

Research Report

Benefits of trees on livestock farms

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WOODLAND
TRUST

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Sheep enjoying tree shade in Swadedale, Derbyshire.

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Introduction

Recent years have seen increasing focus on food security, and pressure for more domestic food production. A growing world population is increasing the demand for food, whilst climate change is having a negative impact on agriculture in many parts of the world.

At the same time there is recognition that the natural environment is fundamental to the delivery of 'ecosystem services'¹. For agricultural production this means healthy soils, pollinating insects, climate regulation, and plentiful and clean water. But farming also has an impact on wider ecosystem services for society, including maintaining water quality, mitigating flooding, and supporting biodiversity.

Whilst the environmental impacts of modern agriculture have often been

criticised, technology has brought huge benefits. The development of sustainable agriculture depends on supporting and increasing production, whilst maintaining and improving the condition of the natural environment.

An approach to these twin aims will require developments in agronomy, plant breeding and effective and efficient use of agricultural inputs. However, we believe that thoughtful integration of trees and other natural elements into farming systems can also support production, and deliver benefits which make sense at a farm scale, whilst also delivering wider public goods.

Working with Harper Adams University College we have reviewed the evidence for the role of trees in farming systems¹.

The development of sustainable agriculture depends on supporting and increasing production, whilst maintaining and improving the condition of the natural environment.

¹Ecosystem services are the range of resources and processes supplied by natural ecosystems. These were brought to prominence and their definitions formalised by the United Nations 2005 Millennium Ecosystem Assessment. This grouped ecosystem services into four categories: **provisioning**, such as food production and water; **regulating**, such as the control of climate; **supporting**, such as nutrient cycles and crop pollination; and **cultural**, such as spiritual and recreational benefits.



Mr Rowlands with his red-poll cattle.

Impacts of climate change

The last fifty years has seen increasing average temperatures, more winter rainfall, and decreases in summer rainfall in all but north east England and the north of Scotland. Low summer rainfall is particularly an issue for the southern and eastern parts of Britain, important for arable production.

Recent years have seen a number of dry spring and summer months. This leads to reduction in pasture and crop yields, and in 2011 was estimated to cost UK farmers £400m². Water is already over abstracted in large areas of southern England. Climate change scenarios predict this will get worse.

Rising summer temperatures will increase heat stress to livestock, and periods of drought during the growing season could mean poor crop germination, reduced

growth rates of pasture and lower yields.

Even where irrigation is available, pressure to maintain domestic water supplies and to protect the ecology of rivers and other water bodies, may mean that availability is restricted. Such irrigation water that is available will need to be used efficiently.

Crop selection and plant breeding, good husbandry and improved irrigation systems will all play a part in addressing the problems caused by increasing frequency of drought, but shelter for pasture and crops can also be an important factor.

Despite the predicted drop in total summer rainfall, it is tending to come in heavier downpours. This is important for its impact on surface water flooding, soil erosion and nutrient loss and subsequently for pollution of water courses and the risk of flash floods.

Rising summer temperatures will increase heat stress to livestock.

Beef suckler farm case study

The Rowlands family have been farming at Mickel Trafford since 1947, running a successful business raising rare-breed, Red-poll cattle.

One of only three farms in the country producing LEAF Marque beef, Mr Rowlands worked with the Woodland Trust to plant a hectare of low-grade peaty land, which was unsuitable for grazing due to a ditch and too costly to use for hay production. Converting the land to woodland helped support local efforts to improve biodiversity and will provide the Rowlands with a sustainable future supply of firewood and hedge-laying stakes.

Mr Rowlands said:

"New woodland is financially viable and can increase margins on low grade and environmentally unimportant sites. Given rising fossil fuel and energy prices and the drive for sustainable fuel use, the financial benefits can only increase. New woodland can add to farm biodiversity and help reduce management costs, and there is a wealth of free advice and information available from the Woodland Trust, the Forestry Commission and others for those considering new planting."

New woodland also helps farms to reduce carbon emissions by acting as a carbon sink, and with the possibility of carbon tax and accounting measures being implemented, this is a way of reducing a business's potential exposure."



Mr Rowlands

Natural England Pictures



All animals suffer in extreme temperatures. Cattle gather under the shade of a tree.

Geograph/Brian Robert Marshall

Shade and shelter for livestock

All farm animals are vulnerable to increased temperatures and, for outdoor poultry and livestock, solar radiation, which affects feed intake, reproductive performance and susceptibility to disease.

Increased heat stress can affect milk yield and herd fertility of dairy animals; it is estimated that hot weather costs dairy farmers in the United States \$900 million/year in reduced milk production and reduced fertility³.

The fleece of sheep provides some protection against extremes of both hot and cold temperature. However when sheep are housed or have to be gathered frequently or over long distances during hot weather, the fleece can inhibit heat loss and cause stress. Heat stress may reduce conception rates of ewes and the libido and fertility of rams.

Outdoor housed pigs can suffer both from heat stress and sunburn, which damages the skin and can interfere with reproduction; including reluctance for sows to take the boar, re-absorption of embryos or abortion⁴.

Hens show reduced feed intake and egg weight, and have a lowered immune system as a result of heat stress⁵. For free

range birds provision of shade can help in regulating the effect of high temperatures.

A number of strategies are available for reducing the impact of high temperatures on animals, including sprinkler systems and provision of shade. Newly shorn sheep must have access to shade as they no longer have the protection of the fleece⁶.

Whilst shade can be provided artificially, planting native deciduous trees in field or in hedgerows provides important shade from solar radiation during the summer, whilst allowing solar gain during the winter. Trees also reduce the ambient air temperature beneath the canopy as a result of the evaporation through leaf surfaces.

Conversely, shelter is an important factor in reducing the impact of cold weather. Animals exposed to cold winds use more of the available feed simply in keeping warm. Animals also adopt irregular feeding patterns, and increased vulnerability to disease⁷. Providing tree shelter belts can improve feed conversion and weight gain, and animal health.

Shelter is particularly important to young livestock, and has been shown to reduce exposure and improve survival of lambs.

Shelter is an important factor in also reducing the impact of cold weather. Tree shelter belts can improve feed conversion, weight gain and animal health.



Sheep congregate under a tree, seeking refuge from the sun.

Geograph/Andy F

Drought and water conservation

Water is lost from pasture and crops through a combination of evaporation from the soil surface, and transpiration, as water vapour is lost from plants through leaf surfaces.

When evapotranspiration occurs, humidity levels increase around the soil or leaf surface. As the air becomes saturated the process slows down, unless water vapour is removed. Faster wind speeds will transfer larger amounts of dry air over the soil or leaf surface and therefore remove saturated air more quickly, increasing evapotranspiration rates.

When levels of available soil water drop below a certain value the crop is water-stressed, and the lack of water results in a reduction in transpiration and ultimately yield.

Effects of shelter

Shelterbelts modify the microclimate by reducing wind speeds and increasing daytime temperatures. Lower wind speeds increase the level of humidity around the plant surface slowing evapotranspiration water loss. The effect is that, although pasture and crops protected by shelter may use the same amount of water as non-sheltered crops, they will have increased photosynthesis rates and increased water use efficiency.

Whilst trees may shade pasture and crops and compete for water and nutrients, reducing yields adjacent to shelter, these reductions typically occur up to a distance of one to two tree heights from the shelterbelt, and are outweighed by the increases in yield represented by more efficient water use.

Shelterbelt height determines the extent of cover. Shelterbelts with an optimum porosity of between 40–60 per cent protect an area up to 30 times the height of the shelterbelt. Two Canadian studies showed that shelterbelts increase overall crop yields, despite an area of reduced yield directly next to the shelter.

Use of windbreaks

In Europe and other temperate agricultural systems which suffer episodes of drought, shelter using tree windbreaks is a common feature.

In Poland large networks of shelterbelts act as water pumps cooling the air of large areas of the landscape. Trees, due to high rates of evapotranspiration, humidify the air reducing evapotranspiration rates in adjoining fields.

Trees are used as shelter in Canada, USA, Australia, New Zealand, China, Argentina and many developing countries. The Agri-Food Canada website states that shelterbelts can increase wheat yields by 3.5 per cent and that figure is greater in drier years. A UK study using artificial shelters showed yield increases of wheat and barley in the years when the weather was hot and dry.

The benefits of shelterbelts become more pronounced when the plants are water stressed and wind direction is consistent. The evidence suggests that under the right conditions native tree shelterbelts could enable UK pasture and crops to use water more efficiently. Shelterbelts can be viewed as an insurance policy against the increased frequency of dry periods during the growing season.

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Soil erosion, water quality and flooding

Soil erosion by wind and water represents an economic cost to agriculture. Around 2.2 million tonnes of topsoil are eroded annually in the UK. Soil type, slope, and farming practice all impact on the risk of soil erosion.

Developments in agriculture over the last 50 years, such as increase in field size, use of heavier machinery, and changes in cropping, have increased the risk of erosion. Climate change and predicted increase in frequency of severe weather events, is likely to magnify the impact⁸.

Erosion can reduce the long term fertility of the soil by removing nutrient rich top soil and organic matter, and can affect water infiltration and increase runoff. In the short terms erosion can lead to loss of seeds, fertilisers and pesticides and incur costs associated with repeat operations.

Runoff

Heavy or severe rainfall can lead to surface runoff. As well as the impact on the farm, this leads to sedimentation and contamination of streams, rivers and other water bodies, damaging fisheries and

wildlife, and increasing water treatment costs. Faecal indicator organisms (FIO) such as *E.coli*, associated with manures, can also contaminate water supplies. Timing and type of cultivations, crop selection, siting of cattle feeders and water troughs, and location of manure heaps, can all affect the likelihood of runoff and contamination of water courses.

Trees can reduce soil and water movement, by increasing water infiltration rates and slowing the flow of transported sediments. By trapping pollutants bound to soil particles, trees can help reduce water pollution, acting as nutrient sinks. Phosphates in particular are associated with trapping of sediment, while nitrate removal can occur by plant uptake.

Studies show that grass / tree buffers can be effective in removing phosphates and reducing nitrate levels in runoff. Most of the nitrate was removed in the first 5m.

Around 2.2 million tonnes of topsoil are eroded annually in the UK.



Tree shelterbelt planted on farmland at Pont Bren in Wales.

Rory Francis

Targeted tree planting on pasture can reduce water run-off and the risk of flooding. Shelter belts of trees can also have a positive impact on pasture growth by increasing water infiltration.



Collecting logs for firewood.

iStock

Targeted tree planting on arable or pasture can reduce water run-off and the risk of flooding. In addition, shelter belts of trees can have a positive impact on pasture growth by increasing water infiltration. Studies at Pontbren in mid Wales found that water infiltration increase by 60 per cent within 5m of shelter belts after just three years of planting.

Planting across the contour or in areas known to be vulnerable to runoff will provide the greatest benefit; knowledge at a farm level will be able to match this ideal to the practical opportunities.

In addition riparian buffers can help stabilise river banks and prevent further erosion. Trees provide dappled shade to watercourses and

lower water temperatures and can be associated with improved oxygen levels to the benefit of fish and other wildlife. It can also be used, with fencing, to limit the access of sheep to wet areas likely to increase the incidence of foot rot.

Wind erosion

Wind erosion tends to affect more limited areas and happen less frequently than water erosion, but when it does occur it can be severe. On vulnerable soils, wind erosion can cause loss of topsoil, seeds, fertiliser and agrochemicals, and cause damage to ditches and water courses. Drier parts of the country are particularly susceptible; the increased frequency of dry summers is likely to exacerbate the problem.

Greenhouse gas emissions

It is estimated that agriculture is responsible for around 9 per cent of total UK greenhouse gas (GHG) emissions. Of this just 9 per cent is as carbon dioxide (CO_2), mostly from use of diesel and other farm fuels. Around 55 per cent is nitrous oxide (N_2O), resulting from application of nitrogen fertilisers. A further 36 per cent is methane (CH_4), mostly as a product of the digestive process of cows and sheep (ruminants) but also from decomposition of animal manures⁹. Both N_2O and CH_4 are more powerful GHGs than CO_2 .

Developments in the diet of ruminants, together with better handling of manures and slurry can contribute to reduction in levels of GHG, as can the timely and measured application of fertilisers and manures.

The planting of trees on farms, for whatever purpose, will have some benefit in capturing atmospheric carbon and

offsetting these emissions.

Wood harvested from shelter belts or woodland can be chipped for animal bedding as a substitute for straw. Trials in Wales found that woodchips used over three years cost £8 per cow (housed for 16 weeks a year), against straw at £23 per head. The woodchip also makes an excellent soil improver and reduces the release of volatile nitrogen compounds in to the air, when compared to straw.

Wood fuel, as renewable energy source, displaces fossil fuels and reduce the carbon footprint of the farm, as well as securing part of the farms energy needs at a time when energy prices are increasing. Wood fuel can be grown in areas which are difficult to farm or can be harvested from trees planted for other purposes, for instance providing shelter. Wood fuel can also be sold off the farm to create an additional source of income.

Around 3 ha of woodland can heat the average farmhouse. Larger areas of woodland could feed a boiler to heat other farm buildings. That woodland does not need to be in one block, but it does need

to be accessible. In each case use of native tree species has the benefit of producing good quality firewood and supporting biodiversity, important to create a diverse and resilient farming system.

Ammonia emissions

Agriculture contributes about 90 per cent of UK ammonia emissions to the atmosphere. Cattle are the major contributor, releasing around 47 per cent of the UK total, with pigs and poultry contributing around 18 per cent. The nitrogen component of ammonia is deposited on land leading to an increase in nitrogen loving plants which can out-compete other species on sensitive habitats. Some species, such as lichens, can be directly damaged by the ammonia, and the nitrogen deposition

can lead to acidification of land and water, impacting on the survival of some species. The combination of these effects changes the ecosystem and reduces overall biodiversity¹⁰.

Trees can trap ammonia. Studies have shown that shelterbelts next to livestock units can reduce ammonia emissions by up to 10 per cent. Buffering important habitats by planting native trees in the path of emissions from livestock units can also help reduce the impact.

It is estimated that agriculture is responsible for around 9 per cent of total UK greenhouse gas emissions... and about 90 per cent of ammonia emissions.



Trees located around farm building can help reduce ammonia emissions.

Geograph/Brian Robert Marshall

Shelter can help improve the working conditions around the farm yard.



WTPL/Stuart Handley
Stacked wooden stakes

Trees provide food and habitat for pollinating insects.

Health and safety

The dust created by dry weather and wind represents a health and safety hazard to farm staff, both in the field and around the farm and packing sheds. Asthma as a result of dust is a reportable disease. Shelter can help reduce the effect of dust being whipped up by dry conditions and wind, both in field, and particularly around yards buildings. Trees can trap dust by

adsorption on to leaf surfaces.

Shelter will provide the additional benefits of reducing heat loss from buildings in the winter and providing shade in summer. Even for well insulated buildings shelter can reduce heating costs by 5 per cent, and that can rise to as much as 40 per cent for poorly insulated buildings.

Timber

Native woodland can produce timber for use on the farm or to diversify farm income. The first harvest of timber from new woodland is likely to be at around 15-20 years. Small diameter timber of species such as oak and sweet chestnut can be used for fencing or sold into bulk

markets, whilst larger timber might be used for farm buildings or for sale to sawmills. Where there is a strong local demand, specialist uses such as thatching spars, birch for horse jumps, and willow for basket making, can also generate income.

Crop pollination

For crops requiring insect pollination, such as oilseed rape and field beans, windbreaks provide shelter for pollinator activity, particularly where shelter trees are integrated into existing hedges. Shelter belts provide food and habitat for pollinating insects, and are used a 'highways' for the

movement of bees, hoverflies and other pollinators.

Concern is sometimes raised that tree belts will act as a reservoir and source of crop pests. In fact research shows that increasing elements of non-crop habitat reduces overall pest risk¹¹.



Trees in the farmed landscape

WTPL/Robin Weaver

Wildlife Conservation

Native woodland creation helps wildlife, particularly where it buffers and extends ancient woodland.

Newly created woodland has a rapid increase in the abundance of insects between establishing trees, attracting birds, particularly species of open country such as sky larks and linnets. The abundance of insects also attracts foraging bats; up to nine species of bats have been found to use even very early stage woodland.

Whilst many of the specialist plants associated with ancient woodland will not colonise for many years, some other woodland plants, such as lords-and-ladies, herb-Robert, wood avens and honeysuckle are faster to colonise.

Targeted woodland creation may also help the movement of species around the landscape as climate change alters their ranges.



WTPL/Robert Bennett

Protecting open habitats

Tree planting and woodland creation provides many benefits. However it is important not to plant trees where there are valuable open habitats such as species rich grassland, including wax cap grasslands, and heather moorland. Wetlands of any

description should not be drained and planted. If you are in any doubt as to the suitability of land for planting please contact us for advice on where to get further help and information (see below).

Wetlands of any description should not be drained and planted.

Improving sporting opportunities

Well sited native woodland can increase the potential of game shooting on farms, particularly pheasants. Native woodland with well designed rides provides shelter and a valuable food source for pheasants. Development of the woodland edge is particularly important and can be achieved by expanding existing woodland. Advice on sporting woods is available from the Game and Wildlife Conservation Trust, with whom we have produced guidance on management of woods for pheasants¹¹.



Pheasant in woodland.

WTPL/Libby Owen

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Sources of funding

England Woodland Grant Scheme – EWGS

The Forestry Commission (FC) offer planting grants for areas of eligible land over 0.25 ha (no narrower than 30m on average, with 15m as an absolute minimum width at any point). Farms can claim up to £2,800 per hectare, with 80% of this paid in year 1 and the remaining 20% paid in year 5 (assuming the FC are satisfied with the scheme).

The proposed planting site must not have been under woodland cover for at least 10 years. Applications must be received before the work commences and won't affect Single Payment Scheme funding.

Depending on the scheme, an additional one off payment of up to £2,000 per hectare in year 1 may be offered (giving a total of up to £4,800 per hectare). To be eligible, schemes must deliver at least one of the following four priorities:

- supporting the Water Framework Directive
- offering public access where there is a demand
- for biodiversity, creating at least 5ha of native woodland habitat and/or in Nature Improvement Areas
- complementing other habitat restoration e.g. PAWS restoration

Farm Woodland Payments – (FWP)

Intended to cover income foregone (loss of agricultural land), FWP doesn't affect SFP. However due to likely changes in EU regulations from 2014, FWP can only be guaranteed on applications for new woods that are planted and claimed by 31 December 2013. Up until this time, farms can claim:

- £200 per hectare per year on grassland for 15 years

- £300 per hectare per year on arable land for 15 years
- Non farmer £150 per hectare per year on any land type

Other sources of funding

Some farmers may not want to claim a government grant for tree planting. The Woodland Trust MOREwoods scheme offers an alternative source of funding. Ideal for small-scale, scattered, low density or narrow planting (such as shelterbelts, riparian schemes or maximising field corners), farmers could receive up to 60% of the costs. Planting under MOREwoods will affect SPS claims.

For farms participating in the Environmental Stewardship Schemes, planting is allowed under the Entry Level Scheme as long as the land isn't being used to claim points. Farms under Higher Level Stewardship may be able to fund planting through the HLS, EWGS or MOREwoods.

Support is available to help you access grants

The Woodland Trust can provide expert free guidance and assistance, helping farmers identify the most suitable funding source. Our support service includes a site visit from one of our experienced advisors to check land suitability, assistance with planting design and help with the paperwork.

You can contact the woodland creation team on 0845 293 5689 or by emailing woodlandcreation@woodlandtrust.org.uk

Additional information can be found on the Woodland Trust website: woodlandtrust.org.uk/farming

Planting trees can benefit your farm

The Woodland Trust believes that creating and maintaining a landscape rich in trees and woods is vital to meet the challenges of climate change, while maximising productive use of the land and supporting biodiversity.

Planting trees and farming need not be viewed as competing land uses but complementary ones, working with the grain of nature to best effect.

Trees planted in the right location provide shelter and shade for animals and crops; wind damage to crops is reduced and the efficiency of water irrigation is improved. Trees can also help to reduce surface water and nutrient runoff into rivers as well as providing an alternative and sustainable source of on-farm energy and timber.

Help and advice

If you would like free advice or guidance on farm planting schemes and grants, please contact our experienced woodland creation team on:

0845 293 5689

woodlandcreation@woodlandtrust.org.uk

woodlandtrust.org.uk/farming

About the Woodland Trust

The Woodland Trust is the UK's leading woodland conservation charity, with 40 years' experience creating, managing and restoring woods. We care more than 1,000 woods on our own estate and have helped create more than 1,000 new woods for people and wildlife.

Find out more at
woodlandtrust.org.uk

The best time to plant trees was 30 years ago. The next best time is now.



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