Productive hedges:

Guidance on bringing Britain's hedges back into the farm business

Sally Westaway and Jo Smith, 2019

with contributions from Meg Chambers and Mary Crossland

ORGANIC RESEARCH CENTRE
ELM FARM

Why hedges are important

Hedgerows are a prevalent feature across Western Europe, with an estimated 700,000 km in Great Britain alone.[1] They have significant cultural and historical value and provide many functions and benefits within the landscape, including sheltering crops and livestock, supporting wildlife and linking habitats, controlling erosion and visually enhancing the landscape. Hedgerows provide a habitat similar to that of woodland edge across agricultural landscapes, providing wildlife refuges from more intensive land use and connecting areas of semi-natural habitat. Many species live in or use hedges, with more than 600 plant species, 2000 insect species, 64 bird species and 20 mammal species associated with British hedgerows.[2] In the UK Hedgerow Habitat Action Plan, 84 of the species associated with hedgerows are of conservation concern.[3]

Hedges in the West Berkshire landscape

Productive hedges

Hedgerows are an important part of the cultural landscape of lowland Britain. Traditional management provided a variety of hedgerow products, which included firewood, but as labour become more expensive and fossil fuels more available, this practice was lost. On today's farm, hedges mark field boundaries whilst also providing shelter for crops and livestock, important habitats for farmland biodiversity and contributing to soil and water management. However, as a resource most hedges are underutilised and are either cut back annually or are neglected altogether; both practices are eventually detrimental, and hedges need periodic rejuvenation by either laying or coppicing to sustain them into the future. Rejuvenation management methods are time consuming and costly and identifying practical economic uses for hedges and hedge material could help offset these costs and encourage sustainable hedge management. For example, management for woodfuel via coppicing or hedgelaying, provides an opportunity to rejuvenate old hedges and has the potential to:

- improve hedgerow vigour, longevity and value to wildlife
- provide logs, woodchip and other hedge products which can be used on farm or sold
- reduce the cost of annual flailing

As well as a woodfuel, hedges can provide other potential economic benefits, for example as a source of tree fodder for livestock, woodchip for animal bedding or soil fertility.

This guide builds on and compliments the 2015 guide ***Harvesting woodfuel from hedges***, downloadable from:

http://tinyurl.com/TWECOM-BPG

Bringing hedges back into the farm business

Markets for hedgerow products are in the early stages of development. However, those able to make use of hedge products, including woodfuel, on farm have the opportunity to bring hedges back into the farm business. Most hedges in the UK are managed by annual flailing; this takes time and costs money but earns nothing in return. Coppicing reduces the need for regular hedge flailing to just side trimming every two or three years to control outgrowth. The potential savings over fifteen or twenty years can be significant. A sample of flailing costs from a number of farms in South West England gave an average of £0.35 per metre for a medium to large hedge[4]; scaled up this equates to a **£5.25 per metre** over fifteen years of annual flailing. Alternatively, hedges could be left to grow up over 10-20 years and their outgrowth kept in check through side flailing every three years, before being coppiced giving an average cost of **£1.50 per metre** to side flail once every three years over a 15-year period.

In addition, there is the opportunity to benefit from the sale or use of hedge products. Four practical case studies in this guide outline some costed examples.

Managing different types of hedges

Every hedge is different and also constantly changing but most can be grouped according to their physical characteristics and previous management. For different hedge types a description and some management recommendations are given below. These categories are quite broad and the excellent Hedgerow Management Cycle available from Hedgelink (www. hedgelink.com) has a more detailed description of the different stages in the life of a hedge and management options for each stage.

Short gappy hedge

Generally, less than 2 m high, with few healthy stems and large gaps forming at the base, this hedge type is typical of arable enclosure hedges which have been flailed at the same point for too many years. Shrubs are often thorny species such as hawthorn and blackthorn. This hedge type needs a change in management to secure its future. If there are more gaps than stems the best management option is to coppice, retaining a few trees if possible, plant up the gaps and remove any invasive species such as elder. If there is still a reasonable stem density, plant up gaps and relax the flailing regime to every two or three years and raise the cutting height.

Photo: Rob Wolton

Thick shrubby hedge

A thick hedge with a high density of healthy stems 2-5 m high, at this stage in a hedge's management cycle it provides a great habitat for wildlife, as well as shelter for livestock and crops. Manage by flailing every two or three years to control field encroachment and maintain structure. Often mixed species, these hedges can be ideal for managing for woodfuel especially if there are high proportions of fast-growing species suitable for coppicing such as hazel, sycamore, willow or ash. For woodfuel, side flail only and coppice when stems are around 10-20 cm in diameter and 5-7 m tall. Any gaps can be planted up soon after coppicing.

Tall gappy hedge

A tall and generally gappy hedge which has not been managed for many years. Typically over 5 m high, comprises a line of small trees, often of several species. The shrub layer may vary from dense to thin, ideal for managing for woodfuel. Coppice when stems are around 10-20 cm in diameter. Any gaps can be planted up soon after coppicing. Can also be layed. Ideally leave one hedgerow tree every 50 m.

Line of mature trees

Photo: Emily Ledder, Natural England

A line of mature or nearly mature trees, often with little or no understorey due to shading. Where possible, retain these hedges as a line of trees and a landscape feature for as long as possible, managing on a long rotation appropriate for the species as you would in a woodland. When trees die or are felled gaps can be replanted.

Recently coppiced or layed hedge

A hedge that has recently been managed by coppicing or laying should be trimmed frequently in the first five years to ensure a dense structure, avoid top cutting if the hedge is to be managed for coppice products of woodfuel in future. Newly planted or coppiced hedges are vulnerable to browsing by rabbits, hares, deer and livestock. Erection of temporary deer or rabbit fencing may be necessary until the regrowth is well established. Another option for protecting the new coppice is stacking some of the brash back over the cut stools.

Planning for hedge management

Hedges are dynamic, the tree species that form them are constantly growing and changing and to retain their function they need to be managed. The management of hedges should be planned on a farm or landscape scale and for each hedge consider both the hedge's current role and its importance (e.g. as a wildlife resource, a landscape feature or as shelter for livestock) as well as the potential value to the farm business.

Hedge products

Whether you want woodchip, logs or another product from a hedge will affect how it is managed, harvested and how material is processed. Equally, hedge type and species composition will determine the products it can produce. Possible hedge products you might want to consider include:

- **Woodchip for fuel, compost or livestock bedding.** Each woodchip use has slightly different requirements – for fuel a higher proportion of larger diameter material will give the best quality chip while the opposite is true for composting as the nutrients are concentrated in the bark and buds. For livestock bedding it is advisable to avoid thorny species.
- **Logs for fuel or fencing materials, hazel hurdles.** Generally straighter coppice material will be best suited. Larger stems will be best suited to logs, hazel hurdles are best made from 6-8 year regrowth.
- **Livestock fodder.** Hedges can be managed in several ways for fodder. The simplest is direct browsing, giving livestock access to the hedge. This may involve managing the hedge to keep browse within reach (e.g. through pollarding or coppicing) and fencing to control access and protect the long term viability of the trees. Other options include cutting fodder to give to the livestock either fresh, dry or ensiled.

Management for woodfuel: hedgelaying or coppicing?

Coppicing is more cost effective and has a higher biomass output (woodchip or logs) compared to hedgelaying; it also takes less time. As such, it is the recommended management option for woodfuel production. However, coppicing will leave a gap in the hedge for a short time until regrowth appears, and repeated coppicing will change the structure of the hedge. Hedgelaying is a good technique for stimulating dense bushy growth at the base of a hedge, creating a livestock-proof barrier, a great habitat for wildlife and producing some fuel. More information can be obtained from the National Hedgelaying Society (www.hedgelaying.org.uk/).

Hedge coppicing: which hedges?

If you would like to manage your farm hedges for woodfuel, start with a map and identify any hedges that are unsuitable. This may be due to their historical or wildlife value, or other functions such as visual screening of farm buildings. Assess the remaining hedges for their suitability for woodfuel, both now and in the future, in terms of size and species composition. As a general rule, no more than 5% of your hedges should be coppiced in any one year.[5] It is also important to consider landscape connectivity; try to maintain or improve linkages between habitats such as woodlands and ponds.

Hedges should be around 5-7 metres tall with stems 10-20 cm in diameter before being coppiced for woodfuel. If a hedge is not yet ready to coppice, avoid top-cutting allowing stems to grow up tall, but you can continue trimming the sides of the hedge. Both mixed and single species hedges can be valuable for woodfuel. Most broadleaf species respond well to being coppiced; those that are especially suitable include hazel, sweet chestnut, willow, ash, sycamore and alder. Some species (e.g. blackthorn) tend to regrow from the roots with suckers rather than coppice. Growth rate and length of coppice cycle will vary between species and site conditions. Fast growing species such as willow, sweet chestnut, ash and hazel are well suited to a shorter coppice rotation of 10-15 years. Slow-growing species like field maple and oak are better suited to longer rotations of 20 years and can also be managed as standards.

Preparing hedges for coppicing

Prior to coppicing it is important to remove all wire, such as old fencing, from inside the hedge to ensure machinery is not damaged. It may also be easier to coppice a hedge once any outgrowth has been cut back. Hedge coppicing on longer (15-20 year) rotations can coincide with fence replacement cycles to minimise the amount of work needed and the costs.

Coppiced hazel hedge, approximately eight months after cutting

Making sure a coppiced hedge regrows

It is essential that if you plan to coppice a hedge, you are confident it will regrow, and are able to protect it from browsing to ensure it does. If a hedge does not regrow or regrowth is poor it will need to be replanted or gapped up. The quality of the cut may also impact regrowth; ideally cuts should be clean with a minimum of 5 cm left when coppicing a stem. Cuts should be angled so water drains away from the centre of the stool or stump. The ability of stems to coppice well often declines with age and varies with species and site conditions, some stumps over 50 years may fail to regrow and require replanting.

Hedge coppicing: which machinery?

The most suitable machinery and management option for your situation will depend on the type of hedge you are coppicing, the length of hedge you plan to coppice and the product you are after (chip or logs). If you have a short section of hedgerow to harvest (less than 100 m) it will be more economical to use a chainsaw. If using larger scale machinery, make sure you have enough hedge length and material (over 250 m) to keep the machines busy for a full day; alternatively, you could team up with neighbouring farms and share the cost. More information can be found in the TWECOM guide to Harvesting Woodfuel from Hedges[6].

Chainsaw

The most basic yet versatile felling machine, comes in a variety of sizes depending on the size of timber and situation. Able to access most sites and hedges. No compaction or rutting in poor ground conditions. Slower working speeds.

Circular saw

Generally tractor-mounted on a hedge cutting arm, and can include 1- 4 circular saw blades. Also known as shaping saws and best used in combination with a second tractor with front-mounted fork to move material after felling. Not suitable for larger material due to lack of directional control of falling material and cutting diameter.

Tree shears

Cut or fell trees using hydraulically-powered shears or steel blades to slice through the timber and usually have an integrated timber grab or accumulator arm to hold and manipulate the felled material. Typically excavator mounted. Different sizes available to suit size of material. Not so well suited to multi-stemmed smaller diameter material.

Felling heads

With either an integral chainsaw cutting bar or circular saw. These are most often found in bioenergy felling heads or forestry harvesters such as the Bracke felling head, generally include a timber grab or accumulator arm and are excavator mounted.

Other considerations

Ownership: Ascertain the ownership of a hedge before you coppice it, particularly if it is a boundary or roadside hedge. Even if you do own it, you may want to consult your neighbours and inform local residents as coppicing a hedge can have a significant impact on the landscape.

When to coppice: There are legal restrictions on the timing of hedge management (see p14). Within these allowed times, timing will depend on ground conditions, access to the hedge and other agricultural operations. Coppicing in late winter allows birds to make good use of the hedgerow berries over the winter.

Access: Consider the accessibility of the hedge when choosing which machinery to use. Ensure all harvesting and processing machinery can get to the hedge without issues such as narrow gateways or overhead cables and powerlines.

Planning and planting new hedges and agroforestry

A useful short definition of agroforestry is 'farming with trees'. Agroforestry includes both the establishment of new trees in productive fields and the integration of existing boundary hedges and trees into the farming system. The aim is to benefit from interactions between the trees and the farming operation (crop and/or livestock) and when planning a new hedge or agroforestry planting it is important to consider how the trees can be planted to maximise the ecological and economic benefits.

Coppice agroforestry

An alternative approach to planting a new boundary hedge is to integrate trees within the farming system, for example with alley cropping, where rows of trees are separated by alleys of crops or pasture. By managing these tree rows as short rotation coppice or biomass hedges, competition for light is reduced compared to full height trees, the coppice regrowth can provide shelter for livestock and crops as well as a product. Species especially well-suited for coppice agroforestry planting are fast growing non-thorny species such as hazel, willow and alder. An example of alley cropping agroforestry for woodfuel production is outlined on page 9.

Design and species selection

Any new hedge or agroforestry planting should start with a review of the existing woody resources and features on the farm, where necessary bringing these features into active management e.g. gapping up, rejuvenation through coppicing or hedgelaying. The position, design and species choice will depend on the objectives of establishing a new hedge or agroforestry planting (e.g. marking a new boundary, providing shelter or a fuel source). Where possible plant new boundary hedges on existing field boundaries or join up gaps in the hedge network or wildlife habitats and if practical look at old maps and reinstate former hedgerows. For in-field planting consider the farming activities and machinery that will need to operate in between the trees.

If the aim is for a wildlife hedge and eventually a stockproof field boundary, plant 4-6 plants per metre in staggered double rows. Mixed species hedges are more valuable to wildlife, while for stock proofing aim for at least 70% thorn species such as blackthorn and hawthorn. Look at local hedgerows for guidance on which species that are thriving.

If the aim is to provide a coppice product such as woodfuel, faster growing species which respond well to coppicing will be more appropriate e.g. hazel, willow, alder and ash.

It is important to recognise that if allowed to grow tall for biomass production these hedges will have a bigger impact on the adjacent fields. Aim to plant species with similar growth rates to aid future management. If planting for production (e.g. woodfuel or timber) think about access for management and extraction of wood products.

Practical planting tips

- Bare root 40-60 cm whips are most commonly used for native species hedge and woodland planting.
- Plant in winter when ground conditions allow.
- Control weeds for the first few years to reduce competition using mulch or herbicide and gap up each year to replace any dead plants.
- Protect newly planted trees using tree guards and stock fencing if livestock are present. Stakes should also be used to support the young whips.
- Remove the stakes and guards once the hedge is well established.
- Hedgerow trees should where possible be planned into new hedge planting approximately one every 50 m. Consider planting taller whips than the hedge plants and tag the hedgerow trees to help identify them during regular management activities.

More practical information on agroforestry design and implementation can be found in the Agroforestry Handbook (2019).

Converting a flailed field boundary hedge into an economic crop of firewood

A fully costed hedge coppicing operation on a livestock farm in Dorset demonstrates that even on a small scale it is economically viable to move a hedge from annual flailing to a fifteen-year coppice rotation producing firewood for sale. Hedge coppicing for firewood production is widely applicable, the process requires no particular skill set, minimum demand for new capital and can be adapted to different farm circumstances.

The farm and firewood business

Racedown Farm in South West England is a 160 ha low intensity livestock farm. The farm has 12 miles of hedges all managed on a 15-20 year coppice cycle, except the roadside hedges which are flailed annually. Half a mile of hedge is coppiced annually. The farm has a small firewood business which sells approximately 175 tonnes of logs per year, hedges make up part of this. Hedge coppicing produces round and split logs for the firewood business as well as small diameter material which is used on-farm or sold as 'ugly sticks' at a lower price and brash material which is fed through a branch logger, netted and sold as kindling. Around 70% of the total hedge biomass produced from coppicing is used or sold. All firewood products are stored undercover for 10 months to reduce moisture content prior to use or sale.

Most hedge material is processed with a saw bench

Photos: Ross Dickinson, 2017

Costing it out

The farmer, Ross Dickinson, was interested in the economics of the process and in 2017 coppiced a 220 m trial hedge and recorded in detail the time, costs, outputs and income[4]. The hedge was mixed species, 6.5 m high, with 15 years growth, on an old hedge bank: an old fenceline was removed prior to coppicing. The hedge was coppiced by hand using a chainsaw. Larger diameter material was processed with a tractor mounted saw bench and log splitter, a branch logger was used for the smaller material. The farm is relatively exposed with poor soils, hence the hedge growth is slower than average, and coppice rotation lengths may be shorter in more favourable conditions.

Headline figures

- 220 m of hedge produced 21.4 tonnes of saleable or useable material
- The overall cost was £3,378 (including labour for hedge preparation, coppicing, processing, burning brash and delivery)
- The income was £4,908 (including sales and savings from not flailing annually)
- The profit from 220 m of hedge was **£1530** (with no subsidy payments)

Welmac branch logger at Elm Farm.

Photo: Organic Research Centre 2013

Operation (for 220m hedge)	Cost
Initial flail 2 hours @ £30/hr	£60.00
Manual coppicing 88.5 hours @ £15/hr	£1,327.50
Processing with branch logger 20 hours @ £30/hr	£600.00
Abstraction of nets 8 hours @ £12/hr	£96.00
Abstraction of cord wood 6 hours @ £30/hr	£180.00
Brash burning 5 hours @ £25/hr	£125.00
Processing saleable material and ugly sticks	£750.00
Delivery cost 15 tonnes @ £16/t	£240.00
TOTAL COST	**£3,378.50**

Product/saving (for 220m hedge)	Income
Savings in annual flailing @ £0.35/m (220 m in 15 years)	£1,155.00
263 x 15kg nets kindling twigs = 3.95 tonnes @ £190/t	£749.50
99 x 15kg nets of cobs = 2.48 tonnes @ £190/t	£470.50
6 tonnes of ugly sticks @ £150/t	£900.00
9 tonnes of saleable logs @ £181/t	£1,633.50
TOTAL INCOME	**£4,908.50**
PROFIT	**£1,530.00**

Case study: Elm Farm hedge management for woodchip

A trial coppicing a length of a traditional boundary hedge and chipping all the resulting material to produce woodchip for fuel was carried out on a farm in the South of England. This trial demonstrates that keeping the production chain as short as possible and using woodchip on-farm for heating greenhouses, barns or the farmhouse is the most cost effective and sustainable use of hedgerow woodchip, offsetting a large part of the cost of regular hedgerow management activities.

The farm

Elm Farm is an 85 ha organic livestock farm near Newbury, Berkshire. It is the site of the Organic Research Centre and this work was carried out as part of a series of research trials investigating the use of farm hedges for woodfuel production. The farm has a total of length of 9.5 km of predominantly unmanaged hedgerow, with approximately 5 km suitable for coppice management, on a 15-year coppice cycle.

A coppiced hazel hedge

The trial hedge is predominantly mature hazel coppice with some blackthorn and was last cut approximately 20 years ago. It is a roadside hedge and has been regularly flailed along the road to prevent encroachment. The hedge was coppiced by hand using a chainsaw in December 2016 and all material chipped immediately after cutting using a self-propelled hand-fed chipper. The total yield of chip from the hedge was 21 m^3 per 100 m. Half of the chip was sold green to a local woodfuel cooperative and half kept for use on the farm and moved to an open sided barn for storage and drying. After six months the moisture content of the on-farm stored chip had reduced to 27%.

The newly coppiced hazel stools. Organic Research Centre, 2016

Chipping material from coppiced hedge. Organic Research Centre, 2016

Headline figures

- 100 m of hedge produced 21 m^3 of saleable or useable woodchip
- The overall cost was £990 per 100 m including preparing the hedge, coppicing, chipping and moving the material
- When used on-farm the income was £1223 including a countryside stewardship grant for hedge coppicing
- The profit from 100 m of hedge when the woodchip is used on farm is **£233**

Harvesting methods using larger machinery, may be more cost effective where there is enough work, and machinery is available locally. This hedgerow was eligible for a coppicing grant under Countryside Stewardship, which in 2018/19 is worth £4 per metre, this contributes towards the cost of woodchip production. See page 15 for details of regional grant and funding bodies.

Operation (for 100 m hedge)	Cost
Fence removal (1 day by hand @ £10/hr for a 7 hour day)	£70.00
Chainsaw and chipping (£9.20/m contractor cost for 3-man team to cut, chip and move material to barn)	£920.00
TOTAL COST	**£990.00**

Product/saving (for 100 m hedge) Income	Income
Savings in annual flailing (field side only @ £0.17/m/yr for 20 years)	£340.00
Coppicing grant (£4/m in 2018/19)	£400.00
Sold off site (supplied green to a local woodfuel cooperative for resale @ £15.40/m^3)	£323.00
Own use (replacing the cost of bought in woodchip @ £23/m^3)	£483.00
TOTAL INCOME (when sold off site)	**£1,063.00**
TOTAL INCOME (when used on farm)	**£1,223.00**

PROFIT (sold off site)	**£73.00**
PROFIT (own use)	**£233.00**

Case study: Wakelyns Agroforestry

A pioneer of agroforestry in the UK over the last 25 years Martin Wolfe planted over 5,000 trees on his farm in Suffolk, whilst still producing a range of arable and vegetable crops. Woodchip from short rotation coppice agroforestry on the farm now provides all the farmhouse heat requirements with excess available for other uses.

The farm

Wakelyns agroforestry is a 22.5 ha agroforestry research farm near Diss, Suffolk. In addition to timber and fruit trees, the farm has hazel (*Corylus avellana*) and willow (*Salix viminalis*) short rotation coppice (SRC) agroforestry systems, which were planted in 1994. The trees are planted as production hedges with twin rows of trees running north/south and organic crops grown in rotation with a fertility-building ley within the 10-12 m wide alleys.

Woodchip production from SRC

Biomass production of the SRC willow has been measured since 2011 and the hazel since 2014. Willow is harvested on a two year rotation. Hazel is harvested on a five year rotation, with only one of the twin rows being cut in any year. The stools are coppiced using a circular saw and cut stems are collected and heaped up to be air-dried in the field during the summer and then chipped on demand. All material is chipped using a 15 cm (6 inch) timberwolf hand fed chipper and used in a Gilles 20 kw boiler to heat the farmhouse. The two species of SRC produce very similar yields under current rotations when converted to annual biomass production.

Woodchip production (results from Smith et al 2017[8])

	m^3/100m	Years of regrowth at coppicing	m^3/100m/yr
Willow SRC	5.74	2 years	2.87
Hazel SRC	14.32	5 years	2.87

Harvesting the SRC

In January 2017 coppicing trials were carried out to look at alternative harvesting machinery and the economics of woodchip production for bioenergy. The coppicing trials included:

- A tractor mounted circular saw. The usual harvesting method, this cuts well but results in non-directional felling which requires collection and stacking of material post-cutting.
- Bracke C16 felling head mounted on a low ground pressure purpose built valmet. This is a specialised machine, fast and efficient with minimal ground damage, which collects and places material in stacks, but there are only a few in the country and haulage costs are high.
- 360 degree tree shears. Effective at coppicing boundary hedges, the blades have a crushing action that can cause the SRC root ball to move and also result in significant splitting of the stems. As a result, the trial of the shears on the SRC was abandoned due to concerns of lasting damage.

Headline figures

- Annual production from a 100 m double row of either hazel or willow was 2.87 m^3 per year
- The cost of harvesting and chipping was between £222 and £443.90 depending on the species and the method used
- The willow woodchip production costs were lower, but the yield and income was also lower

Operation (for 100 m SRC)	Hazel	Willow
Circular saw (@ £48/hour)	£134.40	£112.00
Straightening willow sticks for collection (@ £10.50/hour)	£11.90	£52.50
Bracke felling head (exclusive of haulage) £1.02/m	£102.00	£102.00
Chipping (2.3m^3 per hour @ £48/hour)	£297.60	£120.00
Total cutting and chipping (circular saw)	**£443.90**	**£284.50**
Total cutting and chipping (Bracke)	**£399.60**	**£222.00**
Product/ saving (for 100 m SRC)		
Own use (replacing bought in woodchip @ £23/m^3)	£329.36	£132.02
Own use (replacing heating oil @ £30.45/m^3)	£436.04	£174.78
Profit (best case: Bracke and replacing oil):	**£36.44**	**-£47.22**
Profit (worst case: Circular saw and replacing bought woodchip)	**-£114.54**	**-£152.48**

The figures are more favourable when compared against the cost of replacing heating oil and when harvesting using the Bracke felling head. However, at £680, haulage adds a significant amount to the cost of using the Bracke and the decision as to when the larger machinery becomes effective comes down to scale and the location of the machinery.

What has not been costed here are the potential economic and environmental benefits of introducing trees into agricultural systems (shelter, soil protection and nutrient recycling) or the loss of productive field area for the SRC rows.

Case study: Woodchip from hedges for soil health

An alternative use of material from hedges, especially suited to smaller diameter twiggy material, is to use woodchip produced from farm hedges as a soil improver or to make compost. This offers both a sustainable source of fertility and organic matter that you can grow yourself and a practical on-farm use for hedge material.

The farm

Tolhurst Organics, an eight hectare organic vegetable farm near Reading, Berkshire, is one of the longest-running organic vegetable farms in the country. The farm is stock-free organic and there have been no animal inputs on the farm for 25 years. Fertility comes from fertility building crops, green manures and woodchip compost. The farm has 1.5 km of field boundary hedges as well as a small area (0.2 ha) of willow coppice for fuelwood and a 3 ha newly established (2015) mixed agroforestry alley cropping system. The farm uses composted woodchip applied to a two-year legume ley as part of the fertility-building part of the rotation. The woodchip for the compost currently comes from a local tree surgeon; an alternative would be to use chip produced from on-farm hedges or agroforestry. This has been investigated at Tolhurst Organics.

Growing your own woodchip

Material from a mixed native broadleaf boundary hedge was coppiced and chipped in January 2017 to produce ramial chipped wood (RCW) for use as a soil improver. RCW is fresh woodchip from smaller diameter, younger branches which are nutritionally the richest parts of trees. The hedge material came from a hedge planted 29 years ago and last coppiced nine years ago. The hedge was coppiced by hand with a chainsaw and all material was chipped using a self-propelled hand-fed 7" Timberwolf chipper straight into the back of a muck spreader. The chip was applied at a rate of 7.5 litres/ m^2 to the legume ley in a replicated trial alongside the woodchip compost. Soil testing has been carried over the subsequent two years with no significant differences seen so far. This suggests that applying woodchip green, and so avoiding the need to compost, maybe a viable alternative – research is ongoing.

Costing it out

The total volume of chip produced from the 300 m hedge was 27 cubic metres (9 m^3/100 m); this is quite low but remember it is only the small diameter material being cut and chipped. RCW was applied at 70 m^3/ha.

The woodchip for compost is delivered free of charge by a local tree surgeon, so the costs here are minimal (labour to turn the compost and field space for compost pile).

Operation (per 100m)	Cost
Coppice and chip	£666.00
Cost to spread RCW (at £80/day)	£18.00
TOTAL COST	**£684.00**

Product/saving (per 100m)	Income
Savings in annual flailing of £0.35/m over a 10-year period	£350.00
Coppicing grant @ £4/m	£400.00
Total income	£750.00
TOTAL INCOME	**£750.00**
PROFIT	**£66.00**

The relative costs of the different methods will vary between systems and farms, but RCW is likely to make most economic sense when coppicing to rejuvenate an old hedgerow, where local supply of woodchip is limited, costly and/or the quality cannot be guaranteed, or where hedge or tree management for logs produces brash that will not otherwise be used. It also has the significant advantage in that by sourcing inputs from the farm and getting the infrastructure and systems in place you are essentially future proofing the farm.

Woodchip compost

Iain Tolhurst has been successfully composting woodchip for use as a propagation compost and as a source of soil fertility and organic matter for his polytunnels and fields for over ten years. To make a propagation compost, the woodchip is composted for 12 - 18 months, turned using a mini digger three times a year, then sieved to remove any remaining larger wood pieces and enriched with vermiculite.

The composting process for field application can be achieved in a shorter time period and does not require sieving or enriching.

Breakdown of costs to produce propagation compost from woodchip[10]

Raw woodchip	No charge delivered free to the site by local tree surgeon. A waste transfer licence might be necessary from the local authority.	£0.00
Turning	Using 1.5 t digger, assuming production of 100 m^3 p.a. Hire charge 3 days per annum.	£200.00
	Farm labour 3 days @ £80	£240.00
Grading	Material for compost production	£160.00
Additional material	(vermiculite) and mixing	£500.00
Total		approximately £1,100.00 or 11p per litre

Storing and drying woodfuel

There are a number of options for drying and storing woodfuel and the best solution will depend on specific farm conditions. The availability of field, hard standing or barn space on your farm may determine when you chip your hedge material or dictate the volume of logs/woodchip the farm is able to produce each year.

Options for fuel drying and storage

The moisture content (MC) of wood significantly affects the amount of heat produced, water has to boil away before the wood will burn, reducing the useful heat (as opposed to steam up the chimney). Wet wood smoulders and creates lots of tars and smoke which can also damage stoves or boilers. To reduce the MC of woodfuel, fell trees during winter when they are dormant and contain least moisture then season the logs or woodchip to reduce MC to 25-30% before burning.

1. Air drying in field prior to chipping

If you have space or can be flexible with agricultural operations, coppiced material can be stacked in the field or at the field edge to air-dry for a few months before chipping. With a relatively dry winter, you can expect a final woodchip moisture content (MC) of around 25%. This method of drying can reduce handling or storage costs, but chipping dry material may result in more shards and fines and material can be difficult to handle later if the branches tangle and weeds grow up through them.

2. Self-drying under cover

The moisture content of newly cut wood is around 50%. Woodchip and logs can be stored to dry in a well-ventilated barn or outside under a geotextile cover on a concrete hardstanding. Even small piles of green woodchip heat up quickly, and the heating process drives moisture up through the heap where it evaporates, and steep-sided piles aid this process. A small amount of dry matter (3-5% per month) is lost due to decomposition when drying chip this way. Drying logs can be speeded up by logging, splitting, stacking off the ground and covering soon after felling. If possible, logs should be split to less than 10 cm diameter allowing moisture to move to the surface more easily. After six months for woodchip, and slightly longer for logs, you can expect a MC of around 25-30%, an acceptable level for combustion.

3. Active drying

Green chip or logs can also be force dried in a barn or hooklift bin with underfloor ventilation, where either heated or ambient air is forced under and through the logs or woodchip pile using fans or a grain dryer. This is likely to increase the cost of drying but will decrease drying time and dry matter losses.

Case study: Chip quality from hedges or SRC

Woodchip is a variable fuel. Most woodchip boiler systems are designed to work at high efficiencies requiring woodchip of the correct size, with a low proportion of both fine material and large shards. Using unsuitable woodchip may cause blockages in the fuel feeding system and inefficient operation. The European biomass industry has defined woodfuel standards to ensure consistency and quality.

This case study suggests that hedgerow and SRC woodchip can meet industry standards for quality and that the drying, processing or chipping method used does not significantly impact the chip quality.

Processing to increase chip quality

In 2016/17 trials were undertaken on two different farms to identify techniques for improving the quality of woodchip from hedgerows and agroforestry short rotation coppice (SRC) for use as a biofuel and to look at the associated costs. Some chippers are designed to produce fuel grade chip from large volumes of material, these chippers are usually fed by crane and include an integral sieve to produce a more even sized chip. More widely available and less costly are small-scale manually-fed chippers without a sieve. Both were used in the trials and chip samples were collected and analysed from the different chippers and the different drying and processing methods. Coppiced hedge material was treated in three different ways.

Drying and processing method used	Woodchip quality			Income (£/m^3)	Deductions (£/m^3)		Net return (£/m^3)*
	Moisture content (%)	Ash content (%)	G30 (% particles 3-16 mm)		Handling & admin	Drying & screening	
Dried in the field for six months and then chipped	23.2%	2.6	80.4	£23.00	£4.60		£18.40
Chipped straight after cutting and passively dried undercover for six months	28.6%	2.0	86.8	£23.00	£4.60		£18.40
Chipped straight after cutting then actively dried to 10% MC and passed through a 4 cm^2 screen	10.0%	2.4	81.3	£23.00	£4.60	£3.00	£15.40

**2018 prices, chip delivered in to Hampshire Woodfuel Cooperative's Odiham Hub, does not include haulage costs*

Woodchip quality results

None of the processing methods tested or chippers used had a substantial effect on chip quality. All samples collected met the criteria for G30 wood fuel accreditation that 60 - 100% of particles are between 3 - 16 mm. Screened and dried samples were generally more even sizes with less of the sample falling into the large and small categories. The presence of long shards and slithers in the chip is one of the biggest issues with hedgerow or SRC woodchip, and even when screened all the samples contained a proportion of chip which exceeded the maximum particle length.

Conclusion

If you have a local facility, active drying has potential, especially if space on the farm is limited. Existing farm equipment, for example a grain dryer, can also be used to actively dry chip on farm removing the requirement for haulage. Used directly, the energy cost of hedgerow woodchip ranges from 1.6 to 3.5 pence per kilowatt hour depending on hedge type and machinery used[8] which compares favourably with the cost of commercially produced woodchip from forestry roundwood which retailed at 3.10 pence per kWh in 2017[11]. The best way to make use of the woodchip produced on farm is to use it on farm. Fuel quality can be an issue, and these trials demonstrate that this is likely to be the result of the smaller hedge material rather than the chipper used, or the drying or processing methods. Boiler specifications need to be matched to the locally available woodchip; consider purchasing a robust woodfuel boiler and design a feed system which can tolerate variable woodchip.

Wildlife considerations

Hedgerows are one of the most important farmland habitats for wildlife. They provide food and shelter for numerous mammals, birds and invertebrates, including rare species such as the dormouse and beneficial insects such as bees. When managing hedges it is essential to consider any potentially harmful impacts on wildlife, for example, hedges which link woodlands and are potential dormouse corridors could be maintained as thick hedges with minimal management. It is also important to be aware of the legal restrictions with regards to nesting birds and protected species (see p14).

Managing hedges for woodfuel brings a number of benefits. Coppicing on a rotation creates a diversity of hedge structure within the landscape, providing more habitats for a wider range of flora and fauna. Although healthy hedges regrow rapidly, coppicing does create breaks in habitat continuity and may temporarily affect the movement of some species such as the hazel dormouse. A hedge allowed to grow tall to produce suitable sized stems for coppicing may also become less dense at the base reducing shelter for wildlife.

Hedgerow management has a strong influence on fruit (berries and nuts) production with experimental studies showing hawthorn berry yields from hedges cut every three years exceeds those annually and biennially flailed due to fruit only occurring on second year growth.[12] Although fruit production will be diminished for a few years after coppicing, a hedge under coppice management which is only side flailed every three years is likely to provide a better food resource to wildlife than a hedge which is flailed annually.

Recommendations

- No more than 50% of hedges on a farm should be managed for woodfuel[5]
- No more than 5% of hedges on average should be coppiced in one year, or 10% every two years [5]
- Aim to maintain and improve habitat connectivity across the farm, linking existing habitats
- Coppice hedges in late winter (Jan-Feb) to maintain food resources (hedgerow nuts and berries) and avoid nesting birds
- Retain dead wood within hedgerows wherever possible
- Maintain existing hedgerow trees and allow new ones to grow up; ideally aiming for one mature hedgerow tree every 50m or so. As these trees mature they can be thinned to avoid shading out coppice regrowth.
- Use native and locally appropriate species when planting new hedges or gapping up old hedges. Layer existing hedgerow shrubs where possible to fill any gaps.
- Side flail every two to three years, or if cutting every year, retain about 10 cm of the previous year's growth
- Do not cultivate, spray or fertilise within 2m of the centre of the hedge

A healthy hedge for wildlife has

- **Good density:** especially at the hedge bottom providing food and cover
- **Good size:** good width and height to provide livestock shelter and wildlife habitat
- **Good diversity:** of tree, shrub and ground flora species to provide food and shelter for a wide range of wildlife
- **Good connectivity:** with other hedges and semi-natural habitats within the landscape
- **Well placed:** hedges across slopes (contour planted) to provide extra buffering from erosion and runoff.

More information

For more information on how to manage hedges for wildlife, see the Hedgelink website (www.hedgelink. com) and the Hedgerow Guidance Leaflet produced by PTES (www.ptes.org). The Hedgerow Biodiversity Protocol developed by The Organic Research Centre is a rapid survey-based tool which can be used to evaluate and monitor the wildlife impacts of managing your hedges for woodfuel. The protocol is freely available from The Organic Research Centre website: http://tinyurl.com/TWECOM

Legal considerations

Rural Payments

Farmers and landowners claiming rural payments from government need to comply with the cross compliance (CC) rules. Under current (2018) CC regulations, hedges and trees can only be flailed or cut between 1st September and 1st March, although it is possible to carry out hedge and tree coppicing and hedge laying from 1st March until 30th April. Support for hedgerow and tree management is provided through agri-environment schemes such as the Countryside Stewardship in England, Glastir in Wales, Agri-Environment Climate Scheme in Scotland and the Environmental Farming Scheme in Northern Ireland. Most schemes provide support for creation, restoration and management of hedges, as well as capital support for coppicing and hedgelaying. Check government websites for up-to-date information.

Renewable Heat Incentive (RHI)

RHI is a UK Government financial incentive to promote the use of renewable heat. Annual payments are based on the amount of heat produced. Ofgem is responsible for administering the scheme, for more information visit their website (www.ofgem.gov.uk).

Biomass Suppliers List (BSL)

Self-suppliers, producers and traders of woodfuel who wish to access the RHI market need to register on the Biomass Suppliers List, regardless of whether they sell, give away or use their woodchip themselves. BSL accreditation requires that 100% of timber in the supply chain is legal and 70% is sustainable. Application for small businesses and self-suppliers is quick and simple. For more information see the BSL website (www.biomass-suppliers-list.service.gov.uk).

Felling licence

A felling licence will be necessary from the Forestry Commission before coppicing a hedge if stems are to be felled which are 15 cm or larger in diameter when measured at breast height (1.3 m from the ground) and more than 5 m^3 (timber volume) are to be felled in any defined calendar quarter, reducing to 2 m^3 if any of the wood is to be sold. This licensable diameter reduces to 8 cm or larger in diameter if felling single stems such as hedgerow trees. See the Forestry Commission website for more information(www.forestry.gov.uk).

Hedgerow Regulations 1997

It is not normally necessary to apply for consent under the Hedgerow Regulations 1997 before coppicing a hedge, provided cut stools are given adequate protection and allowed to regrow. If the intent is not to allow the hedge or any part of the hedge, however small, to regrow then a notice of intent to remove must be submitted to the local Planning Authority.

Tree Preservation Order

You will also need to contact your local Planning Authority if any of the trees to be felled or coppiced have a Tree Preservation Order (TPO) or are in a Conservation Area. Local Authorities usually have a map which shows the locations of all TPOs so you can check.

European Protected Species (EPS)

Several of the species covered by the Conservation of Habitats and Species Regulations 2010 may be associated with hedgerows. These regulations therefore have implications for how hedgerows can be managed and operations carried out. Such species include: all 17 species of bat, hazel dormouse, great crested newt, otter, sand lizard and smooth snake. For more information on EPS and the steps land managers should take to safeguard them see: www.forestry.gov.uk/england-protectedspecies.

Protection for designated sites

Work within Special Areas of Conservation (SACs) or Sites of Special Scientific Interest (SSSIs) may require Natural England's consent under Part II of the Wildlife and Countryside Act 1981 (as amended). Check with your Local Authority about more local wildlife site designations. For more details on protected sites see: www.gov.uk/topic/planning-development/protected-sites-species.

Wildlife and Countryside Act 1981

Wild birds and certain woodland animals and plants are protected under Part I of this Act. It requires you to carefully assess the impacts of tree work on wildlife, and ensure animals listed in the Act's schedules are not harmed or killed and that their nests or habitat are not damaged or destroyed.

Summary

Owing their existence to agriculture, hedgerows have been shaped by centuries of human activity. However, the last century has seen a large decline in their presence and quality due to the loss of a direct economic value, agricultural intensification, and the abandonment of traditional management practices such as coppicing and hedgelaying.

As a valuable resource within our rural landscapes, hedges need to be managed in a way which is sustainable, both economically and ecologically, and allows them to continue being healthy and vigorous so they persist for generations to come. The coppicing of hedges for woodfuel or other products has the potential to not only reduce the cost of managing hedges but to provide local communities with a renewable, low cost energy source whilst supporting wildlife and improving the health of hedges. Although markets are in the early stages of development, those able to supply themselves with woodfuel from hedges have an opportunity to make significant savings on the cost of energy. It's time to make the most of this under-utilised resource and bring our hedges back into the farm business.

References:

1. Wolton RJ (2015). Life in a hedge. British Wildlife 26, 306-316.
2. Wolton RJ, Morris RKA, Pollard KA, Dover JW (2013). Understanding the combined biodiversity benefits of the component features of hedges. Report of Defra project BD5214.
3. Maudsley MJ(2000). A review of the ecology and conservation of hedgerow invertebrates in Britain. Journal of Environmental Management 60, 65-76.
4. Dickinson R (2018). A Coppiced Hedge: Converting a flailed hedge into an economic crop of firewood. Racedown Farm, Dorset
5. Wolton RJ (2014). Wood fuel from hedges. Devon County Council, TamarValley AONB and the Devon Hedge Group. ISBN 978-1-84785-042-3
6. Harmer R (1995) Management of coppice stools, Forestry Commission Research Information Note 259. ISSN 0267-2375 www.forestry.gov.uk/fr/infd-5z5gh3
7. Chambers M, Crossland M, Westaway S, Smith J (2015) A guide to harvesting woodfuel from hedges. http://tinyurl.com/TWECOM-BPG
8. Westaway S, Smith J (2018) Assessing, harvesting, chipping and processing techniques for improving the quality of woodchip from hedgerows and agroforestry. SustainFARM Project Deliverable 4.2
9. Smith J *et al* (2017) Lessons learnt: Silvoarable agroforestry in the UK. Agforward report https://www.agforward.eu/index.php/en/silvoarable-agroforestry-in-the-uk.html?file=files/agforward/documents/LessonsLearnt/WP4_UK_Silvoarable_1_lessons_learnt.pdf
10. Vieweger A (2014) Field Lab Report: Peat free woodchip compost for growing media. https://www.agricology.co.uk/sites/default/files/Woodchip%20field%20lab%20report.pdf
11. Forestry Commission (2017) https://www.forestry.gov.uk/forestry/infd-9peg3u
12. Staley J *et al*. (2012) Long-term effects of hedgerow management policies on resource provision for wildlife. Biological Conservation,145 (1):24-29

Acknowledgements

Many thanks to the following who provided their expertise, advice and assistance: Martin Wolfe, Paul and Mark Ward, Iain Tolhurst, Ross Dickinson, Rob Wolton, William Hamer, Robert Benford, John Handy, Nigel Stimson, Matthew Prince, Martyn Neve and Peter Frizzell and to our funders.

SustainFARM is a three year project, funded in the UK by Defra, as part of the European FACCE SURPLUS ERA-NET co-fund programme formed in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). www.sustainfarm.eu

FACCE SURPLUS
SUSTAINABLE AND RESILIENT AGRICULTURE FOR FOOD AND NON-FOOD SYSTEMS

Resources

Hedge management

Hedgelink www.hedgelink.org.uk

National Hedgelaying Society www.hedgelaying.org.uk

Devon Hedge Group www.devonhedges.org

The Woodland Trust www.woodlandtrust.org.uk are offering support for new hedge planting and reinstatement of old hedges. Contact the woodland creation team on Tel: 0330 3335303 or at plant@woodlandtrust.org.uk

Wildlife

People's Trust for Endangered Species (PTES) www.ptes.org

Game and Wildlife Conservancy Trust www.gwct.org.uk

Policy and legislation

Defra www.gov.uk/government/organisations/department-for-environment-food-rural-affairs

Forestry Commission www.forestry.gov.uk

Natural England www.gov.uk/government/organisations/natural-england

Sustainable energy and woodchip quality

DECC www.gov.uk/government/organisations/department-of-energy-climate-change

Ofgem www.ofgem.gov.uk

Biomass Energy Centre www.ofgem.gov.uk

Woodsure www.woodsure.co.uk

Grants and funding

England: https://www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management

Wales: https://gov.wales/topics/environmentcountryside/farmingandcountryside/farming/schemes/glastir/?lang=en

Scotland: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/

Northern Ireland: https://www.daera-ni.gov.uk/topics/rural-development/environmental-farming-scheme-efs

Useful publications

The Agroforestry Handbook: Agroforestry for the UK. Edited by Ben Raskin & Simone Osborn (2019). Soil Association Limited.

TWECOM Best practice guide on Hedgerow harvesting machinery and methods (2015). Available from: www.twecom.eu

Agricology: https://www.agricology.co.uk/resources

Printed by Severnprint on 100% recycled paper using vegetable based inks and powered by renewable energy.

SUSTAINFARM

The Organic Research Centre,
Elm Farm, Hamstead Marshall, Newbury
Berkshire RG20 0HR UK
Tel: +44 (0)1488 658298
Email: elmfarm@organicresearchcentre.com
Charity no: 281276 Company no: 1513190

www.organicresearchcentre.com

Find us on Facebook

flickr