept in mind also in relation to dry cattle raising is that high prices for finished animals is always reflected in high prices for calves so that the profit to the feeder is not in direct proportion to the prices he receives. The breeder will always gain when prices increase and so high prices for cattle benefit the dairy farmer probably as much as they do the feeder.

As stated above, the outputs for dry cattle have been calculated on the assumption that the animals are kept from birth until export or slaughter on a single farm. Since in practice it is not usual to keep animals for such a length of time on any one farm it is of interest to examine the economics of keeping different classes of dry cattle for one year. Accordingly Table I has been prepared to show the required margin between purchase and sale prices of different animals to give certain stated outputs per acre. The animals are considered as being fed for the different periods according to Sheehy's figures for animals sold fat at 2½ years old. The method of making the calculations is the same as that used in Table XII of the Appendix.

TABLE 1.—REQUIRED MARGINS BETWEEN SALE AND PURCHASE PRICES OF DIFFERENT CLASSES OF DRY CATTLE KEPT FOR 1 YEAR TO GIVE STATED OUTPUTS PER ACRE.

Stated outputs per acre	Ages, liveweight and periods for which kept			
	0-12 months 75-466 lbs. April-April	6-18 months 330-717 lbs. Oct.-Oct.	1-2 years 466-853 lbs. April-April	1½-2½ years. 717-1,218 lbs Oct.-Oct.
£	Required margins between sale and purchase price (£)			
16	16	15	20	23
18	17	17	22	26
20	18	19	25	29
22	19	21	27	32
24	20	23	29	35
26	21	25	32	38
28	22	26	34	41
30	23	28	37	44
Approximate price margins ruling in :				
1957	20	18	22	17
1958	19	20	20	26
Average 1957-58	19·5	19	21	21·5

Table 1 shows that at the prices ruling in 1957 and 1958 higher outputs per acre were obtainable from cattle from birth to 12 months of age than from cattle in any other age group. In those years calves kept from birth to 12 months would give on an average outputs of £23 per acre. Older cattle give lower outputs per acre than calves. Cattle from 1½ to 2½ years old would only give outputs of £18 per acre even at differences of £26 between selling and purchase prices. To get an output of £30 per acre the difference between selling and purchase price for 1½ to 2½ year old cattle would need to be £44.

Sheep

In calculating the returns from sheep, fat lamb production from lowland sheep only has been considered. Production of store lambs and fattening of wethers is not dealt with as neither of these enterprises carries an animal through from birth to slaughter or export. The method of calculating the returns from sheep are shown in Tables XIII-XV of the Appendix. Feed requirements of the sheep are based on the recommendations of the Report of the British Grassland Sub-committee (10) since these are the only available figures which could be used for the fat lamb enterprise. In calculating output the following assumptions have been made :—

(1) Weights of ewes are taken as 140 lbs. and weights of wool fleeces at an average of 8 lbs.

(2) The number of lambs reared per ewe is 1·50. This is a higher figure than the national average for lowland sheep which is about 1·3 but since we are comparing sheep with cattle sold fat at 2½ years and with single suckled calves,

better than average management conditions must be assumed. The figure of 1·5 lambs per ewe is based on returns received from a number of good sheep farmers throughout the country the average of whose returns was 1·56 lambs reared per ewe.

(3) The average breeding life of a ewe is taken as 4 years (i.e. 4 crops of lambs). In making the calculations allowance has been made for replacement of the ewe by a two year old hogget and for the sale of the old ewe. Feed for the ram has also been allowed at the rate of one ram per 45 ewes.

(4) 1958 prices for sheep, lambs and wool have been used. Sheep and lamb prices have not been very variable over the past few years but wool prices were lower in 1958 than in the previous few years.

Results

The outputs per lb. S.E. and per acre from sheep are given in Table 2. The returns per acre are about £26 and per lb. S.E. 2·22d. From experience of sheep farming the results would appear to be somewhat understated. Reference to line 7 of Table XV of the

TABLE 2.—OUTPUT PER LB. S.E. AND PER ACRE FOR DIFFERENT LIVESTOCK ENTERPRISES AT DIFFERENT PRICES

	Output					
	Per lb. S.E. d.	Per ac. £	Per lb. S.E. d.	Per ac. £	Per lb. S.E. d.	Per ac. £
	Dairy Cows					
Milk yield gallons	15d.		12d.		9d.	
700 ...	3·08	33·03	2·70	28·93	2·31	24·83
600 ...	2·97	31·64	2·62	27·87	2·26	24·10
500 ...	2·79	29·58	2·48	26·24	2·16	22·90
450 ...	2·68	28·31	2·39	25·22	2·10	22·13
	Single Suckling					
Price of calves	£35		£38		£40	
Output ...	2·01	22·04	2·18	23·85	2·30	25·06
	Dry Cattle					
Year	1958		1957		Average 1957–58	
Store Cattle (26 months)	2·12	21·35	1·84	18·49	1·98	19·92
Fat Cattle 2½ yrs.	1·83	19·12	1·92	20·03	1·88	19·58
	Sheep					
			2·22	25·74		

Appendix shows that the number of sheep units per acre is only 2·78. This is a somewhat lower stocking rate than one would expect from an acre yielding 25 cwts. of S.E. However, when judged in relation to 600 gallon dairy cows the comparison on a stock carrying capacity basis appears fairly reasonable—0·508 cow units per acre (Appendix Table V) as against 2·78 sheep units, or one cow unit equal to about 5·6 sheep units. The results from the sheep therefore can only be very slightly understated if at all.

Comparison of the Results

If dairy cows are taken as the standard, reference to Table 2 shows that the returns from single suckling at 1958 prices (viz. £35 per calf) are only about two-thirds of the returns from 700 gallon dairy cows at 1/3d. per gallon for milk with skim milk returned. The price of milk would need to be as low as 9d. per gallon (9·4d. was the unsubsidized price in butter exports in 1958) and the milk yield per dairy cow as low as 450 gallons before the output from single suckling would be equivalent to the output from dairy cows.* Under the latter conditions, of course, single suckling would be the more acceptable enterprise since its labour content is much less than that of dairying. Calculations using formula (4) on page 9 show that the price of single suckled calves weighing 3½ to 4 cwts. live weight at 8 months of age would need to increase to about £51 each before single suckling would be equivalent to 600 gallon cows at 1/3d. per gallon for milk and to over £53 each before they would be equivalent to 700 gallon cows at the same milk prices.

The returns per acre in 1958 from the sale of store cattle in June were about the same as the returns from single suckling in that year. The returns from fat cattle sold in October in 1958 were however about £3 per acre less than the returns from single suckling in that year. Both store and fat cattle returns in 1957 were less than those for single suckled calves.

As can be seen from Table 2 the returns from dry cattle both per acre and per lb. S.E. are substantially less than those from fairly high yielding dairy cows. At none of the milk yields and prices quoted are outputs per acre from dairying as low as those from dry cattle rearing. Dairying of course requires more labour than dry cattle and probably better housing but if the extra labour required is under employed family labour, the differential in net returns may not be very much different from the gross differential. This latter point can be put another way by saying that many dry cattle farmers could turn over to dairying without having to employ any extra labour.

The returns from sheep are intermediate between dry cattle and milk at 1/3d. per gallon. Per lb. S.E. the returns from sheep are about the same as from single suckling at £38 for calves but the

* The average yield of cows in the country as a whole in 1958 was 473 gallons per annum, while in the Counties of Munster and in Kilkenny it was 516 gallons per annum. The corresponding figures in 1957 were 500 and 534 gallons per annum respectively.

per acre returns from sheep are higher than for single suckling due to the fact that sheep can obtain practically all their feed requirements from grazing and so there is very little loss of nutrients produced in providing hay or silage for winter keep. If, as was suggested above, the output of sheep is slightly understated, then these animals compare favourably with dairy cows taking account of labour, housing and winter feed requirements.

General Comment on Results

Though the basic figures used in arriving at the results presented here may be the subject of some controversy, the general results obtained appear reasonable. The absolute levels of the figures may be somewhat in error but since the basic feed requirements used have been the same for all classes of stock, the relative outputs should be comparable. Because of the theoretical nature of the work one cannot of course be too dogmatic about the reliability of the results but until special experimental trials are carried out these are the best available figures on the subject to date. Because of the importance of grassland in our economy experimental trials on this matter are urgently required and this study should set the pattern for the field trials. Indeed if it served no other purpose this work could be justified in providing the theoretical background on which experiments should be based.

Once the technical co-efficients are determined experimentally, formulae on the lines of those presented below can be derived and used subsequently to derive outputs for the different enterprises under different price relationships.

Formulae for calculating output

Since the prices used in this study had of necessity to be somewhat arbitrary, opinions may differ as to the level of prices used. To enable different prices to be used if required, the formulae given below have been prepared. Any selected prices can be substituted into these formulae to give approximate outputs per lb. S.E. and per acre. In the formulae O/LB = Output per lb. S.E. in pence, O/AC = Output per acre in £ and S.A. = Yield of utilisable S.E. per acre from pasture in cwts.

Formulae for dairy cows :

Output per lb. S.E. :

(1) $O/LB = \sqrt{X_1}(0{\cdot}046\ X_2 + 0{\cdot}0367\ X_3) + 0{\cdot}136\sqrt{X_4} + 0{\cdot}054\sqrt{X_5}$

Output per acre :

(2) $O/AC = S.A.[\sqrt{X_1}(0{\cdot}02\ X_2 + 0{\cdot}015\ X_3) + 0{\cdot}058\sqrt{X_4} + 0{\cdot}022\sqrt{X_5}]$

where X_1 = yield of milk in 100 gallons
X_2 = price of milk per gallon (skim returned) in pence
X_3 = value of skim milk in pence per gallon
X_4 = price of dropped calves in £ each
X_5 = price of cull cows in £

Formulae for single suckling :

Output per lb. S.E. :

(3) $O/LB = 0{\cdot}054\ X_1 + 0{\cdot}007\ X_2 - 0{\cdot}012\ X_3$

Output per acre :

(4) $O/AC = S.A.(0{\cdot}0234\ X_1 + 0{\cdot}003\ X_2 - 0{\cdot}005\ X_3)$

where X_1 = price of 8 months old single suckled calves
X_2 = price of cull cows
X_3 = price of dropped heifer calves for replacement

Formulae for dry cattle :

Store cattle 26 months of age sold in June :

$O/LB = 0{\cdot}05\ X_1\ X_2 - 0{\cdot}05\ X_3 - 0{\cdot}36$
$O/AC = S.A.(0{\cdot}02\ X_1\ X_2 - 0{\cdot}02\ X_3 - 0{\cdot}14)$

Fat cattle 2½ years of age sold in October :

$O/LB = 0{\cdot}038\ X_1\ X_2 - 0{\cdot}04\ X_3 - 0{\cdot}26$
$O/AC = S.A.(0{\cdot}016\ X_1\ X_2 - 0{\cdot}017\ X_3 - 0{\cdot}11)$

where X_1 = weight of animal in cwts. l. wt.
X_2 = price of animal in £ per cwt.
X_3 = price of dropped calf in £.

Formulae for sheep :

$O/LB = 0{\cdot}3\ X_1 + 0{\cdot}057\ X_2 + 0{\cdot}12\ X_3 - 0{\cdot}13$
$O/AC = S.A.(0{\cdot}14\ X_1 + {\cdot}026\ X_2 + {\cdot}055\ X_3 - 0{\cdot}06)$

where X_1 = price of fat lambs in £
X_2 = price of fat ewes in £
X_3 = price of wool in shillings per lb.

Conclusions of an Economic Nature

If it is accepted that the figures given in Table 2 are reasonable estimates of the outputs of the different enterprises for the assumed level of grassland management, certain observations appear appropriate. From the economic point of view the per acre figures are the most interesting but before these can be fully appreciated they must be compared with some suitable standards. Since in this study we are dealing with better than current average conditions of management it seems reasonable to take as our standards the average outputs of the upper income farms in the National Farm Survey in 1955-56. Such outputs are given in Table 3 along with corresponding figures for incomes and investments.

TABLE 3.—ECONOMIC INDICATORS FROM UPPER INCOME FARMS OF DIFFERENT SIZES IN NATIONAL FARM SURVEY 1955–56 (£)

Size Group acres	Total Output per acre	Labour and Family income per acre	Family farm income		Total Investments (Livestock, crops, machinery)	
			Per acre	Per unit	Per acre	Per farm
15— 30 ...	30·0	20·3	19·6	278	31·7	716
30— 50 ...	29·5	19·4	17·5	368	31·5	1,170
50—100 ...	26·8	16·4	14·0	450	30·8	1,644
100—200 ...	25·4	14·2	10·8	711	29·7	3,537
200 and over	22·0	12·2	8·5	981	27·2	5,828

Judged by the figures for total output in Table 3 the outputs per acre from dry cattle raising as calculated in this paper are relatively low. Even at the prices ruling in 1957 and 1958, which were, particularly in 1958, much above the 1956 level, the gross output per acre from cattle was only about £20 on an average. This is less than the average outputs obtained on the good " over 200 acre " farms in the Farm Survey in 1955-56. While these average outputs contained an element of State support, which might not extend to increased output, it is still worthy of note that if cattle raising under the conditions specified in this paper were to be the sole enterprise on an Irish farm, the output per acre would be lower than what good farmers obtained in 1955-56 under conditions of mixed farming.

It could be argued that under a complete cattle economy the expenses would be lower than those for mixed farming. This is probably true, but to obtain from cattle-rearing the outputs specified here, the expenses of manures, hay or silage making, veterinary expenses, rates, annuities, marketing expenses etc. are likely to be at least £7 per acre, giving a labour and family income of no more than £13 per acre. This is very little greater than what the good over-200 acre mixed farmers obtained in 1955-56 and is considerably less than the farm and family income on smaller farms in that year. It is clear that on farms of all sizes, but particularly on farms under 50 acres, the raising of dry cattle would need to be supplemented by enterprises yielding much higher returns per acre if acceptable levels of income are to be attained.

There has been, over the last few years, a fairly widespread impression that single suckling was equivalent to sheep raising. The results of this study do not support this belief. Single suckling has been found to be economically superior at 1958 prices to dry cattle raising but inferior to milk as well as to sheep production. If the recent price relationship continues, it appears likely to expand on large and on part-time farms rather than on small, whole-time farms.

This paper leads to the conclusion that under our conditions, and particularly on smaller farms, dairying and sheep will have to be further developed as principal enterprises for utilising the potential increase in the output of our pastures. The figures presented here confirm that we cannot increase our cattle population without increasing milk as well. They show that, even under conditions of high output per acre from grass, beef will have to be supplemented by other enterprises if acceptable levels of income are to be obtained by whole-time farmers.

The conclusion that an extension of dairying will be necessary points to the urgency of seeing that our production and marketing arrangements are such as to receive the greatest national return for dairy produce exports. The case of Denmark is perhaps worthy of examination. In 1958, without the aid of any subsidy, Danish farmers received on an average 1/7d. per gallon for whole milk for manufacturing purposes. (9) Three main factors contributed to making this price possible: (1) a very efficient manufacturing system, (2) a marketing system which enabled a price of about 40s. per cwt. higher than ours to be obtained for Danish butter

in the British market, and (3) the export of an increasing proportion of higher priced milk products such as cheese, dried milk and cream rather than butter. The development in the production of milk in Denmark and in this country since pre-war is shown in Table XVII of the Appendix together with the constitution of the export of milk products in both countries. The shift to products yielding a higher premium per gallon has been most marked in the case of Denmark.

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APPENDIX

TABLE I.—FEEDING REQUIREMENTS IN TERMS OF STARCH EQUIVALENT (S.E.) FOR 10½ CWT. DAIRY COWS AT DIFFERENT LEVELS OF YIELD

Milk Yield (3·7% Fat)	S.E. required for milk per gal.*	Total S.E. for Milk	S.E. for Maintenance†	Total S.E.	Hay Silage and Grazing Requirements S.E.	
					Grazing	Hay or Silage
gals.	lb.	lb.	lb.	lb.	lb.	lb.
700 ...	2·68	1,876	2,418	4,294	3,300	994
600 ...	2·44	1,464	2,418	3,882	2,888	994
500 ...	2·26	1,130	2,418	3,548	2,554	994
450 ...	2·20	990	2,418	3,408	2,414	994

*Based on Jawetz, *Dairy Sc. Abstracts,* Vol. 18, No. 1. January 1956.
†Based on Sheehy, *Animal Nutrition,* p. 401.

TABLE II.—FEED REQUIREMENTS FOR REPLACEMENT COWS 2 YRS. AND 3 YRS. OLD*

Age Months	Season S=Summer W=Winter	Live Weight at end of period	L. Wt. Increase	Feed Required S.E.	Feed Components (S.E.)					Total Roughage S.E.
					Meal	Whole Milk	Skim Milk	Hay or Silage	Pasture	
		2-year-old cows								
		lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
0–6	S	330	255	504	121	60	87	134	102	236
6–12	W	466	136	852	—	—	—	852	—	852
12–18	S	717	251	1,507	—	—	—	—	1,507	1,507
18–24	W	853	136	1 513	—	—	—	1,260	253	1,513
24+	S	1,176	323	1,913	—	—	—	—	1,913	1,913
Total 10½ cwts.		1,176	1,101	6,289	121	60	87	2,246	3,775	6,021
		3-year-old cows								
0–6	S	330	255	504	121	60	87	134	102	236
6–12	W	375	45	736	—	—	—	736	—	736
12–18	S	604	229	1,310	—	—	—	—	1,310	1,310
18–24	W	672	68	1,310	—	—	—	1,060	250	1,310
24–30	S	946	274	1,840	—	—	—	—	1,840	1,840
30–36	W	1,037	91	1,445	—	—	—	1,195	250	1,445
36+	S	1,176	139	901	—	—	—	—	901	901
Total 10½ cwts.		1,176	1,101	8,046	121	60	87	3,125	4,653	7,778
Average of 2 and 3 year olds (10½ cwt.)		1,176	1,101	7,168	121	60	87	2,686	4,214	6,900
⅙ Average		—	—	1,195	20	10	15	448	702	1 150

*Based on Sheehy, *Animal Nutrition*, p. 320 to 374.

TABLE III.—FEED REQUIREMENTS FOR DAIRY COWS OF DIFFERENT YIELDS (10½ CWT. COWS REPLACED BY 2½ YEAR OLD HEIFERS)

		Yield (gal. per year)			
		700	600	500	450
Roughage required by milch cow for 1 year	S.E. lb.	4,294	3,882	3,548	3,408
Roughage required for replacement cow	S.E. lb.	1,150	1,150	1,150	1,150
Total Roughage required		5,444	5,032	4,698	4,558

TABLE IV.—VALUE OF OUTPUT* OF DAIRY COWS OF DIFFERENT YIELDS AT VARYING PRICES OF WHOLE MILK

		Yield (gal. per year)			
		700	600	500	450
Net value of whole milk sold at 1/3d. per gal. ...	£	43·375	37·125	30·875	27·75
Net value of separated milk at 4d. per gal.	£	8·6	7·3	5·95	5·3
Net value of calves sold at £15 each (0·793 calves sold)	£	10·86	10·86	10·86	10·86
⅛ value of cull cows at £42 ...	£	7·0	7·0	7·0	7·0
Total output (whole milk at 1/3d. per gal.) ...	£	69·835	62·285	54·685	50·91
By-products† as percentage of output	%	25·6	28·7	32·7	35·1
Output per lb. S.E. ...	d.	3·08	2·97	2·79	2·68
Total output (whole milk at 1/– per gal.)	£	61·16	54·86	48·51	45·36
By-products† as per cent. of output	%	29·2	32·6	36·82	39·4
Output per lb. S.E. ...	d.	2·7	2·62	2·48	2·39
Total output (whole milk at 9d. per gal.)	£	52·485	47·435	42·335	39·81
By-products† as per cent. of output	%	34·00	37·7	42·2	44·9
Output per lb. S.E. ...	d.	2·31	2·26	2·16	2·1

* In arriving at output, whole and separated milk fed to replacement cow have been deducted from these milks, before calculating their values. Value of meal fed to replacement cow has been deducted from value of separated milk. Cost of bull service fees at £1 0s. 0d. per cow sold has been deducted from value of calves sold.

†By-products equals value of calves and cull cows sold.

TABLE V.—CALCULATING THE OUTPUT PER ACRE/PER ANNUM FOR COWS OF DIFFERENT YIELDS AT DIFFERENT PRICES OF MILK

Description	Unit	Milk Yield Gallons			
		700	600	500	450
1. Total roughage required per cow unit*	S.E. lb.	5,444	5,032	4,698	4,558
2. Feed supplied by pasture	,,	4,002	3,59	3,256	3,116
3. Feed content of hay and silage	,,	1,442	1,442	1,442	1,442
4. Pasture equivalent of hay or silage (3) $\times \frac{100}{75}$ ...	,,	1,923	1,923	1,923	1,923
5. Total pasture equivalent (2)+(4)	,,	5,925	5,513	5,179	5,039
6. Production per acre (i.e., 25 cwt. S.E.)	,,	2,8	2,8	2,8	2,8
7. Cow units per acre (6)÷(5)	No.	0·473	0·508	0·541	0·556
Output (milk at 1/3d. gal.)					
8. Per animal unit	£	69·835	62·285	54·685	50·91
9. Per acre (8)×(7)	,,	33·03	31·64	29·58	28·31
Output (milk at 1/– gal.)					
10. Per animal unit	,,	61·16	54·86	48·51	45·36
11. Per acre (10)×(7) ...	,,	28·93	27·87	26·24	25·22
Output (milk at 9d. gal.)					
12. Per animal unit	,,	52·485	47·435	42·333	39·81
13. Per acre (12)×(7) ...	,,	24·83	24·1	22·90	22·13

* *Cow unit* equals cow plus replacements.

TABLE VI.—FEEDING REQUIREMENTS IN TERMS OF STARCH EQUIVALENT FOR SINGLE SUCKLING COW, CALF AND REPLACEMENTS* (10 CWT. COW REPLACED BY 2½ YEAR OLD HEIFER)

	Pasture	Hay or Silage	Total
	S.E. lb.		
Requirements of 10 cwt. cow for maintenance at 6·0 lbs. S.E. per day for 365 days	1,290	900	2,190
Requirements of single suckled calf (0·8 maintenance of cow for 8 months) ...	1,034	134	1,168
Requirements of replacement cow from Table VII	483	336	819
Total Feed Requirements per cow unit	2,807	1,370	4,177

*Based on Report of sub-Committee of British Grassland Society. "The assessment and recording of the utilised Output of Grassland," *Journal British Grassland Society*, Vol. X, No. 1, 1955.

TABLE VII.—ROUGHAGE REQUIREMENTS FOR REPLACEMENT OF SINGLE SUCKLING COW 10 CWT. LIVE WEIGHT CALVING AT 2 YEARS OR 3 YEARS OLD*

	Pasture	Hay or Silage	Total
	S.E. lb.		
Requirements for 10 cwt. heifer calving at 2 yrs. old :			
Birth to 24 months at 853 lb. L.wt. (Table II)	1,862	2,246	4,108
853 to 1,120 lbs. L.wt.	1,581		1,581
Total roughage for 2 yr. old heifers	3,443	2,246	5,689
Requirements for 10 cwt. heifer calving at 3 yrs. old :			
Birth to 36 months at 1,037 lb. L.wt. (Table II)	3,752	3,125	6,877
1,037 to 1,120 lbs. L.wt.	538		538
Total roughage requirements for 3 yr. old heifer	4,290	3,125	7,415
Average of 2 and 3 yr. olds (10 cwt.)	3,866	2,686	6,552
$\frac{1}{8}$ Average ...	483	336	819

*Based on Sheehy, *Animal Nutrition*, pp. 331 and 332.

TABLE VIII.–OUTPUT PER LB. S.E. FROM ROUGHAGE FOR SINGLE SUCKLED CALVES 3½–4 CWT. LIVE WEIGHT AT 8 MONTHS OF AGE

Receipts :				
0·99 calves at £35 less cost of bull service fee of £1			£	33·65
$\frac{1}{8}$ of cull cow at £42			£	5·25
Total receipts			£	38·90
Expenses $\frac{1}{8}$ cost of replacement calf meal + milk :				
		£		
1·04 calves at £12		=12·48		
Feed*:—35 gals. whole milk at (1/3+$\frac{4}{5}$ of 4d.)		= 2·65		
105 gals. separated milk at 4d. ...		= 1·75		
1½ cwt. meal at 32/–		= 2·4		
	8)	19·28	. . £	2·41
Output per cow when calf sold at £35			... £	36·49
Output per lb. S.E. when calf sold at £35 ...			... d.	2·01
,, ,, ,, ,, ,, ,, ,, ,, £38 ...			... d.	2·18
,, ,, ,, ,, ,, ,, ,, ,, £40 ...			... d.	2·30

*Feed for replacement calf same as for dairy calf.

TABLE IX.—CALCULATING OUTPUT PER ACRE PER ANNUM FOR SINGLE SUCKLING

		Price of 8 months old calves		
		£35	£38	£40
1. Total roughage required per cow unit (Table 6)	S.E. lb.	4,177	4,177	4,177
2. Feed content of pasture ...	,, ,,	2,807	2,807	2,807
3. Feed content of hay or silage ...	,, ,,	1,370	1,370	1,370
4. Pasture equivalent of hay or silage (3) $\times \frac{100}{75}$	,, ,,	1,827	1,827	1,827
5. Total pasture equivalent required per cow unit (2)+(4) ...	,, ,,	4,634	4,634	4,634
6. Production per acre (i.e., assumed 25 cwt. S.E.) ...	,, ,,	2,800	2,800	2,800
7. Cow units per acre (6)÷(5) ...	,, ,,	0·604	0·604	0·604
8. Output per cow unit (Table 8) ...	£	36·49	39·49	41·49
9. Output per acre (8) × (7) ...	£	22·04	23·85	25·06

TABLE X.—FEEDING REQUIREMENTS IN TERMS OF STARCH EQUIVALENT FOR DRY CATTLE FROM BIRTH UNTIL SOLD FAT AT 2½ YEARS OLD AND WEIGHING 11 CWT. APPROX.*

Age Months	Season	Live Weight (end of period)	L. Wt. Increase	Feed Required S.E.	Feed Components (S.E.)					Total. Roughage S.E
					Meal	Whole Milk	Skim Milk	Hay or Silage	Pasture	
0–6	S	330	255	504	121	60	87	134	102	236
6–12	W	466	136	852	—	—	—	852	—	852
12–18	S	717	251	1,507					1,507	1,507
18–24	W	853	136	1,513				1,260	253	1,513
24–26	S	965	112	640	—	—	—	—	640	640
Total to 26 months		965	890	5,016	121	60	87	2,246	2,502	4,748
26–30	S	1,218	253	1,522	—	—	—	—	1,522	1,522
Total to 30 months		1,218	1,143	6,538	121	60	87	2,246	4,024	6,270
Average for fat Cattle per annum (Sold at 30 months)				2,615	48	24	35	898	1,610	2,508
Average per annum for Store Cattle (sold at 26 months)				2,315	56	28	40	1,037	1,155	2,192

*Based on Sheehy, *Animal Nutrition*, pps. 320-364.

TABLE XI.—OUTPUT PER LB. S.E. FROM ROUGHAGE FOR DRY CATTLE SOLD AT DIFFERENT AGES AND PRICES

		1957 prices	1958 prices	Average 1957–58
Fat Cattle sold in October at 30 months				
Receipts : 0·99 of fat beast at £67 and £71	£	66·33	70·29	68·31
Expenses : 1·04 calves at £9 and £15+ value of meal and milk £6·8	£	16·16	22·40	19·28
Total Output : (birth to 2½ years old)	£	50·17	47·89	49·03
Average Output per annum (per unit)	£	20·07	19·16	19·61
Output per lb. S.E. from roughage ...	d.	1·92	1·83	1·88
Store Cattle sold in June at 26 months				
Receipts : 0·99 of store beast at £53 and £65	£	52·47	64·35	58·41
Expenses : as for fat cattle above ...	£	16·16	22·40	19·28
Total Output : (birth to 26 months)	£	36·31	41·95	39·13
Average Output per annum per unit	£	16·76	19·36	18·06
Output per lb. S.E. from roughage ...	d.	1·84	2·12	1·98

TABLE XII.—CALCULATING OUTPUT PER ACRE FOR DRY CATTLE SOLD AT DIFFERENT AGES AND PRICES

		Fat Cattle 2½ yrs. sold October			Store Cattle 26 months sold June		
		1957	1958	1957–58	1957	1958	1957–58
1. Average Roughage required per beast per annum	S.E. lb.	2,508	2,508	2,508	2,192	2,192	2,192
2. Feed supplied by pasture ...	,,	1,610	1,610	1,610	1,155	1,155	1,155
3. Feed supplied by hay or silage ...	,,	898	898	898	1,037	1,037	1,037
4. Pasture equivalent of hay or silage $(3) \times \frac{100}{75}$	,,	1,197	1,197	1,197	1,383	1,383	1,383
5. Total pasture equivalent (2) + (4)	,,	2,807	2,807	2,807	2,538	2,538	2,538
6. Production per acre (25 cwt. S.E)	,,	2,800	2,800	2,800	2,800	2,800	2,800
7. Cattle units per acre (6) + (5) ...	No.	0·998	0·998	0·998	1·103	1·103	1·103
8. Output per cattle unit (Table XI)	£	20·07	19·16	19·61	16·76	19·36	18·06
9. Output per acre (8) × (7) ...	,,	20·03	19·12	19·58	18·49	21·35	19·92

TABLE XIII.—ESTIMATING SHEEP REPLACEMENTS (1·50 LAMBS REARED PER EWE)

Period	No. Days	Type of Stock (Number)				
		Ewes	Pregnant Hoggets	Dry Hoggets	Lambs	Ram
Oct.-Jan. ...	99	12	4	—	4	
Jan.-March ...	56	12	4	—	4	16/45
March-July ...	112	16	—	4	24	16/45
July-October ...	98	12	—	4	4	16/45

TABLE XIV.—CALCULATING OUTPUT PER ACRE FROM ROUGHAGE FOR SHEEP 140 LB. LIVE-WEIGHT GIVING 1·50 LAMBS WEANED FAT AT 16 WEEKS OF AGE*

Period	Type of Stock	No. Days	Feed per day S.E. lb.	Total S E. lb.	Financial Results	
					Details	Value
						£
Oct.–Jan. ...	12 ewes, 4 hoggets } 16	99	1·6	2,534	*Sales–July* :	
Jan.–March ..	do. 16	56	1·9	1,164†	3·8 ewes @ £6	22·8
Oct.–March ...	4 lambs	155	1·4	868	20 lambs @ £5 10s.	110·0
March–July ...	16 ewes, 24 lambs } 40	112	1·6	7,168	Wool — 20 fleeces @ £1 4s.	24·0
					Total sales	156·8
July–Oct. ...	12 ewes, 4 lambs } 16	98	1·6	2,509	*Less*	
March–Oct. ...	4 hoggets	210	1·9	1,512	8 cwt. sugar pulp £8	
Oct.–Oct. ...	16/45 of 1 ram	365	1·6	208	Depreciation of ram 0·7	8·7
	Total for 16 ewes			15,963		148·1
	Total for 1 ewe			998		9·256
	Output per lb. S.E.				... ...	2·2d.

*Feed requirements for sheep based on "The assessment and recording of the utilised output of grassland" Journal of British Grassland Society, Vol. X, No. 1, 1958.

†Total feed requirements less 8 cwt. sugar pulp (1,702 − 538 = 1,164).

TABLE XV.—CALCULATING OUTPUT PER ACRE/PER ANNUM FOR SHEEP AND REPLACEMENTS

1. Total roughage required per sheep unit (Table 14)	S.E. lb.	998
2. Feed supplied by pasture	,,	974
3. Feed supplied by hay or silage*	,,	24
4. Pasture equivalent of hay or silage (3) × $\frac{100}{75}$ ...	,,	32
5. Total pasture equivalent (2) + (4)	,,	1,006
6. Production per acre (25 cwts. S.E.)	,,	2,800
7. Sheep units per acre (6) + (5)	No.	2·78
8. Output per sheep unit (Table 14)	£	9·26
9. Output per acre (7) × (8)	£	25·74

*Based on 72 lbs. hay per sheep unit to allow for snowy conditions which may often arise.

TABLE XVI.—MONTHLY PRICES OF STORE AND FAT CATTLE AT DUBLIN AUCTIONS AND MARKETS FOR SELECTED YEARS
(SHILLINGS PER CWT. 1.-WT.)

Year	January	February	March	April	May	June	July	August	September	October	November	December
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Store Cattle—Bullocks												
1957	114 6	127 3	141 3	150 9	139 3	131 3	135 3	138 6	132 9	127 6	128 0	129 6
1958	135 9	139 3	146 0	151 3	158 3	151 9	151 3	145 0	143 0	131 6	132 3	129 0
Average (1952–1958)	120 11	127 6	134 0	138 10	138 1	131 6	127 11	123 5	120 0	117 4	116 1	117 6
Store Cattle—Heifers												
1957	105 9	118 9	135 9	140 9	129 6	119 6	126 0	129 6	121 6	116 9	116 3	119 0
1958	128 9	133 6	140 3	147 0	155 9	147 6	151 3	143 6	138 3	131 3	129 9	124 3
Average (1952–1958)	116 3	123 9	130 9	136 4	136 4	128 8	125 2	119 9	114 9	111 1	109 7	110 5
Fat Cattle												
1957	109 9	122 3	127 9	143 6	131 9	119 0	123 0	121 0	119 3	114 9	113 3	118 3
1958	119 3	121 0	126 6	129 0	137 3	134 3	134 6	132 3	131 0	125 0	123 0	125 6
Average (1952–1958)	117 6	123 4	125 8	130 4	132 2	126 11	121 11	118 1	115 6	112 7	110 8	113 4

TABLE XVII.—TOTAL PRODUCTION OF MILK AND EXPORTS OF DAIRY PRODUCTS FROM IRELAND AND DENMARK PREWAR, 1957 AND 1958

	Denmark			Ireland		
	1938	1957	1958	1938/39	1957	1958
	million gals.					
Production of milk	1,160	1,144	1,096	484	618	596
Exports of Dairy Products	000 cwts.					
Butter	3,111	2,313	2,523	377	316	330
Cheese	179	1,234	1,435	20	1	3
Condensed milk ...	313	671	769	111	3	5
Milk powder ...	7	481	510	12	74	98
Fresh milk and cream	—	279	778	4	28	31
Chocolate crumb (in terms of milk powder) ...	—	—	—	—	205	206

DISCUSSION

Professor J. Johnston said: The paper concentrates on the technical possibility of making more effective use of our grassland potential and makes valuable suggestions to that end. It is necessarily somewhat abstract, but it does indicate valuable directions in which a series of controlled experiments can provide more concrete and valuable conclusions.

However the most pressing problems affecting our agricultural situation are not of a technical but of an overall economic character. Technically Ireland, North and South, is capable of becoming the lowest cost producer of livestock and livestock products of any country in Western Europe. Actually the subsidised high cost production of livestock and livestock products by the United Kingdom and other industrial countries in Europe has had a similar effect on the economy of the Republic to what happened in the eighteenth century when all Ireland suffered from British commercial restrictions. One after another our traditional exports outlets are closing up and new ones are not in sight. If we doubled the stock carrying capacity of our land, as is technically possible, we would face an insoluble marketing problem. Egg exports are gone, dairy products and pig products have only a toe hold in external markets; only horticultural expansion offers some hope for the small farmer, and only an expansion of cattle numbers some hope for the larger farmer. But, for biological reasons, an expansion of cattle numbers is the slowest of all forms of agricultural expansion. If expanded by the traditional methods and in the traditional areas they cause an embarrassing increase in the output of milk. Anyhow the calves produced in the dairying areas are a poor sort of raw material for the dry stock farmer in other parts of the country. They are hawked about immediately after birth and 8 per cent. of them die largely because they have been deprived of their mothers' beastings milk—nature's life preserver for calves.

A mortality of nearly 100,000 calves per annum is a loss to the national economy of about £1,500,000 per annum—very much the same figure as the cost to the taxpayer of the subsidy to creamery milk suppliers in a recent year. Is it possible that the one is to some extent the cause of the other, and that if the milk cheque did not bulk so large in the eyes of dairy farmers they might cherish the lives and health of their calves with positive advantage to the national economy, while offsetting, perhaps to 100 per cent., the loss to themselves of some reduction in the milk subsidy?

There is much to be said for an extension of the practice of single suckling in the dry stock areas both because of the higher quality and negligible mortality rates of such calves, and because it causes no embarrassing problem of an unwanted milk surplus.

In general the opportunities for industrial expansion, thanks to Bord na Móna and the E.S.B., are now more favourable than those for agricultural expansion. In the present international climate we must concentrate on removing the external obstacles to agricultural exports before we can advance agriculturally all along the line, and that is a job for our diplomatists rather than our farmers.