



Hybu Cig Cymru
Meat Promotion Wales

Lamb finishing systems

Options for sheep farms in Wales



Content

Foreword	1
Lamb finishing options in Wales	2
The importance of good selection	4
When should lambs be sold as stores?	7
Economics of lamb finishing	9
Understanding feed requirements of growing lambs	11
Outdoor finishing systems	12
Grass finishing post weaning	13
Grass and supplementation	15
Alternative forages - clover and chicory leys	18
Forage crops	21
Indoor finishing systems	24
Silage based rations	27
Ad-lib concentrates	29
By-products	33
Animal health	35
Meat eating quality	37
Key points to consider	37

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Foreword

Cost-effective and efficient lamb finishing systems are essential to optimise output and maximise returns. This booklet provides a practical guide highlighting the key elements of lamb finishing systems suitable for sheep farms in Wales.

In addition to the financial aspects, this booklet also provides information on the physical and environmental requirements of each finishing system and highlights the potential advantages and disadvantages.

Finally the booklet explores the importance of health planning and a stringent vaccination and parasite control programme to ensure losses are kept to a minimum. The importance of trace element supplementation is also highlighted on particular systems where deficiencies are common.

“ It is essential
to maximise
**output and
profitability** ”

Lamb finishing options in Wales

The varied topography of Wales and the large number of sheep breeds and crosses results in a wide range of systems. The following are the most common and most practical options for finishing lambs:

a. Outdoor systems

- Grass only finishing
- Grass plus supplements
- Use of clover and chicory (in mixed swards or pure stands)
- Forage crops (e.g. forage rape, kale, stubble turnips, swedes and fodder beet)

b. Indoor systems

- Silage based (supplemented with compound or home-mixed rations)
- Ad-lib concentrate diets
- Use of moist by-products (e.g. brewers grains)

Careful forecasting and budgeting are vital for all systems. The choice of system will depend on the type of lambs, their weight and the cost and availability of feed supplies. Whether this is for home-produced or purchased lambs the margins can be extremely tight.

Grouping lambs by expected finishing period is crucial to reduce feed costs and avoid producing over-fat lambs at slaughter. Lambs presented outside the desired specification are liable to penalties reducing sale value and profit margin.

Improving the carbon footprint of lamb production through improved efficiency

The challenge that faces sheep producers in Wales is to improve the efficiency of production, which will in turn reduce methane emissions.

Factors that affect carbon footprint on sheep farms include rearing percentage, land type, stocking rate, reliance on purchased feeds and genetics of the flock. A study at Bangor University in 2010 found that efficient rearing and finishing systems had a lower carbon footprint due to improved rearing percentage and higher lamb growth rates achieved through improved finishing diets.

For more detail please see HCC Booklet *'Reducing methane emissions through improved lamb production'*.



“ The challenge that faces sheep producers in Wales is to improve the efficiency of production ”

The importance of good selection

Lambs may be marketed as young as 10 weeks of age from early lambing flocks or taken through to 12 months of age on long keep store finishing systems. The best returns are achieved by producers that match the type and weight of lambs to their system, make good use of home-grown forage and market lambs to maximise returns. Grass, in particular, can often be under-utilised so effective grazing management can improve overall flock performance and reduce the need for expensive purchased feeds.

Lifetime performance of lambs

Lamb prices fluctuate according to seasonal supply and demand, typically peaking in April/May and falling rapidly from June onwards. Prices are at their lowest in late summer and autumn before rising from the end of the year. Planning ahead to target higher sale prices can improve returns but needs to take into account the availability of feed, labour and other resources.

Once the target sale period has been identified, decisions around the best time to lamb can be made. Every day that a lamb is on the farm costs money and in long keep systems, good profitability will only be achieved if the overall system is low-cost. Systems that rely on high concentrate use for ewes and lambs are unlikely to leave a good margin in these situations.



Understanding the lifetime performance needed to reach a target weight by a particular age can help with planning an appropriate lamb finishing system and provides a useful benchmark against which to monitor performance. The table below highlights the overall average daily liveweight gain required to reach a range of finished weights from 3 - 12 months of age. For example, for lambs to reach 42 kg live weight at 5 months of age they will need to grow at an average of 250 g/day throughout their life.

Overall average daily liveweight gain required to reach a range of finished weights

		Age at finish (months)									
		3	4	5	6	7	8	9	10	11	12
		g/day									
Live weight at finish (kg)	30	285	214	171	142	122	107	95	85	78	71
	32	307	230	184	153	132	115	102	92	84	77
	34	329	247	197	164	141	123	110	99	90	82
	36	351	263	211	175	150	132	117	105	96	88
	38	373	279	224	186	160	140	124	112	102	93
	40	395	296	237	197	169	148	132	118	108	99
	42	416	312	250	208	178	156	139	125	114	104
	44	438	329	263	219	188	164	146	132	120	110

The table above assumes an average birth weight of 4 kg

Overall average growth rates for lambs finishing at 9-12 months or more can be below 100 g/day but the aim should be for pre-weaning growth rates to be significantly higher than this. Optimising pre-weaning growth rates will exploit the superior feed conversion of younger animals and reduce the need for expensive supplements later in the year. In the post-weaning period lambs can then be grown slowly on a low-cost ration before entering the final finishing phase. Regular weighing of lambs throughout the season makes it possible to adjust feeding levels where necessary.

Rotational grazing systems

Grass can provide a cheap and potentially high quality feed for lambs but is often under-utilised on farm. Utilisation varies according to the grazing system but can be as low as 50% in set stocking systems and as high as 80% in intensive paddock grazing systems where sward heights are well controlled. In set stocked or continuous grazing systems livestock have access to a large area for most of the grazing season whilst in rotational grazing systems animals are moved around a number of fields based on target sward heights/grass covers or after a set number of days.

Interest in rotational grazing has increased in recent years as a means of increasing both the quantity and quality of grass available to livestock. Monitoring the sward height (with a sward stick/ruler) or grass covers (with a rising plate meter) provides an estimate of available grazing and can help keep the grass at the optimum height. Target sward heights for lambs, under both continuous and rotational grazing are shown in the table below. Where sward heights exceed the target, areas can be shut up for silage production.

Rotational grazing can be introduced to ewes and lambs once lambs are old enough to be moved easily (typically from 4-5 weeks of age). Set-stocked systems are more suitable prior to this for very young lambs. Pre-weaning, individual lamb growth rates can be optimised by allowing ewes with twin lambs to graze ahead of those rearing singles. Checking growth rates of lambs post-weaning will help inform whether sward heights need to be adjusted.

Sward surface height guidelines

		Rotational grazing		Continuous grazing
		Pre-grazing (cm)	Post-grazing (cm)	(cm)
Ewes and lambs	Turn out - May	8-10	4-5	4
	May-weaning	8-10	4-6	4-6
Weaned lambs	Weaning to September	10-12	5-7	6-8
Store lambs	Weaning to start of finishing period	5	4	4

Source HCC – ‘Grassland management’

For more information please see HCC booklet ‘Grassland Management’

Whichever system is chosen the importance of good selection for slaughter cannot be overlooked. The number of lambs meeting market specification at Welsh abattoirs has been improving over recent years, achieving 58% in 2016 but a significant number of lambs are still being presented over fat.

Should lambs be sold as stores or taken through to finish?

Where finishing lambs compete for farm resources (land, housing or labour) with breeding stock the performance of the whole sheep enterprise (or other farm enterprises) can be compromised. Therefore in some situations it may be financially beneficial to sell lambs as stores rather than produce finished lambs.

Careful consideration should be given as to whether to finish lambs on farm or sell as stores. Overwintering lambs on pasture can have a negative effect on spring grass availability and safe grazing. Other considerations include the rearing of entire males and whether or not they can be managed separately to females.

How to decide?

- Know your market and what type of lambs are required
- Handle and weigh lambs regularly to check performance against targets and to ensure they don't get over fat
- If selling deadweight check the grading sheets to see how well your lambs have met the required specification
- Handle lambs carefully to prevent bruising
- Present lambs in a clean and dry condition

More detail on lamb marketing and selecting lambs for slaughter can be found in HCC publication – ‘Lamb Producers’ Handbook From Gate to Plate.’

The quality of breeding stock has a big influence on lamb performance. Purchasing terminal sires with known Estimated Breeding Values (EBVs) can improve growth rates and carcase characteristics of lambs, such as lower fat and higher lean at heavier weights while still meeting market specification.

It would be best to sell lambs as stores when:

- Land is required for other enterprises or for breeding stock
- Grazing and fodder resources are low and needed for ewes and rams
- Alternative feeds cannot be sourced economically
- There is insufficient building space to store feed and feed lambs
- There is insufficient labour

Producers may also question whether finishing lambs on farm will leave a bigger margin than selling as stores. Understanding the likely cost of finishing lambs can inform this decision.

Maximizing returns from selling lambs as stores

- Ensure that lambs are healthy and well grown, paying attention to parasite control, lameness, vaccination programmes and trace element status
- Sort lambs into evenly matched batches by weight, breed, sex, level of finish
- Keep a close eye on store lamb prices and the market outlook for finished lambs to help inform decisions on when to sell
- Consider building up links with lamb finishers and selling direct from the farm.

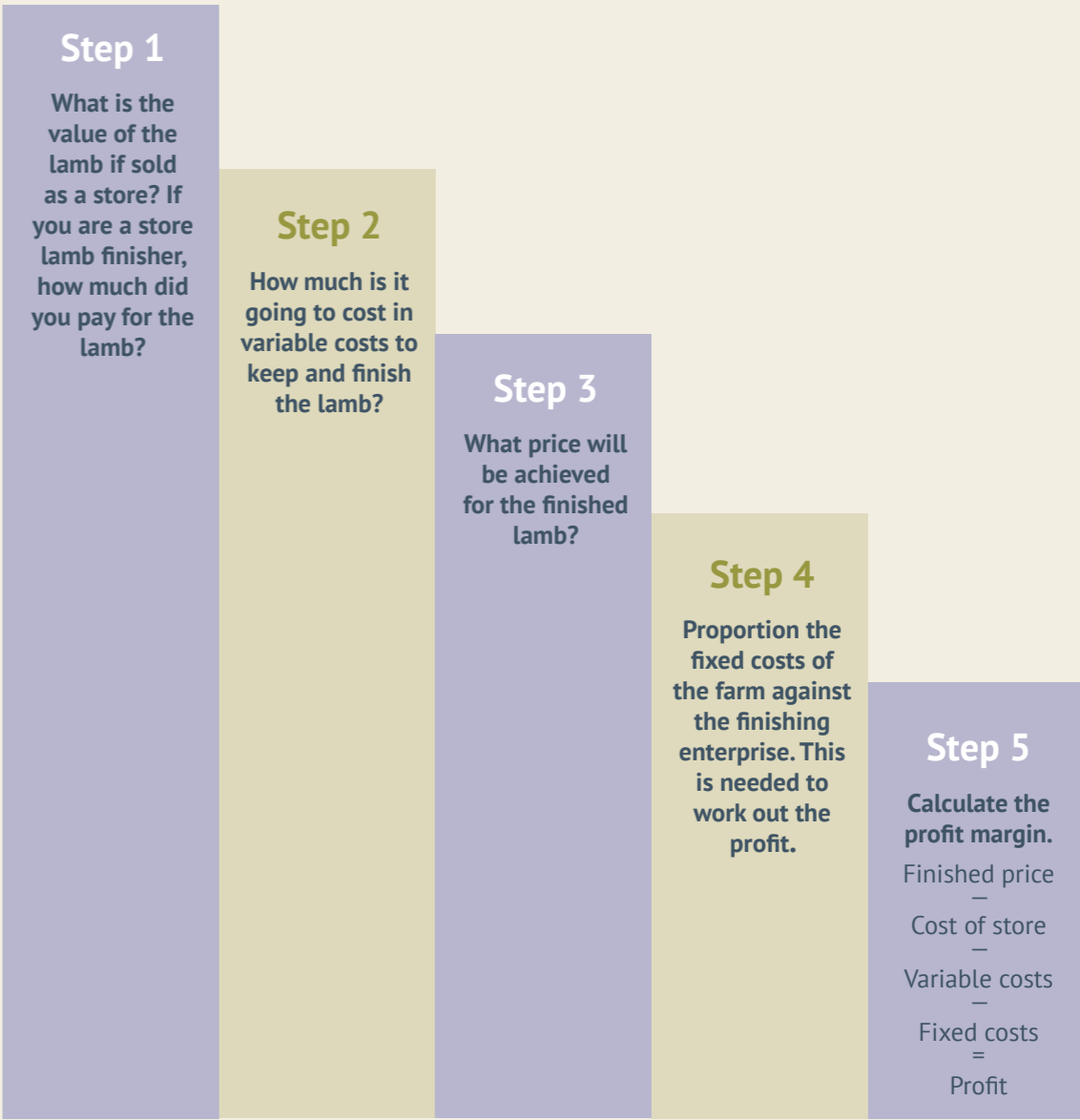


Economics of lamb finishing

Budgets for each system need to be done based on forecast lamb prices (having examined previous prices) and actual costs for feed, labour and other inputs. Prices and costs vary but these calculations are important to assess the potential viability of a system.

Calculating the cost of finishing lambs

The profit margins on finishing lambs can be tight. The calculations will vary from farm to farm, follow these five steps to calculate the cost of finishing lambs on your farm.



How do your costs compare?

(The example shown is based on a farm with 300 home produced short keep lambs on ad-lib concentrates)

	Example (£/lamb)	Your Farm (£/lamb)
Value of store lamb @ 35 kg	60.00	
Variable Costs:		
Feed	7.00	
Forage	Included in bedding	
Bedding	0.33	
Vet & Med	0.20	
Marketing	3.00	
Total		
Income from finished lamb @ 40 kg*	74.50	
Gross margin		
Fixed costs attribution	0.50	
Profit	3.50	

*Allows for a loss of 2 lambs in 300

Lamb selection is also critical to maximise output per lamb. Avoid penalties for over fatness, dirty fleeces, damage or disease. An over-fat carcase may not be suitable for its intended purpose (i.e. may be too fat for export or the supermarket) and a price penalty (p/kg) will be applied. A second issue, which is often the hardest to quantify, is the cost of keeping that animal to lay down the excess fat. It is expensive in energy (and therefore cost) terms with fat requiring around four-six times more energy to produce than the same weight of lean meat.

Keeping data on the performance of individual animals is possible with the aid of EID technology. Analysing data relating to lamb growth rate and days to finish for lambs from individual ewes could identify and improve selection of the most prolific and productive ewes.

Understanding feed requirements of growing lambs

Understanding the energy and protein requirements of growing and finishing lambs will help decide which lamb finishing system to use and whether additional concentrate feeds will be required.

Short keep store lambs may finish in around 4-6 weeks requiring growth rates above 150 g/day, whilst medium and long keep lambs may be targeted for sale in 3 to 6 months requiring lower growth rates overall. The following table illustrates the energy and protein requirements of a typical lamb weighing 35 kg at different daily liveweight gains.

Energy and protein requirements of growing lamb

Daily liveweight gain (g/day)	Dry matter Intake (kg/day)	Metabolisable energy (ME) (MJ/day)	Metabolisable protein (MP) (g/day)
50	0.7	7	60
100	0.8	9	74
150	1.0	11	88
200	1.2	13	102

Derived from AFRC (1995), Energy and protein requirements of livestock



Outdoor finishing systems

Maximising the returns from grazed grass and other forage crops will reduce the reliance on purchased concentrates. Grazed grass is the predominant feed for sheep systems and when managed correctly is generally the most cost-effective way of finishing lambs at 4-6 months of age. However a number of other forage crops can also be used to improve lamb growth rate and extend the grazing season.

Some systems of lamb finishing, particularly forage crops in poor grazing conditions, can lead to significant damage to soil structure. Careful siting of forage crops is vital to minimise the risk of poaching and runoff into water courses. Whichever crop is grown the aim must be to optimise yield and quality and maximise utilisation of the crop.

Managing lambs at weaning

Young lambs are dependent on the ewe's milk but by around 12 weeks of age grass should be able to meet almost all their requirements. Therefore plan to wean lambs at 12-16 weeks of age, unless they are very close to finished condition and sort them by weight into small, medium and large groups. Managing the weaning process carefully will minimise growth check in the lambs and will allow plenty of time to prepare breeding stock for the following year.

To reduce stress, weaned lambs should remain on the pasture that they are used to (so they can easily find water, shelter etc) and move ewes out of sound and sight of the lambs. Allow a few days before turning weaned lambs onto pasture with a known low worm egg burden and sufficient grass (sward height of 6 cm) in order to maximise live-weight gain.



Grass finishing post weaning

Grazed grass is one of the most important and potentially cheapest feeds available for finishing lambs during the summer and autumn months. Monitoring soil nutrient status, efficient use of fertilisers and manures and effective weed control all contribute to maximising the potential of grassland. Poor grass utilisation can however result in more than half of the grass grown being wasted.

Well managed grassland that is utilised effectively can:

- Increase stocking density of livestock grazing a set area.
- Finish lambs more quickly - lowland farms should aim to finish a minimum 80% of lambs off grass.
- Reduce the need for supplementary feed later in the season.

Lamb growth rates are affected by the overall nutritional quality of the grass. Lambs will have the highest growth rates (150-200 g/day) on short leafy swards with high intake characteristics whilst performance on mature, stemmy swards can be as low as 50-60 g/day. The following table summarises typical growth rates that can be expected on a range of forage diets.

Forage Type	Typical Daily Live Weight Gain (g/day)
Poor quality grassland	<100
Medium quality permanent pasture	100
High quality grazed grass	>200
Silage aftermath	100-150
Autumn grass	70-150
Root crops for comparison	150-250

High sugar grass varieties have been shown to significantly improve protein utilisation in grass through better rumen efficiency resulting in reduced nitrogen losses. In grazing trials on both lowland and upland farms high sugar grasses have increased stock carrying capacity (by up to 20%) and improved forage intakes and live-weight gain (up by 20%) in lambs compared to those on standard ryegrass leys. This improved performance is also beneficial for the environment with reduced greenhouse gas emissions and lower nitrogen excretion.

Managing grass height throughout the year is one of the most difficult tasks in sheep farming. Keeping swards short and leafy is the key to high digestibility grass and high lamb growth rates. Conserving grass as silage or hay can assist in managing grass height with fields being closed up when grass growing too fast is getting away from for ewes and lambs (over 8 cm and rising) and stocking rate can be increased on other areas.

Target sward heights on set stocked grassland are 4-6 cm early in the season (with high nutritional quality) but after weaning, lambs will perform better if sward heights are 6-8cm. Sward heights above 8cm are too long and will result in a build up of dead material in the sward. Where grass is grazed rotationally early season targets are 8-10 cm pre-grazing and 4-6 cm post-grazing, this then rises to 10-12 cm pre-grazing and 5-7 cm post grazing later in the season.

Post weaning the aim should be to match lamb stocking rates to the rate of grass growth. In a lowland system well managed grass may support 25-30 lambs/ha in July/August falling to 8-12 lambs/ha in October/November. In a good growing season stocking rates need to be increased and in a slow growing season stocking numbers need to be reduced or supplements introduced.

Health challenges at grass

- Fluke and worms at certain times of the year, particularly on permanent pasture;
- Trace element deficiencies can limit lamb performance in some areas.

Advantages of finishing on grass

- Cheap system provided grass quality and lamb performance is satisfactory;
- Finishing lambs as part of a rotational / mixed livestock system.

Disadvantages of finishing on grass

- Performance on poorer quality swards can be disappointing;
- Grass growth vulnerable to weather conditions.

Grass and supplementation

Although well managed grassland can meet the needs of finishing lambs for a proportion of the year, supplementary feed may be necessary in certain circumstances. Creep feeding of lambs early in the season or supplementation at the end of the year can be financially beneficial provided the increased costs are recovered through improved output.

Situations where supplementary feeding of lambs is useful

- Producing finished lambs early in the season before the price falls;
- To maintain growth rates in intensively stocked systems where grass becomes limiting in mid-season;
- To supplement grass during a forage shortage;
- To provide fat cover for large lean lambs that are difficult to finish in the weeks prior to marketing;
- Intensive finishing at grass later in the season in the absence of aftermath grazing.

Key points to consider for creep feeders

- Site creep feeders carefully so that they are sheltered from the weather and are on a dry standing;
- Provide enough feeders so that access for lambs is not limited;
- Ensure that clean fresh feed is available at all times through regular topping up, and clean feeders regularly;
- Ensure feeders are moved regularly to reduce build up of muck and soil which can lead to increased risk of coccidiosis and feet problems.

A fresh supply of clean water must be available at all times.

Choice of creep feed

Creep can be purchased as a compound feed or a home mix. It should be palatable and high in metabolisable energy (12.5 MJ/kgDM or above). It should contain an appropriate lamb mineral mix to prevent urinary calculi. For this reason compound feeds containing minerals suitable for breeding ewes are not suitable for lambs.

It is often best to use a pelleted compound feed in the early stages of creep feeding very young lambs and making a gradual transition to a home mix from 6 weeks of age onwards. Young lambs cannot digest whole grains effectively and will only do so once they are ruminating fully. Examples of suitable home mixes for creep feed are shown below:

Ingredients	Kg/tonne	Kg/tonne	Kg/tonne
	Example 1	Example 2	Example 3
Whole or rolled barley	675	675	850
Oats	-	100	-
Sugar beet feed shreds	100	-	-
Soyabean meal	200	-	150
Rapeseed meal	-	200	-
Lamb mineral/vitamin supplement	25	25	25
Metabolisable energy (MJ/kgDM)	12.8	12.8	12.5
Protein (% as fed)	17.4	15.0	15.6

Performance of lambs on creep-feed

The additional liveweight gain of creep-fed over grass fed lambs will vary according to the quantity and quality of grass available. Where high quality grass of more than 5 cm is available there is little improvement in performance and additional costs will not be recovered.

The highest response is seen with high stocking rates and where sward heights are below 4 cm. An additional 1 kg of liveweight gain can be achieved for every 5-6 kg of creep consumed. Creep intakes can exceed 1kg per head per day when creep is offered ad-lib.

Autumn finishing of lambs

Towards the end of the growing season any lambs that have not reached finished condition can be designated for short, medium or long keep finishing.

Short keep lambs (5-7 kg away from finished weight) can be finished successfully on good quality autumn grass plus whole cereals fed at up to 0.5 kg per head per day. Growth rates of 150-200 g/day can be achieved and lambs will typically finish over a 4-6 week period. Stocking rates can range from 20-30 lambs per hectare depending on grass quality and size of lamb (pure hill breeds vs terminal sire crosses).



Health challenges for grass and supplementary feeding

- Coccidiosis oocyst numbers can build up if poaching around feeders becomes a problem;
- A suitable lamb mineral must be fed to prevent urinary calculi;
- Feeders need to be moved regularly or lime used to reduce the incidence of lameness;
- Avoid excess intake at any one time, making sure that trough space is adequate for the number of lambs to feed at once. Excess starchy feeds can cause acidosis.

Advantages of grass and supplementary feeding

- Creep fed lambs can target the early market;
- Simple system to operate;
- Helps maintain high stocking rates.

Disadvantages of grass and supplementary feeding

- High costs of labour and feed may not be recovered if lambs are marketed at incorrect time;
- Diseases such as coccidiosis can build up and in severe cases creep feed may need to be medicated with a coccidiostat or lambs treated orally.

Alternative forages - clover and chicory leys

The inclusion of alternative forages in grazing swards either as mixes with grasses or as pure stands can improve forage quality and animal performance. Red clover, white clover and chicory can all be successfully used for finishing lambs.

White clover



White clover is a perennial legume that is normally grown in a grass clover mixture. The optimum amount of clover on an overall dry matter basis is judged to be around 30 % although the actual contribution from clover will vary throughout the year. When well managed, grass/clover swards should persist for at least 8-10 years. Small leaved white clovers are best suited to continuous sheep grazing systems.

Health challenges of white clover

- Risk of bloat if clover dominates in the sward. Risk can be reduced by introducing animals gradually and supplying some long dry forage.

Advantages of white clover

- Nitrogen (N) fixation - can fix up to 150 kg N/ha per year in a ryegrass/white clover sward reducing the need for purchased fertiliser;
- Mixed swards can yield 10-11 tDM/ha per year with crude protein (CP) content typically 18-20% although CP can be as high as 23-25% where clover dominates;
- Growth pattern of white clover complements that of grass. Clover starts to grow later in the spring but will boost production in mid-season when grass production can fall;
- Grass/white clover swards have higher mineral and trace element levels than ryegrass swards;
- Intakes may be 20-30% higher on grass/clover swards compared to ryegrass swards;
- Grass and white clover swards can increase lamb weight gain from weaning to slaughter by over 50 g/head/day over those achieved on grass only swards.

Disadvantages of white clover

- High N applications in mid or late-season can reduce clover content of mixed swards, although modern varieties can be more tolerant of nitrogen.

Red clover



Red clover is a perennial legume, typically persisting for up to three years. Some modern varieties may last longer. It is grown primarily to produce high yields of protein rich silage with minimal fertiliser costs, but aftermaths can provide high quality grazing for finishing lambs later in the year. Red clover can be grown in mixed swards with grass or as a pure stand.

Health challenges of red clover

- Risk of bloat – risk minimised by not turning stock out when hungry, introducing clover rich swards gradually and providing some long stemmed/dry forage.

Advantages of red clover

- Nitrogen fixation – fixes up to 250 kg N/ha per year;
- High yielding – 9-15 tDM/ha per year can be achieved from ryegrass and red clover swards;
- High quality silage produced – ME 10-11.4 MJ/kgDM, crude protein 14-19 %;
- Superior growth rates achieved compared to ryegrass and lambs finish earlier. Growth rates of over 200 g/day are achievable in late summer;
- Additional benefits suggest improved trace element availability and reduced worm burdens.

Disadvantages of red clover

- Should not use red clover for breeding ewes over mating as the oestrogens in the clover can affect fertility;
- Red clover is vulnerable to overgrazing which will reduce persistency.

Chicory swards



Forage chicory is a broad-leaved perennial that can be grown as a pure stand or with grasses and clovers in mixed swards. The plant has a deep tap root enabling it to withstand drought conditions and also has higher mineral content than many grass species. With careful management swards containing chicory can persist for up to five years.

Health benefits of chicory

- Has the potential to reduce the impact of internal parasites;
- Chicory is higher in minerals and trace elements than grass.

Advantages of chicory

- Lamb growth rates reported to be similar to legumes and can be as high as 250-300 g/day;
- Good yields and feed quality – UK yields are commonly in the range of 6-9 tDM/ha for pure chicory swards with ME of 10.4-12.0 MJ/kgDM and crude protein typically 16-20% but can be up to 25%;
- Mixed grass, clover and chicory swards typically yield around 10 tDM/ha with a ME 11-12 KJ/kgDM and crude protein 18-20%;
- Complementary crop that can offset shortfall in other species due to its high summer growth rate, drought tolerance and relatively high protein content.

Disadvantages of chicory

- Chicory requires careful grazing management – rotational or strip grazing with a back fence optimises utilisation. Undergrazing will encourage bolting, and potentially reduce nutritional value and crop utilisation;
- Care must be taken not to damage the crown of the plant through overgrazing particularly in late autumn/winter or in wet conditions. Sheep sometimes take a while to get used to grazing chicory and often favour the grass in the mix over the chicory at first;
- The high digestibility and low dry matter of chicory may cause loose dung so lambs may need crutching before slaughter;
- Chicory does not fix nitrogen so will require fertiliser applications for optimum production. Rates required will be lower if grown in mixes with clovers.

Forage crops

Forage crops are a cost-effective choice for finishing lambs on many farms, fitting into both arable and grassland rotations. They can be used to extend the grazing season or fill forage gaps in the summer period.

When selecting a site for grazing root crops or forage brassicas it is always important to:

- Choose a suitable site in terms of soil type and drainage to reduce the risk of poaching and run-off into water courses;
- Check the nutrient status of the soil and apply fertiliser and lime according to soil results (see Defra Fertiliser Manual RB209);
- Control weeds before sowing;
- Provide a run back and dry lying area – essential for helping to keep stock clean.

Lambs can be finished successfully on a variety of forage crops. The table below indicates suitable sowing and feeding dates for some of the most popular options.

Crop	Sowing date	Feed during
Forage rape	April - August	July - January
Stubble turnips after grass	May - June	August - September
Stubble turnips after winter barley	July - August	November - February
Kale	April - July	October - March
Kale/rape hybrids	March - August	May - December
Swedes	March-- May	October - March
Fodder beet	March - May	October - December*

**or can be lifted to extend feeding period*

Forage crops are often the system of choice to finish medium keep (6-12kg from finish) and long keep store lambs (12-18 kg from finish). The most suitable brassicas for grazing in the winter are kale, swedes and some of the rape/kale hybrids. Stubble turnips and forage rape are less frost hardy and are best for extending the grazing season to the end of the year although in the right conditions stubble turnips can be grazed through January, February and March.

Brassicas should always be fed with ad-lib dry, long forage to improve crop utilisation and strip grazing is the best way of managing the crop to minimise wastage. Animals should be introduced to the crop gradually to avoid digestive problems, building up to full access over a week or more and should always have access to water. Animals should always be provided with minerals and trace elements when grazing brassicas, since they can be deficient in copper, iodine and selenium.

Most forage crops provide a cost effective alternative to conserved forage and concentrates and have high energy and/or protein content. There may be benefits to supplementing leafy crops with an energy source and root crops with a protein source. The nutritional value of each crop is shown in the table below:

	Dry Matter (%)	ME (MJ/kgDM)	Crude protein (%)	Average DM yield (t/ha)	Utilised yield (t/ha)
Swedes	10-12	12-13	10-11	8	6-7
Kale	13-17	10-11	14-17	6-10	4.8-8
Fodder beet	12-19	12-12.5	7-10	15	12.0
Stubble turnips	10-15	10-11	17-18	5-6	4-5
Rape/kale hybrids	12-15	10-11	18-19	6*	4.8
Forage rape	10-13	10-11	19-20	4	3.2

*Includes re-growth if early sown.
Yield and quality information derived from HCC booklet 'Easier management systems for sheep'.*

Assessing crop yield

To estimate crop yield and plan grazing days:

1. Take several (5 or 6) 1 metre square areas of the crop (cut at 10 cm from the ground for rape and kale);
2. Weigh the plants, and calculate the average weight of the metre squares;
3. Multiply the average weight by 10,000 to get fresh yield in kg per hectare – to convert to tonnes per hectare divide this figure by 1,000;
4. To arrive at a dry matter yield simply multiply fresh yield by the dry matter % in the table above divided by 100.

Example for estimating crop yield – stubble turnips with dry matter of 12% used.

Area	Weight of plants (kg)			
1	4.1			
2	4.8			
3	4.5			
4	3.9			
5	4.4			
6	3.8			
Average weight of each area (kg)	4.25	x 10,000	= 42,500kg/ha (42.5 t/ha)	Fresh yield per hectare
		x 12/100	= 5.1 t/ha	Dry matter yield

Yields will vary according to germination, rainfall and soil fertility, but calculating crop yield will help to work out feed availability and plan winter rations.

Forage and brassica crops carry a number of health warnings

- Many brassica and root crops can be low in minerals and trace elements potentially requiring supplementation with iodine, selenium and copper;
- Nitrate poisoning can occur in brassica crops particularly where high levels of nitrogen are used;
- Many brassica and root crops can be low in fibre so require long fibre such as straw, hay or big bale silage to be available.

Photosensitisation can be a problem on brassica crops – this appears to be more common in kale and rape and in actively growing young crops.

Advantages of forage crops

- High yielding, potentially cheap crops for finishing lambs – the majority can be safely fed up to 70-80% of the diet without problems;
- High growth rates can be achieved, up to 250 g/day;
- Useful to grow as a break crop in grass to grass reseeds.

Disadvantages of forage crops

- Forage crops not suitable for all situations;
- Environmental impact/soil loss can be high if site not chosen carefully;
- Poor grazing conditions can lead to significant damage to soil structure;
- Utilisation can be very low in unfavourable weather conditions resulting in disappointing performance and the need to supplement lambs with more expensive concentrate feeds;
- Lambs can become dirty on forage and root crops so an area/housing to clean them before marketing is essential.

Indoor finishing systems

Indoor finishing may be used for specialist early lambing flocks or for winter finishing of older lambs. The most common diets for indoor finishing are ad-lib concentrates or silage plus concentrates. Alternatives such as moist by-products can also be used successfully.

Housing requirements

Buildings should have good natural ventilation. This will allow the free circulation of air above the sheep reducing the risk of high humidity and condensation whilst avoiding draughts at floor level. Floors should be slightly sloping to allow free drainage and to limit the build up of wet bedding. Cereal straw is the bedding of choice in the majority of situations although there are alternatives available.

Lambs need access to clean water at all times. Make sure that smaller lambs can reach the water easily and provide a step if necessary.

Allow up to 1 m² per lamb finishing depending on live-weight. *See table below:*

Lying area (m ² /lamb)	Up to 30 kg	30 to 35 kg	More than 35 kg
Straw bedded pens	0.6-0.7	0.7-0.8	0.8-0.9
Slatted floors	0.4-0.5	0.5-0.6	0.6-0.7
Feeding space (mm/lamb)			
Ad-lib forage	100-120	100-120	100-120
Concentrate feeds (rationed)	300	350	400

Indoor finishing for older lambs

A number of farms choose to house lambs and finish on ad-lib concentrate to provide a quick (4-6 weeks) finish. As lambs get older, their feed conversion ratio (FCR) reduces, making them less efficient at turning feed into bodyweight. FCR in older lambs varies from 6:1-10:1 compared to 3:1 prior to weaning.

Assuming feed intake of 1.5 kg per head per day at a FCR of 8:1, it would require 40 kg of concentrate to gain 5 kg in bodyweight. For a compound feed costing £230 /tonne this equates to £9.20 per lamb on feed costs alone.



Shearing lambs at housing

Lambs that are shorn at housing have improved feed conversion efficiency, are less prone to heat stress and will take up less space than unshorn lambs. A reduction in lying area of 10% can be made but feeding space should not be reduced.

Shorn lambs will eat more and finish quicker so care must be taken to ensure these lambs do not become over fat by regularly weighing and assessing body condition. Some abattoirs may also apply a penalty to shorn lambs as shearing can decrease the value of the skin. It is advisable to contact the abattoir you are supplying to find out what deductions, if any, they apply to shorn lambs.

Health challenges of indoor systems

- Pasteurella;
- Heat/cold stress;
- Acidosis.

Advantages of indoor systems

- Feed use and animal performance can be closely monitored and diets adjusted when necessary;
- High live-weight gains and fast finishing;
- Removes lambs from pastures allowing greater grazing area other livestock;
- Allow pastures to recover for spring.

Disadvantages of indoor systems

- High feed costs;
- Higher labour costs than outdoor finishing systems;
- Risk of acidosis. Rapid breakdown of starch and sugar leads to a decline in rumen pH as a result of lactic acid production. This will adversely affect rumen microbes leading to lower voluntary feed intakes and poor fibre digestion. At the very least this will lead to reduced performance. To avoid this diets should not be finely ground and should include some digestible fibre (e.g. sugar beet pulp) and animals should have access to plenty of long fibrous forage;
- Risk of respiratory and lameness problems and greater spread of infectious diseases.

Silage based rations

Conserving forage in the summer months is important for supplementary feeding during winter when grazing is limited in both quality and quantity. For lamb finishing the best results are seen on palatable, short chop silage with a good fermentation. Analysing silage ahead of the finishing period allows cost-effective supplementation and optimises lamb growth rates.

Grass silage – target quality for finishing lambs

Dry matter (DM)	>25%
Metabolisable energy (ME)	>11.0 MJ/kgDM
pH	>4.0
Ammonia	<10%

Chopped silage is most suitable as it is digested in the rumen quicker which leads to a higher throughput and increased intakes. Long silage can slow the digestion process leading to reduced intakes and reduced efficiency. Maize silage is not routinely used in lamb finishing diets but trial work has shown that it can be used as long as protein levels are balanced appropriately.

Levels of supplementation depend on silage quality and range from 0.2 to 1 kg/head per day depending on target sale dates. ‘D-value’ is the digestibility of the silage and is a good indicator of how much silage the lambs can eat to meet their energy requirements. Silage with a ‘D-value’ of 70 or greater would be ideal and require the least supplementation whilst that with a D-value below 64 is not recommended for lamb finishing since growth rates will be slow without significant levels of concentrates.

Typical supplementation levels for grass silage of varying quality

D-value	Metabolisable energy (ME) MJ/kgDM	Typical supplementation
68 and above	10.8 and above	0.2-0.3 kg/head/day
65-67	10.3-10.7	0.4-0.5 kg/head/day
64 and below	10.2 and below	Not suitable for lamb finishing

Suitable supplements include purchased compounds or mixes of whole cereals and fibrous feeds like oats and sugar beet pulp (or other by-products) with rapeseed meal or soya and minerals.

Good quality grass silage should be able to support growth rates of 100 g/per day. Addition of 100 g/head/day of soyabean meal can increase growth rates to 140 g/day, and further addition of cereals could lift performance to 150 to 200 g/day.

Health challenges of silage based rations

- Listeriosis is a particular risk with silage feeding and is associated with consumption of silage that has been contaminated with soil. Clinical signs include dullness, one-sided paralysis of the face (often with a drooping ear), and circling behaviour. The condition is difficult to treat and antibiotics are the only option. Avoid feeding obviously poor silage (mouldy, foul smelling).

Advantages of silage based rations

- Easier to make in bad weather than hay;
- Higher D- value than hay;
- Cheaper than an ad-lib concentrate system.

Disadvantages of silage based rations

- Can go off quickly;
- More bedding is needed when feeding silage compared to hay;
- Lameness can be a problem.

Ad-lib concentrates

Indoor early lamb production

This is a specialist, high cost system that relies on lambing ewes indoors in December and January and finishing lambs during March to May to take advantage of higher prices in early spring. The system requires adequate building space to house ewes before lambing and when taking the lambs through to finish.

In this system, creep is offered from around 7-10 days of age. In the early stages it is extremely important that fresh feed is available at all times to encourage lambs to eat the creep. Lambs will start to consume significant quantities of creep from around 3 weeks of age. Pelleted feeds are often considered to be more palatable for very young lambs but after weaning lambs may be moved gradually on to home mixed rations if required.

Whole grain can be included in rations for lambs over 8 weeks of age. Lambs are weaned at around 6-7 weeks of age (typically weighing 16-18kg), once they are consistently eating 250 g of creep per head per day.



Target composition of concentrate feeds for early lambing systems

	Metabolisable energy (MJ/kgDM)	Crude protein (%)
Young lambs to weaning	12.5	16-18
Lambs post-weaning	12.5	15-16

Lamb growth rates on this system can be as high as 300-400 g/head/day with feed conversion efficiency of around 3.5:1.

It is not necessary to castrate or tail lambs on this system. Entire male lambs have higher growth rates, convert feed more efficiently and are leaner at finish resulting in heavier carcasses at slaughter.

Depending on the breed type and market requirements finished lambs can be selected from 34 kg up to 38-40 kg. It is essential to handle lambs frequently to ensure they are sold at the optimum weight and fat level.

Health challenges of ad-lib concentrates in early lamb production

- Coccidiosis can be a problem and lambs may require medication;
- If feed is not available at all times then lambs can gorge leading to acidosis, bloat and even death.

Advantages of ad-lib concentrates in early lamb production

- Allows a high farm stocking rate;
- Can extend the lamb marketing period when used alongside a spring lambing flock improving overall cash flow for the business.

Disadvantages of ad-lib concentrates in early lamb production

- High cost system vulnerable to shifts in lamb price early in the season.



Finishing store lambs on ad-lib concentrates

This system can be used to finish any end of season lambs. The diet should be introduced gradually, building up over 10-14 days to ad-lib feeding. Once lambs are eating continuously feeders should not be allowed to become empty for significant periods. This will reduce the risk of animals overeating when feeders are refilled.

Lambs require access to long forage so systems can either use bedding generously or feed some straw or hay. Purchased compound feed or home mixed rations may be used. The following table gives examples of suitable home mixed rations.

Ingredient	Kg/tonne Example 1	Example 2	Example 3	Example 4
Whole cereals (to include 10% whole oats preferably)	775	750	825	775
Soya	-	-	150	100
Rapeseed	200	-	-	
33% protein concentrate	-	250	-	
Beans	-	-	-	100
Mineral	25	-	25	25
ME (MJ/kgDM)	12.5	12.8	12.8	12.8
CP (%)	15	15	15.6	15.3

Intakes of concentrates are likely to be 1.0-1.5 kg/head/day with liveweight gains of 150-250 g/head/day. Feed conversion rate is likely to be in the range 6:1 to 10:1. The concentrate should be 14 to 16% crude protein and lambs should finish in 4 to 6 weeks depending on initial weight and target sale weight.

Male lambs that can be difficult to finish, can perform well on this system as long as they are separated from ewe lambs.

Health challenges of finishing store lambs on ad-lib concentrates

- Acidosis can result when high levels of concentrate are fed. This can be avoided by ensuring the correct level of fibre is included in diet, meal size is maintained at low levels for gradual intake, and very fine products are not used. Cereals should not be ground.

Advantages of finishing store lambs on ad-lib concentrates

- Feed use and animal performance can be easily monitored and diets adjusted when necessary.

Disadvantages of finishing store lambs on ad-lib concentrates

- Expensive if purchased concentrates are used.



By-products

Although not widely used there are a number of alternative feeds that may be suitable for inclusion in lamb finishing diets. Many of these are by-products of the food and drink industries and they may be presented in dry, moist or in liquid form. Moist feeds can partially replace long forage and concentrate feeds.

Moist feeds

Moist feeds can be stored in temporary clamps created on a dry concrete base by lining straw bale walls with plastic sheeting. After filling and consolidation the product is covered with weighted silage sheeting.

Moist feeds can also be stored in Ag-Bags. Some run off can occur with moist feeds and it is important that this is not allowed to enter drainage systems or water courses.

Moist feeds include products such as brewers grains, pressed beet pulp and moist wheat co-product. These can be mixed with dry feeds such as sugar beet pulp to produce higher dry matter feeds (e.g. grainbeet) with high energy and protein levels and stored in temporary clamps.

Grainbeet is a moist feed produced on farm by mixing brewers grains (5 parts) and molassed sugar beet feed (1 part). The resulting feed has a dry matter of 30-35%, energy content of 12 MJ/kgDM and crude protein of 19%. It can be used to extend forage supplies or as the sole diet for finishing lambs. In trials grainbeet fed lambs have performed as well or better than lambs on conventional cereal based diets.

Dry feeds

Dry feeds such as distillers pellets can provide high protein, high energy feeds (beware high copper levels in some products). Typical energy and protein content of distillers feeds are shown in the table below.

Nutritional content of dried distillers products

	Energy (MJ/kgDM)	Crude protein (%)
Maize distillers	15.0	28.0
Barley distillers	13.0	26.0
Wheat distillers	13.7	34.0

Health challenges of by-products

- Copper toxicity can result if high levels of some distillers products are fed to sheep – always check copper levels before purchasing and feeding these products;
- Bespoke mineral supplements may be needed.

Advantages of by-products

- Can be a cost effective choice for finishing lambs;
- Lambs perform similarly to those on a concentrate diet.

Disadvantages of by-products

- Moist products may not be available in all areas;
- Moist products are typically delivered in large bulk loads so need suitable storage facilities.

Animal health

It is important on any lamb finishing system to start with lambs that are in good health in order to keep losses to a minimum and to use feed supplies efficiently. These include management for optimum health and biosecurity, and timely separation of ram lambs.

The farm flock health plan should include control of internal and external parasites, lameness and vaccination programmes.

Lambs born on the holding should be vaccinated against clostridial diseases and pasteurella since passive immunity from colostrum will have waned by around 10 weeks of age. A primary course of clostridial vaccine with two injections four weeks apart should give full protection. An additional booster injection may be necessary for lambs considered to be at high risk later in the season.

A programme of faecal egg counting should be in place for grazing lambs and worm drenching done on the basis of the results. Effective wormers should be used and the anthelmintic resistance status on the farm known so that lambs can be treated with appropriate products.

The abattoir grading sheet provides feedback on lamb specifications and on diseases that can be identified from the carcase. This information can help make more informed management decisions on remaining livestock on the farm.

Liver fluke is an increasing problem and is responsible for sub-optimal performance in finishing lambs. In 2015 lamb liver condemnations due to fluke peaked at over 16%. An effective fluke control programme needs to be discussed with the farm vet.

Biosecurity

The farm flock health plan should also include a biosecurity plan. Part of this plan should include health and quarantine procedures for when livestock are brought on the farm. Where store lambs are purchased for finishing they should be checked for signs of disease and any affected animals separated from the rest and treated as necessary. All purchased stock should be put in quarantine for at least 3 weeks to avoid spreading infectious diseases (e.g. sheep scab or footrot) to resident sheep. Treatments for internal and external parasites should be given on arrival and lambs footbathed straight off the lorry.

Ram Lamb Management

If finishing entire ram lambs, these need to be kept separately from ewe lambs from 20 weeks of age. This will prevent unwanted pregnancies and will ensure that the ram lambs do not waste their energy resources chasing ewe lambs.

The aim should be to keep lamb losses between weaning and sale to below 2%.

Trace element deficiencies in growing lambs

Trace elements are extremely important in terms of optimum performance of livestock. Deficiencies can have significant effects on the growth rate of lambs. The most common deficiencies on Welsh farms are selenium, cobalt and iodine.

It is important to weigh lambs regularly to monitor growth rates and identify sub optimal performance. If lambs are not meeting target growth rates, it is important to consider the following:

- Is there adequate food and is it of the correct quality?
- Is the ration balanced for energy and protein and major minerals?
- Are all lambs able to get their fair share of the ration?
- Are all lambs free of underlying disease issues (e.g. worms, fluke, footrot) that can restrict growth?

If the answer to all these questions is yes then consider blood sampling a representative number of lambs to check for trace element deficiency. The farm vet will advise on numbers to sample and corrective treatments.

Cobalt deficiency is very common in lambs post weaning and can be easily rectified by providing vitamin B12 or other cobalt supplements (bolus, in feed etc.). Selenium, iodine and copper are often deficient on root crops.

For further guidance please see HCC Booklet *'Trace Element Supplementation of Beef Cattle and Sheep'*.

Meat eating quality

Lambs that are gaining weight prior to slaughter have better meat eating quality. It is recommended that they should be gaining at least 100 g/day for the 2 weeks prior to slaughter. This increases the amount of intramuscular fat in the muscle, leading to an improved tender and juicier lamb meat product.

Key points to consider when choosing a lamb finishing system

- Will finishing lambs compete for farm resources with breeding stock?
- The type of lamb you are dealing with – breed, weight etc.
- Target market and the type of lamb required – local butcher, supermarket or export market;
- Target finishing period;
- Growth rate required;
- Available home-grown forage – grass, stubble turnips etc.
- Cost and availability of supplementary feed supplies;
- Financial implications;
- Health challenges;
- Would you be better off selling lambs as stores?

Outdoor finishing options

OUTDOOR finishing options	Type of lamb (finishing time)	Expected growth rate (DLWG)	Benefits	Disadvantages	Animal health	Other considerations
Grass finishing	Mid season	150-200g	Cheap	Growth rates can be as low as 50-60g/day on poor quality grassland	Consider investigating trace element status	Risk of poaching and run off if overstocked in wet weather
Grassland and supplementation	Early season	200-300g	Lambs finish before price falls	High costs may not be recovered if lambs are marketed at incorrect time	Build up of muck and soil can lead to increased risk of Coccidiosis	Ensure feeders are placed on dry standing areas to avoid poaching
	Late season	150-200g	To supplement grass during a forage shortage. Helps maintain high stocking rates			
Grass/White clover	Mid season	200g+	Higher mineral and trace element levels than ryegrass swards	Clover is not tolerant of high N applications	Risk of bloat if clover dominates	Nitrogen fixation reducing need for fertilizer
Grass/Red clover	Mid-late season	200g+	Improved trace element availability and potential for reduced worm burden	Do not use for breeding ewes over mating	Risk of bloat if clover dominates	Nitrogen fixation reducing need for fertilizer
Mixed Chicory	Mid season	250-300g	Drought tolerant. Potential for reduced worm burden	Requires careful grazing management	Higher mineral content than many grass species. Reduced worm burden	Risk of poaching and run off if overstocked in wet weather
Forage Crops	Mid-late season	250g	High energy and protein content	Low in fibre. Lambs can become dirty and require cleaning before marketing	Often deficient in copper, iodine and selenium. Nitrate poisoning can occur	Risk of poaching and run off

Indoor finishing options

INDOOR finishing options	Type of lamb (finishing time)	Expected growth rate (DLWG)	Benefits	Disadvantages	Animal health	Other considerations
Silage alone	Late season	100g	Removes lambs from pastures	High costs and health issues	Listeriosis and acidosis risk. Respiratory problems and spread of infectious diseases	Removes risk of poaching on wet winters
	Late season	150-200g				
Silage & cereals		300-400g	Allows high farm stocking rate	High costs system vulnerable to shifts in lamb prices	Coccidiosis, acidosis and bloat can be problems	Lower carbon footprint due to high growth rates and sale at young age
Ad-lib concentrates	Late season	150-250	Entire lambs can perform well if separated from ewe lambs	High cost system	Acidosis	Remove risk of poaching on wet winters
By-products	Late season	150g+	Cost effective	Products not available in all areas & typically delivered in bulk	Bespoke mineral supplements may be needed	Risk of run-off from moist by-products





“Whichever system is chosen the importance of **good selection** of finished lambs cannot be overlooked”

Further information on HCC's activities and other relevant publications can be found at www.hccmpw.org.uk