Managing UK hedges for firewood: is this practical, economic and environmentally acceptable?

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ABSTRACT

The UK's hedges are in decline, with recent substantial losses being reported in all four countries. Much of this decline reflects unsustainable management. At the same time public funding for essential hedge rejuvenation work, laying and coppicing, is falling. New economic reasons need to be found for farmers to manage their hedges sustainably, and production of wood fuel offers significant hope in this respect. Experience from northern continental Europe, supported by recent work in south-west England, demonstrates that hedges can be sustainably and practically managed to produce heating fuel at a very competitive unit price. However, this requires a change from the traditional system of laying hedges and producing logs to one of coppicing and producing woodchips. This will have both positive and negative consequences for biodiversity and several of the ecosystem services delivered by hedges: appropriate environmental safeguards need to be put in place. Cultural resistance may be expected, necessitating engagement with local communities. Overall, managing hedges once more to provide an energy crop offers a substantial opportunity to stem the current decline in the UK's rich hedgerow heritage.

INTRODUCTION

The UK's hedges are in decline: we need to find new approaches to secure their future. Managing them for wood fuel offers a potential solution, as this paper demonstrates.

Across Great Britain, between 1998 and 2007, there was a statistically significant 1.7% decrease in hedgerow length (Carey *et al.*, 2008). 8,000 km of "woody linear features" were lost in England in this ten year interval, 2,600 km in Scotland and some 1,000 km in Wales (although this last figure was not statistically significant) (Countryside Survey, 2009; Norton *et al.*, 2009; Smart *et al.*, 2009). These high losses largely reflect unsustainable management, with two undesirable processes much in evidence. Firstly, many hedges are being neglected and permitted to grow into lines of trees: between 1998 and 2007 the length of managed hedgerow in England fell by 6.1% (26,000 km), in Scotland by 7.4% (1,700 km) and in Wales by 5.6% (3,200 km) (Countryside Survey, 2009; Norton *et al*., 2009; Smart *et al.*, 2009). Secondly, an increasing number of hedges are being cut short year after year, without periodic rejuvenation (laying or coppicing). Both processes lead to gap formation and eventual hedge loss. This situation is exacerbated by falling levels of public grant aid for hedge rejuvenation: in England, in 2010 grant given through agri-environment schemes was only 10% of that in 2004 (Natural England, pers. comm.). In Northern Ireland, there was a net loss of 4.6% of hedges (5,472 km) over the same time frame, and an actual loss of 10.5% (12,505 km) of hedges present in 1998 (McCann *et al*., 2012). The great majority of this loss was by physical removal due to building construction or field enlargement.

Despite the wealth of ecosystem services delivered by hedges (Appendix A), in reality there are currently few practical or economic reasons for farmers to manage their hedges well, especially in arable areas. Such management is expensive and often time consuming. Hedges need demonstrably directly to contribute to farm profitability. One way to achieve this is through managing them as a source of low cost renewable energy. There is nothing new in this idea – for centuries hedges were regarded as an important source of fuel. Writing in the late 18th Century, Marshall (1796) noted that *"Many farms have no other woodland, nor supply of fuel, than what their fences [hedges] furnish; yet are amply supplied with this; beside, perhaps, an over-plus of posts, cord wood, faggots, and the bark of oak, for sale. Hedge-wood is looked up to as a crop."* Only in the last 50 years or so, with ready access to other energy sources such as coal and oil, have farmers ceased to consider their hedges to be valuable for wood for the fire. The tradition has not been lost to such an extent in northern Europe. Hedges across large parts of northern France and north-western Germany are currently managed primarily as a source of fuel, and sustainably so (Chambres D'Agriculture Bretagne, 2006).

With increasing awareness of the benefits of renewable energy, rising fossil fuel prices and the introduction of public support payments such as the Renewable Heat Incentive (Department of Energy and Climate Change, 2012), it is timely to consider looking once more to hedges as a source of heating fuel. This paper explores the ways in which UK hedges may be sustainable, practically and economically managed to produce a fuel crop in a manner suited to modern times, and the yields and costs that may be expected. It draws on extensive experience from northern continental Europe and recent research carried out in south-west England (Wolton, 2012a, 2012b, 2012c).

Methods of harvesting, processing and combustion

Over most of the UK, good hedge management practice is normally considered to consist of regular trimming to keep them thick and bushy for as long as possible (Wolton, 2007). When they start to become gappy they are allowed to grow up and then layed by hand. It is at this stage that the firewood is extracted, as cordwood or poles. The remaining small stems, branches and twigs are burnt in a bonfire on site. The cordwood or poles are stacked to season, and then cut and split, usually by chainsaw and axe but sometimes with a firewood processor, into logs ready for the stove or boiler. This method of firewood production may be called the 'Lay + Log system'.

In contrast, in northern continental Europe usual practice is to coppice hedges, restricting any cutting of subsequent re-growth to side trimming (Wolton, 2012a). Coppicing is carried out by chainsaw and the trees and bushes lifted clear by tractor-mounted grabs and placed in a neat row beside the hedge. Occasionally both these operations are performed at the same time using a feller-buncher head on a large excavator. The whole trees and bushes are then fed, again by a grab, into a large chipper which blows the chips into a high-sided trailer. The chips are stored in a heap where, heated by fermentation, they self dry over a period of 4 to 6 months, before combustion in a woodchip boiler. This method of firewood production may be called the 'Coppice + Chip system'.

Environmental effects of introducing the Coppice + Chip system

If widely introduced, the Coppice + Chip system will have significant impacts on biodiversity and on some of the environmental services which hedges deliver (Wolton, 2012b). These need to be considered at both the landscape level and individual hedge level.

On the positive side, hedges are likely to be on average taller and wider than existing stock and so store more carbon. Together with acting as a source of renewable energy, the change to a Coppice + Chip management system will therefore have a beneficial impact on climate regulation. Taller hedges afford increased shelter to livestock, and are more effective in screening unsightly developments and protecting privacy. The change may also have a positive effect on populations of insects which pollinate food crops, such a bumblebees and hoverflies, and on the amount of fruits, berries and nuts available for wildlife and man. Landscape character will change because there will be a greater diversity of hedgerow structure, hedges will be on average higher, and isolated mature hedgerow trees will be less visually prominent. Whether these landscape changes will be considered desirable or not will depend on local landscape character and society's aspirations.

With fewer hedges being kept short by regular cutting, available evidence suggests that the species-richness of invertebrate, bird and mammal communities will increase (Barr *et al.*, 2007). However a few species are known to favour short hedges and these may be adversely affected. Coppicing may also benefit herbaceous communities, although any increase in fencing to protect the stools may have an adverse impact on diversity through the exclusion of grazing animals.

On the negative side, coppicing leads to greater disruption to landscape connectivity than does laying because coppiced hedges initially have no woody cover at all. This will adversely affect some species such as some bats and hedgehogs *Erinaceus europaeus*. Many will also be affected by the cessation of top trimming and consequent loss of dense woody growth: hazel dormice *Muscardinus avellanarius* and several passerines for example require such dense growth to breed successfully. Any reduction in the isolation of mature trees with free crowns may also have a negative impact on biodiversity, for example on lichens that favour unshaded bark, and on trees that require high light levels to set fruit.

The risks to the long term viability of the hedge itself also need to be considered. First, the re-growth from coppiced stools can be very vulnerable to grazing by livestock, rabbits, hares and deer. Secondly, if growth is allowed to become too mature before coppicing, then there may be a loss of individual trees and shrubs either due to heavy shading or to loss of vigour. Thirdly, for hedges set on banks, dense shade and wind rock may result in collapse or erosion.

Expected yields

In terms of energy production, the Coppice + Chip method has considerable advantages over the Lay + Log one (Table 1). For a start, the whole crop is utilised. When a hedge is layed, and at the optimal stage for doing so, typically about 25% of the biomass is retained within the layed hedge and 70% of the extracted biomass is wasted when burnt on site (Wolton, 2012c). Consequently, only about 20% of the biomass present in the standing hedge before laying is actually utilised as heating fuel. For a hedge that has more mature growth and which is at the optimal point to coppice, a larger proportion of the biomass will be available, about 70%. Under the Coppice + Chip system, however, virtually 100% of the biomass is available for combustion – there is no wastage. The Coppice + Chip system is also much less time consuming, an important consideration for farmers and other land managers. The time taken to harvest (by laying or coppicing), process (into logs or chips) and transport the crop from hedge to store is eight times greater for the Lay + Log system than for the Coppice + Chip one (Table 1). Furthermore, because wood chip boilers are fully automated and do not have to be fed by hand, there are substantial time savings at this stage too. A woodchip boiler may only require 15 minutes attention every 10 days (Wolton, 2012a).

Table 1. Comparison between Coppice + Chip and Lay + Log systems of harvesting wood fuel from hedges. Note that these figures are a rough guide only since there is considerable variation between hedges. The figures are based on hedges that are between (but not including) the optimal time to lay and lines of mature trees. The Coppice + Chip figures come from northern France (Alain Coic pers. comm.; Celia Bresson, pers comm.), the Lay + Log ones from work in South-West England (Wolton 2012c).

System	Time for 100 m of hedge (man hours)				% of material used	Cost of processing per h (£)	Unit energy cost p/KWh
	Laying/ coppicing	Processing	Transport	Total Time			
Coppice + Chip	8 (with chainsaw)	2	1	11	100	200	2 to 3
Lay + Logs	56	28 (with chainsaw and axe)	3	87	70	16	4 to 21

The yield that can be expected from a hedge will vary considerably according to the maturity of growth when harvested and woody species composition. Nutrient availability and exposure will also influence yields. As a rule of thumb, with the exception perhaps of single-species hawthorn *Crataegus monogyna* or blackthorn *Prunus spinosa* hedges for which no data are available, hedges at an optimal and sustainable stage to coppice managed on a 15-year rotation under the Coppice + Chip system may be expected typically to gain 10 MWh of energy per km per year (Wolton, 2012c). The heat energy demand of a poorly insulated farmhouse with four bedrooms is likely to be about 30 MWh per year. It follows that roughly 200 m of hedge will need to be coppiced each year to heat such a building, or 3 km over the full length of the rotation (15 years). If an additional 50% of hedges continue to be managed under the Lay + Log system as recommended for environmental reasons (Wolton, 2012b), then 6 km of hedge are required in all. In the south-west of England at least, most commercial arable or livestock farms will have at least this length of hedge, and often much more.

DISCUSSION

Using the Coppice + Chip system heat energy from hedges can be produced at 2-3 pence per KWh. This compares very favourably to the current (May 2012) price of natural gas at 4.8 p per KWh, heating oil at 6.0 p per KWh, LPG at 7.6 p per KWh and electricity at 14.5 p per KWh (Biomass Energy Centre, 2012). It is also cheaper than buying wood pellets, typically 4.2 p per KWh, and on par with buying in wood chips (typically 2.9 pence per KWh). With rising fossil fuel prices, hedge energy will become increasingly attractive and has the benefit of being a renewable source.

Access to specialised equipment is required to implement the Coppice + Chip system, notably tractor-mounted grabs to lift cut trees out of hedges and chippers capable of handling whole trees. Such equipment, especially the chippers, is expensive but can be hired or made available through a machinery ring. Wood chip boilers are expensive as well, considerably more so than log boilers, and require considerable capital investment. Nevertheless savings on purchase of oil or gas are considerable, and a farm may expect to recover its investment within about 8 years. Government renewal energy incentives, for example the Renewable Heat Premium and Renewable Heat Incentive in England, improve rates of return further (Department of Energy and Climate Change, 2012). For every unit of energy expended on harvesting and processing, as much as 44 units of energy will be gained. This ratio is important, since often the energy required to harvest and process will come from fossil fuels, for example diesel for tractors or petrol for chainsaws. In comparison, the energy return expected from oilseed rape diesel is 1: 4.5, from *Miscanthus* 1: 27 and from short rotation coppice 1: 33 (Nevoux, 2010).

The hedgerow energy crop can either be used directly on farm to heat the farmhouse or production units (e.g. pig or poultry sheds), or sold off-farm. In northern France, several community initiatives have been established with the ultimate aim of conserving hedges (see: http://www.boisbocageenergie.fr and http://www.energiequelle-wallhecke.de for examples). Here farmers deliver surplus green wood chips to a central storage depot at an agreed price, for later purchase by end users. These include local government offices, schools and residential homes. Both producers and users subscribe to fund central administration and quality control.

For environmental reasons, the Coppice + Chip system needs to be introduced sensitively and with appropriate safeguards. In particular, there are risks to biodiversity, especially to those species which require high degrees of landscape connectivity or dense woody growth. To maintain the full range of biodiversity present in hedges at a landscape scale, and ensure the long term future of hedges managed for wood fuel, it is recommended (Wolton, 2012b) that:

1 The biodiversity, landscape character and cultural heritage of a farm and its environs should be assessed before any work begins, to identify features of particular importance or value so these can be safeguarded, and also to assess the risk to coppice re-growth from deer, rabbits, etc..

2 No more than half the hedges on a farm should be managed through coppicing with no subsequent top trimming. The remaining half should be managed though laying and top trimming (to create dense growth), with some mature lines of shrubs and trees retained or allowed to develop.

3 The coppice rotation should not extend beyond 25 years, and normally be between 10 and 20 years (depending on species present).

4 The rotation should be introduced gradually, with no more than 5% of hedges on a farm coppiced in any one year.

5 Mature isolated hedgerow trees should be retained and the hedges on either side of those with particular aesthetic or biodiversity value should be kept short.

Cultural resistance may be expected, both because coppicing is not the traditional practice over most of the UK, and because uncut hedges are perceived as untidy and a sign of poor husbandry. Reflecting this, local communities should be engaged though information and advice before works starts.

The Lay + Log system may require much more time and be considerably less cost effective, but still makes good use of some of the biomass produced by hedges. It will continue to be practiced by many, and this is to be welcomed on the grounds that it will help to maintain the full range of structures and biodiversity associated with hedges, and is an important and valued part of the UK's cultural heritage, keeping traditional skills alive.

CONCLUSIONS

Managing hedges to produce a fuel crop can be sustainable, practical and cost effective if a system of coppicing to produce wood chips is followed. This has been well demonstrated in northern Europe, and is supported by recent work in south-west England. Further research is, however, required to investigate the potential for single species hawthorn and blackthorn hedges to produce fuel cost effectively. Overall, promoting the management and cropping of hedges for wood fuel offers considerable scope as a means of halting the current decline in the UK's hedges.

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