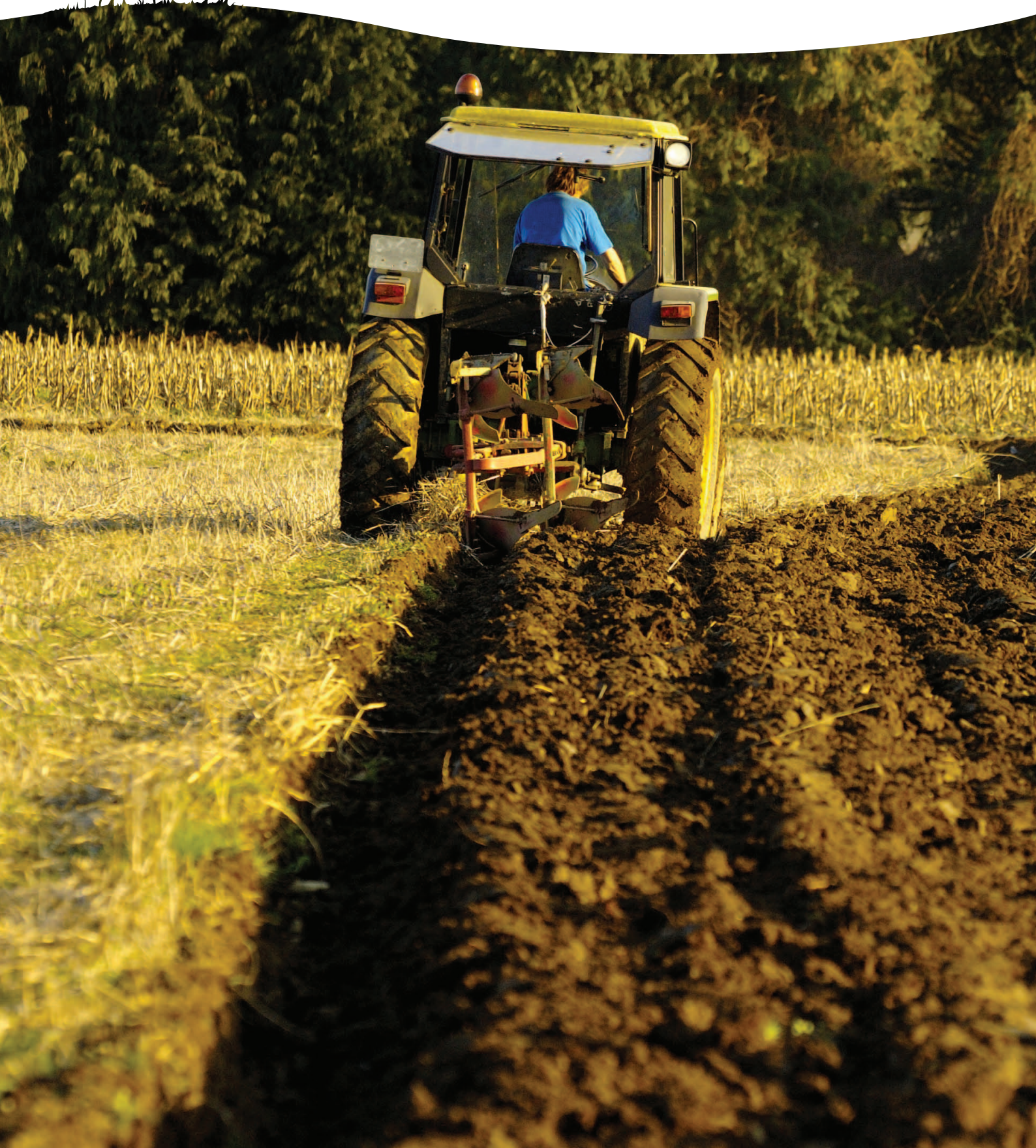
WOODLAND TRUST

Benefits of trees on arable farms

Woodland Trust Report



Contents

Trees in the farming landscape

WTPL/Colin Baglow

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 while 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'[i]. For agricultural production this means healthy soils, pollinating insects, climate regulation, with 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.

While 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, while 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, delivering benefits at the farm scale and wider public goods.

Working with Harper Adams University College we have reviewed the evidence for the role of trees in farming systems and the benefits they provide[1].

The thoughtful integration of trees into farming systems can support production, delivering real benefits at the farm scale while also delivering wider public goods

[i]Ecosystem 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.

Certain Soil types are particularly vulnerable to drought, having a real impact on crop quality and yield.

iStock/Susan Stewart

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.

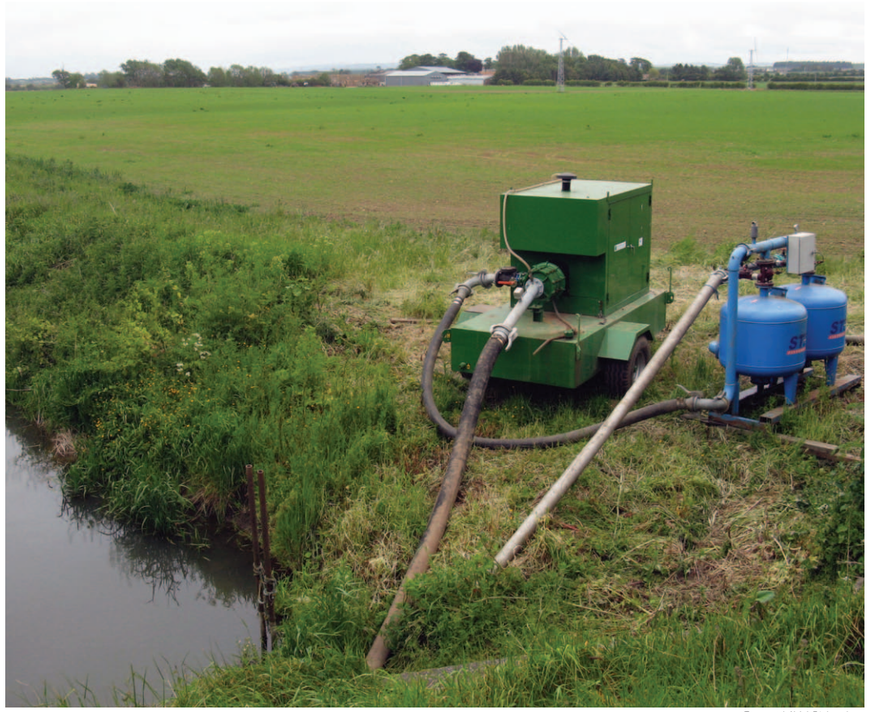
Dry spring and summer weather reduces crop yields and in 2011 was estimated to cost UK farmers £400m. Water is already over abstracted in large areas of southern England. Climate change scenarios predict this will get worse.

For UK agriculture and horticulture, periods of drought during the growing season could mean poor crop germination, reduced growth rates 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 crop husbandry and improved irrigation systems will all play a part in addressing the problems caused by increasing frequency of drought, but crop shelter 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.

...crop shelter has an important role to play in addressing the problems caused by increasing frequency of drought



GeographIM J Richardson

Pressure to maintain water supplies may mean that restrictions are placed on abstracting water.

A study has shown that tree shelterbelts can increase wheat yield by 3.5%, with more in drier years.

Geograph/Hugh Venables

Drought and water conservation

Water is lost from crops through a combination of evaporation from the soil surface and crop transpiration, as water vapour is lost from plants through leaf surfaces. The rate of evapotranspiration is controlled by solar radiation, temperature, wind speed and humidity.

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. Lack of water results in a reduction in transpiration and ultimately crop yield.

Effects of shelter

Shelterbelts modify the crop 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 a crop protected by shelter may use the same amount of water as a non-sheltered crop, it will have increased photosynthesis rates and increased water use efficiency.

While trees may shade crops and compete for water and nutrients (lowering crop yields adjacent to shelter) these yield 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.

Use of windbreaks

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

A study in Italy showed that a shelterbelt of 40 per cent porosity could increase rain-fed durum wheat yields and reduce evapotranspiration rates up to a distance of 12.7 times the height of the shelterbelt[3]. 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 crop evapotranspiration rates in adjoining fields[4].

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[5]. Two Canadian studies showed that shelterbelts increase overall crop yields, despite an area of reduced yield directly next to the shelter.

A UK study using artificial shelters showed yield increases of wheat and barley in the years when the weather was hot and dry[6]. Studies also show that shelter reduced mechanical damage of plants, potentially reducing water loss from damaged tissue. This benefit is evident from an early stage. Shelter reduces the possibility of sand blasting by soil of seedlings.

The benefits of shelterbelts become more pronounced when the plants are water stressed and wind direction is consistent.

Trees modify the crop microclimate by reducing wind speeds and increasing daytime temperatures

The evidence suggests that native tree shelterbelts could enable UK crops use water more efficiently. Shelterbelts can be viewed as an insurance policy against the increased frequency of dry periods during the growing season.

In addition, shelter can also help prevent lodging and subsequent harvesting losses. Opportunities for ingress of diseases, particularly fungal infestations and rots, can also be reduced.

Soil erosion

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[7]. The sandy soils of eastern and central England are particularly susceptible to erosion. Wind erosion tends to affect more restricted areas and to be more limited in frequency than water erosion, but when it does occur it can be very severe. 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 loss of hedgerows have increased the risk of soil erosion. Climate change and predicted increase in frequency of severe weather events is likely to magnify the impact of erosion[8].

Runoff

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 term, erosion can lead to loss of seeds, fertilisers and pesticides and incur costs associated with repeat operations.

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.

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

Dr Richard Smith, Environment Agency

Soil erosion is a significant problem for farmers.

An estimated 25 per cent of the phosphates and 50 per cent of nitrates in rivers are from agricultural sources. Sediment deposits can increase the turbidity of water bodies and settle in spawning beds affecting valuable fisheries. In some cases sediment deposits can increase the risk of flooding.

Trees can help reduce soil and water movement by increasing water infiltration rates and slowing the flow of transported sediments. Organic matter added from leaf litter and root debris can also promote soil structure reducing surface water run-off. 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. In addition, riparian buffers can help stabilise river banks and prevent further erosion.

Studies in the USA and New Zealand show that buffers composed of grass, trees and shrubs can be effective at lowering levels of sediments in run-off[9]. While studies from Europe and North America show that phosphate can be removed by tree/grass buffers, a UK study showed that 99 per cent of subsurface nitrate applied to a nearby arable field could be removed by grass/tree buffer. Most of the nitrate was removed in the first 5m[10]. Further work in Poland, Italy, Estonia, USA and Canada has also shown that tree/grass buffers can be effective at reducing nitrate levels in runoff.

Targeted tree planting has been identified as one of the ways to mitigate diffuse pollution from agriculture and deliver the quality standards of the Water Framework Directive.

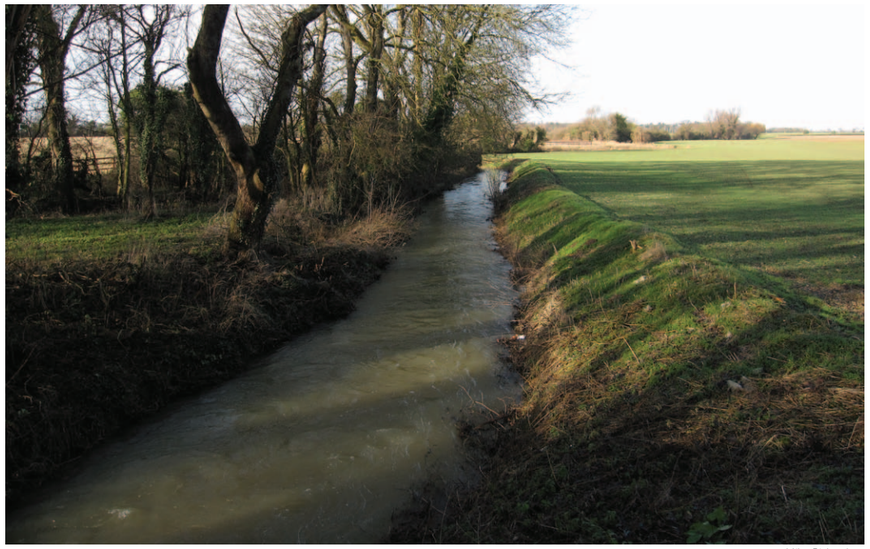
Planting across the contour or in areas known to be vulnerable to runoff will provide the greatest benefit; knowledge at a farm level will be able to match this ideal to the practical opportunities.

Wind erosion

On vulnerable soils, especially peats and sandy 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 in Yorkshire, East Midlands and East Anglia are particularly susceptible; the increased frequency of dry summers is likely to exacerbate the problem. Fine seedbeds for sugar beet, carrots and onions are more prone to erosion.

Trees help reduce soil and water movement, by increasing water infiltration rates and slowing the flow of transported sediments



Mike Richardson

Soil erosion leads to river sedimentation, damaging habitats for fish and other wildlife.

Greenhouse gas emissions

It is estimated that agriculture is responsible for around 9 per cent of total UK greenhouse gas (GHG) emissions. Of this around 9 per cent is 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 manures[11]. Both N_2O and CH_4 are more powerful GHGs than CO_2.

Minimising tillage reduces the loss of soil carbon and N_2O and the CO_2 emitted from machinery fuel. Timely and measured application of manures and fertilisers also helps reduce loss of N_2O. Reducing surface water runoff will help with improving fertiliser efficiency.

The planting of trees on farms, for whatever purpose, will have some benefit in capturing atmospheric carbon and offsetting these emissions. Wood fuel, as renewable energy source, displaces fossil fuels and reduces 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. 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.

It is estimated that agriculture is responsible for around 9 per cent of total UK greenhouse gas emissions... planting trees will have some benefit in capturing atmospheric carbon and offsetting these emissions

Rory Francis

Wood fuel being collected by farmers at Pont Bren in Wales.

Farming in the Lincolnshire Fens – case study

Brickyard farm is a 400 acre, organic mixed farm growing cereals, brassicas and other vegetables, with some grassland maintained for livestock production. Located in a flat and intensively farmed agricultural area (the Lincolnshire Fens) over the past 100 years the Danby family have integrated trees, woods, hedges and shelterbelts into the unproductive areas of their farm. Managed under HLS, these trees play an important role in the Danby's farming system.

George Danby said: *'As farmers, we are custodians of the landscape, with responsibilities to protect the environment. The decisions we make need to take into account more than just our own immediate interests. At Brickyard farm, we've developed a farming system where wildlife and commercial operations support each other. Our trees and hedgerows host lacewings and hoverflies which help control aphids on valuable brassica crops, and provide cattle with protection from the elements. Winds can whip across the Fens so the shelterbelts and woods are needed to help protect exposed soils. Potatoes in three of our most tree-sheltered fields always come early'*

John and George Danby at their farm in Boston, where trees have a positive impact on their farming systems

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 harbour crop pests. In fact research shows that increasing elements of non-crop habitat reduces overall pest risk[12].

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 reduce the effect of dust being whipped up in the field and yard by adsorption onto leaf surfaces and slowing wind speeds.

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. This can rise to as much as 40 per cent for poorly insulated buildings.

Shelter can help improve the working conditions around the farm yard

Wildlife conservation

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

Newly created woodland leads to a rapid increase in the abundance of insects between the establishing trees.

Northeastwildlife.co.uk

Woodland creation sites support species such as skylarks

This attracts birds particularly species of open country such as skylarks and linnets. The abundance of insects also attracts foraging bats; up to nine species of bats have been found to use very early stage woodland.

While many of the specialist plants associated with ancient woodland will not colonise for many years, some 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.

Protecting open habitats

Wetlands of any description should not be drained and planted.

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.

WTPL/Richard Becker

Waxcap fungi grassland.

Improving sporting opportunities

Game Wildlife Conservancy Trust: Marcus Jenny

Pheasants are birds of the woodland edge

Well sited native woodland can increase the potential of game shooting on farms, particularly for 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 pheasants[13].

...woodland can increase the potential of game shooting

WTPL

Pheasants are rarely found more than 50m into woodland.
Providing a graded woodland edge will benefit both game and biodiversity.

Woodland for wildlife and game – case study

Henry and Edward Heath's mixed arable and stock farm near Braintree now boasts two new blocks of native woodland – a huge addition to the few hedge and willow trees that previously adorned the farm. Support by the Woodland Trust, the planting of 2,250 broadleaf trees on 2.5 acres of previous set-aside and unproductive land is a major step towards raising the farm's conservation profile and will create windbreaks to protect crops and livestock.

Henry said '*With few trees on our farm, we were initially motivated to plant trees to improve wildlife habitat but then realised there are many other benefits we could gain. We specifically went for a mix of trees and shrubs to encourage game birds and supply firewood, helping us diversify our income and potentially save money on fuel bills in the future.*'

Henry Heath

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Sources of funding and advice

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 (SPS).

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 SPS. 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, assist with design of the planting and help with the paperwork.

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

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

Planting trees can benefit your farm

We believe 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.

The Woodland Trust believes planting trees and farming should not be viewed as competing land uses, but complementary ones.

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 for 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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