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The economics of harvesting wood for heating fuel from hedgerows

Case study: Hedge at Locks Park Farm, Hatherleigh

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Introduction

In January 2010 I laid a 90m long Devon hedge at Locks Park Farm and took the opportunity to explore the economics of harvesting wood as a heating fuel from hedges. I worked out the energy content of the firewood harvested, and through recording the time spent on laying the hedge and extracting the wood estimated the cost of the operation. The energy obtained was compared with that of the heating oil that could be bought in at the same cost. In this way I was able to assess the cost effectiveness of obtaining heating fuel from the hedge.

The hedge

The hedge that was laid is species-rich, with grey willow, ash, hazel, oak, birch, blackthorn and rowan as the main trees and shrubs, in descending order of frequency. It was last laid 15 years beforehand and was not cut apart from occasional side trimming on one side.

Procedure

The hedge was laid in the traditional Devon style. The stems and branches not required for laying were thrown to one side of the hedge across a wire fence. This resulted in large tangled heaps. In the days after the hedge had been laid, these heaps were pulled apart, and the side growth trimmed with a bill hook from all stems and branches greater than 3cm in diameter. The trimmed stems and branches, cut to a length of c1.5m, were then stacked in rough cords, and the brash heaped for burning. These stacks were left out, uncovered, in the field to air dry for nine months after which they were removed to a shed on farm c.1km away. Here they were cut by chainsaw into 30cm lengths suitable for use in wood-burning stoves. Larger logs (>15cm diameter) were split by axe. All this followed normal practice on the farm.

For the specific purpose of this research, the cut and split logs were sorted into the main different tree and shrub species, placed in dumpy bags and weighed by lifting the bags on top of a weighing cattle crush. The moisture content of the logs was determined by weighing a representative sample before and after drying to remove all water. The drying was achieved by placing the logs in the bottom oven of an Aga at approximately 100˚C until their weight was stable (minimum of 24 hours). An inexpensive moisture meter proved to give wildly unreliable readings by comparison, considerably over-estimating water content.

Results

The man hours taken to achieve each of the steps involved in the above process are given in Table 1. (See Note 1.)

Operation	**Man hours**	**Rate (£ per hour)**	**Cost(£)**
Laying	30	15	450
Extraction of usable firewood and stacking in cords on site	17	8	136
Burning of brash	6	8	48
Transport of cord wood from field to shed	3	10	30
Cutting and splitting to size suitable for wood stove	12	12	144
Total	68		808

Table 1. Man hours and rates to lay hedge, and extract and process timber to stove ready state.

The weight and moisture content of firewood harvested is shown in Table 2, by species. The willow was sorted into two size categories because larger stems, where the logs require splitting for use in wood stoves, dry more slowly. Very few of the stems of other species were >15cm diameter.

Species	**Weight when weighed (Sept 2010) (kg)**	**Moisture content (%) (*wet basis)**
Grey willow (<15cm diameter)	1,005	18
Grey willow (>15cm diameter)	430	22
Ash	1,070	17
Birch	65	19
Oak, hazel, rowan and blackthorn	190	20
Total	2,760	

Table 2. Weight of wood harvested from hedge after being air dried in the field for the summer, and moisture content when weighed**.** *(Wet weight – dry weight)/wet weight x 100

The energy value of the wood harvested, and that of heating oil bought in at the same cost are shown in Tables 3a (which includes the cost of laying and burning brash) and 3b (which excludes these costs). See notes 2 and 3.

Equivalent weight of wood at 20% moisture content	Energy value of this wood (at 4.1kWh per kg)	Total cost of firewood production	Volume of oil which could be bought for this sum (at 44p per litre)	Energy value of this oil (at 10 kWh per litre)	Increased cost of sourcing energy from wood (at 4.4p per KWh)
2,815 kg	11,542 kWh	£808	1,836 litres	18,364 kWh	£300 (2.6p per kWh)

Table 3a. The energy content of the wood harvested and of the amount of heating oil that could be bought for the same cost as extracting and processing the wood, and the cash value of energy difference. Figures include the cost of laying the hedge and burning brash.

Weight of wood at 20% moisture content (wet basis)	Energy value of this wood (at 4.1kWh per kg)	Cost of firewood production, excluding costs of hedge laying and burning brash	Volume of oil which could be bought for this sum (at 44p per litre)	Energy value of this oil (at 10 kWh per litre)	Saving from sourcing energy from wood (at 4.4p per kWh)
2,815 kg	11,542 kWh	£310	704 litres	7,045 kWh	**£198 (1.7p per kWh)**

Table 3b. The energy content of the wood harvested and of the amount of heating oil that could be bought for the same cost as extracting and processing the wood, and the cash value of the energy difference. Figures exclude the cost of laying hedge and burning brash, but include all other costs.

Conclusion

For this particular hedge, it was uneconomic to lay it purely for the firewood crop for use in wood stoves. However, if it was going to be laid anyhow, and the firewood extracted as a by-product, then it was a very cost effective source of heating fuel, saving £198 on the costs of heating oil (1.7p per kWh). Buying in the energy as oil would have cost 61% more than the cost of extracting the wood from the laid hedge.

It must be stressed that this is the result from a single case study. Hedges vary considerably in the amount of usable wood they contain, and hedge management techniques vary across the country and between individuals. Further similar case studies are required before any general conclusions can be drawn.

The average energy required to heat a domestic house each year is about 20MWh. Consequently the wood harvested from the 90 m hedge, with 15 years growth, would meet 57% of this requirement.

In our three-bedroom farmhouse at Locks Park Farm we use, for both heating and cooking, roughly 2,000 litres of heating oil per year, and the 90m of hedge laid would have supplied about enough wood for our two wood stoves for a year. So, the hedge will provide about a third of our annual energy demand for both heating and cooking.

As a source of green energy, the hedge wood was exceptional. The only non-renewable fuels were the petrol used for the chainsaw (c.10 litres for laying and cutting logs) and the diesel used by the tractor in extraction (c. 3 litres). This gives a ratio of 1 unit of fossil fuel to 89 units of renewable wood fuel.

Hedge laying provides rural employment and so benefits the local economy. It is also a necessary part of the hedge management cycle, and to maintaining hedges in favourable condition for biodiversity and other ecosystem services.

Information sources

The typical energy values of fuels were taken from the Biomass Energy Centre website www.biomassenergycentre.org.uk. Further information was taken from guidance contained in the Forestry Commission paper *Wood as fuel: a guide to choosing and drying logs* http://www.forestry.gov.uk/pdf/eng-woodfuel-woodasfuelguide.pdf/$FILE/eng-woodfuel-woodasfuelguide.pdf, and the technical supplement to this document available from the Biomass Energy Centre. The price of heating oil was taken from http://www.oilpricecheck.co.uk/latest.htm on 30 September 2010. Advice on local labour costs was received from a neighbouring farm business which contracts out a range of relevant services (Hutton Bros, Rutleigh Ball Farm). The method of laying (or steeping) of Devon Hedges is presented in the Devon Hedge Pack at http://www.devon.gov.uk/hedges.

Explanatory notes

1. Man hours were based on usual contractor's rates in the area, and excluded time for rests and non-productive work. They are inclusive of machinery use. The rates vary according to the level of skill required and according to any machinery (eg chainsaw or tractor) involved.

2. Firewood is normally considered to be an efficient fuel when at 20% moisture content or less.

3. At a given moisture content, all hardwoods have virtually the same energy value per unit of weight. For example, 1kg of willow at 20% moisture will give out the same heat as 1kg of ash at 20% moisture.

Supplementary information

1. This case study assumes that the efficiency of wood stoves is the same as that for oil burners, a reasonable assumption since the efficiency of each is similar at about 75% to 86% for modern equipment.

2. If the wood had been processed into chips or as longer logs for log boilers, then the economics would be different. Likewise, if the hedge had been coppiced rather than laid, the economics would be different.

3. The log sorting took an additional hour at £8 an hour, weighing took another hour valued at £20 per hour, and the moisture measurements a further 1 hour at £10 per hour – these costs were not included in the calculations above.

4. The hedge was laid under a Higher Level Stewardship agreement which provided grant at £5 per metre (£450 for the hedge) – this was not taken into account in the calculations either.

5. 65kg of chain saw shavings and dust were lost when the cord wood was cut into short lengths (2.3% of the crop). This loss was not factored into the calculations.

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