Prime lamb production for grass based systems – key issues affecting lamb performance

Drs. Tim W.J. Keady and James P. Hanrahan

Animal and Grassland Research and Innovation Centre, Teagasc, Mellows Campus, Athenry, Co. Galway, Ireland

Introduction

Ireland is the largest net exporter of lamb in Europe with exports accounting for 78% of lamb production. Prime lamb production in Ireland is grass based and seasonal, with lambing normally targeted to coincide with the start of the grass growth in spring. Sixty eight percent of lambs are slaughtered between June and December. Whilst the national breeding flock declined by half between 1992 and 2010 it has subsequently increased by 6%. Currently there are 2.6 million breeding ewes in 33,766 flocks.

At farm level, stocking rate and weaning rate are the main factors affecting productivity for sheep production. Currently the mean stocking and weaning rates on Irish sheep farms are 7.2 ewes/ha and 1.35 lambs per ewe joined to the ram. Efficiency at farm level has not improved in recent years. For the years 1993 to 1998 the mean stocking and weaning rates were 9.2 ewes/ha and 1.28 lambs per ewe joined to the ram, respectively. Consequently, on average for the industry, technology is not being adopted at farm level.

Whilst grazed grass is an expensive forage to produce, it is the cheapest feed available to the ewe flock for the majority of the year. In intensive systems of mid-season prime lamb production grazed grass accounts for 86% of total dry matter intake. Consequently, it is essential to optimise lamb performance from grazed pasture to improve margins from sheep production. This is achieved by continuously supplying high feed value pasture for the duration of the grazing season. Feed value is a combination of nutritive value (i.e., digestibility) and intake characteristics (which is a combination of herbage supply and digestibility). One of the benefits of the temperate climate that prevails in Ireland is the fact that grass grows for most of the year.

The aim of this paper is to present information on the optimum lamb performance, and carcass output, from grazed pasture and the management necessary to achieve this optimum. Furthermore, alternatives to grazed grass for finishing lambs during the grazing season are discussed including the use of concentrate feeding and alternative forages.

Output of lamb carcass per hectare

For systems of mid-season prime-lamb production litter size, and consequently lamb carcass output per ewe, but ultimately per hectare, together with grassland management, followed by silage feed value (for feeding during the winter indoor feeding period), winter shearing and rearing male progeny entire (as rams) are the main factors affecting the efficiency, and thus profitability, of prime lamb production (Keady and Hanrahan, 2006). A number of studies, each lasting for 3-4 years, that have been completed in recent years at Athenry have shown that lamb carcass output of up to 500 kg/ha is consistently achievable from grass-based mid-season prime lamb production systems (Table 1). These high outputs of lamb carcass are due to a combination of high stocking rates coupled with high prolificacy, thus high weaning rate (lambs weaned per ewe joined with the ram). Furthermore, using systems of year-round grazing, which limit stocking rate due to high grass demand in autumn to finish lambs and prepare ewes for the breeding season whilst at the same time closing off half of the paddocks to build herbage for winter grazing, lamb carcass outputs of 344 kg/ha are achievable. Using data from the National Farm Survey the national average output of lamb carcass on lowland farms is only about 194 kg/ha, which is approximately 39% of that achieved at Athenry and reflects the low stocking rate coupled with the low number of lambs reared per ewe joined to the ram.

Table 1. Achieved lamb output at Athenry and the national average output

	Conventional system	Conventional system	Conventional system	Year round grazing	National average
Years	1998-2001	2000-2004	2006-2009	2000-2004	2010-2011
Ewes/ha	16.5	14.4	14	10.5	7.2
Lambs reared/ewe joined	1.70	1.86	1.78	1.86	1.35
Lamb carcass output					
- kg/ewe	31.3	34.8	34.7	34.8	27
- kg/ha	494	501	486	365	194
	(Nolan and McNamara, 2002)	(Keady et al., 2009)	(Keady and Hanrahan, unpublished)	(Keady et al., 2009)	(National Farm Survey)

Lamb performance from grazed pasture offered as the sole diet
The achievable potential level of lamb performance both pre- and post-weaning, which is influenced by litter size, is presented in Table 2. Studies at Athenry have clearly shown that high daily live-weight gain of lambs reared as singles and twins are achievable from grazed grass offered as the sole diet. At Athenry lambs reared as triplets are offered up to a maximum of 300 g concentrate daily until weaning whilst their dams receive 0.5 kg daily for the first 5 weeks post-lambing. Male lambs are reared entire. No lambs receive concentrate supplementation post weaning and are finished on grazed grass as the sole diet. Therefore, using the data presented in Table 2, flocks that are weaning 1.3, 1.5, 1.7 and 1.9 lambs per ewe joined to the ram, and thus rearing 1.37, 1.58, 1.79 and 2.0 lambs/ewe lambed, the target flock lamb live-weight gain from birth to weaning (at 14 weeks of age) is 316, 307, 301 and 295 g/day respectively. This clearly illustrates that flock target lamb performance must take account of weaning rate. Therefore, when discussing lamb performance at pasture, flock litter size must be considered. Post weaning target lamb performance is presented in Table 2.

Table 2. Target lamb daily live-weight gain (g/day) from grazed pasture

	Birth/rearing type		
	1	2	3*
Pre-weaning	340	295	290
Weaning to slaughter	200	195	175

* Lambs reared as triplets received up to 300g concentrate per head daily up to weaning.

Factors contributing to lamb performance from pasture
Factors such as lamb birth weight, which is influenced by nutrition during pregnancy, grassland management and male lamb management, all of which are under the control of the producer, influence lamb performance from pasture.

1. <u>Lamb birth weight</u>

The birth weight of lambs influences subsequent growth rate and consequently weaning weight. Previous studies at Athenry have shown that each 0.5 kg increase in lamb birth weight increases subsequent weaning weight by 1.7 kg (Table 3). The increased weaning weight is due to a combination of the increase in birth weight per se and increased growth rate. Increased birth weight per se, and higher growth rate from birth to weaning accounts for 53% and 47% of the increased response in weaning weight, respectively (Keady and Hanrahan 2009b).

Table 3. Influence of lamb birth weight on subsequent weaning weight

Increased weaning weight (kg) per 0.5 kg increase in birth weight	Source
1.6	Keady et al (2007)
1.7	Keady & Hanrahan (2009a)
1.7	Keady & Hanrahan (2009b)

Lamb birth weight is influenced by many factors including ewe genotype, and, management and nutrition during mid and late pregnancy. Studies at Athenry have shown that shearing ewes at housing (mid December) increased lamb birth weight by 0.6 kg (Keady et al., 2007, Keady and Hanrahan, 2008, 2009a). Relative to housed unshorn ewes, ewes that were extended grazed during mid pregnancy (Keady and Hanrahan, 2009a, Keady et al., 2007), late pregnancy (Keady et al., 2007) or during both mid and late pregnancy (Keady et al., 2007, Keady and Hanrahan, 2009a) produced lambs which were 0.18, 0.37 and 0.59 kg heavier at birth. Ewes that were shorn at housing or extended grazed at pasture during mid and late pregnancy produced lambs having similar birth weights.

Ewes that are housed during mid and late pregnancy are normally offered grass silage supplemented with concentrate in late pregnancy. From a review of the literature, each 10 g/kg (1 percentage unit) increase in silage D-value increases lamb birth weight and ewe weight post lambing by 52.3 g and 1.3 kg, respectively (Keady et al. 2013). The response to concentrate feed level in late pregnancy is dependent on forage feed value. For example, increasing the quantity of concentrate offered in late pregnancy from 15 to 25 kg for grass silages with D-value of 656 and 713 g/kg increased lamb birth weight by 0.5 and 0.1 kg, respectively (Keady and Hanrahan, 2010a).

The ingredient composition of concentrate offered to pregnant ewes also affects lamb birth weight. Keady and Hanrahan (2012) formulated 2 concentrates which were iso-energetic and iso-nitrogenous but differed in protein source and consequently digestible undegradable protein concentration. Replacing rapeseed, maize distillers and maize gluten with soyabean meal as the protein source increased lamb birth weight by 0.36 kg, equivalent to increasing the feed level of the non-soya-based concentrate by 75%, i.e., 16 to 28 kg during late pregnancy (Keady and Hanrahan, 2012).

Plane of nutrition offered during mid and late pregnancy also has an effect on lamb mortality. Each 1 kg reduction in weight loss in ewes between mid pregnancy and post lambing reduces lamb mortality by 0.2 percentage units (Keady and Hanrahan, 2013). Lamb birth weight also impacts on mortality The optimum birth weight, in terms of lamb mortality, varies with litter size. For twins and triplets the optimum birth weight is 0.93 and 0.78 times that of singles (Hanrahan and Keady, 2013).

2. Grassland management

Effective grassland management involves matching grass supply and feed value with animal requirements. Grass growth varies throughout the grazing season. For example, typical daily grass dry matter growth rates for March, April, May, June, July, August, September and October are 10, 30, 70, 60, 50, 60, 40 and 30 kg/ha, respectively. Meanwhile, the demand of the ewe flock increases, reaching a peak prior to weaning and declines thereafter as the requirements of dry ewes decline and lambs are being drafted for sale.

The main objective of grassland management is to have a plentiful supply of highly digestible grass available to the animals for the duration of the grazing season. However, as the grazing season progresses grass matures and goes from vegetative to reproductive state consequently increasing the proportion of stem and reducing digestibility and intake potential. Therefore, to achieve optimum level of lamb performance from grazed grass, pasture must be managed to maximise the proportion of leaf in the sward canopy, thus maintaining herbage digestibility and intake potential. This is achieved by grazing swards to different residual heights during the grazing season. Sward height measurement is the easiest and most effective way of managing pasture. Target post-grazing sward heights, which differ for rotational and set stocked grazing systems, for ewes and their lambs are summarised in Table 4, based on many studies undertaken at Athenry. Similar levels of lamb performance are achievable from well-managed set stocked and rotational-grazing systems. The main advantage of the rotational grazing system is that it simplifies the removal of excess herbage (paddocks) from the system, due to periods of rapid grass growth (e.g., early May), for forage conservation and enables the inclusion of extra herbage (e.g., after-grass) when grass growth slows down in mid-summer. Also the rotational grazing system facilitates higher grass utilisation consequently reducing costs of production.

Table 4. Recommended sward heights for target lamb performance (cm)

	Grazing system	
Month	Rotational – post grazing	Set stocked
March	3.5 – 4	5
April	3.5 – 4	5 – 6
May	4.5 – 5	6
June	5.5 – 6	6 – 7
July	6	7 – 8
August	6	7 – 8
September	6	8

(Keady 2010)

The lamb growth rates achieved to weaning for the years 2008 to 2012 in the flock used for nutrition and grazing studies at Athenry, and grazed on predominantly old permanent pastures, are presented in Table 5. Due to some of the dietary treatments offered in these studies, lamb birth weight was below optimal for a sizable proportion of lambs. As outlined earlier each 0.5 kg reduction in lamb birth weight results in weaning weight being 1.7 kg lower. The flock consists predominantly of Belclare X Scottish Blackface dams while the sires used are Suffolk. At Athenry ewes rearing singles or twins and their lambs receive no concentrate supplementation whilst at pasture. Ewes rearing triplets are offered 0.5 kg concentrate daily for the first 5 weeks post-lambing and their lambs get access to up to 300 g concentrate daily to weaning.

Table 5. Daily live-weight gain to weaning (g/day) and weaning weight (kg; in parentheses) at Athenry from 2008 to 2012 (g/day)

	Birth/rearing type		
Year	1	2	3
2008	335 (38.8)	284 (32.9)	308 (34.3)
2009	330 (38.5)	279 (32.5)	277 (31.3)
2010	331 (37.8)	282 (32.2)	281 (31.4)
2011	311 (36.6)	264 (30.7)	291 (32.5)
2012	323 (37.3)	262 (30.3)	272 (30.2)
Mean	326 (37.8)	274 (31.7)	286 (31.9)

In 2008, grass supply was scarce due to low temperatures in mid April with post grazing sward height being as low as 2.6 cm at times. For April, May and June mean post grazing sward heights were 3.5, 4.8 and 5.5 cm and mean pre-grazing sward heights were 6.4, 8.6 and 7.9 cm, respectively. Managing the swards as described above resulted in mean daily live-weight gains from birth to weaning of 335, 284 and 308 g daily for singles, twins and triplets, respectively.

In 2009, mean post-grazing sward heights were 3.8, 3.8 and 4.0 cm and pre-grazing sward heights were 5.8, 7.0 and 6.6 cm for the months of April, May and June, respectively. Managing the swards as described above resulted in mean daily live-weight gains from birth to weaning of 330, 279 and 277 g daily for singles, twins and triplets, respectively.

For 2010 mean post-grazing sward heights were 3.0, 4.6 and 5.0 cm and mean pre-grazing sward heights were 4.4, 7.2 and 7.7 cm for April, May and June, respectively. Managing the swards as described above resulted in mean daily live-weight gains from birth to weaning of 331, 282 and 281 g daily for singles, twins and triplets, respectively.

For 2011 mean post-grazing sward heights were 2.9, 3.1 and 3.1 cm and mean pre-grazing sward heights were 4.6, 5.5 and 4.8 cm for April, May and June, respectively. Managing the swards as described above resulted in mean daily live-weight gains from birth to weaning of 311, 264 and 291 g daily for singles, twins and triplets, respectively.

For 2012 mean post-grazing sward heights were 3.9, 5.0 and 5.8 cm and mean pre-grazing sward heights were 8.2, 8.3 and 9.7 cm for April, May and June, respectively. Managing the swards as described above resulted in mean daily live-weight gains from birth to weaning of 323, 262 and 327 g daily for singles, twins and triplets, respectively.

The data presented for years 2008 to 2012, which differed in prevailing weather conditions and thus herbage availability, clearly illustrate that high levels of lamb performance, both pre- and post-weaning, are achievable from grazed grass offered as the sole diet. Furthermore, ewes can be forced to graze tight in April without adversely affecting lamb performance. The key to achieving high levels of lamb performance from pasture is the provision of adequate quantities of high-digestibility herbage. The easiest way to manage grassland for the flock is to use sward height when deciding on flock movement to new pasture, and the removal of paddocks from the grazing rotation for forage conservation.

3. Male lamb management

Many producers castrate male lambs because this has always been custom and practice, worries about behaviour and performance post-weaning, and due to the perception that it improves subsequent eating quality. The effect of castrating male lambs on subsequent lamb performance is presented in Table 6. Castrating male lambs reduced lamb weaning weight by 1.8 kg whilst increasing the age at slaughter by 16 days, consequently reducing the price received per kilogram carcass as carcass price normally declines as the season progresses in Ireland. Meanwhile, for the loss of revenue the producer has not produced a product of superior meat quality. Hanrahan (2010) concluded from an extensive review of the literature that “where male lambs are reared on an all-grass diet and slaughtered by the end of the grazing season, leaving male lambs entire has no negative effect on meat quality, whether assessment is laboratory based or through in-home consumer tasting”. One study reviewed by Hanrahan (2010), undertaken in England, had evaluations by consumers of legs of lamb from castrates and entires (Dransfield et al. 1990). The data presented in Table 7 show that the meat eating quality experience of legs of lambs from 34% of the entire males were “very much better than usual” compared to 14% for legs from castrates. Consumers ranked the meat eating quality experience of 17% of legs from castrates “worse than usual” compared to only 6% for legs from entire males.

Table 6. Effects of castration of male lambs on subsequent performance

	Sex category	
	Entire	Castrate
Weaning weight (kg)	31.7	29.9
Sale date	8 August	24 August
Carcass weight (kg)	18.1	18.2

(Hanrahan, 1999)

Table 7. Consumer evaluation of home-cooked leg roasts from male lambs slaughtered in August[§]

Category descriptions[‡]	Aroma		Eating quality	
	Entire	Castrate	Entire	Castrate
Very much better than usual	33%	14%	34%	19%
Much better than usual	20%	25%	20%	40%
Better than usual	47%	51%	40%	24%
Worse than usual	0%	0%	6%	17%

[§]Dransfield et al. (1990); joints were oven roasted in 92% of cases
[‡]Consumers were asked to evaluate the eating quality relative to their usual lamb purchase

Effect of weaning weight on drafting pattern

Increasing lamb performance pre weaning enables lambs to be drafted for slaughter at a younger age. Earlier drafting normally means a higher price, as carcass price normally declines as the grazing season progresses. Drafting data were collated for the Athenry flock from 2006 to 2012 inclusive. Lambs within the flock were usually drafted at intervals of 3 to 4 weeks and the mean drafting weight was close to 45 kg across all seasons and rearing classes. In order to provide a description of the effect of weaning weight on the actual drafting pattern, groups of lambs representing high, medium and low weaning weights were formed from the data for each year, based on the pregnancy feeding treatment of their dams; all lambs per individual treatment were included. Based on these data each 1 kg increase in weaning weight reduced age at which 50% and 75% of lambs were drafted for sale by 7.1 and 6.6 days, respectively. As an example of the actual drafting pattern the data from 2007 are shown in Figure 1; the mean age at slaughter of the heavy, medium and light groups was 146, 165 and 172 days, respectively. Another way of examining the effect of weaning weight on the drafting pattern is to compare singles, twins and triplets. This comparison is shown in Figure 2 using data on all lambs drafted for slaughter from 2006 to 2012; lambs born and reared as singles were 6.5 kg heavier at weaning than those born and reared as twins. The age by which 75% of the singles and twins were slaughtered was 168 and 214 days, respectively; equivalent to 7 days per 1 kg difference in weight at weaning. In the case of lambs born and reared as triplets, while the difference in weight at weaning was only 1 kg, it took 13 days longer to get to 75% drafted when compared with twins. This suggests that triplet-reared lambs are at a relative disadvantage post weaning under the management system used at Athenry. It is clear from these results that increasing weaning weight reduces age at drafting and improves the price received per 1 kg carcass. The feed demand of the flock is also reduced.

Figure 1. An example of the effect of average weaning weight (mean of treatment groups) on the drafting pattern (data from 2007)

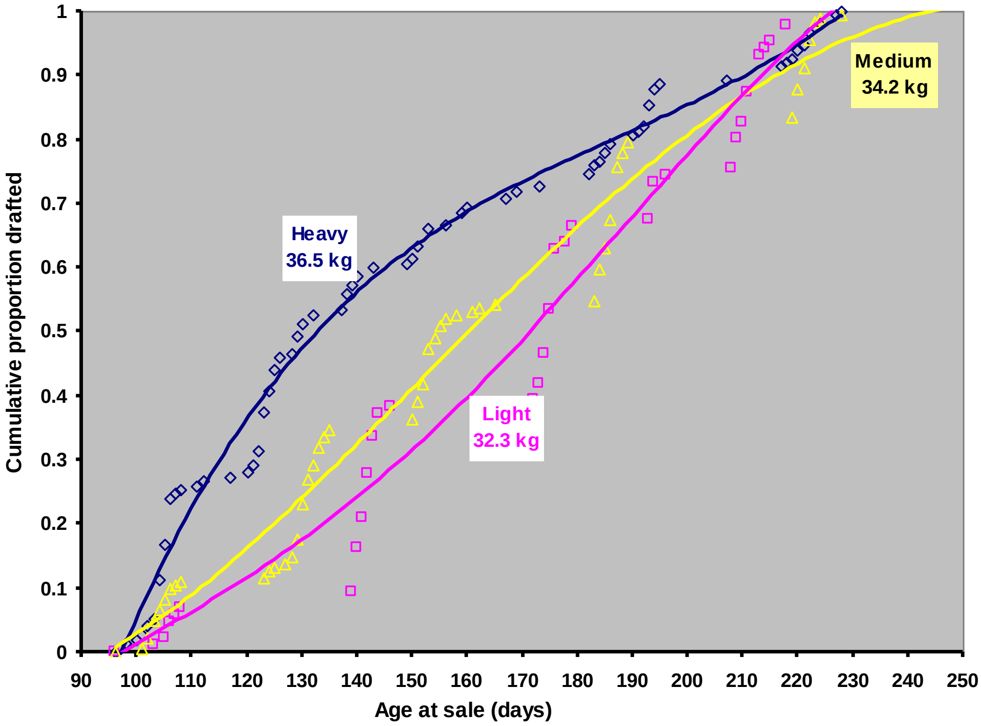
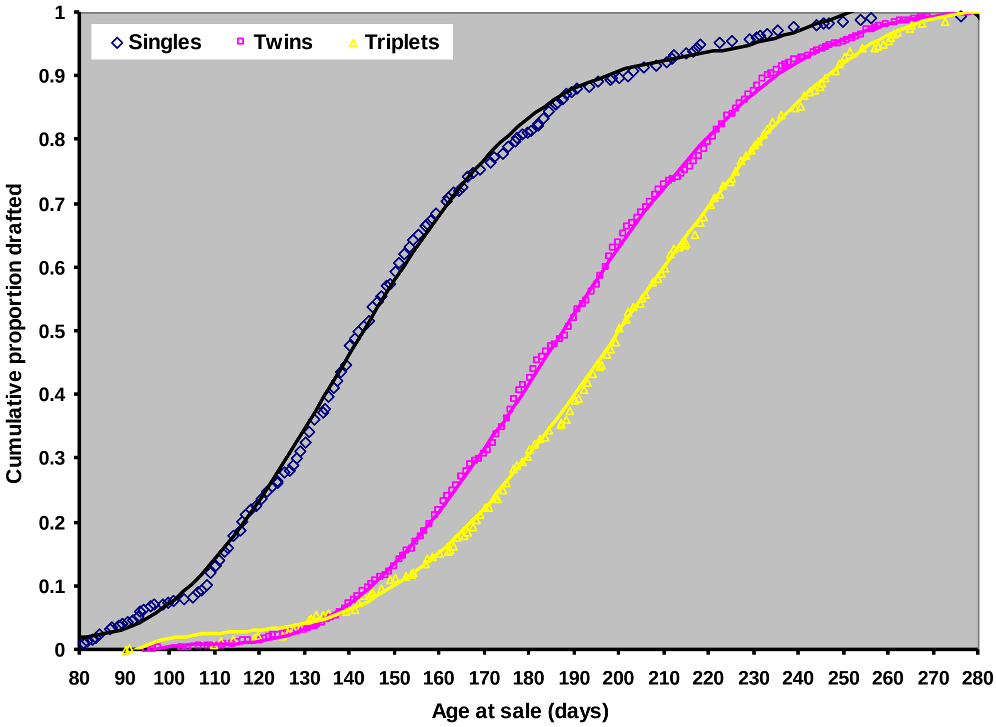


Figure 2. Effect of weaning weight, as reflected in rearing type (single, twin or triplet) on the drafting pattern (all years; adjusted for year effects)



Feeding concentrate to lambs at pasture

Many producers feed concentrate to lambs at pasture from approximately 3 weeks of age until slaughter with the intention of increasing lamb growth rate subsequently reducing age at slaughter and achieving higher price per kilogram of carcass. The lamb performance response to concentrate feeding depends on grass supply and digestibility, and on the level of concentrate offered. Previous studies at Athenry have clearly shown that higher responses to concentrate (creep) feeding occur when lambs are forced to graze pasture to a very low residual sward height up to weaning, whilst little response is obtained where there is an adequate supply of highly digestible grass. For example, pre-weaning the response to concentrate feeding has varied from 210 g to 88 g lamb live-weight gain per 1 kg concentrate when lambs grazed to a residual sward height of 4.2 cm or had access to creep grazing, respectively. Subsequently, at Athenry in two consecutive years when lambs were offered 14 kg concentrate from weeks 5 to 14, the response to concentrate feeding was 78 g and 0 g live-weight gain per 1 kg concentrate in years 1 and 2 respectively.

A four year study at Athenry involved evaluating the effect of grass supply and concentrate feed level on lamb performance. The ewes used in the study were predominantly rearing twins as the number of lambs reared per ewe ranged from 1.7 to 1.9 during the 4 years of the study. The effects of the level of concentrate offered and grass availability, as determined by residual sward height in a set-stocked grazing system, are presented in Table 8. The data clearly show that high levels of lamb performance were achieved from grass as the sole diet in a set-stocked grazing system. Increasing concentrate feed level increased lamb performance and reduced the age at slaughter, regardless of sward height.

Table 8. The effects of concentrate feed levels and grass availability on lamb performance from birth to slaughter

	Concentrate feed (g/lamb per day)					
	Low sward height (5cm)			High sward height (6 cm)		
	0	300	600	0	300	600
Weaning weight (kg)	31.4	34.3	36.9	33.7	36.7	37.5
Drafted at weaning (%)	7.3	20.7	42.8	20.4	41.2	53.7
Age at sale (days)	167	140	125	154	126	118
Concentrate intake (kg)	0	32.5	52.9	0	27.5	46.0

(Grennan & McNamara, 2005)

Lambs offered a maximum of 300 g or 600 g concentrate/day consumed 30 kg and 50 kg concentrate, respectively, from birth to slaughter. Feeding 300 g concentrate per lamb daily on the low sward resulted in the same level of lamb performance pre-weaning as lambs grazing the high sward without concentrate supplementation. Therefore, concentrate feeding replaced good grassland management. Concentrate feeding reduced the age to slaughter by 28 days. However, increasing grass height from 5 cm to 6 cm reduced the age at slaughter by 13 days, equivalent to feeding 16.3 kg concentrate per lamb from birth to slaughter. Studies (Keady and Hanrahan 2009, and Keady et al 2007) at Athenry have shown that shearing ewes at housing increased subsequent lamb birth and weaning weights by 0.6 and 2.2 kg, respectively, which is equivalent to the response to feeding 22 kg concentrate per lamb from birth to weaning.

The data from Athenry clearly show that concentrate feeding at pasture increases lamb performance, and that the effect varies with grass supply. Furthermore, age at slaughter is reduced by 28 days. However, does concentrate feeding increase financial returns in a mid-season prime lamb production system given that in Ireland most ewes lamb within a 6 week period from mid-February?

To determine the potential financial implication of feeding concentrate it is essential to include the drafting information and individual carcass weight data for all lambs for the entire flock. The drafting data from a commercial mid-season prime lamb producing flock for 2008 to 2012 are presented in Table 9. No concentrate was not offered to lambs reared as singles or twins whilst lambs reared as triplets received up to 300 g concentrate daily, until weaning. Carcass value actually received and the carcass value that would have been realised had the lambs been offered concentrate (based on selling 4 weeks earlier) are presented in Table 9 to estimate the effect of concnetrate feeding on financial returns. The mean carcass weights for the flock were 21.8, 21.1, 21.7, 22.2 and 22.0 kg respectively for 2008, 2009, 2010, 2011 and 2012. The data presented in Table 9 clearly show that feeding concentrate dramatically increased the price received per kilogram of lamb carcass for the first draft of lambs. However, when the increased price which would have been received due to earlier drafting as a result of concentrate feeding is calculated for the whole flock the increase in average carcass price was 2, 10, 22, 11 and 11 c/kg in 2008, 2009, 2010, 2011 and 2012, respectively. This clearly illustrates that whilst concentrate feeding reduced the age of slaughter by 28 days it had relatively marginal effects on the average price received per kilogram of
lamb carcass for the whole flock. Lambs offered concentrate up to a maximum of 300 g per day consume 30 kg of concentrate prior to slaughter. The cost of concentrate consumed by lambs prior to slaughter is €9, €10.50 and €12 when concentrate costs are €300, €350 and €400/t respectively. In order for the extra carcass price to cover the cost of concentrate consumed by the flock, the concentrate would need to have been purchased for €14.5/t, €70/t, €144/t, €83/t and €87/t, respectively, in 2008 to 2012. In the costing exercise no value was attributed to the grass that was not consumed due to earlier sale of lambs offered concentrate because the opportunity value of the grass on a sheep farm in the summer is relatively low. However no cost has been included for the price of the feeders or the labour required to feed the concentrate daily.

The data in Table 9 show that under the market conditions that prevailed from 2008 to 2012, the extra carcass value received due to concentrate feeding at pasture in mid-season prime lamb producing flocks did not even come close to covering the cost of concentrate offered. Therefore, to improve financial margins the majority of producers should focus on improving grassland management which is low cost, rather than trying to replace poor grassland management with concentrate which is an expensive solution and guaranteed to reduce margins.

Have alternative forages a role in finishing lambs?
Lamb growth post-weaning is mediocre on many commercial units. As already demonstrated in this paper, whilst concentrate supplementation increases lamb performance it is not financially justifiable. In recent years there has been some interest at industry level in including tyfon or chicory, as part of grass seed mixtures to enable lambs be finished off pasture. This involves re-seeding pasture in May at the time of peak grass demand (grazing plus forage conservation) to ensure that the new crop is available for grazing post-weaning from mid-June onwards. However, whilst many producers reported benefits from the use of tyfon or chicory to finish weaned lambs, there is little or no information on the size of the response obtained or on whether any perceived response was due to the new grass re-seed per se or to the inclusion of the alternative forage in the seed mixture.

Tyfon is a brassica, a cross between stubble turnip and chinese cabbage. It only survives for one season and can provide up to 4 grazings with most of the forage produced in the first rotation.

Chicory is a perennial forage crop with a deep tap root that is tolerant of drought. There is evidence that it may have anthelmintic properties, consequently reducing internal parasites in sheep. Chicory has a persistency of up to 5 years depending on sward management and prevailing weather conditions.

Table 9. The effects of concentrate feeding (300g / lamb daily) on lamb carcass value (concentrate feeding reduced drafting age by 28 days) from 2008 to 2012

	No concentrate		Price (€/kg carcass) at sale		
Year	Date	% Sold	No conc. offered	Concentrate offered (sold 4 weeks earlier)	Difference (c/kg)
2008	3 July	6	3.95	4.27	+32
	22 Aug	29	3.66	3.66	0
	12 Sept	45	3.66	3.60	-6
	21 Oct	70	3.48	3.55	+7
	11 Nov	90	3.50	3.48	-2
	4 Dec	100	3.50	3.50	0
		Average	*3.60*	*3.62*	*+2*
2009	9 July	12	3.72	4.51	+79
	17 Aug	38	3.69	3.67	-2
	10 Sept	69	3.69	3.67	-2
	12 Oct	83	3.43	3.61	+18
	27 Nov	100	3.44	3.45	+1
		Average	*3.62*	*3.72*	*+1*
2010	15 July	37	4.33	4.94	+61
	22 Aug	54	4.34	4.34	0
	13 Sept	79	4.17	4.46	+29
	27 Oct	89	4.23	4.28	+5
	22 Nov	100	4.53	4.22	-31
		Average	*4.30*	*4.52*	*+22*
2011	15 July	12	4.65	5.36	+71
	22 Aug	33	4.70	4.65	-5
	13 Sept	53	4.49	4.59	+10
	27 Sept	75	4.41	4.60	+19
	4 Oct	89	4.44	4.49	+5
	14 Nov	100	4.80	4.45	-35
		Average	*4.56*	*4.67*	*+11*
2012	17 July	8	4.78	4.89	+11
	17 Aug	21	4.82	4.78	-4
	13 Sept	36	4.62	4.82	+20
	2 Oct	58	4.48	4.72	+24
	23 Oct	68	4.50	4.47	-3
	19 Nov	76	4.40	4.50	+10
	3 Dec	84	4.30	4.34	+3
	27 Dec	92	4.25	4.33	+8
	15 Jan	100	4.31	4.29	-2
		Average	*4.59*	*4.71*	*+11*

The effects of tyfon and chicory, grazed either as pure stands or in combination with perennial ryegrass, on lamb performance post-weaning were evaluated in a grazing study at Athenry. The performance of lambs grazing old permanent pasture was the benchmark to determine the benefits from reseeding per se. Paddocks were ploughed and seeded on 29 May (delayed by 3 weeks due to prevailing weather conditions) to give the following five treatments: perennial ryegrass (PRG), chicory plus PRG, tyfon plus PRG, chicory and tyfon. A sixth treatment consisted of old permanent pasture.

The perennial ryegrass mixture was based on intermediate heading varieties (Aberdart, Aberstar, Greengold and Dunluce at 2.5, 9.9, 7.4 and 7.4 kg/ha, respectively). In addition Chieftain and Crusader varieties of clover were included in the seed mixture at 1.2 kg and 1.2 kg/ha, respectively. When chicory or tyfon was included they displaced 3.7 kg/ha of the grass seed mixture. When grown as pure stands, chicory and tyfon were seeded at 6.2 kg/ha.

The old permanent pasture had been grazed only by ewes and lambs for the previous 10 years, and had been used recently for extended grazing. Its botanical composition was: meadow grass 39%, perennial ryegrass 27%, cocksfoot 11%, clover 8%, timothy 8% and weed species 7%. Furthermore the old permanent pasture was not topped during the grazing season in question.

Weaned lambs commenced grazing the experimental treatments on 7 July and were drafted for slaughter every 3 weeks. Lamb performance is shown in Table 10. It is perceived by some producers that including alternative crops such as tyfon results in high rates of live-weight gain during the first weeks of grazing. This was not evident in this study over the first 3 weeks (Table 10). High levels of lamb performance were achieved throughout the study, the average daily live-weight gain being 217 g/day overall. Lambs grazing the old permanent pasture produced essentially the same daily live-weight gain as the lambs on the new perennial ryegrass sward or the other treatments. Relative to the new perennial ryegrass sward, including chicory in the seed mixture reduced live-weight gain by 36 g/day, consequently increasing the number of days to reach slaughter weight. However, kill-out percentage was increased by 1.2% units. Including tyfon in the seed mixture had no effect on lamb performance. Grazing pure stands of either tyfon or chicory did not affect performance relative to lambs grazing the new perennial ryegrass pasture or the old permanent pasture. Lambs that grazed the old permanent pasture, the new perennial ryegrass sward or the tyfon plus perennial ryegrass sward had similar drafting patterns.

Table 10. Effect of sward type on lamb performance

	Sward type					
	Perennial ryegrass (PRG)	Tyfon + PRG	Tyfon only	Chicory + PRG	Chicory only	Old permanent pasture
Live-weight gain (g/day)						
- weeks 1-3	308	244	184	240	167	284
- start to finish	226	220	213	190	226	219
Carcass weight (kg)	19.0	18.9	19.0	19.6	19.8	19.0
Kill out (%)	42.1	42.6	42.9	43.2	43.4	42.1

(Keady and Hanrahan 2010)

The distribution of herbage yield during the grazing season was greatly influenced by the re-seeding treatment. For example, the new perennial ryegrass sward and the swards that included either chicory or tyfon produced the same total dry matter yield during the experiment. However, the sward containing tyfon produced higher yield during the first rotation but lower herbage yield during the subsequent rotations. For example, the sward containing tyfon produced 200%, 62%, 55% and 69% of the forage produced in the perennial ryegrass sward during rotations 1, 2, 3 and 4, respectively. The corresponding values for the sward containing chicory were 129%, 101%, 83% and 90% respectively. Tyfon grown as a pure stand produced a heavy yield in the first rotation, but much lower yield in subsequent rotations. The pure stand of chicory produced consistently low yields throughout the study, producing 74%, 41%, 55% and 63% of the forage produced in the perennial ryegrass sward during rotations 1, 2, 3 and 4, respectively.

Herbage utilisation is one of the major factors affecting the real cost of forage (Keady et al 2002). In the current study, to maintain reasonable herbage utilisation, it was essential to graze the swards containing tyfon tight to reduce the quantity of leaf remaining on the ground surface. Also, it was noted that including tyfon in the seed mixture resulted in open swards, which reduced herbage production later in the season with a possible negative impact on long-term sward botanical composition.

Sward type had a major impact on stock carrying capacity, and therefore on live-weight gain per hectare (Table 11). In the reseeded pastures, relative to perennial ryegrass, including either chicory or tyfon in the seed mixture did not increase lamb live-weight gain per hectare. Whilst use of chicory as a pure stand resulted in the same lamb daily live-weight gain as perennial ryegrass (Table 11), live-weight gain per hectare was reduced by 42% due to the much lower herbage production.

Table 11. Effect of sward type on lamb output per hectare (relative to PRG)

	Sward type				
	Perennial ryegrass (PRG)	Tyfon + PRG	Tyfon only	Chicory + PRG	Chicory only
Lamb grazing days	100	94	92	99	56
Live-weight gain (kg/ha)	100	90	87	93	58

(Keady and Hanrahan 2010)

The results of this study show that there was no benefit from re-seeding, or from the inclusion of either tyfon or chicory in the seed mixture, on lamb performance post-weaning. Currently tyfon and chicory seed is 4 to 5 times more expensive than grass seed, consequently increasing re-seeding cost. Also re-seeding with the objective of producing tyfon for lambs post-weaning involves removing paddocks from the grazing cycle at the time of peak herbage demand one month prior to weaning. At this time of the year the objective should be to conserve winter forage supplies whilst at the same time maintaining lamb growth rate during the last 4 to 6 weeks prior to weaning by providing a continuous supply of high feed value grass to the flock. Finally, use of alternative forages reduces annual stock carrying capacity and alters the distribution of herbage production through the grazing season.

Whilst re-seeding showed no benefit in lamb performance, newly re-seeded pastures have been shown to increase herbage production, particularly at the beginning and end of the grazing season. On moderately stocked farms improving grassland management provides a cheaper alternative to improving lamb performance from pasture than reseeding. If re-seeding is to be undertaken, the ideal time is late July or August (when grass demand is reduced); this subsequently provides high feed value grass for finishing lambs in September and for preparing the ewe flock for the breeding season.

Adoption at farm level

Lamb growth rate varies dramatically between farms. For example on 40 commercial sheep units from 2001 to 2003 and on 6 commercial sheep units in 2009, pre-weaning growth rates of twin lambs varied by 100 g/day (Hanrahan 2004) or 35 g/day (Hanrahan and Lynch, 2010), respectively.

Consequently, weaning weight differed by 10 and 3.5 kg, respectively, which has a major knock-on effect on the age at slaughter, carcass price and cost of production. A major proportion of the reduction in pre-weaning performance is due to grassland management. So why is good grassland management not being adopted on commercial farms?

1. Lack of attention to developing and implementing a grazing plan, as indicated by poor grass supply particularly early in the season (post lambing).
2. Little or no measurement of grass availability on which to base subsequent management decisions on the allocation of fresh pasture.
3. On a large proportion of farms sheep is not the primary enterprise.
4. Inadequate farm structure due to little or no investment in farm infrastructure including sheep housing, sheep handling facilities or sheep-proof fencing, thus reducing the ability to control livestock and increasing labour requirement.
5. During times of poor lamb price, the perception by producers that improved performance gives a small return for the extra management input.
6. Many sheep producers have off-farm employment.
7. Many sheep producers farmed for subsidy pre-decoupling and consequently did not focus on technology to improve efficiency, but instead increased stocking rate.
8. Low rates of adoption may also reflect a lack of practical experience/knowledge of well-managed grassland systems among parties involved in the knowledge transfer process, and a consequent tendency to over-complicate the changes involved.

Conclusions

1. Lamb carcass outputs of up to 500 kg per hectare are consistently achievable from grass-based systems due to a combination of high stocking and weaning rates.

2. High levels of lamb performance can be obtained from grazed pasture offered as the sole diet. The target daily live-weight gain for twin lambs pre- and post-weaning is 295 g/day and 195 g/day, respectively.

3. Each 1 kg increase in weaning weight reduces age at slaughter by 6 to 7 days.

4. To achieve high levels and lamb performance from grazed pasture:
   - (a) have a grazing plan that ensures adequate grass at turn-out, i.e., start to remove stock from paddocks the previous November in rotation with post grazing sward heights of 4 cm.
   - (b) Graze pasture tight early in the season. For a rotational grazing system target post-grazing sward heights are 3.5, 4.5, 5.0 and 6cm for April, May, June and July respectively.
   - (c) Remove paddocks from the grazing system in late April / early May when there is an estimated 15 days grass supply ahead of the flock.
   - (d) Allocate the highest feed value pasture to lambs post-weaning, i.e., aftergrass or graze lambs in a leader-follower system – the lambs as leaders and the dry ewes as followers.
   - (e) When grass supply is scarce in April, grazing to a post-grazing sward height of <3 cm for 2 weeks does not require concentrate supplementation for the ewes.
   - (f) Increase lamb birth weight - each 0.5 kg increase in lamb birth weight increases weaning weight by 1.7 kg and reduces days to slaughter by 12 days.
   - (g) Leave male lambs entire. The benefit of higher growth rate from entire male lambs, relative to castrates, increases as lambs get older.

5. Concentrate feeding lambs at pasture:

(a) Increases lamb performance and reduces the age of slaughter.
(b) The response to concentrate feeding depends on grass supply and concentrate feed level. As grass supply and concentre feed level increase, response to concentrate, as determined by lamb live-weight gain per kilogram concentrate, decreases.
(c) For the majority of mid-season prime lamb producers feeding concentrate is <u>not</u> financially justifiable.
(d) Sheep producers should invest in good grassland management, rather than concentrates. This will increase financial margins and reduce labour requirements.

6. Alternative forages:
   (a) Do not increase animal performance relative to well-managed, old permanent pasture.
   (b) When growing alternative forages the emphasis/focus of the producer may change from increasing flock productivity to growing the alternative forage crop.
   (c) Tyfon increases forage production for the first grazing cycle, but reduces forage availability for the second, third and fourth rotations.
   (d) Utilisation of tyfon can be as low as 60%.
   (e) Including tyfon in the seed mixture results in open swards during the first grazing season.
   (f) Chicory produces low herbage yield, and consequently a much reduced stock carrying capacity.
   (g) On moderately stocked farms (i.e., < 9 ewes/ha) emphasis should be on managing existing swards rather than re-seeding.
   (h) On a sheep farm re-seeding should occur in early autumn when herbage demand is relatively low as the lambs are weaned /sold and winter forage has been conserved.
   (i) Re-seeding in early autumn provides high feed value herbage to finish any remaining lambs And to prepare the flock for the breeding season whilst ensuring early grass for the subsequent lambing season.

References

Dransfield, E., Nute, G.R., Hogg, B.W., and Walters, B.R. (1990). Carcass and eating quality of ram, castrated ram and ewe lambs. *Animal Production*, 50: 291-299.

Grennan, E.J. and McNamara, N (2005). Finishing lambs on summer pasture and response to creep feeding. *End of Project Reports: Sheep Series* No. 23, pp 1-21.

Hanrahan, J.P. (1999). Genetic and non-genetic factors affecting lamb growth and carcass quality. *End of Project Reports Sheep Series* No. 8, pp 1-33.

Hanrahan, J.P. (2004). A new era for lowland sheep production? Flock performance and issues from on-farm studies. *Irish Grassland Association Journal,* 38: 3-10.

Hanrahan, J.P. (2010). Lamb castration and meat quality. *TResearch,* 5: 22-23

Hanrahan, J.P. and Lynch, C. (2010). Introducing the BETTER Sheep Farm programme. *Today's Farm,* 21(1): 24-25.

Keady, T.W.J. and Hanrahan, J.P. (2006). Efficient sheep production in a subsidy free environment – research from Athenry. *Irish Grassland Association Journal,* 40: 15-27.

Keady, T.W.J. and Hanrahan, J.P. (2008). Effect of season of shearing on ewe and progeny performance. *Proceedings of the British Society of Animal Science,* p124.

Keady, T.W.J. and Hanrahan, J.P. (2009a). Effects of shearing at housing, grass silage feed value and extended grazing herbage allowance on ewe and subsequent lamb performance. *Animal,* 3: 143-151.

Keady, T.W.J. and Hanrahan, J.P. (2009b). The effects of allowance and frequency of allocation of deferred herbage and grass silage feed value, when offered to ewes in mid-gestation on ewe and lamb performance and subsequent herbage yield. *Animal,* 3: 879-890.

Keady, T.W.J. and Hanrahan, J.P. (2010). An evaluation of tyfon and chicory, as the sole forage or in combination with perennial ryegrass on the performance of finishing lambs. *Proceedings of the British Society & Animal Science,* p 151.

Keady, T.W.J. and Hanrahan, J.P. (2010). An evaluation of the effect of grass silage and concentrate feed level on ewe and subsequent progeny performance and on potential concentrate sparing effect. *Proceedings of the British Society of Animal Science,* p38.

Keady, T.W.J. and Hanrahan, J.P. (2012). Effect of concentrate feed level and protein source on the performance of ewes in late pregnancy and the performance of their progeny. *Proceedings of the British Society of Animal Science,* p77.

Keady, T.W.J., Hanrahan, J.P. and Flanagan, S. (2009). An evaluation of two grassland-based systems of mid-season prime lamb production using prolific ewes of two genotypes. *Irish Journal of Agricultural and Food Research,* 48: 87-102.

Keady, T.W.J., Hanrahan, J.P. and Flanagan, S. (2007). Effects of extended grazing during mid, late or throughout pregnancy and winter shearing of housed ewes, on ewe and lamb performance. *Irish Journal of Agriculture and Food Research*, 46: 169-180.

Keady, T.W.J., Hanrahan, J.P., Marley, C.L. and Scollen, N.D. (2013). Production and utilization of ensiled forages by beef cattle, dairy cows, pregnant ewes and finishing lambs – A review. *Agriculutral and Food Science*, 22: 70-92.

Keady, T.W.J., Kilpatrick, C.M., Cushnahan, A. and Murphy, J.A. (2002). The cost of producing and feeding forages. *Proceedings of the XIII International Silage Conference, Auchincruive, Scotland,* pp 322 – 333.

Nolan, T. and McNamara, N. (2002). High output mid-season lamb meat systems. *End of Project Reports: Sheep Series* No20.