Overview of animal production from pastures in Ireland

M.J. Drennan[1], A.F. Carson[2] and S. Crosse[3]
[1]*Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland*
Email: mdrennan@grange.teagasc.ie
[2]*Agricultural Research Institute of Northern Ireland Hillsborough, Co. Down BT26 6DR*
[3]*Teagasc, Oak Park, Co. Carlow*

Key points

The importance of grassland to agriculture in Ireland is indicated by the fact that:
1. Sixty percent of agricultural output is from grassland as cattle, milk and sheep products.
2. Over 90% of the total farmed area is in grass.
3. Livestock are almost entirely dependent on grazed grass for 200 to 235 days of the year.
4. Grass conserved as silage is the main source of fodder in winter.
5. To improve competitiveness changes are continuously taking place, which include:
   - increased suckler herd size and a movement to late maturing continental cattle breeds;
   - movement in the dairy herd towards Holstein with increased production per animal;
   - increased importance, post CAP reform, of technical efficiency to maintain competitiveness in a more market-orientated era, and
   - greater influence on future livestock systems of agri-environmental support schemes and environmental legislation.

Keywords: grassland, animal production, systems

Introduction

Animal production from pasture accounted for over 60% of the total Agricultural output on the island of Ireland in 2003 (€4,975 million) (Table 1). Beef cattle, milk and dairy products and sheep accounted for 34%, 25% and 5% of output, respectively. There are over 130,000 farmers in the Republic of Ireland (ROI) and 34,000 in Northern Ireland (NI). Of this total in the ROI, 27% are involved in dairying, 51% mainly in beef, 17% in sheep and less than 6% mainly in tillage (Connolly *et al.,* 2004) (Table 2). Average family farm income varies from €7,337 for those mainly involved in cattle rearing to €30,138 for those exclusively in dairying. Corresponding Utilisable Agricultural Areas (UAA) for these two groups are 26.4 and 40.1 ha. The number of livestock units (LU) per holding varies from 27.7 on cattle rearing farms to 86.4 on farms with dairying and other enterprises. The overall stocking density was shown to be 1.53 livestock units per ha devoted to livestock but varies considerably between the different enterprises. Figures for NI show a similar trend.

Land use

Ireland has a total land area of 8.24 million ha with 6.89 million ha in ROI and 1.35 million ha in NI (Table 3). Over 90% of the land area is grassland in both ROI (91%) and NI (96%), while the figure for Great Britain (GB) is 71%.

Table 1 Output value (million €) in agriculture, 2003

	Gross output at producer prices		Direct* payments		Total		% of total	
	ROI	NI	ROI	NI	ROI	NI	ROI	NI
Milk	1,445	494	-	-	1,445	494	25	24
Cattle and Calves	1,23	291	850	276	2,079	567	36	27
Sheep and Lambs	193	58	109	29	303	87	5	4
Pigs and Poultry	434	283	-		434	283	8	14
Other	1,429	604	134	13	1,563	617	27	30
Total	4,731	1,229	1,093	245	5,824	2,048	100	100

*Various EU premiums; Source: CSO (2004); DARD (2004)

Table 2 National farm survey data by farming system - all farms, 2003

Farm system	Dairying	Dairying and other	Cattle rearing	Cattle other	Mainly sheep	Mainly tillage	All systems
% of Population	16.2	10.7	27.5	23.3	16.8	5.7	100.0
Mean FFI (€)	30,138	24,656	7,337	8,106	13		15,054
UAA (ha)	40.1	53.0	26.4	29.4	37.3	63.7	36.1
Total LU	74.3	86.4	27.7	40.3	48.4	40.8	48.6
LU/UAA	1.91	1.85	1.06	1.41	1.32	1.46	1.53

FFI = Family Farm Income; UAA = Utilisable Agricultural Area; LU = Livestock Units

Table 3 Land use in Ireland and GB

	Ireland		GB
	ROI	NI	
Total land area (m.ha)	6.89	1.35	NA
Forestry (m.ha)	0.60	0.08	NA
Total farmed (m.ha)	4.42	1.07	16.5
Total crops (%)	9	5	30
Grassland (%)	81	80	36
Rough grazing (%)	10	15	35

Source: DAF (2004), DARD (2003), Hopkins (2000)

Farm size

The average UAA per holding in the ROI and NI is 31.4 and 38.0 ha, respectively (Table 4). The average UAA for the EU15 is 18.7 ha per holding with the UK being at the top end of the scale (67.7 ha) and Italy at the lower end (6.1 ha). As an indicator of change, average farm size in ROI has increased gradually from 22.3 to 32.0 ha/holding between 1975 and 2002.

Table 4 Utilised agricultural area (UAA) per holding

	UAA (m.ha) 2002	No. of holding ('000) 2000	UAA per holding 2000
EU15	130.1	6,771	18.7
France	29.6	664	42.0
Ireland: (ROI)	4.4	142	31.4
(NI)	1.1	28	38.0
Italy	15.3	2,154	6.1
Netherlands	1.9	102	20.0
UK	15.7	233	67.7

Source: Eurostat (2002)

Climate

Rainfall, temperature and radiation are the most important climatic components affecting grass production. Ireland is suited to grassland farming. Located between 51°N and 55°N latitude it has a temperate, humid climate, influenced by the prevailing westerly winds and the proximity of the ocean and the gulf stream. Annual average rainfall in lowland areas (elevation less than 100 metres) varies from about 750 mm in parts of the east and northeast to greater than 1,200 mm in the west, northwest and south-west. While there are no well defined dry and wet seasons, the year may be divided into a relatively dry half, February to July, and a relatively wet half, August to January. There is considerable year-to-year variability in total annual rainfall.

The mean annual temperature over Ireland has a distinct north-northeast to south-southwest gradient. For example, at Hillsborough in the north-east, the mean annual temperature is 8.6°C, whilst in the south, at Moorepark, the mean temperature stands at 9.8°C (Table 5). Monthly mean temperature decreases by approximately 1°C for each 150 metres increase in altitude. Grass growth is considered to be continuous at temperatures over about 6°C in Irish conditions. Year-to-year fluctuations are comparatively small.

Table 5 Monthly mean temperature (°C) and rainfall (mm) at [1]Hillsborough (north-east) and [2]Moorepark (south) averaged over a 30 (1961-90) or 20 (1982-2001) year period

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Temperature													
N	4.0	3.9	5.3	7.1	9.7	12.6	14.2	14.0	12.2	9.7	6.0	4.8	8.6
S	5.2	5.6	7.1	8.2	11.0	13.6	15.7	15.2	12.9	10.2	7.3	6.0	9.8
Rainfall													
N	87	60	70	57	62	64	57	83	85	94	82	84	885
S	109	92	81	66	61	68	54	92	78	114	101	109	1025

N = north-east; S = South Source: [1]Cruickshank (1997); [2]Shalloo *et al*. (2004)

Grassland

Grassland in Ireland is composed predominantly of long-term permanent pastures with only about 3 percent reseeded yearly. With such a high proportion of land in grass, it is not surprising that cattle and sheep largely rely on grazed and conserved grass as sources of feed. A typical grass growth curve for Ireland shows that growth commences in March, reaches a peak of about 80 kg of dry matter per ha per day in late May, with a second lower peak of

about 65 kg in early August followed by a rapid decline until growth almost ceases in November (Figure 1).

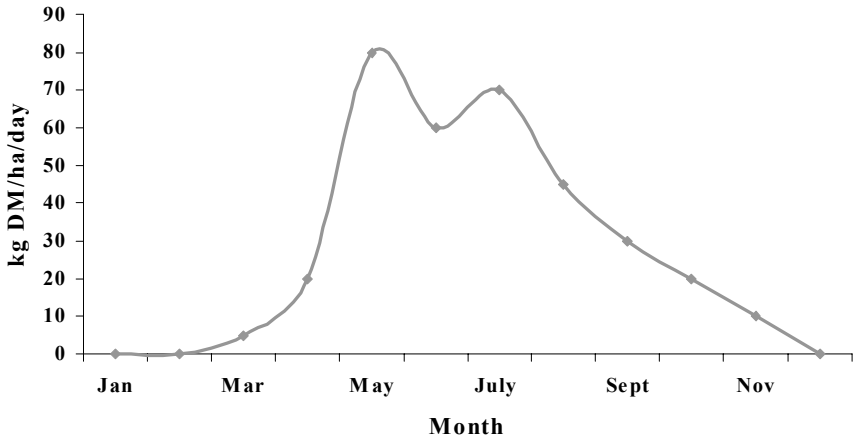

Figure 1 Typical grass growth curve for Ireland

Total annual grass dry matter production varies from about 15 t/ha in the southwest to 11 t/ ha in the northeast in an average year (Figure 2) (Brereton, 1995). The length of the grass growing season varies from about 8 months in the north-east of the island up to 11 months in the extreme south-west (Keane 1992). The estimated starting dates of the grazing season vary from March 25 in the southwest to April 20 in the northeast (Brereton, 1995) (Figure 3). Thus, the grazing season varies from about 235 days (mid March to early November) in the south and southwest to about 200 days (mid April to late October) in the midlands and north. Soil type has a major effect as poorly drained soils have a shorter grazing season due to utilisation problems and have a correspondingly longer winter feeding period. Moisture deficit is generally not a problem in relation to grass production in Ireland with only small losses in production potential which (<1.5 tonnes DM/ha) are confined to a narrow coastal strip in the east and southeast (Brereton and Keane, 1982).

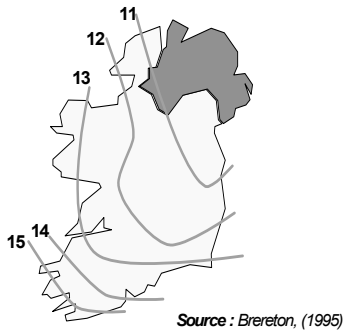

Figure 2 Model estimates of annual dry matter grass production (t ha^{-1})

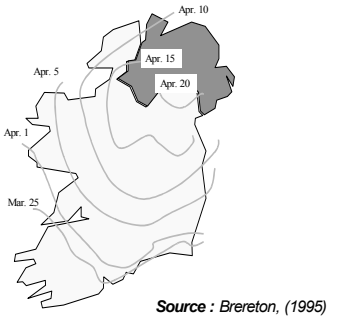

Figure 3 Estimated starting dates of the grazing season in Ireland

Provision of winter feed

Grass silage is the principal source of winter feed for livestock in Ireland. Indeed the proportion of farms that make silage continues to increase, now standing at 86% of all farms in the ROI (O'Kiely *et al*., 2000) (Table 6). The total area harvested for grass silage in 1999 was 1.24 million ha providing 4.6 million t. of edible silage DM. First cut accounts for over 70% of the silage harvested with second harvests from the same area accounting for most of the remainder. It is estimated that baled silage accounts for 35% of the area harvested for silage. Virtually all baled silage, and almost 75% of conventional silage, is made without the application of additives. It is estimated that 0.2 million ha of grass is harvested for hay each year. Similar trends in the provision of winter feed are seen in NI with an estimated 0.32 million ha of grassland now harvested for silage yearly producing 1.2 million t of edible silage DM (DARD, 2004). Although increasing in recent years, the total quantity of maize silage harvested in the ROI amounted to only 19,600 ha in 2003 or about 3% of conserved forage DM.

Table 6 Trends in the percentage of farms that make silage within the main farming enterprises

	1991/92	1999
Dairying	91	99
Beef	52	86
Sheep	50	76
All systems	65	86

Source: O'Kiely *et al*. (2000)

Fertiliser use

Recent data from the ROI (Coulter *et al*., 2002) show that fertiliser use is greater on grassland areas used for silage than for grazing or hay areas (Table 7). Application rates of fertiliser nitrogen (N) were shown to be 109, 133 and 53 kg/ha on grazing, silage and hay areas, respectively. Within farming systems, fertiliser use was shown to be greater for dairying than for beef cattle or sheep systems (Table 7).

Table 7 Estimated nitrogen, phosphorus and potassium fertilizer applied (kg/ha) to grassland for grazing, silage and hay and for different farming systems

	Nitrogen	Phosphorus	Potassium
Grazing	109	9	21
Silage	133	15	49
Hay	53	11	27
Dairying	176	12	26
Cattle	48	8	17
Sheep	48	6	13

Source: Coulter *et al*. (2002)

National cow herd

There have been substantial changes in the composition of the cow herd over the last twenty years. In the early 1980's total cow numbers in the ROI were just over 2 million, of which 80% were dairy cows and 20% suckler cows (Figure 4, CSO publications). The introduction by the European Union (EU) of milk quotas in 1984 and increased milk production per cow has resulted in a gradual decline in dairy cow numbers from 1.65 million in 1984 to 1.16 million in 2004. The corresponding change from 1984 to 2004 in suckler cow numbers was from 0.44 to 1.21 million. The average number of cows in dairy and suckler herds is 37 and 15 respectively (CSO, 2001). In NI, significant quantities of milk quota have been imported from GB, leading to an expansion in overall milk output (37% increase in milk quota held by NI producers over the last 10-years). Whilst overall numbers of dairy cows in NI have remained relatively unchanged (0.28 million), average milk yield has increased from 4,639 to 6,290 litres per cow over the period from 1984 to 2003, with average herd size now standing at 61 (DARD, 2004). The milk yield increase in the ROI was from 5,080 l. in 1985 to 6,166 l. in 2003 (ICBF 2003).

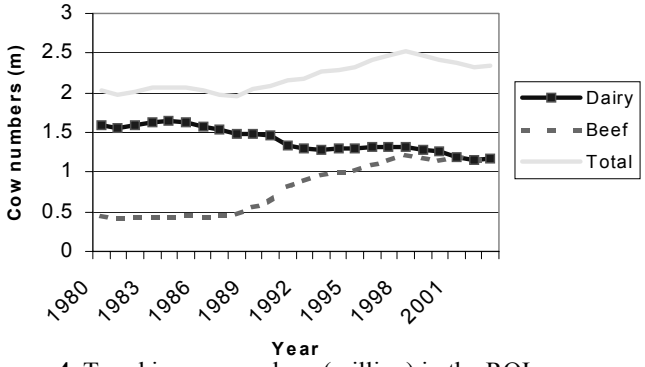

Figure 4 Trend in cow numbers (million) in the ROI

Breed composition of the cattle herd

The dairy cow herd in the ROI is predominantly Holstein-Friesian (98%) and has changed little over recent years (Drennan, 1999a). Fifty percent of dairy cows in the ROI are bred to Holstein-Friesian sires, about 28% to late maturing beef breeds (e.g. Charolais) and 22% to early maturing breed sires (Hereford and Aberdeen Angus).

There has been major changes in the composition of the beef herd, on both the dam and sire side in both the ROI and NI. Between 1992 and 2003 the proportion of beef cows comprised of late maturing breeds increased from 40 to 71%. Increasing usage of late maturing breeds is also evident on the sire side. Approximately 85% of suckler cows are now bred to continental breed sires, of which over 40% are bred to Charolais sires (Table 8).

Table 8 Breed composition (%) of the beef cow herd in 1992 and 2003 and breed of sire used (%) on beef dams in 2003

	Beef Cow Herd				Sire Breed	
	1992		2003		2003	
	ROI	NI	ROI	NI	ROI	NI
Aberdeen Angus	9	23	12	16	6	10
Hereford	35	12	20	6	5	5
Friesian	20	11	-	1	-	-
Simmental	9	23	17	18	8	7
Limousin	8	12	19	33	25	25
Belgian Blue	-	-	-	-	7	6
Charolais	7	7	21	12	44	40
Other breeds	12	2	11	11	5	8

Source: Drennan (1999a), ICBF (2003), DARD (2004), Kirkland *et al*. (2004)

Calving pattern

In the ROI, both the beef and dairy herds are predominately spring calving, which indicates the dependence on grazed grass. In the beef herd, 16% of calvings are in January-February, 43% in March-April, 22% in May-June with only 19% in the remaining 6 months of the year (Figure 5). The corresponding percentage figures for the dairy herd are 34, 41, 12 & 13. The marginally earlier calving in the dairy than in the beef herd reflects the fact that dairying systems are mainly in the southern part of the country, which as discussed previously, has earlier grass growth than northern areas.

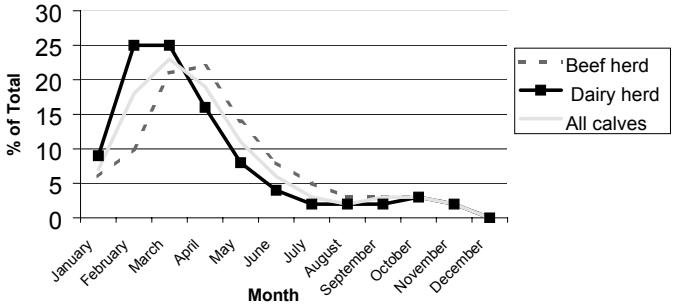

Figure 5 Calf birth by month in beef and dairy herds in the ROI 2003

In NI, the majority of dairy cows calve over the autumn-winter period with only 18% calving in the January to April period (CAFRE, 2003). This is mainly a result of the higher output systems practised in NI along with the shorter growing season and more difficult ground conditions early and late in the season.

Cattle slaughterings

For orderly marketing, an even supply of beef throughout the year is desirable. However, in contrast with most other EU countries, beef production in Ireland, because it is based on grazed grass, has tended in the past to have a pronounced seasonality in production (Figure 6). In 1990, 40% of prime cattle slaughterings in ROI were in the final quarter of the year. This has changed in recent years and the corresponding figures for 2003 were 28% for ROI and 26% for NI. Various EU schemes including the eligibility to meet premium payments have contributed to this change, which may again be altered following the decoupling of subsidy payments from production systems. Average carcass weights in 2003 for steers, young bulls, heifers and cows in ROI were 341, 327, 273 and 294 kg respectively. Corresponding percentages with carcass conformation classes of EUR were 59, 82, 67 and 12%. Similar carcass weights and carcass quality were recorded in the NI beef industry.

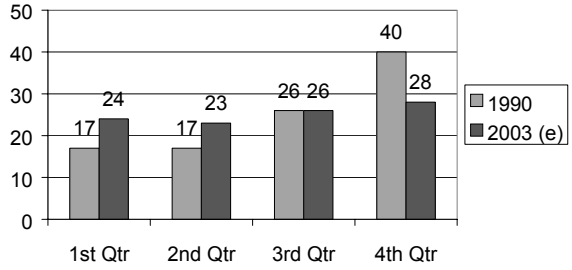

Figure 6 Seasonality of prime cattle supplies in the ROI (%)

Cattle and beef production and exports

In the ROI, total cattle disposals in 2003 were 2.08 million, of which 1.86 million were slaughtered and 0.22 million were exported live (Bord Bia 2004). Total beef availability was 583,000 t carcass weight equivalent (includes 20,000 t imported) of which 14% was used for the home market, with the remainder exported. The home market is supplied almost entirely by heifer beef. Live cattle exports have varied widely from year to year. Between 1995 and 2003 exports varied from 57,000 head in 1997 to peaks of over 400,000 head per year in 1999 and 2000 (*Appendix Table 1*). In the peak export years, three-quarters were to continental EU countries (Spain, followed by Italy and Holland being the main markets) with minimal numbers to non-EU markets. In contrast, non-EU markets accounted for 71 and 73% of total live exports in 1995 and 1996, respectively with Egypt and Libya accounting for practically all exports in these years. Between 1995 and 2003 beef carcass exports varied from 345,000 t in 2001 to 554,000 t in 1999 (*Appendix Table 2*). While non-EU markets accounted for 40 to over 60% of exports in the period up to 2000 most have been exported to EU countries in recent years. In 2003, 53, 30 and 17% of total meat exports were to the UK, continental EU and non-EU markets, respectively.

In NI, cattle disposals in 2003 were 408,000 head all of which were slaughtered (DARD 2004). BSE (Bovine Spongiform Encephalopathy) export restrictions on beef have changed markets considerably over the past decade. In 1995, 52% of prime beef production in NI was exported outside the UK, chiefly to continental Europe. In 2003, of the 0.41 million of prime beef cattle slaughtered, 80% were exported to GB with the remainder used largely for home consumption (LMC, 2004).

Beef production systems

The data outlined shows that the climate in Ireland is ideal to grow grass and thus a suitable feed source is available which is the major cost factor in animal production. Beef, dairy and sheep production systems were designed to make optimum use of grass. As indicated earlier grass growth is confined, on average, to 7 to 8 months of the year when grass can be grazed cheaply *in situ*. For the remainder of the year it is necessary to conserve the grass from the time of most rapid growth (spring) to use in the period when grass growth is negligible in winter. In the past, grass conservation was as hay, which because of our wet climate was not ideal. Conservation of grass as silage was first introduced in the 1950's and has since continued to increase. It has the advantage over hay of being less dependent on weather conditions, allowing somewhat greater scope for mechanisation and permitting harvest at an earlier stage of grass maturity thereby allowing the production of higher quality conserved feed. In general, the systems are based on spring calving/lambing thereby ensuring that animal feed requirements are lowest when feed costs are greatest. When feed requirements are greatest in lactation the animals are at pasture and the management systems are designed to provide high quality leafy pasture throughout the grazing season. Compensatory growth is also availed of in that growing cattle are fed for moderate rates of gain in winter and subsequently high growth rates are attained at pasture. The grassland management practice results in beef cows being in good body condition at the start of winter and studies have shown that these cows can tolerate substantial losses in body reserves over the winter period without ill effects on subsequent cow or calf performance.

There is practically no veal production in Ireland with young bull beef production accounting for only 6% of male slaughterings in the ROI (Bord Bia 2004) and 18% in NI (LMC, 2004). Although declining, slaughter age of steers is generally between 24 and 30 months of age, while heifers are slaughtered 4 to 6 months earlier than steers. Most animals are housed in winter. Animal housing includes slatted floor sheds, straw-bedded courts, and cubicle accommodation.

Although numerous production systems are operated at farm level, the majority in the ROI involve spring born calves. Target weights at different stages of growth for these systems, based on studies at Grange Research Centre, are presented in the following sections for calves from suckler (Drennan 1999b, 2004, Drennan and Keane 2001) and dairy (Keane 2001, Drennan and Keane, 2001) herds.

Suckling systems

In studies of beef systems at Grange Research Centre, Limousin x Friesian and Simmental x (Limousin x Friesian) cows are used. Mature cows are bred to Charolais sires of high beef merit or Simmental sires for breeding herd replacements. Heifers are managed to calve at 2 years of age and are bred to easy calving Limousin sires.

Average calving date is mid March with the cows and calves turned out to pasture in April. Calves are weaned in October-November, when all animals are housed. Weaned calves are offered grass silage plus 1 kg of concentrates daily, normally over a 5-month winter period, following which they are put to pasture for a second grazing season. Heifer progeny are slaughtered in November at 20 months of age having received 3 kg of concentrates daily with grass (or silage) for the final 3 months. Steers are housed in mid October and offered silage plus 4 to 5 kg concentrates daily until slaughter in early March at two years of age.

Both semi-intensive and more extensive systems have been examined (Table 9). In the semi-intensive system 0.81 ha of grassland is allowed per cow unit, (cow, progeny and 25% replacements) with 225 kg of fertiliser N applied per ha and two silage harvests taken yearly. Fifty-five percent of the area is harvested for silage in late May (good quality for progeny with a dry matter digestibility (DMD) of about 740 g/kg) with a further 30% harvested in July (for cows with a DMD of about 650 g/kg). The extensive system has a lower stocking rate (1.0 ha /cow unit), less than half the level of fertiliser N applied (100 kg/ha) with one silage harvest half of which is in May (high DMD for progeny) and the remainder in June (lower DMD for cows). As no second silage cut is planned in the extensive system, although some may be harvested to maintain grass quality, there is an opportunity to accumulate sufficient grass as autumn approaches to allow the heifers to be finished outdoors. In both systems, flexible paddock rotational grazing programmes are operated with the objective of providing adequate supplies of leafy pasture throughout the season. Similar animal performance levels were obtained on both systems and the mean weights achieved by steers and heifers at different stages are shown in Table 10. With the same concentrate inputs per animal similar high animal performance levels can be obtained from semi-intensive or extensive grassland management systems. Consequently, beef output per ha is greater on the semi-intensive system (510 versus 410 kg/ha) but, due to lower costs in the extensive system, margins per ha were shown to be similar for the two systems.

Table 9 Details and performance of semi-intensive and extensive sucking systems

	System	
	Semi-intensive	Extensive
Stocking rate: ha/cow unit*	0.81	1.0
Nitrogen: kg/ha	225	100
Number of silage cuts	2	1
Percent of area harvested	85	55
Silage tonnes/cow unit	14.5	13.5
Heifers finished with concentrates on	Silage	Grass
Concentrates/cow unit (kg)	700	700

*Cow plus progeny to slaughter plus 25% replacements

Table 10 Animal weights (kg) and age at slaughter (days)

	Steer	Heifer
Weaning weight	316	288
Yearling weight	404	373
Slaughter weight	700	565
Carcass weight	396	309
Age at slaughter	725	606

Dairy calf to beef systems

Calves are born in February-March and are at pasture from May to November. Calves are rotationally grazed ahead of the yearling cattle. At a fertiliser N application rate of 114 kg/ha, the grassland area required for late maturing beef breed x Friesian and Friesian steers taken to slaughter is 0.55 ha. To provide adequate winter feed (total of 1.5t of silage DM consumed per animal) 55% of the total area is harvested in late May. Total lifetime concentrate inputs are 1000 kg (130 kg in calf stage and end of first grazing season, 120 kg during the first winter and 750 kg (5 kg/day) during finishing). Because of their earlier slaughter, the concentrate requirements of early maturing breed crosses are about 300 kg less than for Friesians and continental crosses. Lifetime live weight targets for both Holstein-Friesian and continental x Holstein-Friesian steers slaughtered at 2 years of age are shown in Table 11. The weights for Friesians also apply to early maturing breed crosses but the latter would have a shorter finishing winter and a lighter slaughter weight (carcass weight 295 kg).

Table 11 Target weights and gains for Holstein/Friesian (FR) and Continental x Friesian (CT) steers slaughtered at 2 years of age

Date	System event	No. days	Weight (kg)		Age (weeks)
			FR	CT	
Mid March	Purchase		45	50	
Mid May	To pasture	58	80	90	8
Mid November	To house	189	230	240	35
Late March	To pasture	126	300	320	53
Mid October	To house	210	490	510	83
Mid March	Slaughter	147	620	650	104
Overall		730	620	650	
Kill-out (g/kg)			520	538	
Carcass wt (kg)			320	350	

Dairying

In 2003 the volume of milk sold off farms in Ireland totalled 6,972 million litres (Table 12). Close to 90% of this milk output was manufactured into butter, cheese, cream, and whole milk powder, with 10% produced for the liquid milk market. In the ROI, 57% of the milk used in manufacture was for butter and 20% for cheese. In NI, the main milk products are milk powder and cheese, using an estimated 20 and 50% of milk produced, respectively.

Table 12 Milk output and disposal[1], 2003 (m.l whole milk only unless otherwise stated)

Manner of disposal	ROI	NI
Milk sold off farms	5,200	1772
Milk used in farm households[2]	45	
Imported milk Intake	349	9
Total milk available	5,594	1782
Of which		
Used for liquid consumption	505	213
Used in the manufacture of:		
Butter	3,216	34 cream
Cheese	1,106	200 + 64 cream
Cream[3]	220	587 + 270 cream
Whole Milk Powder	247	587 +270 skim milk
Chocolate Crumb	129	
Miscellaneous Products	717	

[1]Milk output and disposal will not reconcile due to the existence of different production processes in the production of milk based products
[2]Including milk used for the production of farm butter, cream and cheese and milk given as payment in kind to agricultural employees
[3]Includes milk used for the manufacture of cream by creameries and pasteuries
Source: DAF (2004), DARD (2004)

Spring-calving systems

Milk production in the ROI is predominantly based on spring-calving systems. Thus grazed grass, makes a major contribution to the feed budget of dairy cows. The Blueprint (Dillon and Stakelum 1999) for efficient dairying based on calving at the start of grazing in spring sets a target of 6,000 litres of milk per cow with an average fat content of 3.9% and a protein content of 3.4%. This level of performance is achievable at a stocking rate of 2.5 cows/ha, a N input of 325 kg/ha and a mean calving date in mid February-early March. The inputs per cow include 500 kg of concentrates, 3.6 t (DM) of grazed grass and 1.4 t (DM) of silage. The blueprint is applicable for dry land in the south and it will change to reflect differences in soil type and location within Ireland.

The objective over the main grazing season (May to September) is to achieve high cow performance from an almost complete grass diet. This is achieved by allocating an adequate daily supply of high quality grass. The provision of adequate silage for the winter is also important over this period. The aim of autumn grazing management (September to November) is to maximise the amount of grass utilised while at the same time finish the grazing season with the desired farm grass cover so as to set up the farm for early spring grass. The timing of autumn supplementation depends on grass growing conditions, stocking rate, calving pattern and milk yield.

It is recommended that, on dry land, all of the farm should be grazed initially, starting in early-March if grass supply and weather conditions permit. This may not be possible in all years. Early grazing is facilitated by early applications of N fertiliser and the correct timing of final autumn defoliation. However, due to the low growth rate in early spring, grass supply will not be adequate to meet the dairy cow's demand when first turned out to grass. With

compact spring-calving and stocking rates of 2.5 cows/ha, daily grass growth will not be adequate to meet the cows demand until mid to late April. Therefore, up to that date and depending on turnout date, supplementary concentrates and silage will be provided with grass. It is important that the first rotation should not finish before mid to late April. At a stocking rate of 2.5 cows per hectare, 45 to 50% of the total area can be closed for silage on the first week of April.

During the early part of the grazing season (late April to June), tight grazing (residual sward height of 6 cm) is critical. First cut silage is taken during mid to late May with a second silage crop (35% of farm closed) cut 7 to 8 weeks later (mid to late July). The two cuts will provide a total of 7 t of silage (20% DM) per cow. From mid to late August onwards, the total farm is available for grazing. During this period (July to September), grazing pressure may be relaxed to allow a post-grazing sward surface height of 7-8 cm in order to increase milk yield per cow without resulting in deterioration in sward quality afterwards.

Autumn calving systems

Research at the Agricultural Research Institute of Northern Ireland has examined systems to allow high nutrient intake to support milk production from high genetic merit Holstein-Friesian cows which are widespread in the NI dairy industry (Ferris *et al*., 2004). Systems examined incorporated the following broad approaches to increasing nutrient intakes:

- improving the feed value of the silage offered or increasing concentrate feed level during the winter.
- offering a high allowance of high quality pasture without supplementation or tighter grazing regimes combined with concentrate supplementation during the summer.

Although total milk outputs were similar with each of the four systems (7,900 litres/cow), milk protein contents were higher with systems involving high concentrate inputs during the winter. System had only minor effects on the degree of tissue loss/gain during lactation and on the fertility of the cows involved. However, the land requirement associated with each of the systems was very different ranging from 2.3 to 3.3 cows/ha. Consequently gross margin per ha increased with increasing stocking rate, while gross margin per cow and gross margin per litre of milk produced were relatively unaffected by system. Thus the profitability of different grassland production systems for autumn calving cows is to a large extent influenced by the fixed costs which arise on the individual farm,

Sheep production

The ewe population is 3.9 million in ROI and 1.1 million in NI. Corresponding average flock sizes are 113 and 126 ewes (CSO, 2004; DARD, 2004). Over the past 10 years, total ewe numbers have fallen by approximately 25% in both the ROI and NI. In the ROI, most of the decline in ewe numbers has been in hill areas, whereas in NI hill ewe numbers have remained relatively unchanged with the decline being more evident in the lowland sector.

Sheep production in 2003 amounted to around 4 million lambs in the ROI and 0.8 million lambs in NI. In the ROI, 70% of lambs were exported, mainly to France (70% of exports). In NI, 39% of lambs were exported to the ROI for processing. Of the lambs slaughtered in NI the majority were exported to GB (63%), with 22% to continental Europe (mainly France) and 15% marketed for home consumption (LMC, 2004).

Hill sheep systems are predominately based on Scottish Blackface and Cheviot ewes either bred pure or crossed with prolific breeds (e.g. Belclare, Blue-Faced Liecester) to produce crossbred female replacements for the lowland sector. Typical levels of performance in hill sheep systems are presented in Table 13. In most hill sheep systems lambs are mainly sold at weaning for finishing in the lowland sector or housed and finished off on concentrate diets.

Table 13 Output from Scottish Blackface and Cheviot ewes on hill farms across Northern Ireland (Carson *et al*., 2001)

	Scottish Blackface	Wicklow Cheviot
No. lambs born per ewe mated	1.29	1.29
No. lambs weaned per ewe mated	1.14	1.20
Lamb live weight at weaning (kg)	30.5	31.5
Age at slaughter (months)	9.7	8.5
Carcass weight (kg)	17.8	18.3

The dominant system of lowland sheep production is grass-based. The great majority of ewes lamb in spring and are managed in an integrated grazing/silage/housing system, often mix-stocked with cattle or in association with tillage enterprises.

Developments in recent years have seen the emergence of a significant core of specialist lowland sheep producers who have invested in relatively large flocks ranging from 400 to 800 ewes for economy of scale and labour efficiency. Research in sheep production has been focussed in particular on two major determinants of production efficiency, namely, the number of lambs reared per ewe joined (Hanrahan, 1997; Dawson and Carson, 2002) and the number of ewes stocked per ha of pasture. The set target for ewe productivity is 1.7 lambs reared per ewe mated (Flanagan 2003, 2004).

The significance of ewe productivity and stocking rate, was evident in the comparative performance of flocks managed in intensive and extensive systems at Knockbeg (Flanagan, 2003) (Table 14). Lamb output per ha in the intensive and extensive systems were 450 and 342 kg of carcass per ha, respectively.

Table 14 Flock performance and output at Knockbeg Sheep Unit, Carlow: Pooled results for 1999 and 2000

System		Grazing/silage/housing	Extended grazing
No. ewes per ha		14	10
Ewes lambing (%)		95	96
No. lambs reared/ewe joined		1.76	1.78
Carcass wt. (kg)		18.8	19.3
Age at slaughter (days)		160	146
Lamb output:	kg/ewe	33.3	34.1
	kg/ha	450	342

Environmental issues

In NI over 11,000 farmers participate in voluntary agri-environmental schemes, covering over a quarter of the farmland area. The schemes, which have been developed under the EU Rural Development Regulation (EC 99/1257), focus on maintaining and improving biodiversity through the positive management of wildlife habitats, improving water quality of rivers and lakes by nutrient management planning and the adoption of the Codes of Good Agricultural Practice; and the maintenance of landscape and heritage features by integration of their management into farming system.

European Union legislation including the Water Framework Directive (EC 2000/60) and the Nitrates Directive (EC 91/676) will have implications for grassland production systems in Ireland. NI has adopted a 'total territory' approach within the Nitrates Directive, and will produce a legally binding action programme during 2005. This will impose restrictions on the spreading periods for both organic and inorganic manures, define a minimum storage period for organic manure, and set maximum limits on phosphorus balances on individual farms.

The Council of Ministers of the European Union has recognised that farmers in receipt of direct agricultural support have important responsibilities towards the protection of the environment, animal health and welfare, and public health. Farmers will therefore be required to observe certain conditions in these areas in return for receipt of direct agricultural support, which post-reform of the Common Agricultural Policy (CAP), is now decoupled from production.

In the ROI, the Rural Environment Protection Scheme (REPS) was introduced in 1994 and now almost 44,000 farmers participate in the scheme. In this scheme inputs of both organic and inorganic N on grassland are limited, a nutrient management plan developed and pollution avoidance is critical. In the third version of the REPS scheme, which has been introduced in the last year, there is greater emphasis on broader environmental objectives with farmers expected to be managers of the natural heritage. The action programme with regard to the Nitrates Directive is presently being finalised with the ROI.

Appendix tables

Appendix Table 1 Irish live cattle exports from the ROI, 1992-2003 ('000 head)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	370	190	57	171	416	401	101	147	220
of which to:									
International markets	263	139	7	29	74	65	11	32	37
Continental EU	89	41	23	137	324	311	40	73	143
United Kingdom	18	10	27	5	18	27	50	42	40

Source: Bord Bia

Appendix Table 2 Destination of beef exports from the ROI, 1995-2003 ('000 tonnes cwe)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	440	425	450	510	554	495	345	460	500
of which to:									
UK	100	60	95	85	95	110	220	255	265
Continental EU	158	100	90	130	150	135	72	116	150
International markets	183	265	265	295	309	250	50	89	85

Source: Bord Bia

Acknowledgements

The authors thank Miss D. Hennessy for assistance in data assembly and Ms. M. Weldon and Miss S. Caffrey for typing the manuscript.

References

Brereton, A.J. & T. Keane (1982). The effect of water on grassland productivity in Ireland. *Irish Journal of Agricultural Research,* 21, 227-248.

Brereton, A. J. (1995). Regional and year to year variation in production. In: Jeffrey, D.W., Jones, M.B. & J.H McAdam (eds.) 1995 Irish grasslands – their biology and management: *Dublin Royal Irish Academy,* 12-22.

Bord Bia (2004). Irish Food Board. *Meat and Livestock Review and Outlook 2003/04*, 80pp.

Carson, A.F., B.W. Moss, L.E.R. Dawson & D.J. Kilpatrick (2001). Effects of genotype and dietary forage to concentrate ratio during the finishing period on carcass characteristics and meat quality of lambs from the hill sector. *Journal of Agricultural Science, Cambridge,* 137, 205-220.

Central Statistics Office (CSO) (2001) Publications.

Central Statistics Office (CSO) (2004) Publications.

College of Agriculture, Food and Ruaral Enterprise (CAFRE) (2003). *Greenmount Dairy Benchmarking Report*

Connolly, L., A. Kinsella & G. Quinlan (2004). *National Farm Survey 2003,* 16pp.

Coulter, B.S., W.E. Murphy, N. Culleton, E. Finnerty & L. Connolly (2002). A survey of fertiliser use in 2000 for grassland and arable crops. *Teagasc, End of project report,* 34pp.

Cruickshank, J.G. (1997). Soil and Environment: Northern Ireland. Published by the Agricultural and Environmental Sciences Division, DANI and the Environmental Science Department, The Queen's University of Belfast.

Dawson, L.E.R & A.F. Carson (2002). Options for genetic improvement within the NorthernIreland sheep industry. In*: 75th Annual Report of the Agricultural Research Instituteof Northern Ireland,* 58-68.

Department of Agriculture and Food (DAF) (2004). Annual Review and Outlook for Agriculture and Food.

Department of Agriculture and Rural Development for Northern Ireland (DARD) (2003). The Agricultural Census in Northern Ireland – Results for 2003. *A National Statistical Publication.*

Department of Agriculture and Rural Development for Northern Ireland (DARD) (2004). Statistical Review of Northern Ireland Agriculture 2003. *A National Statistical Publication.*

Dillon, P. & G. Stakelum (1999). Spring Milk Production. In: J. Murphy (ed.) A new agenda for dairying, 3-7.

Drennan, M.J. (1999a). Breed composition of the Irish Cattle Herd. *Teagasc, Beef Production, Series,* No. 22, 26pp.

Drennan, M.J. (1999b). Development of a competitive suckler beef production system *Teagasc, Beef Production Series* No. 18, 32pp.

Drennan, M.J. (2004). Quality suckler beef from low and high input grassland management systems. *Teagasc, Beef Production Series* No. 48*,* 15pp.

Drennan, M.J. & M.G. Keane (2001). Producing cattle in the current policy and market environment. R and H Hall *Technical Bulletin,* 12pp.

Eurostat (2002). Farm Structure 1999/2000 Survey.

Ferris, C.P., D.C. Patterson & J. Murphy (2002). Grassland-based systems of milk production for autumn calving dairy cows: a three-year comparison. In: 75th Annual Report of the Agricultural Research Institute of Northern Ireland*,* 44-57.

Flanagan, S. (2003). Extended grazing by sheep as a substitute for silage and housing. In: Proceedings of Agricultural Research Forum, Tullamore, March, p109.
Flanagan, S. (2004). Feed demand and grass supply profiles for mid-season lamb production. In: Proceedings of Agricultural Research Forum, Tullamore, March, p26.
Hanrahan, J.P. (1997). Exploiting genetic resources to enhance the competitiveness of lowland sheep systems. *Irish Grassland and Animal Production Association Journal*, 31, 106-115.
Hopkins. A. (2000). In: A. Hopkins (ed.) Grass. Its production and utilization, 1-12.
Irish Cattle Breeding Federation (ICBF) (2003). In: Andrew Cromie (ed.) Irish Cattle Breeding Statistics, 24pp.
Keane, T. (1992). Chapter 3: Temperature In: T. Keane (ed.) Irish Farming, Weather and Environment. AGMET Group Publication, 21-27.
Keane, M.G. (2001). Development of an intensive dairy calf to beef system and associated grassland management. *Teagasc*, *Beef Production Series,* No. 41*,* 34pp.
Kirkland, R.M., T.W. J. Keady, P.A. Ingram, R.W.J. Steen, J. Comerford, D.C. Patterson & C.S. Mayne (2004). In: Proceedings of the British Society of Animal Science, p38.
Livestock and Meat Commission (2004). *Livestock and Meat Commission Yearbook 2004*.
O'Kiely, P., K. McNamara, D. Forristal & J.J. Lenehan (2000). Grass silage in Ireland. *Farm and Food* 10, 33-38.
Shalloo, L., P. Dillion, J. O'Loughlin, M. Rath & M. Wallace (2004). Comparison of a pasture-based system of milk production on a high rainfall, heavy-clay soil with that on a lower rainfall, free-draining soil. *Grass and Forage Science,* 59, 157-168.