

The Demonstration Farms

Report 2

Woodchip for Livestock Bedding Project

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Mae'r Proiect Sglodion Pren ar gyfer Samau Da Byw a gyflenwir gan Hybu Cig Cymru yn derbyn arian cyfatebol gan y Comisiwn Coedwigiaeth, Asiantaeth yr Amgylchedd Cymru a Llywodraeth Cynulliad Cymru fel rhan o Cyswllt Ffermio.

INTRODUCTION

The Woodchip for Livestock Bedding Project aimed to investigate the potential use of woodchip as an alternative to straw as an indoor bedding material. The first phase of the project studied the initial housing phase and investigated the impact of the moisture content of the wood, effect of diet on bedding performance and effect of wood species on woodchip performance. The findings of the initial phase can be found in [Report 1](#).

This follow-on study examined the use of woodchip as bedding material on 10 farms across Wales. The purpose of these farms was to test the findings from the earlier work by utilising practical on-farm demonstrations on commercial farms.

It is not always possible to draw direct comparisons between the individual demonstrations on the 10 farms but the study aimed to represent the most commonly used systems on livestock farms in Wales. In this way, other farmers in the area were able to identify with the system that best matched their own and draw on the experiences of the demonstration farm before deciding whether to use woodchip bedding on their own farm.

The project was funded by the Welsh Assembly Government, through Farming Connect, the Forestry Commission Wales and the Environment Agency Wales.

OBJECTIVES

The objective of this part of the project was to investigate and demonstrate the following issues:

- Ease of sourcing woodchip for the demonstration farms at the sites across Wales
- Practicalities associated with storing woodchip in bulk on farms
- Performance of woodchip as indoor bedding in a commercial farm situation
- Practicalities of using woodchip as part of routine husbandry on farms
- Cost of using woodchip compared to straw

DEMONSTRATION FARMS

In order to select the demonstration farms, approximately three farms were visited in each area prior to making the final selection. Identifying these potential farms was done through liaison with the regional Farming Connect facilitators, contacts known within HCC and by farmers who wished to become involved in the project contacting the project officer. The final selection was made according to the following criteria:

- Even geographical spread across Wales
- Farming systems typical of their area
- Willingness to host an open day
- Suitability for hosting an open day

It was also considered important to get an even distribution of demonstrations utilising sheep and those utilising cattle. This proved difficult, as more farmers appeared more willing to house their cattle on the woodchip than sheep. From the final selection there were three farms using only sheep, six farms using only cattle and one farm housing sheep and cattle on the woodchip.

Location of demonstration farms

The locations of the selected demonstration farms are shown in Figure 1.

Figure 1

Ffermydd Arddangos Prosiect Naddion Pren ar gyfer Gwasarn Da Byw
Woodchip for Livestock Bedding Project Demonstration Farms



Meat Project logo: Ffermydd Arddangos Prosiect Naddion Pren ar gyfer Gwasarn Da Byw a gwasarn gan Hybu Cig Cymru a gwasarn gan Gwasarn Cymru. Cofrestrwyd ym 2014 gan y Cyswllt Cymru, Menter a Chymorth Cymru a Llywodraeth Cymru a Llywodraeth Cymru a Llywodraeth Cymru.

The Woodchip for Livestock Bedding Project delivered by Hybu Cig Cymru, a Welsh leader in the Private, Commercial, Environment Agency Wales and the Welsh Assembly Government as part of Farming Connect.

SOURCING THE WOODCHIP

The physical qualities of the woodchip were selected according to the findings of the initial housing phase (see [Report 1](#)). However, it was discovered that there is huge regional variation in the availability, quality and cost of woodchip. This created considerable problems and in many cases the greatest cost was haulage.

In some areas woodchip from recycled wood is being promoted as animal bedding. The types of recycled wood include chipped pallets, waste wood from the building industry and furniture making, and the wooden drums that are used for coiling new power cables on. Steps are taken to remove the nails by passing the material over strong magnets. Woodchip from these sources make very effective bedding material because of the high dry matter content of the wood. However, care must be taken as woodchip produced from recycled wood often produces a splinter-like shape, which has the potential to cause injury to the animals. The cost is usually very attractive as the material being chipped is a waste product that needs to be disposed of. One of the demonstration farms used woodchip produced from chipped pallets and details of how this product performed will be discussed in a later section.

When using recycled wood it is important to ensure the wood has not been treated with preservatives or glues. There is no information available on whether residues will accumulate in the soil and because of this the Environment Agency has recommended that woodchip that has been treated with glues or preservatives should not be used. Unfortunately, it was beyond the timescales and scope of this project to investigate this issue further.

Wherever possible, farmers were encouraged to utilise wood from their own farms for the demonstration. This proved to be particularly effective on one farm since the farmer was able to supply enough wood for himself and for one of the other demonstration farms. Another of the demonstration farms was also able to utilise woodchip created as a by-product from another of his farm enterprises. This will be described in more detail later.

It was hoped that any farmer who had been doing any hedge thinning would be able to chip this material for use as bedding. However, it became apparent during this study that the volume required to create enough woodchip for which to house animals for any length of time was greater than that of thinnings produced at any one time. Added to this was the cost of chipping a small amount of wood. Although we still advocate the use of such material as animal bedding, farmers need to consider whether it is cost effective to chip small quantities, or whether it is practical to stockpile hedge thinnings until a large enough quantity has been produced. Of course, if this material can be added to any other wood that may arise from woodland management on the farm then it becomes worthwhile to hire a chipper. There may also be benefits in avoiding the restrictions imposed on burning hedge thinnings on farm.

It had been suggested that the project should utilise the quantities of wood that are chipped and left alongside highways, railway embankments, power lines and in forestry. This material is usually the result of thinning and trimming programmes (to remove overhanging branches from roads and power lines) and is usually chipped as soon as it has been cut. However, previous work on the development sites ([Report 1](#)) has shown that this fresh “green” wood is unsuitable for animal bedding because it has a high moisture content and hence has limited absorbency and so does not perform as well as woodchip produced from seasoned wood. This material is very attractive to farmers

because it is cheap and in some cases the contractors will deliver it free of charge as a way of disposing of a waste product. Hence, while it is appreciated that farmers will be tempted to use this, it is not recommended.

Table 1 gives information on the suppliers of woodchip for each demonstration farm.

Table 1 Woodchip suppliers for the Demonstration Farms

Demonstration Farm	Woodchip supplier
Bodgaeaf Isaf	Local supplier of chipped pallets
Hendre Arddwyfaen	Gwynfor Evans, Corris
Blaencwm	Own wood chipped by Gwynfor Evans, Corris
Cae Coch	Wood supplied by Blaencwm and chipped by Gwynfor Evans, Corris
Pencefn Drysgol	Gwynfor Evans, Corris
Blaenglowon Fawr	Teifi Timber, Llanllwni, Pencader
Cilgryman Fawr	Mike Plumb, Narberth, Pembrokeshire
Lower End Town Farm	Mike Plumb, Narberth, Pembrokeshire
Gilfach Farm	Teifi Timber, Llanllwni, Pencader
Maindiff Farm	By-product from on-farm composting unit

Size and shape of chips

From the work detailed in [Report 1](#) the project recommends a chip size of 30mm² for livestock bedding. It was found that a square, blocky shape is preferable to a thin, pointy shape since there is less potential for injury to the animal. The size and shape of chip produced was found to be rather variable and factors such as moisture content of wood and size and shape of wood being fed into the chipper can dramatically affect the size and shape of the end product. Screens are inserted into the chipper but these affect the maximum size and have less control over the minimum size of chip.

When recommending the size of woodchip to be used it is useful if the farmer considers the intended use of the woodchip after it has been used as bedding. If the intention is to re-use the composted woodchip as bedding the following winter then a larger chip (up to 50mm²) can be used. However, if the intention is to spread the composted woodchip on the land as soon as possible then a smaller chip size should be used since a smaller chip will break down quicker than a larger chip.

Moisture content of wood

One of the main findings from the first report was that using woodchip with moisture content of below 30% is crucial in order to maximise its performance. A drier woodchip has a greater capacity to absorb faeces and urine and hence, nitrogen. Not only does this lead to a drier bed but it also means that the woodchip has taken on board nitrogen that is essential for the composting process.

Table 2 Moisture content of woodchip used on demonstration farms

Demonstration farm	Moisture content of wood (%)
Cae Coch	23.3
Blaencwm	23.3
Pencefn Drysgol	37.2
Blaenglowon Fawr	52.5
Maindiff Farm – screened wood	33.8
Maindiff Farm - sawdust	18.9
Lower End Town Farm	32.2
Gilfach	39.7
Hendre Arddwyfaen	42.6

The moisture content of the woodchip at Bodgaeaf Isaf and Cilgryman Fawr was not assessed.

The table shows that only Cae Coch and Blaencwm used woodchip of the desired moisture content and this illustrates the difficulty in obtaining dry woodchip. In all cases, when suppliers were contacted it was specified that the project required woodchip with a moisture content of 30% or less, but in most cases what was delivered was wetter. This highlights a major problem in the use of woodchip as animal bedding as this project has consistently shown that the drier woodchips perform the best. It was also apparent that an organised supply chain is required to ensure that wood is sourced early enough to allow it to dry prior to being chipped. This may mean that woodchip suppliers need to be sourcing wood 12 months prior to them being able to sell it, which could mean additional costs to farmers. Another option would be for farmers to source and stockpile wood in advance.

The situation with Cae Coch and Blaencwm demonstrates how this could work effectively. Blaencwm had a supply of soft wood that had been stored on the farm for over 12 months. After a prolonged dry period a chipper was hired in to chip enough wood to supply both Blaencwm and Cae Coch. The result was a very high quality woodchip with low moisture content. Haulage distances and costs were minimised because of the proximity to both farm holdings and it also proved cost effective to chip for both farms on the same day.

Chippers used

The wood for Cae Coch, Blaencwm, Hendre Arddwyfaen and Pencefn Drysgol was chipped using a Heizohack HM8400. At Cilgryman Fawr the wood was chipped with a Laimet HP25 using a 30mm cone. The wood for Lower End Town was chipped using a Jenson 340.

The wood supplied to Gilfach and Blaenglowon Fawr came from Teifi Timber Sawmills. Their wood chippers are static machines that are permanently part of the sawmill line. Two chippers are incorporated into the line, a Klockner chipper and a Broadbeck chipper, the latter being to chip bark from the outer edge of the wood. Both machines produce a chip of 25-30mm in size.

The wood at Mairdiff Farm was shredded using machinery that is used to shred green waste for the composting facility. This produced a product that varied in size and shape and was very different to the material used on the other demonstration farms.

Figure 2 Chipping wood with a Heizohack HM8400



PARAMETERS MONITORED BY THE DEMONSTRATION FARMS

All of the demonstration farms were asked to monitor the parameters outlined below. This allowed the study to compare the use of woodchip versus straw under different systems and farming practices. Comparisons were then made on the suitability of woodchip for the different systems and indeed, whether it is better suited to some systems and not to others.

Quantity of bedding used

The demonstration farmers were asked to record how much bedding (straw and woodchip) was applied to the pens. The weight of woodchip was determined by filling the bucket (of either the tractor or the loadall) and then weighing this by whatever means were available.

Frequency of applications and time taken to apply bedding

Recordings were also made of how often fresh bedding needed to be applied to each pen and the time it took to apply this material. The purpose of this was to establish which system has the greatest labour requirement.

Weather

The weather was recorded so that if additional bedding was required it would be possible to check if this was due to wet weather. It is well known that extra bedding is often required during periods of prolonged rainfall and so when interpreting the results it may be necessary to refer to the weather conditions.

Liveweight, body condition score and cleanliness

Where possible the demonstration farms monitored liveweight, body condition score and cleanliness of the animals. Not all farms had facilities to weigh the animals so body condition score proved a useful measure in these cases. Cleanliness was assessed using the Meat Hygiene Service (MHS) system of scoring where animals were scored from 1-5, with 1 being clean and 5 being dirty.

Cost of using straw versus woodchip

The difference in price between using straw as bedding and using woodchip as bedding was assessed for each of the demonstration farms. The figures were approximate and based on the amount of bedding material used over the monitored period. The main problem with assessing the cost is that straw was priced per tonne whereas woodchip was priced per m³. A further difficulty arose with measuring how much woodchip was used. Straw use was quite easy to monitor as the number of bales were easily recorded and the cost per tonne easily calculated. However, to measure the quantity of woodchip used required the volume of the handling buckets used on the farm had to be calculated and a record kept of the number of buckets used. In some cases the amount of wood used to produce the woodchip was known and so the price was worked out on a per tonne basis.

BEEF CATTLE DEMONSTRATIONS

Seven of the demonstration farms housed beef cattle on woodchip. These farms represent a range of different systems as outlined below.

1. Suckler cows and store cattle

Blaencwm, Llanuwchllyn

There were 18 Welsh Black cows at Blaencwm and traditionally the cows, calves and stores were housed on straw. However, Blaencwm also had its own sawmill enterprise and they were keen to investigate the potential of utilising low-grade wood and off cuts for bedding.

The cows and calves were housed on 16 November 2006 and were split into two groups, one housed on straw and the other on woodchip. There were no facilities to weigh the cattle but during the demonstration the cows did not lose condition and the calves grew satisfactorily.

The table below shows the cleanliness scores for the two groups of cattle. Only the adult cattle were recorded. The cattle on the woodchip kept significantly cleaner than those housed on straw.

Table 3 Cleanliness scores of cattle at Blaencwm

Group	Bedding	23 Nov	30 Nov	7 Dec	14 Dec	21 Dec	28 Dec	4 Jan	11 Jan	18 Jan
1	Woodchip	1.0	1.25	1.6	1.9	2.0	2.0	2.0	2.3	2.4
2	Straw	1.6	2.5	3.0	3.4	3.8	3.8	3.8	4.0	4.1

The group housed on straw were given fresh bedding every two to three days, which amounted to one bale per week. This group were cleaned out on a weekly basis. The group housed on woodchip were given fresh bedding twice a week for the first four weeks and then it was only required once a week. This group were not cleaned out until the end of the demonstration. The table below illustrates the cost of housing the cattle over the eight week demonstration on the two different bedding materials.

Table 4 Cost of using different bedding materials at Blaencwm

Bedding material	Total amount used	Cost per unit	Total cost
Straw	8 bales	£15/bale	£120
Woodchip	27.6 m ³	£11/ m ³	£304

Although the wood belonged to Blaencwm, for the purposes of this report it was given a value of £10/tonne before the cost of chipping and haulage was added. However, if this farm was able to generate enough waste wood from the sawmill it may be more cost effective to use woodchip than buy in straw.

Maindiff Farm, Abergavenny

Maindiff Farm provided an opportunity to demonstrate the potential for using a recycled material as woodchip bedding. Maindiff Farm received green waste from local county councils and this was composted on site in a purpose built facility. During the process the compost was screened to remove any large pieces of wood that had not broken down. Historically these pieces of wood would re-enter the composting process repeatedly until they had broken down. However, on this occasion they were used as bedding material under suckler cows. This woodchip bedding had a very different appearance to the woodchip used on the other demonstration farms and because it had been passed through a shredder rather than a chipper the end product was not of a uniform size.

Sawdust is also delivered to Maindiff Farm from various sites and so as part of the demonstration one pen was housed on sawdust. This was produced from very dry wood from the manufacturing industry and hence produced a very dry bedding material. Young cattle were housed on this and remained very clean throughout the demonstration.

Table 5 shows the frequency that fresh bedding material was applied to each pen. It took approximately 10 minutes to apply each bedding type but when the frequency of applications is taken into account the screened wood and sawdust had much less of a demand on labour.

Table 5 Frequency of application and amounts of bedding used at Maindiff Farm

Pen	Bedding material	Frequency of application	Total amount used
1	Screened wood	Every 5 days	18 JCB buckets
2	Straw	Every 1-3 days	40 bales
3	Sawdust	Every 6 days	14 JCB buckets

There were no facilities to weigh the cattle on the farm but adult cattle remained in good condition throughout the demonstration and the young cattle grew at the desired rate. The cleanliness of the cattle was monitored and those housed on the sawdust maintained the highest level of cleanliness. The cattle on the woodchip also stayed very clean but those housed on straw tended to get dirty. This is the main reason why straw was applied every 1-3 days. No health problems were recorded for any of the cattle during the demonstration.

It was very hard to calculate a cost for the screened wood and sawdust at Maindiff Farm. In the case of the sawdust it was costing the farm nothing because it was a waste product that was disposed of under licence at the farm. With the screened wood this was a by-product of another process. The farm charged a gate fee for the green waste to be delivered to the farm and the cost to the farmer to process this waste is beyond the scope of this study. However, using the wood and sawdust as bedding material was an ideal way to utilise a product that was produced on the farm rather than buying in straw.

Blaenglowon Fawr, Talgarreg

Two groups of store cattle were housed on 1 December 2006, one group on woodchip and the other on straw. The cattle were fed silage *ad libitum* and additional straw was offered to the ones housed on woodchip. The cattle on the woodchip kept consistently cleaner than those housed on straw and in particular there was no accumulation of muck on the buttocks of the cattle housed on woodchip. However, the cattle housed on the woodchip did tend to have dirtier briskets. The table below shows the quantities of each bedding type used and the cost of each.

Table 6 Cost of different bedding materials and frequency of application at Blaenglowon Fawr

Pen	Bedding material	Total amount used	Cost per unit	Total cost	Frequency of application
1	Woodchip	8.5 tonnes	£29/tonne	£246.5	Every 6-7 days
2	Straw	7.25 bales	£60/tonne	£145	Every 11-12 days

It is interesting to note that fresh woodchip was required more frequently than fresh straw during this demonstration. This is possibly explained by the high moisture content of the woodchip which was 52.5% and hence not as absorbent as the straw.

No weights were recorded for the cattle but their growth was considered equivalent on the woodchip and straw. No health problems were observed in either group of cattle apart from one heifer that became lame on the woodchip but this was not considered to be due to the woodchip.

Cae Coch, Rhydymain

The cattle used in the demonstration at Cae Coch were a mixture of Welsh Black cows with calves and yearling steers. They were housed on the 11 November 2006 with two groups of cows and calves housed on straw. There were three cows in each pen and one pen contained three calves (born May 2006) while the other pen contained four calves (born July 2006). Three pens of cattle were housed on woodchip. The first pen housed five yearling steers that were born in March 2006 and were weaned at housing. The second pen contained one five-year old Welsh Black bull and four in-calf heifers and the third pen contained three cows and three calves (born April 2006).

Silage was offered to the cattle twice daily and dung was removed from a scrape clean feeding passage twice weekly. The cattle housed on straw ate some of their bedding and hence became dirtier quicker. Some straw was offered in the trough of the animals housed on woodchip but the silage was of high dry matter content and so was considered to provide enough roughage.

Table 7 Cost of different bedding materials and frequency of application at Cae Coch

Pen	Bedding material	Total amount used	Cost per unit	Total cost	Frequency of application
1,2,3	Woodchip	50m ³	£11/ m ³	£550	Approx every 8 days
4,5	Straw	20 bales	£60/tonne	£400	Daily

The table shows the cost of using the different bedding materials and the frequency that fresh bedding was applied at Cae Coch. There was sufficient woodchip for the animals to be monitored until the end of April making this the only demonstration farm that assessed a full winter housing period.

2. Finishing cattle

Bodgaeaf Isaf, Pwllheli

Bodgaeaf Isaf has used woodchip for approximately five years and has found it to be an excellent alternative to straw on which to bed cattle. Their woodchip was produced from chipped pallets that had been passed over strong magnets to remove the nails. For the demonstration 23 cattle were housed on the woodchip and 22 on straw on 14 August 2006. They were housed earlier than usual because of a shortage of grazing.

Figure 3 Cattle housed on woodchip at Bodgaeaf Isaf



Table 8 shows the growth rates achieved by the cattle on the woodchip and straw. Both groups had an average daily growth rate of 1.14kg illustrating that the bedding type had no effect on performance.

Table 8 Average daily weight gain of cattle at Bodgaeaf Isaf

Pen	Bedding material	Average weight (kg) 14/8/06	Average weight (kg) 11/9/06	Average weight (kg) 9/10/06	Average weight (kg) 6/11/06	Average daily weight gain (kg)
1	Woodchip	486	518	564	582	1.14
2	Straw	570	607	638	666	1.14

The quantity of woodchip and straw used was recorded for a six-week period from 30 September 2006 to 8 November 2006. The table below shows the quantities used and how often fresh material needed to be applied to the pens.

Table 9 Cost of different bedding materials and frequency of application at Bodgaeaf Isaf

Pen	Bedding material	Total amount used	Cost per unit	Total cost	Frequency of application
1	Woodchip	9 tonnes	£10/tonne	£90	Every 2 days
2	Straw	11 tonnes	£60/tonne	£660	Every 2 days

All animals were given fresh bedding often enough to maintain a MHS cleanliness score of 1. The majority of animals achieved this with only a few in each pen slipping to a MHS score of 2 or 3. There were no health problems observed throughout the demonstration.

Gilfach, Neath

Gilfach Farm had approximately 140 suckler cows and all the progeny were finished on the farm between 20 and 24 months of age. The demonstration on this farm involved finishing cattle with a pen of 24 cattle housed on straw alongside a pen of 23 cattle on woodchip. The demonstration began on 6 November 2006 and finished on 8 January 2007.

Comparable growth rates were seen on the woodchip and the straw (Table 10) but the differences in quantities required and costs for the woodchip and straw show a different picture (Table 11).

Table 10 Average daily weight gain of cattle at Gilfach

Group/pen	Bedding material	Number in pen	Average weight kg 27/11/06	Average weight kg 2/1/07	Average daily weight gain
1	Woodchip	23	501	548	0.06kg
2	Straw	24	521	564	0.05kg

Table 11 Cost of bedding materials at Gilfach

Group/pen	Bedding material	Total number of days housed	Total quantity of bedding used	Cost per unit	Total cost
1	Woodchip	62	60m ³	£11.50/m ³	£690
2	Straw	62	13 bales	£60/tonne	£260

Both fresh straw and fresh woodchip was applied three times a week. Woodchip took approximately 15 minutes to apply to the pen compared to straw, which took 10 minutes. Both pens required cleaning out in mid December. This demonstration period coincided with an extremely wet period of weather. The farm recorded a total rainfall of 10 inches during November; however, this would equally affect both bedding materials.

The health of the cattle was excellent on both bedding materials and no incidences of ill health were recorded during this demonstration. The cleanliness of the animals is recorded in the table below.

Table 12 Cleanliness of animals at Gilfach

Group/pen	Bedding material	Average MHS score 27/11/06	Average MHS score 2/1/07	Change in MHS score
1	Woodchip	1.0	2.7	+ 1.7
2	Straw	1.0	2.9	+1.9

Figure 4 Cattle housed on woodchip at Gilfach



Figure 5 Cattle housed on straw at Gilfach



3. Pedigree cattle

Cilgryman Fawr, Whitland

This farm produced pedigree Limousin cattle to sell as breeding stock. Cleanliness was a major priority for this farm as not only are the cattle exhibited at shows but they also regularly receive visitors to view their stock. The farm used a mix of straw and sawdust to house their cattle on as they found that this kept the cattle exceptionally dry and clean. They were keen to try woodchip bedding based on their previous experiences with a wood based product and had a particular interest in how clean it would keep the animals.

A delivery of 60m³ of woodchip was made to Cilgryman Fawr and the bulls were housed on 14 November 2006. However, in order to keep the bulls to their desired level of cleanliness excessive quantities of woodchip were required and consequently this farm

had used up all the woodchip available by 10 December 2006. They found that the bedding was becoming very wet and dirty and to rectify this sawdust was sprinkled over the bed. This proved to be very effective in absorbing the excess moisture. The moisture content of the woodchip used at Cilgryman Fawr was not assessed but the poor performance observed suggests that the moisture content was high.

Table 13 Average daily weight gain of bulls at Cilgryman Fawr

Pen	Number of animals	Bedding material	Average weight (kg) 14/11/06	Average weight (kg) 16/1/07	Average daily weight gain (kg)
1	4	Woodchip	648	755	1.7
2	4	Woodchip	725	865	2.2
3	3	Woodchip	717	877	2.5
4	3	Straw	840	943	1.6

When the bulls were housed on 14 November 2006 they all had a MHS cleanliness score of 1; however by 20 November 2006 the bulls in all four pens were significantly dirtier. Pens 1, 2, 3 and 4 recorded MHS scores of 3, 4, 3 and 2 respectively. It is interesting to note that the three pens bedded on woodchip were dirtier than pen 4 that was bedded on straw but it must be remembered that sawdust was used in conjunction with the straw. The condition score of the bulls remained at 3 throughout the demonstration.

The heifers housed on woodchip had a MHS cleanliness score of 2 when they were housed on 14 November 2006 and this deteriorated to 3.5 by the end of the demonstration. The heifers housed on straw and sawdust had a MHS score of 2 at housing and this remained fairly constant throughout the demonstration. The heifers had an average condition score of 2 on 14 November 2006 and this increased to 3 over the course of the demonstration.

Table 14 Average daily weight gain of heifers at Cilgryman Fawr

Pen	Number of animals	Bedding material	Average weight (kg) 14/11/06	Average weight (kg) 15/1/07	Average daily weight gain (kg)
1	6	Woodchip	373	484	1.8
2	5	Woodchip	446	582	2.2
3	5	Woodchip	452	570	1.9
4	5	Woodchip	494	598	1.7
5	5	Straw	521	612	1.5
6	5	Straw	572	684	1.8

As the woodchip supplied to Cilgryman Fawr was used up by 10 December 2006 the table below compares the amount of straw and sawdust used with the amount of woodchip used over the same time period. The straw and sawdust was mixed together so the total cost of these needs to be added together before comparing with the woodchip. It is not clear why the heifers required so much more sawdust than the bulls but could be due to the heifers being stocked at a higher density.

Table 15 Amount used, cost and frequency of application of different bedding materials at Cilgryman Fawr

Bedding material	Total weight used 14/11 – 10/12/06	Cost per unit	Total cost	Cost per pen	Frequency of application
Straw	1 bale	£60/tonne	£20	£6.60	Twice during time period
Sawdust	23 Skid steer buckets	£5.80/bucket	£133	£44.30	Bulls- every 8-10 days Heifers- every 4 days
Woodchip	60m ³	£20/ m ³	£1200	£171	Bulls and heifers every 3 days

The cost of using the different bedding materials was calculated on a cost per pen basis, since there were seven pens in total using woodchip bedding compared to three pens using straw.

There were no health problems observed at Cilgryman Fawr during the demonstration but there were concerns that the bulls did not appear comfortable on the woodchip. This was attributed to their weight and an improvement was seen when sawdust was added to the pen. Prior to the application of sawdust the bulls were lying at the edge of the pens in the wetter material but following application of the sawdust they were happier to lie in the centre of the bed.

SHEEP DEMONSTRATIONS

1. Ewe lambs

Lower End Town Farm, Lampeter Velfrey

Eighty ewe lambs were housed on 14 December 2006, 40 on woodchip and 40 on straw. Their performance was monitored until 25 January 2007 and then they were turned out to grass. The results in the table below show that both groups of lambs lost weight while they were housed. The lambs were fed silage *ad libitum* and following a silage analysis it was discovered that the silage was providing below maintenance level of nutrition. To rectify the problem energy blocks were given and the lambs were wormed.

Table 16 Performance of ewe lambs at Lower End Town Farm

Pen	Bedding material	Average weight (kg) 22/12/06	Average weight (kg) 22/1/07	Total weight loss (kg)
1	Woodchip	33.40	30.78	2.62
2	Straw	34.40	30.74	3.66

Both groups of lambs were footbathed twice while they were housed as a routine treatment. There were concerns that the woodchip may cause bruising to the lambs' feet but this was not observed. In contrast, the lambs on the woodchip had drier feet which were free of muck. A few sore and overgrown feet were observed but there appeared to be more cases of this with the lambs housed on straw. Two lambs died in the woodchip pen, the cause of which was not identified, but was not considered to be due to the woodchip.

Figure 6 Ewe lamb demonstration at Lower End Town Farm



There were problems with the feeding area in the woodchip pen becoming heavily dunged and the lambs did look muckier in this pen. Consequently the woodchip bedding was forked over regularly by hand to improve the drainage and utilise the bedding more

effectively. Originally the silage was fed from racks that were within the pens but due to the problems with the bedding becoming dirty the silage was fed along the outside edge of the pen and the lambs accessed this by putting their heads through the barrier.

Table 17 Quantity used and cost of bedding materials used for ewe lambs at Lower End Town Farm

Pen	Bedding material	Total quantity used 14/12/06-25/1/-07	Cost per unit	Total cost
1	Woodchip	19m ³	£20/ m ³	£380
2	Straw	1 quadrant bale 2/5 mini Heston bale	£60/tonne	£26

There were differences in the time taken to apply fresh bedding to the straw pen compared with the woodchip pen. Over the six-week period that the ewe lambs were housed it took a total of 90 minutes to apply fresh straw compared with 195 minutes to apply fresh woodchip. This is mainly down to the fact that woodchip bedding had to be spread by hand as it was too heavy for the animals to move around with their feet.

2. Finishing lambs

Pencefn Drysgol, Tregaron

This farm operated a large-scale lamb finishing enterprise. Lambs were bought in on a regular basis at between 34 and 40kg and fed on home produced feeds with the aim of finishing them in 2-6 weeks. The target dead weight was 20kg with a conformation class of U3L.

The first groups of lambs were housed on woodchip on 23 October 2006 and Table 18 shows their performance compared with two groups housed on straw. Straw and hay was offered in racks to the lambs housed on woodchip to provide roughage for these animals, as they were not able to obtain it from their bedding.

Table 18 Average daily weight gain of lambs at Pencefn Drysgol

Group/pen	Bedding material	Number in pen 23/10/06	Number in pen 9/11/06	Total weight of lambs (kg) 23/10/06	Total weight of lambs (kg) 9/11/06	Average daily weight gain (kg)
1	Woodchip	51	50 *	1735	2040	0.359
2	Woodchip	55	55	1878	2200	0.344
3	Straw	56	56	1952	2480	0.554
4	Straw	52	52	1889	2240	0.397

* - One lamb removed from pen 27/10/06, average daily weight gain calculated using 50 lambs

The average daily liveweight gain for the lambs on straw was 0.478kg per day compared to 0.352 kg per day for the lambs on woodchip for this 17-day period (Table 18). This was repeated with a second batch of lambs that were housed in the same four pens, two pens on woodchip and two on straw. The average daily liveweight gain for these batches was 0.349kg per day for the lambs on woodchip and 0.483kg per day for the lambs on straw.

Pencefn Drysgol were confident that they consistently achieve daily liveweight gains of 0.480 kg with their lambs that are housed on straw.

It should be noted that these daily liveweight gains were only calculated for the 17 days that the lambs were housed as part of the project. These figures are not representative of their liveweight gains from birth to finishing.

Figure 7 Lambs on woodchip at Pencefn Drysgol



The cleanliness of all lambs whether they were housed on straw or woodchip was very good. One dead lamb was removed from a woodchip pen on the 27/10/06 but its death was not thought to be due to the woodchip. One other lamb housed on the woodchip was in poorer condition than the others on the 9/11/06 and this poor performance was thought to be due to the woodchip bedding. Two further lambs were treated for lameness but in both cases it was not attributed to the woodchip bedding.

Table 19 Quantity used and cost of bedding at Pencefn Drysgol

Group/pen	Bedding material	Total quantity used	Cost per unit	Total cost
1	Woodchip	7m ³	£22/ m ³	£154
2	Woodchip	7m ³	£22/ m ³	£154
3	Straw	750kg	£60/tonne	£45
4	Straw	750kg	£60/tonne	£45

Fresh straw needed to be applied daily but was done mechanically and only took a couple of minutes for each pen. Fresh woodchip only needed to be applied weekly and took about 20 minutes per pen to apply and spread around the pen.

Lower End Town Farm, Lampeter Velfrey

Lower End Town Farm housed two groups of lambs for finishing on the 4th February 2007, one group on straw and the other on woodchip. There were 28 lambs in each group. The feed was administered *ad libitum* from hoppers, which created problems with high levels of muck around the feed area. Five lambs in each group were not fit for sale

on 22 February 2007 and were monitored for a further 13 days. The table below shows the performance of the 23 lambs that went for slaughter on 22 February 2007.

Table 20 Daily weight gain of lambs at Lower End Town Farm (First group to go to slaughter)

Pen	Bedding material	Average weight (kg) 4/2/07	Average weight (kg) 22/2/07	Average daily weight gain (kg)
1	Woodchip	37.32	43.67	0.35
2	Straw	39.08	45.67	0.37

The table below shows the performance of the 10 lambs, five in each pen, which took longer to finish and were therefore monitored for 31 days.

Table 21 Daily weight gain of lambs at Lower End Town Farm (Second group to go to slaughter)

Pen	Bedding material	Average weight (kg) 4/2/07	Average weight (kg) 7/3/07	Average daily weight gain (kg)
1	Woodchip	35.5	43.6	0.26
2	Straw	36.1	45.4	0.30

It is not clear why these ten lambs grew slower than the others in the group. Daily weight gains were slightly less on the woodchip.

There were no health problems observed with either group of lambs but a precautionary footbath was given.

Blaenglowon Fawr, Talgarreg

Seventy lambs were housed on 23 December 2006, 35 on woodchip and 35 on straw. They were housed on the woodchip until 10 January 2007 when the lambs that were ready for slaughter were drawn from the group. Any remaining lambs were re-housed on straw. Their growth was monitored and is shown in Table 22. The lambs were fed a pelleted finishing diet *ad libitum* together with *ad libitum* straw from a rack.

Table 22 Average daily weight gain of lambs at Blaenglowon Fawr

Pen	Bedding material	Average weight (kg) 29/12/06	Average weight (kg) 10/1/07	Average daily weight gain (kg)
1	Woodchip	37.06	38.97	0.16
2	Straw	36.64	40.04	0.28

Table 23 shows the cost of housing the lambs on woodchip compared to straw and the frequency at which fresh bedding was applied.

Table 23 Cost and frequency of application of bedding at Blaenglowon Fawr

Pen	Bedding material	Total amount used	Cost per unit	Total cost	Frequency of application
1	Woodchip	2625kg	£29/tonne	£76	Every 8 days
2	Straw	1.25 bales	£60/tonne	£25	Twice during demonstration

The lambs kept equally clean on the woodchip and the straw bedding and there were no health problems observed.

3. Pregnant ewes

Hendre Arddwyfaen, Cerrigydrudion

Eleven pens of pregnant ewes were housed on 22 January 2007 approximately one month prior to lambing. Three of the pens were housed on woodchip and the other eight pens were housed on straw. The body condition score of the ewes at housing was between 2 and 3 and this remained constant during the run up to lambing. The ewes had a MHS cleanliness score of 1 at lambing and again this was maintained throughout.

The ewes were fed silage *ad libitum* from 22 January 2007 to 16 February 2007 when they were switched to hay prior to lambing beginning. This was found to keep the woodchip bedding much drier and fresh applications were required less frequently as shown in Table 24.

The ewes were not lambed on the woodchip bedding due to concerns about the ewes not being willing to mother a lamb that picked up woodchip on its coat while wet. The ewes were removed from the woodchip bedding immediately prior to lambing and housed on straw bedding.

Table 24 shows the amounts of bedding used. It should be noted that three pens of woodchip are being compared with eight pens of straw.

Table 24. Cost and frequency of application of bedding at Hendre Arddwyfaen

Bedding material	Total quantity used	Cost per unit	Total cost	Cost per pen	Frequency of application
Woodchip	33m ³	£15/m ³	£495	£165	Every 4 days before diet change Every 7 days after diet change
Straw	21 bales	£60/tonne	£382	£48	Every 2-3 days

One ewe aborted her lambs on the woodchip bedding on 4 February 2007. This was not considered to be due to the woodchip bedding. There were no other health problems during the demonstration.

DISCUSSION

Availability of woodchip across Wales

Wood is readily available across Wales from a variety of sources. A good distribution of companies and private operators with chippers was found and, in theory, marrying the wood supplies with the chippers should have been an easy process. However, a problem arose when it was stressed that the wood needed to have a moisture content of less than 30%. There were very few suppliers who were aware of the importance of this or had the space and facilities for storing wood to allow it to dry. The majority of companies approached were chipping green wood that had been recently felled.

A small minority of suppliers were aware of the importance of dry wood because of their involvement with supplying wood fuel boilers. Wood fuel payments are made according to the calorific value of the wood which is directly influenced by its moisture content. The time taken and storage facilities required to dry the wood is the main reason why woodchip is comparatively more expensive than straw. Also, as wood fuel boilers increase in popularity the cost of woodchip bedding may rise further.

The Forestry Commission is now putting a wood supply chain in place to help with the sourcing of dry wood for chipping. This facility is primarily for those seeking wood for fuel boilers but will also be available for farmers wanting woodchip bedding.

Facilities for storing and handling woodchip on farms

A major disadvantage of woodchip bedding is the amount of space required to store it. Due to its voluminous nature, when compared weight for weight more space is required to store woodchip than straw. Also straw comes in neatly packaged bales that will stack on top of each other and if necessary, these are weather-proof enough to be stored outside. Woodchip however needs to be stored undercover and sheltered from driving rain. It is possible to store woodchip outdoors covered with a weather proof tarpaulin but care must be taken to avoid water seeping in from underneath.

Wood can be stored more efficiently before it is chipped but due to the cost of hiring a chipper it is more cost effective to chip a large quantity in one go. Therefore, it is not advisable to chip small quantities as and when they are required.

The type of buildings that a farm has is also a consideration when considering using woodchip. It was seen at Hendre Arddwyfaen that the layout of the sheep pens did not lend itself well to using woodchip and a lot of manual handling was required. However, the sheds at Gilfach, for example, were ideal as the cattle could be shut off the bedding area and the machinery could be driven into the shed to apply the fresh bedding.

For handling and using woodchip bedding it can be concluded that a high degree of mechanisation and buildings in which machinery can be driven are required. Even in a situation where woodchip is cheaper than straw, the labour requirement must be considered.

Performance of woodchip bedding in a commercial farm situation

The initial housing demonstration done at IGER-Aberystwyth, ADAS-Pwllpeiran and Glynllifon College concluded that woodchip was as effective as straw as a bedding material provided that the woodchip is dry. In most cases the information from the demonstration farms has supported these conclusions.

The exception to this was the poor performance of finishing lambs on woodchip at Pencefn Drysgol and Blaenglowon Fawr. In both cases it appeared that the poor performance of the animals was directly attributable to the woodchip bedding but the reasons for this are not clearly understood. During the initial housing phase ewe lambs were housed at IGER on woodchip and straw and the liveweight changes observed were due to the diets and not the bedding material. It appears however, that when the animals are put under pressure to perform (ie grow quickly) the woodchip bedding does not provide conditions that are as favourable as the straw. To clarify this point further, it should be noted that the woodchip still provided a dry, clean bed that kept the animals free from disease but some other factor was playing a part. Based on observations from the farmers involved and from discussions with the project officer it was considered that the lambs were not as comfortable on the woodchip bedding and spent less time lying down. The knock-on effect of this was that less time was spent ruminating and therefore feed was not being converted into growth. These concerns were subsequently investigated further in a trial conducted at the Institute of Rural sciences, Aberystwyth University (see [Report 3](#)).

The recycled wood used at Bodgaeaf Isaf under cattle performed extremely well as a bedding material. The growth rates of the cattle were equally as good on the woodchip as they were on the straw and due to the relatively low prices paid for the woodchip it proved more cost effective to house the animals on woodchip than on straw (see Table 25). This highlights the potential of recycled wood as a bedding material but care must be taken to source a product that has had all nails removed and contains no chemical preservatives or treatments.

ANALYSIS OF COSTS

A comparison of the cost of using woodchip compared to straw is shown in the tables below although care must be taken when comparing the figures between farms as the pens varied in size, as did the number and type of animals housed. In most cases there was an equivalent area and number of animals housed on both the woodchip and straw on each farm but where this differed the figures are shown on a per pen basis as indicated in the table. The demonstration on each farm varied in length of time so the number of days is shown and the costs are also worked out on a per day basis to aid comparisons.

Table 25 Comparison of cost per day of using woodchip and straw under cattle

Farm	Days	Total cost of woodchip	Total cost of straw	Cost of woodchip per day	Cost of straw per day
Blaencwm	60	£304	£120	£5.06	£2.00
Cae Coch	164	£550	£400	£3.35	£2.44
Blaenglowon Fawr (cattle)	100	£246	£145	£2.46	£1.45
Bodgaeaf Isaf	39	£90	£660	£2.30	£16.92
Gilfach	62	£690	£260	£11.12	£4.19
Cilgryman Fawr *	26	£171	£51 [#]	£6.57	£1.96

* Costs shown are per pen and not the total cost for the whole demonstration

[#] Straw and sawdust are used together hence costs have been added together

Table 26 Comparison of cost per day of using woodchip and straw under sheep

Farm	Days	Total cost of woodchip	Total cost of straw	Cost of woodchip per day	Cost of straw per day
Lower End Town (ewe lambs)	42	£380	£26	£9.04	£0.62
Pencefn Drysgol	17	£308	£90	£18.11	£5.29
Hendre Arddwyfaen*	60	£165	£48	£2.75	£0.80

* Costs shown are per pen and not the total cost for the whole demonstration

These figures show the tremendous variation that was observed across the demonstration farms. This was due to a variety of factors such as different systems and different types of animals housed. There was also variation in the amount of straw used on each farm highlighting the difficulty in comparing figures between farms. However, useful comparisons can be made between the cost of using woodchip compared to straw on each farm and the tables illustrate how on all farms (except Bodgaeaf Isaf) it was more expensive to use woodchip than straw.

One factor that was often overlooked on farms was the labour input. The project was very conscious to record the difference in labour inputs when using straw as bedding compared to when using woodchip. The length of time recorded on each demonstration farm is shown in Table 27. Due to the variation in days on the demonstration it has also been calculated on a per day basis. During 2006, Hybu Cig Cymru (in conjunction with English Beef and Lamb Executive and Quality Meat Scotland) commissioned a survey to calculate a cost per hour for unpaid family labour on farms. This figure was calculated to be £11.18 per hour. This figure has been incorporated into the results shown below to put a monetary value on the time taken in each of the systems.

Table 27 Comparison of time and labour costs when using woodchip and straw on the demonstration farms

Farm	Days	Woodchip	Straw	Woodchip per day	Straw per day	Woodchip £ per day	Straw £ per day
Blaencwm	60	12 hrs	7 hrs	12 mins	7 mins	£2.28	£1.33
Cae Coch	164	11 hrs 5 mins	13 hrs 50 mins	4 mins	5 mins	£0.76	£0.95
Pencefn Drysgol	17	1 hr	45 mins	3.5 mins	2.6 mins	£0.67	£0.49
Gilfach	62	7 hrs	4hrs 20 mins	6.7 mins	4.2 mins	£1.27	£0.80
Maindiff	65	2 hrs	6hrs 50 mins	1.8 mins	6.3 mins	£0.34	£1.20
Cilgryman Fawr	26	2 hrs	1hr 5mins	4.6 mins	2.5 mins	£0.87	£0.48
Bodgaeaf Isaf	39	5hrs 15 mins	5hrs 50 mins	8 mins	9 mins	£1.52	£1.71
Lower End Town (ewe lambs)	42	3hrs 15 mins	1 hr 30 mins	4.6 mins	2.1 mins	£0.87	£0.40
Hendre Arddwyfaen	60	4hrs 45 mins	1 hr 50 mins	4.8 mins	1.8 mins	£0.91	£0.34
Blaenglowon Fawr (cattle)	100	8hrs 5 mins	2 hrs 55 mins	4.9 mins	1.8 mins	£0.93	£0.34

RECOMMENDATIONS FOR UTILISING WOODCHIP POST BEDDING

Current common practice is to remove straw-based bedding material from the shed post housing and store it in a muckheap prior to spreading it on the land. The same applies to woodchip bedding but, as part of the Woodchip for Livestock Bedding project, investigations were carried out to provide farmers with information on how they should compost their woodchip bedding (see [Report 4](#)).

The composting process is necessary for a number of reasons;

- To facilitate the breakdown of the wood particles
- To sanitise the material (kill pathogens such as *E.Coli* and *Salmonella*)
- To remove excess moisture from the material

Farmers therefore have two options when deciding what to do with their woodchip bedding after housing animals on it; to spread it onto the land or to re-use it as bedding the following winter.

Composting the bedding material

Whatever the desired use is for the woodchip bedding it needs to be composted. This involves piling the material into a heap either indoors or outdoors. Environment Agency guidelines must be followed to ensure muck heaps are positioned away from watercourses. Ideally, any muck that was scraped from the feeding passages during the housing period should also be added to the heap as this provides valuable nitrogen. The heap should be turned every four-six weeks for the next six months as this aerates the heap and encourages microbial growth. The microbes are responsible for the breakdown of the particles including the wood and also cause the sharp rises in temperature that will be observed. Temperatures as high as 70°C will be achieved in heaps that have the correct ratios of carbon (from the wood) and nitrogen (from the faeces and urine) and this has the effect of sanitising the compost and evaporating the water.

Woodchip bedding as fertiliser/soil conditioner

Investigations carried out at the University of Wales, Bangor, IGER-Aberystwyth and ADAS-Pwllpeiran looked at the suitability of composted woodchip for spreading on forage and arable crops. Their findings are described in [Report 4](#). This work showed that after six months of composting the woodchip was still not sufficiently composted for spreading on the land. The effect of this is that if the material is used as a fertiliser/soil conditioner before it is fully composted then it will remove nitrogen from the soil to aid its decomposition rather than release nitrogen into the soil. This will have a detrimental effect on plant growth.

Therefore, spreading woodchip onto the land after just six months of composting is not recommended.

Re-using composted woodchip as bedding

The main advantage of woodchip bedding is that following composting it can be re-used as bedding the following winter. The composting process destroys any potential pathogens and removes excess moisture. Therefore, following composting care must be taken to store the material under cover to keep it as dry as possible. Ideally moisture content of below 30% is required to ensure maximum absorbency.

The composted woodchip bedding can be used in exactly the same way as before although the overall volume may have reduced slightly and it may be necessary to add fresh woodchip. The bedding material can then be used for several seasons providing that it is composted each year to sanitise and dry the bedding.

It has already been noted that woodchip bedding (at 2006/07 prices) is more expensive than straw bedding but the ability to re-use woodchip bedding will reduce its costs. It may be possible to spread the initial cost of the woodchip over three or even four years, which may help to bring it in line with the cost of straw bedding. However, there will be an additional cost if further woodchip is required as the volume of the original material reduces.

CONCLUSIONS

The following conclusions are derived from the work outlined in this report but also include the conclusions from the project as a whole.

- Woodchip that has a moisture content of less than 30% provides a good alternative to straw as a bedding material for cattle and adult sheep.
- When dry woodchip is used the animals remain healthy and clean.
- Woodchip requires large, covered areas for storage.
- Woodchip requires mechanical handling facilities.
- Woodchip bedding does not appear to suit finishing lambs.
- Woodchip is more expensive than straw at 2006/07 prices.
- Availability of dry woodchip was limited at the time of the project but this situation is improving.
- Woodchip needs to be fully composted before it can be spread on the land, which may take more than 2-3 years.
- Woodchip bedding is ideally suited to re-use, which has significant cost benefits.