ECONOMICS OF BALE GRAZING

A REPORT FOR AHDB BEEF & LAMB

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Authors

Emily Grant – Forrit
Rhidian Jones – RJ Livestock Systems

Summary

Originating in North America, bale grazing is a grass and hay outwintering system for cattle that is seeing increasing interest from UK farmers as a method of reducing costs in suckler-beef systems. This report draws together management and financial information from seven farms across the UK which are currently bale grazing. The report seeks to highlight to readers where cost savings can be made before applying a cost-benefit analysis to their own system. As always when looking outwards at other farms, this report shows what is possible, rather than what is probable.

The farms are part of the wider Pasture for Life – Innovative Farmers project, which is looking to quantify the impacts of bale grazing on forage quality, quantity and soil health post-bale grazing.

Each of the seven farms was interviewed and asked to supply details of their bale grazing system, any key cost savings and wider non-financial benefits compared with housing. This was a small sample size, with a wide range in scale of both land area and herd sizes. All but one of the farms have also been undergoing much wider enterprise restructuring or system changes.

The potential benefits and costs of bale grazing will be unique to each farm and will depend on the type of housing system previously used.

Potential key cost/efficiency gains

- Good-quality hay plus deferred grass provides sufficient nutritional needs for a dry cow, so there are savings in making hay for cows rather than silage; even more so if buying in straw to balance a silage diet
- With housing, straw is a major cost. At the time of writing (summer 2024), straw prices are predicted to rise, possibly by around 50%
- Depending on the efficiency (layout, type) of the housing system, fuel and labour costs are at least half. Much of the fuel reduction cost comes from a shift from tractors to UTVs when on the bale grazing
- Setting out bales as soon as they are made reduces handling and storage costs

Key cost considerations

- The potential income forgone is important to factor in – for all the farms, pasture wasn't available for grazing once shut off in the summer. The recovery period the following spring also meant all but one farm only had a single graze of the bale-grazing field during the growing period, just ahead of shut-off

- For farms that are reducing purchased straw, the change in nutrient (P & K) import value should be accounted for
- Fixed costs in machinery and buildings are difficult to drop. Only one participant disposed of some machinery and one had repurposed existing sheds for a diversified enterprise

All of the participants reported non-financial benefits, both wellbeing (work/life balance or enjoyment) or biodiversity improvements.

The cost-benefit analysis showed a net financial benefit to the farm when bale grazing of £1.58 per head per day – approximately half of the housing cost. This financial benefit is helping to maintain the viability of the herd within the wider farm system.

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INNOVATIVE FARMERS
PART OF THE DUCHY FUTURE FARMING PROGRAMME

PASTURE FOR LIFE

Introduction

Work in Ireland identified that the cow consumes over 80% and 50% of the annual feed requirement in calf-to-weaning and calf-to-beef systems respectively (McGee & Crosson, 2015). Consequently, feeding the suckler cow – particularly over the winter – is a major expense incurred in suckled-calf production systems.

Maintaining profitability in suckler-beef systems is a challenge, particularly in the current climate of high input costs and a changing subsidy regime. In farming, little opportunity exists to control the sale price, leaving just two key levers to managing profitability: either improving output (kgs of product sold) or reducing costs. The ideal scenario is to maintain output at lower cost.

Managing for profit

The relationship between farm output and costs is complex. Work in New Zealand looking at uncertainty in pastoral dairy farms – price, climate change impacts and future environmental regulations – showed that higher-stocking-rate systems were more exposed to climatic and economic risk, but performed better in terms of production, profit and equity growth. Conversely, lower-stocking-rate systems showed a lower environmental footprint and profit variability, but also lower production, profit and equity (Beukes et al., 2019).

Cost control can be achieved either by reducing expenses or by utilising existing resources (such as land or labour) more efficiently. This reflects the difference between cost effectiveness and cost efficiency. Both cost efficiency and effectiveness are important for businesses to ensure they are optimising resource use while also minimising costs. However, cost control should never compromise profitability. The most effective cost control seeks to at least maintain output with less input.

When considering a management change to improve profitability, it's also important to consider any hidden costs that may arise that aren't necessarily visible or measurable but have impact (known as implicit costs). For example, deferring grass to allow outwintering may result in a pasture deficit in autumn and a lost 'opportunity' to use the grazing area for another class of stock. Considering these wider impacts on the system is essential to ensure all the financial implications of making changes are included.

But, as a first step, identifying the costs within the business that can be reduced or eliminated without compromising strategic goals and performance should be the priority.

Methodology and limitations

There were seven farms in total in this project. They form the Pasture for Life – Innovative Farmers project, which is looking to quantify the impacts of bale grazing on forage quality, quantity and soil health post-bale grazing. More details about the wider project can be found on the Innovative Farmers website - https://innovativefarmers.org/

Each of the farms was interviewed (Dec 23–Jan 24) and asked to supply details of their bale-grazing systems and key cost savings versus housing. They were also asked to identify any wider, non-financial benefits they had experienced as a result of bale grazing.

Cost-benefit analysis is a useful way to interrogate the benefits and implications of making a change to part of an existing enterprise. It gives an opportunity to not only identify the cost savings, but to also take account of hidden costs. It balances the potential rewards against associated costs, including opportunity cost, to give a clear picture of impacts on the whole farm system.

Whilst cost-benefit analysis is useful to identify and value trade-offs and impacts of alternatives, it occasionally requires assumptions where there is uncertainty or incomplete data available. Variable costs are relatively easy to assess and allocate, but fixed costs, such as depreciation, repairs and maintenance, are more complicated.

Given the complexity of agricultural systems, there is also the risk that the analysis may not completely capture all the relevant costs, benefits or outcomes of alternatives. It also doesn't apply all tests that may be relevant, such as feasibility (cash flow, capital availability), risk, practicalities or personal preferences/values.

This project involved a small number of farms with a wide range in size and scale of both land area and herd sizes. Although changing to bale grazing involves some system restructuring, all but one of the farms have also been undergoing much wider enterprise restructuring or system changes. For example, one farm has recently changed from sheep to cattle; another has converted to organic; and a third is transitioning from dairy beef to sucklers following TB. Four of the seven are also still building cattle numbers. These wider system changes on most of the participating farms have made analysis of the financials of bale grazing difficult.

However, much of the information collected from the participating farmers was around management. The report therefore uses this information to illustrate the potential for bale grazing, with relevant financial or physical data where possible. There is also a cost-benefit analysis given for one farm where suitable 'before' and 'after' financial data was available. The aim being that readers will be able to consider where cost savings can be made before applying a cost-benefit analysis to their own system. As always when looking outwards at other farms, the report shows what is possible, rather than what is probable. The cost-benefit of adopting bale grazing will be unique to each farm and those looking to make change should undertake their own assessment.

Bale grazing

Originating in North America, bale grazing is a grass- and hay-based outwintering system for cattle. It involves setting out hay bales onto pasture ahead of the winter and feeding in a planned, controlled manner using electric fencing. Bales can be fed in situ or rolled out and fed with an allocation of deferred pasture. The cost saving comes from cattle being outside, harvesting their own feed and spreading their own muck. Well managed, there are also potential health and welfare benefits from being outside.

Well suited to North American dry, cold winters, farmers in the UK are looking to adapt the system to help reduce their wintering costs. However, with our more temperate maritime climate, key challenges in the UK tend to be wet weather and fluctuating temperatures, often above freezing. Snowfall amounts vary across the country but aren't consistently predictable.

All wintering systems seek to fill the 'demand' gap when pasture growth ceases. Filling that gap involves shifting dry matter production from the summer to the winter period. This can be done by either cutting and conserving forage, usually as hay or silage, or by deferring grass for grazing later. All the farms used hay – either produced on farm or bought in for their suckler cows. One farm used herbal ley silage in ring feeders for bale grazing heifers.

As with any wintering system, the biggest cost involves getting food to the animal. Allowing the animal to harvest forage in situ is always the lowest cost. But the biggest challenge with that is to be able to defer sufficient quality and quantity of forage to last the winter.

Cattle outwintering isn't new to the UK, but forage crops, particularly brassicas, would be more typical, often as a break crop as part of a pasture-renewal system.

Potential benefits of bale grazing versus forage crops (brassicas or fodder beet) are:

- No cultivation is required
- Soil is protected over winter, reducing potential sediment loss
- Less N loss from pasture
- Stock don't need feed transitioned
- Animals not standing in mud
- Potentially less loss of production time in terms of shut-off date and the first regraze the following season

Ongoing work in New Zealand by AgResearch on bale grazing as an alternative to winter forage crops suggests that a bale-grazing area needs to be 50% greater than for a forage brassica crop. Their provisional cost analysis shows that although a kale crop is lower cost, the benefit from bale grazing comes from the opportunity cost of pasture not grown while new grass establishes (Quorum Sense, 2022).

The potential benefits and costs of bale grazing will be unique to each farm and depend on the type of wintering system currently being implemented. The main benefits and costs are shown in the table below. This report draws on the project farms for further information and data relating to these.

Table 1. Potential benefits and costs of bale grazing

Potential benefits to the business	Potential costs to the business
↓ Fuel ↓ Labour/Time ↓ Straw ↑ Pasture fertility ↑ Wellbeing ↑ Biodiversity	↓ Summer/autumn grazing area ↓ Stock numbers/output ↓ Reduced growth rates in youngstock ↓ Pasture fertility from 'exporting' hay ↑ Stranded costs (e.g. empty shed) ↑ Bale wastage

The project farms

The farms cover a geographic spread across the UK (Aberdeenshire to Penrith to Oxfordshire). All participants have suckler cows, though the farms are very different in terms of farm size (44 to 1141 ha), land type and capability (rotational grass leys to rough hill), stock numbers (14 to 220 breeding females), stocking rates and classes. The capital stocking rate (the liveweight of breeding females per hectare) ranged from 56 kgs LWT/ha to 323 kgs LWT/ha.

Cattle breeds included both pure and crossbred and were mostly native or hill types – Angus, Shorthorn, Angus x Shorthorn, Luing, Shetland, Hereford x British Friesian or Angus x Saler x Stabiliser. Only one farm sold all offspring store. Another sold both store and fat, while the remaining five farms finished offspring, four of those direct to consumers. Three of the participants with purebreds were selling or planning to sell breeding stock.

All participants are outwintering on similar pasture types – either permanent pasture or rough grazing, although two also used temporary grass leys for youngstock or in-calf heifers. Soil types varied from clay, sandy clay loam to sandy loam. Experience of bale grazing varied from two to five years, with a mean of 3.6 years.

How the farms implemented bale grazing

Table 2. Summary of key farm information

	Farm A	Farm B	Farm C	Farm D	Farm E	Farm F	Farm G
Stock class bale grazed	Cows, IC heifers	All	Cows, IC heifers, weaned calves	All	All	Cows, calves at foot	All
Number mobs	4	1	3	2	1	2	1
Mob size (largest if >1)	70	52	60	45	34	80	48
Bales made on field grazed		✓					
Bales purchased		✓		✓			✓
Bales unrolled	✓	✓	✓	✓	✓	✓	✓
Number days on bale grazing	73	34	116	137	100	170	80
Shut-off date	1 Jul	31 Jul	21 Jul	15 Jun	1 Mar	1 Aug	15 Jul
Bale grazing start date	1 Nov	28 Feb	15 Dec	1 Nov	25 Dec	1 Nov	15 Nov
Bale grazing end date	21 Feb	30 Apr	10 Apr	1 May	25 Apr	30 Apr	1 Apr

Cost considerations

This next section considers key management aspects of bale grazing which can impact system costs or income forgone. It draws on the data provided by participants.

As noted in the methodology section, variation in scale and size of the participating farmers has made giving clear cost reduction indications challenging. For example, Farm E bale grazes a mob size of 34 head, Farm A 70 head. Both have the same daily labour time requirement and cost while bale grazing. However, on a per head basis, Farm A's labour cost per day is half of Farm E's. This demonstrates economies of scale and highlights some of the challenges and nuances of how costs behave within and when comparing different farms. For example, the labour cost per head per day for Farm A while housing is the same as Farm E while bale grazing, at £0.29 per head per day. Farm E therefore potentially has further labour cost-saving opportunities by increasing mob size (this herd is still building numbers).

Table 3. Labour efficiency

	Farm A	Farm E
Daily labour cost of bale grazing (0.5 hour @ £20/hour)	£10	£10
Number head in mob	70	34
Labour cost/head/day bale grazing	£0.14	£0.29

Daily time input

The time required per day to implement bale grazing varied from half an hour to two hours. This was very much dependent on the number of mobs or the location of the bale-grazed area. Five of the farms either previously housed or still currently house for part of the year. For those, the difference in time spent on bale grazing compared with housing will also vary with the type of housing system (e.g. cubicle sheds vs straw courts). For those five farms, the reduction in time input is outlined in Table 4.

Table 4. Reduction in daily labour requirement bale grazing vs housing

	Reduction in time/day on bale grazing vs housing
Average	-51%
Max	-75%
Min	-33%

Time spent setting out bales

All the participants set out bales ahead of winter, usually immediately after making the hay to avoid more than one handling. Only one farm made hay in the same field as they bale grazed. Three farms bought in hay – all as species-rich bales to help improve pasture diversity via seed drop. The amount of time spent putting out bales varied from two to 80 hours, or 8.8 to 26 bales per hour. Potential reasons for that variation weren't immediately clear, but the two farms with the highest bales/hour (23 and 26) were providing less of the diet as hay. For both, their diet ratio was 37% hay: 63% deferred. The farm that put out 8.8 bales per hour was providing 48% hay: 52% deferred. Hydraulic trailers also save time in terms of securing loads.

Table 5. Time spent putting out bales

	Number bales put out	Bales put out/hour
Average (median)	100.0	14.4
Max	800.0	26.0
Min	36.0	8.8

Laying out bales ahead of winter is a key cost and efficiency gain, particularly if bales move direct from the field they were made in, whereby they are only handled once. Although there is a slight trade-off with hay waste from outside storage. All participants felt that weather wastage was low (see Table 11).

Labour costs

Only two farms employed staff. The remaining farms were family labour only. How participants valued their or their staff's time ranged from £0 to £22.50/hour. The median value given was £15.86, which is close to the minimum wage employers cost of a £21K salary (FAS, 2023). For those without staff, there was probably an underestimation of their time value, which should be accounted at managerial level and would expect to be around £39–40/hour (£52.5K salary).

Fuel use

One farm (Farm C) had comparable data on their fuel use under their previous housing system vs their new outwintering regime. This included a portion of the winter on deferred grazing prior to starting bale grazing. The big savings (72% reduction) are from reducing the type of machine used and the degree of mechanisation – in this case, forage mixer wagon to UTV and bale un-roller. In a similar manner, Farm A saw a 62% reduction in fuel costs.

Table 6. Fuel use comparison – Farm C

	Housed	Outwintered
Fuel used to set out bales (litres)	-	75
Fuel use/day (litres)	40	5.17
UTV fuel use/day (litres)	-	2.86
Fuel cost £/day	£32.00	£8.91
Total saving while outwintering	£3,601	
% reduction in daily fuel cost		72%

Straw costs and value

For two participants who both previously housed all winter (Farm A and Farm C) reducing purchased straw has been one of the biggest cost savings. Both farms produce some of their own straw as well as bought in. For both, the straw was for bedding as well as balancing silage diets. Farm A has reduced straw usage by 1,000 bales, Farm C by 1,500 bales. Valuing that straw at £20/bale gives significant savings, but at the time of writing (2024), straw prices are currently 50% higher. Cost savings come not only from the straw itself but also the time spent handling it. As one respondent reported: “We used to spend the whole of August and September hauling straw.” However, purchased straw also provides valuable phosphate and potash (PDA, 2009). The current (2024) P and K value of a five-foot straw bale is £2.98 per bale. Any reduction in nutrient import value needs to be accounted for in a cost-benefit analysis.

Diet quality

Some of the farmers had undertaken forage analysis of both the deferred grazing (n=3) and hay (n=4) that they were feeding. Although sample size was low, the results align with published data for deferred grass (SRUC, 2022; Kingshay, 2012) and hay (FAS, 2022). The average metabolisable energy and crude protein of both are detailed in Table 7.

Table 7. Hay and deferred grass analysis

	Deferred grass		Hay	
	MJ ME/kg DM	%CP	MJ ME/kg DM	%CP
Average	9.1	13.2	8	10.5
High	9.5	14.8	8.7	13.6
Low	9.1	12.8	7.1	7.6

Recommendations for suckler-cow maintenance are a minimum of 9% CP and 9 MJ ME/kg DM. In all cases, the deferred grass provides sufficient to meet maintenance needs. Although the hay that analysed at the 'low' end – 7.1 MJ ME and 7.6% CP – would fail to provide sufficient nutrition if fed alone. In this case, the proportion of deferred grass in the daily diet is important to help balance the diet.

Table 8. Recommended levels of energy and protein for growing and finishing stock

	MJ ME/kg DM	% CP
Growing stock	10.7–11.0	15
Finishing stock	12.5	13–15

Although protein levels in the deferred grass are good, the ME content isn't sufficient to support growth or finishing.

Five of the seven farms ran cows with youngstock as a single mob, but no growth rate data over winter was available for youngstock; one participant estimated 0.3 kgs/hd/day, possibly less from December to mid-March.

Some of the farms were still suckling calves at 10–11 months old. Although milk production would be low, this would push the energy and protein requirements of the cow above maintenance, likely towards 12% CP. With a 60% deferred grass to 40% hay ration, this would provide sufficient dietary protein. None of the participants supplied any supplementary feeding while bale grazing. Minerals were offered in the form of rock salt or seaweed.

Two of the seven participants bale grazed in-calf heifers separately from the mixed-aged cows. This was to ensure heifers received a higher plane of nutrition and were less likely to be bullied by older cows. One of the farms bale grazed heifers on deferred Italian/Westerwolds ryegrass, plus herbal ley silage. The analysis of that pasture was more than sufficient for growing stock, at 11.3 MJ ME and 24% CP. This was their first year of trialling this and full data wasn't yet available.

Portion of deferred grass and hay

From the information provided by farmers about paddock size and hay allocation, the proportion of deferred grass:hay supplied was calculated, both on a percentage of dry matter and ME basis*.

Table 9. Proportion of hay and deferred grass in diet

	% diet on a dry matter basis		% of diet on an ME supplied basis	
	Deferred grass	Hay	Deferred grass	Hay
Average	58%	42%	60%	40%
High	63%	48%	67%	48%
Low	52%	37%	52%	33%

*NB. These figures make assumptions of pasture entry and exit heights and % wastage. But based on information provided, all diets provided sufficient daily ME.

Body condition score (BCS) change

It's important to ensure that cows are at the correct BCS for their stage of production, but their ability to lay down fat when pasture supply and quality is good gives the opportunity to utilise some of this energy over winter. Average BCS at the start of bale grazing was 3.3 and five of the seven farms reported zero/nil to low loss of condition.

Table 10. Change in cow body condition score

	BCS at start of bale grazing	Loss of BCS by end of bale grazing
Average (median)	3.3	0.4
Max	4.3	1.5
Min	2.5	0.0

It takes more energy to lay down fat than is provided to the animal when mobilising it. Each kg of LWT lost yields 28 MJ ME versus each kg liveweight gained which requires 55 MJ ME. So there is a hidden cost to utilising BCS. Work in New Zealand (B&LNZ, 2012) suggests that the loss of 1 BCS (approximately 7% of liveweight) is equivalent to 1,137 MJ/ME. Assuming a pasture of 10.5 ME, and a dry matter rental value of 3p/kg DM, the net cost is equivalent to £3.24/head/BCS loss. However, many herds that house also make use of controlled BCS loss over winter; if the policy and BCS change is the same whether housed or outwintered, then the cost to the business remains neutral.

It's important to note that livestock increase their feed intake during cold winter weather. For cattle, this is likely to require a 10–20% increase in feed allowance when outwintering. Leaner cows will also have a higher energy requirement. Wind chill on wet coats will have the most impact.

Soil nutrient loss or gain

While the wider Innovative Farmers project is looking at soil health and fertility, nutrient import and movement around the farm is important when considering bale grazing. Improving the fertility of a bale-grazing area may be a specific aim and low-fertility fields will respond well to nutrient input. But this may need to be balanced by replacing nutrients lost in fields that supply the hay. Consideration should also be given to oversupply in fields that already have adequate fertility levels. One participant bale grazes the same field where they made hay, so is effectively keeping a 'closed nutrient loop' within the field.

On a fresh-weight basis, a tonne of hay is a valuable source of macronutrients – 14.9 kgs of nitrogen (N), 5.9 kgs of phosphate (P) and 17.9 kgs of potash (K) (IOTA, 2010). Based on these figures, one farm's hay input is equivalent 80 kgs N, 32 kgs P and 98 kgs K per hectare. Ruminants excrete 70–90% of the macronutrients they consume, so not all those nutrients will go back to land. Of the N, P and K that is excreted, 98% of the P, 33% of the N and 10% of the K is excreted in the dung, with the balance being excreted in the urine.

Nutrient hotspots can occur in any feeding system if stock linger in fixed locations, are heavily stocked or repeatedly bale graze the same area. The risk of nutrient loss increases where hotspots occur, but the risk of loss is also a function of rainfall and soil type, with free-draining soils more likely to leach more mobile N and K. Nitrogen losses in any wintering system usually occur because deposition is greater than plant demand during winter.

Without further research, it is difficult to know the exact fate of nutrients in a bale-grazing situation and hopefully the wider research will help to start to answer this. But work from Canada and the USA suggests nutrient loss can be mitigated by rolling out bales to help spread nutrient deposition (all the participating farms do this) and to avoid bale grazing the same site year-on-year.

For farms that buy in straw for housing, it's important to note that straw also contains valuable P and K, with a current estimated P and K value of £2.98 per bale.

Hay wastage

All participants were asked to estimate what percentage of their bales were uneaten. While most felt that any unutilised bales weren't 'waste', none of the participants had data on pasture growth, quality or soil health/carbon differences on bale-grazed areas. However, this falls within the scope of the Innovative Farmers/Pasture for Life project and some data may be available once the project concludes. Nevertheless, uneaten hay still comes as a cost to the business, and the degree of that cost will depend on the cost of producing or buying bales.

Table 11. Bale wastage

	% bale wastage	Bale cost (made on farm)	Bale cost (purchased)
Average	10.7%	£11.90	£28.80
Max	25%	£13.00	£35.00
Min	5%	£8.00	£21.50

Grazing and rest periods

All participants included deferred grazing with their bale allocation. One farm had pasture measurements ahead of winter grazing of 2.2–3.6 t DM/ha. These areas included rough hill to improved pasture with shut-off dates from the end of June through to early July. For the whole group, shut-off dates for the bale grazing area are detailed in Table 12.

Table 12. Dates of shut-off, start and end of bale grazing

	Bale-grazing area shut-off date	Date of start of bale grazing	Date of end of bale grazing
Average	15 July	4 December	12 April
Earliest	1 March	1 November	21 February
Latest	1 1 August	28 February	30 May

Dates for the start and end of bale grazing varied from the start of November to the end of April. The time spent bale grazing varied from 34 to 170 days (Figure 1 below). Commencement date depended on a variety of factors, such as available pasture resources, weaning, calving date, etc. As shown below, Farm A finishes bale grazing (and then houses ahead of calving in early April), before Farm B starts bale grazing. Although Farm A's rest period is longer, it aligns with strong early-season pasture growth, allowing the bale-grazing site to be grazed again from April until the end of June, in this case providing pasture to lactating ewes, plus lambs when their nutritional needs are high.

For those farms not using bale grazing for the whole winter, forage for the first part of winter was supplied by deferred grass, without bales. Deferred grass will be the lowest-cost forage option, providing the hay effectively increases the dry matter and thereby stocking rate per hectare, thus allowing outwintering on a smaller area. Two participants were working towards reducing the need for hay altogether.

Date to first grazing following bale grazing varied from 21 April to 26 July. Compared with housing, the shut-off date and first regraze of the following season are costs to the business. For Farm A (shown in Figure 1 below), under their previous housing system (end of October to mid-March), they would have grazed the 9 ha during the 'deferred' period from July to early November and again from mid-March.

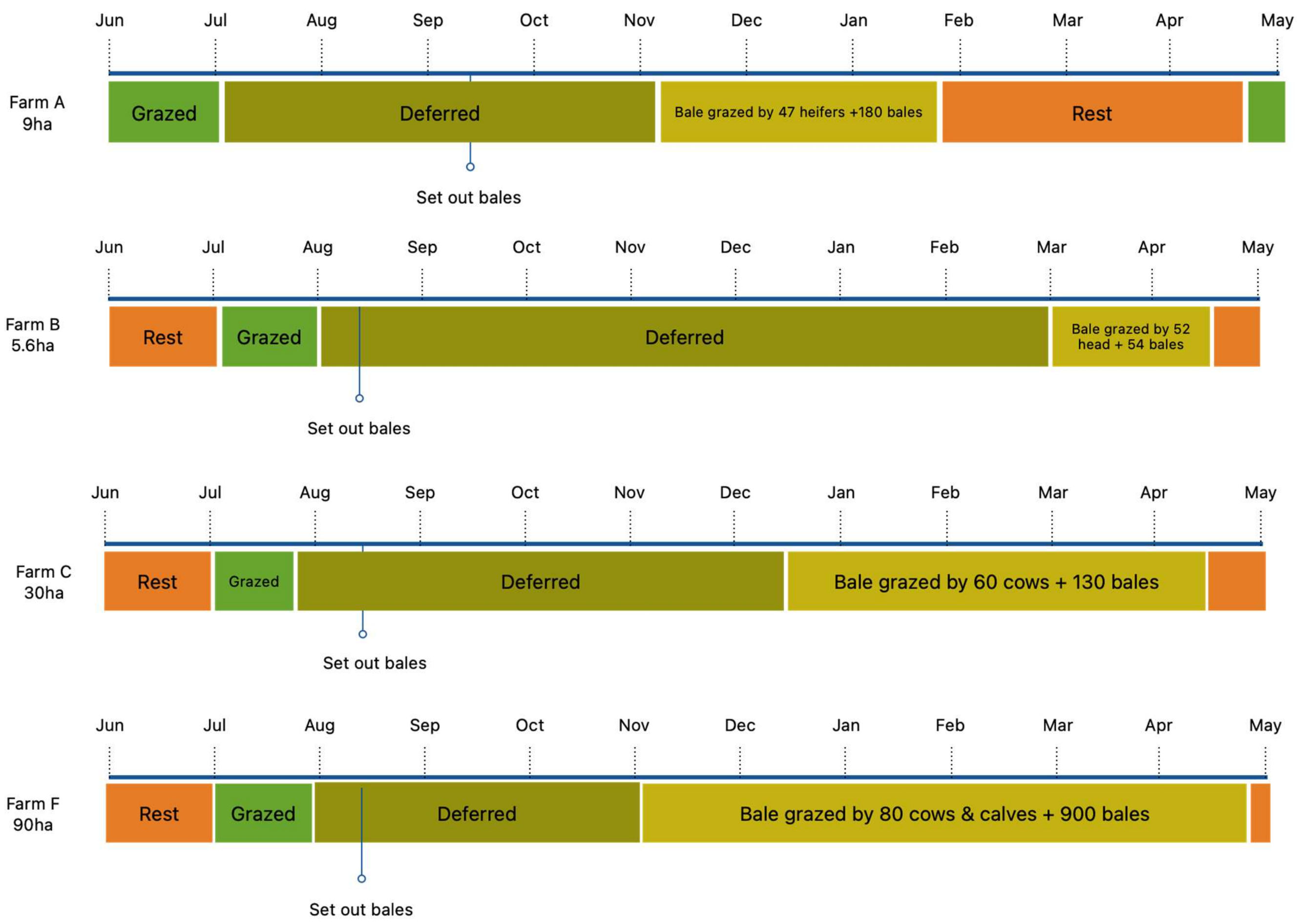

Figure 1. Rest, graze and bale-grazed periods for four of the farms

Even if we consider the deferred period as the equivalent of an unharvested hay or silage crop, for Farm A they would likely still have had an aftermath graze ahead of housing if they had cut and baled and would have had better pasture utilisation from cutting than winter grazing.

Amelioration

None of the respondents reported any significant poaching damage to fields (information collected December 2023), nor issues where rejected or hay waste remained. Other than potentially rolling to level or hand sowing some seed on any bare areas, all of the farmers were happy with pasture recovery.

Water

Provision of water is a key consideration for bale-grazing systems. The participants used a range of options to ensure supply throughout the winter; although they do acknowledge that frozen water can be a key challenge. Four of the participants used mobile water troughs that were moved with the stock. One farm had just put in place some frost-free fixed troughs and two used fields with access to natural water. Those using troughs all had a plan B in case of freezing, which involved not back fencing to allow access to natural or fixed water supplies. Most of the participants were also rotationally grazing during the summer, so the mobile water infrastructure was not solely an additional cost to the bale-grazing system. Water infrastructure costs will vary on a farm-by-farm basis. But one participant invested £6,800, which when depreciated at 15% gives an annual cost of £1,020.

Wider non-financial benefits

One of the limitations of cost-benefit analysis is that it only includes financials. There are often wider benefits of management change that we can't easily put a financial value on, such as wellbeing, work/life balance or enjoyment, or biodiversity or animal health and welfare improvements. These benefits tend to align with personal values and can be a key driver of why some chose to adopt bale grazing. It's important to still capture these as part of the analysis process.

Figures 2 and 3 outline some of the key wider benefits participants identified as part of their bale-grazing systems.

'Much happier being "outside" rather than in the yard'

Have more family time

If things go wrong in the shed, it's harder to fix than a broken wire

Feels more like a 9-5 job than a tie – weekends are now weekends

Compared to housing – time is a big saving

Less monotony in winter

Much less time spent carting straw and mucking out

Figure 2. Personal or wellbeing benefits

More insects

Notice more birds

More voles from the differed grass

Seeing yellow rattle where we have imported species-rich bales

Grass looks lusher and more abundant

Financially making cattle more sustainable takes the pressure off everything in the system

Compared with housing, the cattle are so much cleaner and healthier

Cows are fitter at calving

Figure 3. Biodiversity, health and welfare benefits

Cost-benefit analysis – Farm a

As noted earlier, a direct cost-benefit analysis of housed vs bale grazed for all the participant farms has been difficult due to wider business restructuring, expansion or never having housed. However, Farm A has undergone the least business change and their data gives a fair indication of the costs and benefits of housing vs bale grazing.

A large mixed upland farm approximately 1,200 ha, part owned and part rented, the farm is made up of 547 ha of hill, 242 ha of rough grazing, 240 ha of permanent pasture and 162 ha of temporary grass and arable. A good portion of that is currently in GS4 or SAM3 multispecies, with 20 ha of winter wheat.

There are 220 head of April-calving beef cows, including heifers. These are currently mainly Angus and Simmental crosses, with a building herd of Luings. Calves are sold mostly store, with some taken through to finish. Historically, all cattle were housed from the end of October in straw-bedded courts. Cows were turned out after calving in April. Including for the cows and youngstock, 2,300 bales of straw were used annually for both bedding and feeding. Use was made of home-grown straw, with additional purchased. The housed cows received a diet of 14 kgs silage, 4 kgs straw and 1.5 kgs pot ale syrup fed through a mixer wagon. Youngstock are still housed.

The farm also runs approximately 2,400 breeding ewes, including hill Blackfaces and Easycare crosses. Historically, there was a stratified sheep system, with hill ewes producing in-bye ewes for the low ground, but this has now shifted to composites for all but one hill with Blackfaces.

With the change in Basic Payment Scheme, focus over the past couple of years has been to reduce costs and workload and utilise the farm resources more effectively. The sheep are gradually being moved down the hill onto in-bye ground, with a good part of the hill now being deferred from May to outwinter most of the cows during the first half of winter from the start of November. In the new year, cattle then move onto bale-grazing fields closer to the sheds, before being housed in February. In-calf heifers don't go to the hill but are bale grazed from November until February on some of the better ground.

The farm bale grazes three mobs: one of heifers and second calvers, plus any lean cows, then two mobs of 70 head of cows. Each mob of 70 head are bale grazed on 9–10 ha, with 180 bales made from a different field set out on their ends in September. A contractor mows, with tedding and baling done in-house. Bales are all set out in one day, with one staff member all day, plus another for half the day. A hydraulic trailer is used for moving bales.

The bale-grazing fields are shut off in early July to allow covers to build. The aim is to feed the cows a diet of 50:50 deferred grass:hay. Once on the bale grazing in the new year, the cattle are moved daily, with bales rolled out onto the previous day's grazed area, with a single wire electric fence moved forward to give a fresh allocation of pasture. There is no back fence. Each mob requires approximately 30 minutes to unroll bales and move the fence. A side-by-side is used to do these daily tasks, meaning that tractors are only on the field when hay is set out in September. The bale grazing lasts approximately 63 days.

The key cost saving areas of this farm compared with housing are:

- Switch from making silage to hay, plus having an unharvested 'standing hay crop' in the bale grazing area
- Reduced purchased straw and pot ale syrup
- Reduced daily labour requirement
- Reduced fuel use and wear and tear on machinery and equipment
- Reduced costs of mucking out and muck spreading

Under the old housed system, sheep would usually have utilised the bale-grazing area over autumn and into winter. The system changes to allow the bale grazing mean that ewe numbers have been reduced slightly. There is also a reduction in the imported fertility from the phosphate and potash content of the purchased straw. These are dealt with as income forgone in the cost-benefit analysis shown below (Figure 4).

Cost-benefit of change from housed to bale grazed system Data based on 70 head on 9 ha with 180 bales for 63 days' unimproved grassland vs 70 head housed for 140 days. Cows on bale grazing are still housed from the end of February until calving in April. Farm has de-stocked some ewes			
Housed		**Bale grazed**	
Reduced costs due to change		*Additional costs due to change*	
Silage 14 kgs/head @£0.12p/kg DM	£16,464.00	Setting out bales 6hrs @ £17/hr	£102.00
Feeding straw – 156 bales @£20/bale	£3,120.00	Making 180 bales hay @ £12/bale	£2,160.00
Bedding straw – 24 bales/week @£13/bale	£6,240.00	Bale wastage @ 10%	£216.00
Labour 6 hrs/week @£17/hour (employed)	£2,040.00	Labour – daily moves 0.5hrs/day @ £17/hr	£535.50
14 t Pot ale syrup @£141/t	£1,974.00	Fuel @ £3.21/day	£202.23
Fuel @ £0.13/head/day	£1,274.00		
Muck spreading ~700 t @£50/hr	£560.00		
Total costs saved	£31,672.00	*Total cost increase*	£3,215.73
Total costs saved/head /day	£3.23	Total cost increase/ head/day	£0.73
Additional income due to change		*Income forgone due to change*	
None	Nil	8 ewes/ha over 9 ha @£50/hd before forage costs	£3,600.00
		P&K value purchased straw 156 @£2.98/bale*	£464.88
Total income increase	£0.00	*Total income forgone*	£4,064.88
Total income increase/ head/day	£0.00	Total income forgone/ head/day	£0.92
Net benefit/ head/day	£3.23	Net cost /head/day	£1.65
Benefit less cost £/head/day	£1.58		

	* AHDB (March, 2023) https://ahdb.org.uk/knowledge-library/livestock-manures-for-the-arable-rotation adjusted for cattle offtake
Wider benefits	Wider costs
'If things go wrong in the shed, they tend to be harder to fix than a burst wire'	*Still have fixed costs tied up in shed and machinery*
Less monotony over the winter	*Risks of poor weather – winter 2023–24 has been wet*
Cleaning out pastures better over winter	*Potential nutrient losses from bale-grazing field*
Cattle being more financially viable takes pressure off sheep enterprise output	
Seeing a lot more voles in the bale-grazing fields	

Figure 4. Cost-benefit analysis of bale grazing vs housing – Farm A

Although the farm doesn't bale graze all winter, the cost saving when not housing is £3.23 per head per day. The saving comes from not making silage (£1.68), the reduction in straw use (£0.95), labour (£0.21), pot ale syrup (£0.20), fuel (£0.13) and muck spreading (£0.06).

To balance, the cost to bale graze is £1.65 per head per day. This is made up of income forgone from reduction in ewes (£0.99), making hay (£0.59), labour (£0.15), loss of P and K from purchased straw (£0.13), bale wastage (£0.06), fuel (£0.06) and setting out bales (£0.03).

The net financial benefit to the farm when bale grazing is £1.58 per head per day. Effectively, this is halving the housing cost. The farmer also noted wider benefits: notably there being less monotony over winter, freeing up time for other tasks and improving the financial viability of the cattle, thus reducing the pressure on other enterprises to prop it up. They are also noting more voles in the bale-grazing fields and have reported seeing more barn owls.

The biggest overall savings have been in switching from silage to hay and not having to purchase straw. Fuel costs have more than halved, with labour costs halved. Given the likely high straw price in winter 2024/25, this cost saving is likely to be even greater.

This farm grazes deferred hill during the first half of winter. The cost savings will be even greater during this period as there is no need to provide or roll out hay. Cattle are now only housed for around six weeks ahead of calving. Although not within the scope of this report, this combination of deferred and bale grazing outwintering is offering significant savings to the business and helping maintain the viability of the herd within the wider farm system.

Further work

Potential nutrient gain or loss is an important aspect of implementing bale grazing on UK farms. While there is useful work from North America, our climate and soil types are different and therefore warrant further research to fully understand the implications and costs of nutrient losses or gains.

Another area of interest is the potential for bale grazing heifers and/or youngstock on rotational leys with hay or silage. Two of the participating farmers currently do this, but there isn't sufficient data to undertake a cost-benefit analysis within this report. It is an area that may prove useful to wider industry who perhaps don't have access to hill or rough grazing or are seeking to find alternatives to forage crop wintering.

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