Trees in orchards
A report into the sustainability benefits of integrating non-cropping trees in the top fruit sector
October 2013
Report produced by sustainability consultants Best Foot Forward, commissioned by the Woodland Trust.

September 2013
Trees in Orchards

An evaluation of the use of non-cropping trees in fruit orchards: what benefits can they bring; how significant are those benefits; and who is in a position to do something about it?

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Summary

Introduction
There is growing interest from companies operating in the UK’s food system in understanding and reporting the benefits of sustainable practice at the point of production – farms, forests, or in this case orchards. Food retailers and manufacturers are keen to achieve and communicate enhanced performance, and may wish to do this in a distinctive manner. The promotion of non-cropping trees in orchards, linked to credible sustainability outcomes, could provide a distinctive practice-based intervention tool, and deliver enhanced environmental and productivity outcomes.

This report describes the functions which non-cropping trees can have in orchards and explores the salient issues in orchard sustainability. This puts the potential benefits of trees in the context of the issues that really matter in the top fruit industry, and identifies whether non-crop trees can make a difference. A stakeholder analysis of the supply chain explores who might have an interest in the sustainability functions that non-cropping trees can deliver in orchards.

Findings
Analysis of the potential for non-cropping trees to address sustainability in orchards provided a number of clear findings:

1. Non-cropping trees already play a practical role in orchards – predominantly as shelter from the elements.
2. The existing role of non-cropping trees could be significantly enhanced to include a supporting role for pollinators, and also for beneficial insects and birds as part of an integrated pest management strategy.
3. In both cases tree establishment would need to be planned carefully, to integrate with existing orchard management functions, and to avoid adverse outcomes – such as wind tunnelling, the harbouring of disease, and the creation of frost pockets.
4. If non-crop trees are to be used to support beneficial organisms, they should be seen in the context of the habitat complexes that trees can be associated with – banks, ditches, shrubs, climbers, herbaceous hedge-bottoms, scrubby edges. Establishing ‘woody habitat features’ rather than just planting trees will be functionally important.
5. Other, ancillary, benefits of trees could include the production of woodfuel. Cutting of trees will be useful to control height and spread, and so use of the arisings for woodfuel could make practical and economic sense. Realising the value of ‘linear features’ for woodfuel is gaining currency as a practice, and reflects ‘bocage’ management practices found in northern France.
1. Orchards in the UK

1.1 The tree fruit industry

Fruit orchards are quintessential to many British landscapes. Kent is known for its apples, cherries and cobnuts; Gloucestershire its Perry pears; Shropshire its damsons, and Herefordshire, Devon and Somerset their cider apples. But orchards are far fewer in number and area than they were; declining 57% since 1950\(^1\). The main productive orchards are very different in character to the ones in our cultural imagination; more utilitarian, less diverse, but more productive.

The UK tree fruit industry in the UK was worth £157 million in 2011, and covers just less than 17,000 hectares. Eighty per cent of production is apples - just over half of this for cider; a little over 10% of orchards produce pears – mainly conference; 5% plums, and the remaining 5% is made up of various crops, of which cherries are the most significant proportion\(^2\). In 2010 the UK produced 235,450 tonnes of apples (on a marginal decline), 32,800 tonnes of pears (noticeable increase in recent years), 13,200 tonnes of plums and sloes (fairly constant), and 1,200 tonnes of cherries (FAOSTAT).

Compared to other agricultural sectors, the tree fruit growing sector is relatively small, both in terms of area and value. Levels of self-sufficiency are also low, compared to other indigenous crops; 35% for apples; 18% for pears, and 17% for plums\(^3\). However, there is real commercial interest in domestic production. For retailers ‘buying British’ represents an important and resonant marketing point, and for processors and retailers having domestic sources of production – especially where they are dedicated suppliers – provides a hedge against some of the risks inherent in international markets. In recent years British orchards have increasingly adopting more competitive growing and crop-protection methodologies, such as fruit walls and Integrated Pest Management. The result is a small industry, but one which is rapidly evolving and has ceased declining in recent years.

\[\text{Chart 1. Fruit production in the UK}\]

\(^1\) Common Ground, The Apple Source Book, Hodder and Stoughton, 2007  
\(^2\) Figures from DEFRA  
\(^3\) Top import locations for apples, pear and plums include EU (France, Spain, Italy, Portugal) and Southern Hemisphere (South Africa, New Zealand, Chile) See FAOSTAT
1.2 Top fruit systems in the UK

1.21 Traditional orchards

Although not usually counted as part of the mainstream productive orchard industry, traditional orchards actually still cover more area – despite considerable declines in the late 20th Century. A number of features of traditional orchards set them apart from modern, more intensively productive orchards, including:

- The use of full or half standard trees, rather than more easy to crop bush forms. Taller trees mean that traditional orchards can be, and often are, grazed by livestock.
- The use of old traditional fruit varieties, and in some cases a wider range of varieties in a single orchard.
- Wider spacing between trees.
- Older trees; partly because modern orchards are grubbed up and replace trees on a more regular cycle, and partly as a function of the fact that many traditional orchards are no longer being actively managed.

Traditional orchards are considered to be of considerable ecological value, providing a mosaic of scrub, hedgerow and grassland habits valuable for a wide range of animals and plants. This is in addition to the value of the fruit trees themselves, which can be important for saproxylic (deadwood-dependent) insects. Traditional orchards were added to the UK Biodiversity Action Plan as a Priority Habitat in 2007. They also have strong cultural and aesthetic value – making an important contribution to the genus loci in many parts of the UK.

Although there may be a perception that traditional orchards are being replaced by modern intensively managed orchards, most direct losses have been through conversion to agriculture or housing.

1.22 The dominant productive orchard systems

Most top fruit production in the UK is from relatively intensively managed orchards. These are characterised by narrow tree spacing, usually in uniform rows; the use of shrub forms, increasingly pruned into a ‘hedge’; the use of a restricted number of merchantable varieties, and increasingly systematic and mechanised management regimes.

A significant change in the management of orchards in recent years has been the increasing sophistication of pest management. Pests are a major factor in and determinant of management system in UK orchards. ‘Conventional’ orchard systems would apply a range of synthetic pesticides at points within the production calendar, to a greater or lesser extent on a prophylactic basis. Orchards are now managed almost exclusively under some form of ‘Integrated Pest Management’ (IPM) system. IPM takes a more multi-faceted and systems-oriented approach to managing orchard pests; key characteristics include:

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4 Orchard cover in the UK ~42,300ha (commercial 16,950 + traditional 25,350, 24,600 of which is in England)
6 38 separate pests and diseases have been identified for apple orchards (Pennell, 2006a), and 30 for pear orchards (Pennell, 2006b)
• Identification and monitoring of pests and conditions associated with pest outbreaks;
• Use of damage thresholds to trigger treatments/interventions;
• Preventative measures - planting resistant varieties, modifying the ecosystem to make it less habitable for pests;
• Integrated management tools: including biological, cultural, mechanical/physical, and chemical control;
• Biological control options within orchards include providing habitats for ‘natural enemies’ of pest species - often predatory or parasitoid insects.

European pesticides legislation\(^7\) has restricted many classes of pesticide and specifically requires the use of IPM. Partly as a result of this, virtually all orchard management regimes now fit somewhere on the IPM spectrum.

1.23 Organic orchards

Around 5% of top fruit orchards are registered as organic\(^8\). Organic orchard systems will tend to use IPM principles, albeit with a significantly restricted range of chemical inputs. Aside from restricted pesticide options, organic systems restrict the use of synthetic fertilizers, herbicides and chemical fruit thinners. Organic practices include certified controls like applications of *Bacillus thuringiensis* (BT) toxin and pheromone-mating disruption (PMD); the use of composts mulches for fertility, and fabric mulch matting, cultivation and mowing to control weeds. Fruit thinning is done by hand.

1.24 Recent developments in top fruit production

‘Fruit walls’

Since the 1950’s, the trend in orchard production has been away from ‘traditional orchards’ with full standard trees to uniform plantings of dwarf or bush tree forms, for ease of management and harvesting. More recently there has been a move towards more intensive ‘fruit walls’. In these systems the fruit trees are intensively trained and pruned into hedges a couple of metres high separated by grass strips. Fruit walls can achieve significantly higher yields per hectare, and lend themselves to mechanical management – for both harvesting and pruning. Fruit wall systems usually incorporate drip irrigation.

*Concept orchards*

Collaboration between commercial fruit growers and East Malling Research in Kent, supported by Sainsbury’s, have developed a series of concept orchards\(^9\). These are trialling and demonstrating combinations of orchard growing systems for both apples and pears, and reflect the current state of the art in IPM and fruit wall techniques.

\(^7\) DIRECTIVE 2009/128/EC ‘Establishing a framework for Community action to achieve the sustainable use of pesticides’


1.3 The current position of orchard sustainability and non-cropping trees

Whilst non-cropping trees are already part of orchard landscapes, there are currently few instances where non cropping trees are being used explicitly to promote orchard sustainability. However, as with most high profile and recognisable raw materials, sustainability is an important issue for both reputation and direct practical reasons.

1.31 Sustainable orchard practice

A number of identifiably sustainable practices have been adopted in the top fruit supply chain – see table 1. Many of these are also resource/cost saving measures and are relatively easy to adopt.

Table 1: Environmental measures already taken by growers, packers and those who store fruit¹⁰:

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Function</th>
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<tr>
<td>Planting the headlands of orchards with plants and shrubs to attract beneficial insects to maximise pollination and reduce pests.</td>
<td>Promoting biodiversity Pollination services Pollination services Pollination services Pollination services Pollination services</td>
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<tr>
<td>Providing refuges on trees in orchards for beneficial insects.</td>
<td>Promoting biodiversity Pollination services Pollination services Pollination services Pollination services</td>
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<tr>
<td>Providing nesting boxes for birds.</td>
<td>Promoting biodiversity Pollination services Pollination services Pollination services</td>
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<tr>
<td>Using pheromone traps to attract and control pests.</td>
<td>Promoting biodiversity Pollination services Pollination services</td>
</tr>
<tr>
<td>Using mulches to control weeds.</td>
<td>Promoting biodiversity Pollination services</td>
</tr>
<tr>
<td>Minimising fungal infections by removing fallen fruit and macerating leaves in the autumn.</td>
<td>Promoting biodiversity</td>
</tr>
<tr>
<td>Collecting rainwater for storage in on-farm reservoirs for irrigation.</td>
<td>Promoting biodiversity</td>
</tr>
<tr>
<td>Recycling water used in pack-houses by filtering and purifying with UV.</td>
<td>Promoting biodiversity</td>
</tr>
<tr>
<td>Producing electricity for pack-houses and cold stores through solar panels.</td>
<td>Promoting biodiversity</td>
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<tr>
<td>Insulating cold stores and pack-houses to minimise energy usage in combination with computerised controls to maximise efficiencies.</td>
<td>Promoting biodiversity</td>
</tr>
<tr>
<td>Collecting waste cardboard and paper for recycling.</td>
<td>Promoting biodiversity</td>
</tr>
<tr>
<td>Selling fruits that are unsuitable for the fresh market for processing or juice and composting rotten fruit.</td>
<td>Promoting biodiversity</td>
</tr>
</tbody>
</table>

¹⁰ From English Apples and Pears: [http://www.englishapplesandpears.co.uk/environment.php](http://www.englishapplesandpears.co.uk/environment.php)
1.32 Non-cropping trees currently in orchard landscapes

Non cropping trees are already found in and around orchards; either established as part of the orchard system, or incidental to and often pre-dating establishment of the orchard. Examples include:

1. *Windbreaks* – typically alder species
2. *Hedgerows and boundary trees*
3. *Nearby trees copses and woods*
4. *Remnant traditional orchard trees*
2 Functions of non-cropping trees in fruit orchards

2.1 Tree functions

Tree functions within orchards are described under three different headings:

- Improving orchard performance
- Reducing the local impacts of orchard practices
- Wider ecosystem services

Potential problems caused by non-cropping trees are also outlined.

2.1.1 Improving orchard performance

1) Providing shelter
Trees are already commonly used to provide shelter in orchards. Windbreaks and shelterbelts help control the orchard microclimate; this can help with pollination, and reduce physical damage to trees, buds and fruit from wind or frost damage. Efficiency is limited by the trade-off between wind-breaking and frost. Porosity of windbreaks should be around 60% to prevent inversions developing and subsequent frost damage.

Italian and black alder (Alnus cordata, and Alus glutinosa) are commonly used – being relatively fast growing and harbouring few insect or fungal pests. Willows are also fast-growing and provide valuable early season pollen (for protein) for wild bees, though can be troublesome if their roots get into drainage system.

2) Supporting pest management
Pest and disease management represents the most significant management cost for top fruit producers. In recent years there have been increasing restrictions on the use of pesticides, matched by an increasing understanding of how to manage pests through Integrated Pest Management, and linked to a range of biological controls.

Biological control includes the active encouragement of organisms that prey on or parasitise crop pests. Examples include species of wasps, which can parasitise leaf miners, and a range of other beneficial insects such as hoverflies, spiders and lacewings. Passerine predators, such as great tits can have a considerable impact on reducing damage from caterpillar populations\(^\text{11}\), and bats may have a role in controlling pests such as the codling moth.

Conventional approaches to biological control include direct introductions of beneficial species, the establishment of wildflower swards, and the installation of artificial nesting boxes and shelter sites. Getting the right assemblage of habitat features, and the right timings for them, can be a challenge – organisms exist in ecosystems and these are complex. For example, a meta-analysis of studies into the effect of plant management on pest control carried out showed mostly positive results (16 cases).

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or null (9 cases), but also negative results in some cases (5 cases); revealing the difficulties of identifying selected plants or plant assemblages for the control of key pests.

Numerous studies also show that proximity of orchards to semi-natural habitats can confer important biological control benefits on crops. Semi-natural habitats can benefit from inherent structural and species heterogeneity, and have the potential to continue producing new habitat without the need for on-going deliberate interventions and installations. By inference, introducing non-cropping trees, and habitat features associated with trees (such as banks, thickets, scrub, hedgerow flora) could be expected to deliver a wide range of semi-natural structures and resources for many beneficial organisms.

3) Supporting pollinator populations

Tree fruit crops are dependent on insect pollination, and this is carried out partly by domestic honey bees and importantly also by wild populations of bumble bees, solitary bees, and hoverflies. There have been serious declines in all of these pollinators in agricultural landscapes across Europe and North America. Declines have been attributed to various combinations of factors, including pests and diseases, habitat loss, and environmental stresses - including pesticides. As a result there is widespread concern about the impact on all crops which are dependent on insect pollination – and this includes crops from orchards.

There is significant evidence showing that pollination is enhanced in orchards where there is diverse pollinator habitat nearby. There is a case for assuming that in the context of declining pollinator populations in the landscape as a whole, the provision of pollinator habitat in and around orchards will help secure productivity. ‘Pollinator self-reliance’ might be a good strategic objective for an orchard, or complex of orchards.

Many farmers already work with apiarists to host honeybee colonies for pollination. Many also actively manage habitats for wild bees. On the whole this involves the management of meadow swards, and more specific artificial habitat provision. But non-cropping trees could have a role to play in providing pollinator habitat. The trees themselves and the habitats and plants that can be

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13 Maalouly et al, 2013, Codling moth parasitism is affected by semi-natural habitats and agricultural practices at orchard and landscape levels, Agriculture, Ecosystems and Environment Volume 169, Pages 33–42
associated with trees, for example ivy\textsuperscript{20} can provide important nesting and pollen and nectar sources to help sustain pollinator populations throughout the year (see detail in box 1).

Tree habitat may be more expensive to establish than other, more conventional pollinator habits – such as herb-rich field margins. However, the long-term management of tree habitat is likely to be relatively low-intensity and therefore easier to maintain. It also requires a more active decision to remove tree habitat, whereas field margin habitats are more likely to be lost through neglect.

As well as helping to sustain and maintain pollinator populations, the shelter provided by trees can help improve pollination success, by allowing insects to settle and browse for longer amongst flowers.

4) **Hydraulic lift**

Certain tree species have been claimed to lift water from the water table using deep tap roots during the day and deposit it close to the surface at night through their lateral roots. This may provide benefits for less deep-rooted plants in the vicinity. The phenomenon is referred to as hydraulic lift. Oaks have recently been shown to exhibit hydraulic lift in mixed woodlands in Europe\textsuperscript{21}, indicating that they may play an important functional role in habitats that experience severe drought events. This could be important for orchards at risk of water stress. However, quite how the trees involved in hydraulic lift would need to be configured in the orchard for this effect to be as cost effective as micro-irrigation is unclear.

5) **Producing woodfuel**

Rotational cutting of non-fruit-cropping trees in and around orchards provides a potential source of woodfuel. Individual trees, copses, and hedges could all be cropped, and could be supplemented by pruning material and that from rotational grubbing-up of areas of the orchard.

There are examples of active and organised cropping on scattered and hedgerow trees, often in the context of orchards, in ‘Bocage’\textsuperscript{22} landscapes in Normandy – see Bois Bocage Energie\textsuperscript{23}. A range of products can be produced (chips, logs, pellets) and used or sold.

Woodfuel cutting and processing is likely to be ancillary to the main business of fruit production. But where trees are used in and around orchards, then management through coppicing, pollarding and pruning is likely to be required – and so it will often make sense to make use of the product that arises.

\textsuperscript{20} Garbuzov, M and Ratneiks, F., 2013, Ivy: an underappreciated key resource to flower-visiting insects in autumn, Insect Conservation and Diversity (pre-publication early view, online version)


\textsuperscript{22} ‘Bocage’ refers to traditional small field systems surrounded by old hedges and hedge banks.

\textsuperscript{23} http://www.boisbocageenergie.fr
Nesting and hibernation sites:

By extension, trees too are more likely to provide a wider range of system benefits if they are established and allowed to develop in the context of a range of different associated habitat features. ‘Tree habitat complexes’ are likely to provide two important functional benefits: (1) Pollen and nectar continuity, and (2) Nesting and hibernation sites:

1. **Pollen and nectar continuity**

Pollen and nectar are crucial food sources for pollinators and help support the species complexes involved in pest population control. Fruit trees in orchards only provide pollen and nectar for a small portion of the season through which insects need to feed. In the absence, or partial absence, of sources in the wider landscape the following habitat features are likely to be important:

- **Tree and shrub blossom.** Blackthorn (Prunus spinosa), hawthorn (Crataegus spp) and gean (Prunus avium) are all important early season pollen and nectar sources. Though hawthorn is susceptible to fireblight – an important orchard disease. Several species of willow (for instance, goat willow – Salix caprea), though wind-pollinated, are still valuable as early season sources of pollen; an important source of protein.

- **Hedge bottoms.** The habitats next to trees, woods, hedges and copses provide a range of microclimates, disturbance levels, and shade levels. These provide a range of resources over an extended season; for example providing conditions for woodland, hedgerow, and meadow wildflowers to thrive, and undisturbed tussocks and thickets for overwintering insects.

- **Climbers.** The climbers and lianas associated with trees can provide sources of pollen and nectar. Ivy (Hedera helix) in particular is very important – flowering very late and providing resources for insects just before they enter hibernation.

2. **Nesting, shelter and hibernation sites:**

The wide range of species involved in pollination and pest predation require a wide range of habitat structures and features; from deadwood for sometimes protracted larval stages of saproxylic (deadwood-dependent) invertebrates, to hollow twigs and abandoned rodent holes for hibernation, to nesting, foraging and shelter for birds. Key habitats linked to trees include:

- **Deadwood.** Important for habitat or food resources for many beneficial species at some stage in their life cycle

- **Banks and ditches.** Often at the base of hedgerows – these can be important as a source of nest-making material for some species, and often contain holes which can be colonised.

- **Dense, tussocky vegetation.** Many species of invertebrate require relatively undisturbed tall herb vegetation to develop

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**Box 1: Trees or Tree Habitat?**

Providing habitat for pollinators and for insects and birds that can help with pest management are two potentially key functions for non-cropping trees in orchards. In both cases much of the value of trees comes from the habitat complexity or heterogeneity they can provide; in terms of physical structures, microclimates, substrates to feed on, and diversification of the timing over which resources are provided in the year. This complexity is important for meeting the wide range of needs of the diverse range of organisms that are involved in pollination and pest management (by way of illustration, there 24 species of bumblebee, 225 species of solitary bee, and 270 species of hoverfly found in the UK – according to Buglife). It is difficult and costly to replicate this comprehensively through direct or artificial means; which is why ‘semi-natural’ habitats can be so important – a living system to support a living system.

By extension, trees too are more likely to provide a wider range of system benefits if they are established and allowed to develop in the context of a range of different associated habitat features. ‘Tree habitat complexes’ are likely to provide two important functional benefits: (1) Pollen and nectar continuity, and (2) Nesting and hibernation sites:

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- **Dense, tussocky vegetation.** Many species of invertebrate require relatively undisturbed tall herb vegetation to develop

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**Table 2: Pollen and nectar demand and availability**

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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.12 Reducing the local impacts of orchard practices

Reducing pesticide drift

The vulnerability of top fruit crops to pests and disease means that even under IPM systems, most will be treated with a range of agrochemicals. These carry with them risks to human health and can have serious impacts on nearby habitats and watercourses. There is substantial evidence to show that trees in leaf provide a physical barrier to pesticides\(^{24}\), trapping up to 90% of spray drift when in full leaf\(^{25}\). The requirement for trees to be in leaf means that trees will intercept far less drift from pesticide applications early in the year, and it is important to maintain complementary spray drift reduction practices, such as one-sided spraying of the last tree row. The reduction of spray drift is often achieved as an added benefit from windbreaks – although effective establishment, in relation to prevailing winds, may not always make the two functions naturally complementary.

2.13 Wider ecosystem services

1. Providing wildlife habitats

The habitat value in relation to the organisms involved with pollination and pest management also applies to the provision of wider habitat value – of benefit to the landscape as a whole. More insects, more nesting sites and more structurally and species-diverse vegetation will attract a wide range of species, including birds and mammals.

“*Hedgerows, scrub and non-fruit tree species, which occur either on boundaries or within orchards, contribute directly to the biodiversity value of orchards*”\(^{26}\)

Traditional orchards have been highlighted as UK BAP priority habitats due to their steep decline in recent years; this biodiversity is not seen in commercial monoculture orchards, so management of diverse boundaries could have an important role to play.

2. Improving landscape quality

Orchards are generally considered to be an aesthetic asset in the landscape – particularly when they are in bloom. However, the increasing infrastructure linked with modern orchards has the potential to draw criticism from nearby communities, as part of wider concerns about the ‘industrialisation of the countryside’ or loss of traditional landscapes. This may have reputational and ‘goodwill’ implications for some growers, and could be relevant strategically when seeking permission for other sorts of development on their holding. The use of non-cropping trees, and tree features such as copses and hedges, is likely to soften the visual impact of these types of orchard.

3. Carbon sequestration

The introduction of non-cropping trees into orchards could increase the level of biomass in the orchard system, and this may have an additional carbon sequestration function. However, it is difficult to see how this would make a reliably substantial difference.

---


2.14 Problems caused by establishing non cropping trees

1. Loss of productive area
The introduction of any non-cropping trees into an orchard may create some level of competition with orchard trees for light and water. Any benefits will therefore need to be traded off against absolute losses in productive area.

2. Pests and diseases
While trees and tree habitat may help with the control of orchard pests, they may also harbour pests and diseases. Specific threats include the spread of tree climbing weeds such as clematis, and classically the harbouring of the serious fungal pathogen, fireblight27 by hedgerow hawthorns, sorbus species, and crab apples.

Less specifically, the manipulation of habitat in and around an orchard is not guaranteed to have a positive impact on pest/beneficial insect dynamics28, and could result in inadvertent adverse results. It is important that these interventions are planned and executed deliberately, in the context of a targeted integrated pest management plan.

3. Microclimate problems
Poorly planned hedges, tree belts, and banks can create problems with microclimate. For example:

- Tree belts or hedges can create frost pockets by preventing the flow of cold air downslope and out of an orchard (trees can also deflect the flow of cold air away from an orchard – which is a good thing).
- Insufficiently porous windbreaks can increase the risk of temperature inversions, again carrying the risk of frost damage.
- Where trees reduce air flow and increase humidity in a fruit crop, they can increase the risk of fungal diseases.
- Poorly placed trees and windbreaks can increase wind-speeds, either by funnelling air between trees, or underneath tree canopies if there is no understorey. This can increase the chances of wind damage.

2.2 Evaluation

Analysis 1 overleaf categorises the performance of trees for different functions in two ways:

<table>
<thead>
<tr>
<th>How easy is it to establish trees for this purpose?</th>
<th>Is it likely to be effective?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very easy to establish trees for this purpose</td>
<td>Trees will definitely deliver benefits</td>
</tr>
<tr>
<td>Some technical challenges or conflicts to overcome</td>
<td>Trees are likely to deliver benefits</td>
</tr>
<tr>
<td>Requires careful planning to overcome difficulties</td>
<td>It will be challenging for trees to deliver benefits</td>
</tr>
<tr>
<td>Very difficult to establish trees for this purpose</td>
<td>Unlikely that trees will deliver meaningful benefits</td>
</tr>
</tbody>
</table>

2.2.1 Which functions are most promising?

The analyses in Table 2.71 provide the basis for a simple categorisation of tree mechanism according to their potential utility. The scores from first, ease of establishment, and second likelihood of effectiveness are used to give four categories in the following ‘league table’:

<table>
<thead>
<tr>
<th>Category 1: Simple to establish and likely to succeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1 Providing wildlife habitats</td>
</tr>
<tr>
<td>2 1 Providing shelter to crop trees</td>
</tr>
<tr>
<td>2 1 Producing woodfuel</td>
</tr>
<tr>
<td>2 1 Supporting pollinator populations</td>
</tr>
<tr>
<td>2 1 Reducing pesticide drift</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 2: Difficult to establish, but likely to succeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 2 Supporting IPM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 3: Easy to establish, less likely to succeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3 Improving landscape quality</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 4: Difficult to establish, less likely to succeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 4 GHG sequestration</td>
</tr>
<tr>
<td>4 3 Hydraulic lift</td>
</tr>
</tbody>
</table>
### Analysis 1 – How well do trees work?

<table>
<thead>
<tr>
<th>Tree function and mechanisms</th>
<th>How easy is it to establish trees for this purpose?</th>
<th>Is it likely to be effective?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Improving orchard performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing shelter to crop trees</td>
<td>Creating windbreaks is well established in the industry, though getting the right result and avoiding some of the pitfalls of poor windbreak design requires thoughtful and technically competent design.</td>
<td>2   Properly planned and established windbreaks are very likely to be effective.</td>
</tr>
<tr>
<td>Supporting pest management</td>
<td>Using trees to support pest management should be planned as part of a carefully thought-through Integrated Pest Management strategy.</td>
<td>3   In the context of a well thought through IPM strategy, trees have the potential to deliver real benefits.</td>
</tr>
<tr>
<td>Supporting pollination</td>
<td>Using trees, and habitats associated with trees, to support pollinator populations should not be as technically challenging as for pest management. However, it should be planned in conjunction with other pollinator habitat measures and species that harbour and carry disease (such as hawthorn) will need to be avoided.</td>
<td>2   If properly planned, trees and related habits will provide benefits for pollinators.</td>
</tr>
<tr>
<td>Hydraulic lift</td>
<td>Based on current understanding of hydraulic lift, the establishment of trees for this purpose would be technically challenging and results likely to be very uncertain.</td>
<td>4   It is theoretically possible, but unlikely for trees to provide these benefits.</td>
</tr>
<tr>
<td><strong>Reducing the local impacts of orchard practices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reducing pesticide drift</td>
<td>The effect of tree belts on reducing pesticide drift is fairly well-proven in orchards, and is often a co-benefit of windbreak establishment.</td>
<td>2   Trees are very likely to provide benefits, especially after the early part of the season, when leaves are fully out.</td>
</tr>
<tr>
<td><strong>Wider ecosystem services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing wildlife habitats</td>
<td>Establishing trees, and habitat features associated with trees, to provide wildlife habitats will require an informed approach, but presents few real technical challenges.</td>
<td>1   Trees and associated habitat features will provide enhanced wildlife habitats in productive orchards.</td>
</tr>
<tr>
<td>Improving landscape quality</td>
<td>Establishing hedgerow and boundary trees to enhance landscape quality is unlikely to present many technical challenges.</td>
<td>1   Orchards are usually already pretty, and so achieving an appreciable difference may be hard</td>
</tr>
<tr>
<td>GHG sequestration</td>
<td>It will be difficult to plan a planting and management regime for non-cropping trees which will out-perform the orchard crop in terms of carbon sequestration.</td>
<td>3   Non cropping trees are unlikely to provide significantly additional levels of sequestration.</td>
</tr>
</tbody>
</table>
**Box 2  Might non-cropping trees include traditional orchard trees?**

Whilst we focus in this report on non-orchard trees, it is useful to consider the potential role of non-commercial or semi-commercial fruit trees in and around production orchards – as an add-on to the cropping system. Traditional fruit trees could be established in similar patterns to other non-cropping trees – along boundaries, as part of wind breaks etc. Or they could be established in discrete areas, perhaps adjoining in within the commercial growing area, or close to farm buildings – where they might be helpful as sheltered in-bye grazing, or for poultry. And in many instances, in traditional orchard areas, they will not need to be established; only retained.

**Potential advantages, over non-fruiting trees:**

- **Biodiversity.** Traditional orchard trees – if grown as full standards and allowed to over-mature - are likely to provide habitat which is at least similar to the valuable and endangered habitat found in old traditional orchards
- **Cultural heritage.** Planting non or semi-commercial varieties would be a means of maintaining fruit tree heritage
- **Genetic conservation.** Retaining traditional varieties may be valuable as a repository for traits and characteristics that may be useful in the future. There are real advantages for this sort of ‘circa-situ’ conservation – in that it reduces reliance on geographically limited (and therefore strategically vulnerable) fruit collections, and it provides the possibility for developing or retaining locally adapted landraces. In this sense, they may be seen as a means of helping maintain the orchard’s long term viability.
- **Additional markets.** Fruit trees may provide crops for additional or niche markets – which may engage local markets and customers, and may integrate with other elements of the farm business, aside from the principal top-fruit operation.

**Potential drawbacks:**

- **Disease.** Fruit trees will harbour fruit tree pests and disease, and there is a risk that adjacent traditional trees might increase the risk of infection / infestation.
- **Management.** Fruit trees – even non-commercial ones, are likely to need more management (pruning/replacement) than semi-natural tree species. They are also likely to cost more to establish – tree cost, protection, staking, etc.
- **May be less effective for supporting beneficial organisms such as pollinators.** One of the advantages of using non-cropping trees in proximity to orchards is that a wider range of resources (pollen, nectar, nesting sites) might be provided. Fruit trees are less likely to add diversity to the system – especially the timing of blossom.

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29 In the sense of: Paprstein, F et al., 2010, On-Farm Orchards of Fruit Trees, Czech Journal of Genetic Plant Breeding, 46, (Special Issue): S65–S69
3. **Putting non-cropping trees in orchards into context**

This part of the analysis looks at the salient sustainability issues associated with orchards, and assesses the extent to which the functions identified for non-crop trees in orchards can measure up to and address those issues. In essence, (1) are the functions outlined relevant to the issues that matter in orchards, and (2) if they are relevant are they effective enough to make a difference?

3.1 **What are the key sustainability issues for orchards?**

The Horticultural Development Company’s (HDC) Tree Fruit Panel identifies labour, crop protection, water, genetics, energy and waste as the major challenges facing the industry over the next decade\(^{30}\). We make a slightly different analysis; amalgamating water, energy and waste under ‘resource scarcity’, and adding three key issues: Pollination, Cultural Heritage and Climate Change, as explained below.

3.11 **Pollination**

In recent years there have been serious declines in both wild and domestic pollinator populations and species in agricultural landscapes across Europe and North America. This has been attributed to various combinations of factors. Loss of semi-natural habitat is implicated in wild declines in populations. In the case of honey bee loss three interacting factors are considered to be important: (1) environmental stressors, (2) genetic diversity and vitality, and (3) pests and pathogens\(^{31,32,33}\).

Effective pollination is critical for orchard crops, and traditionally orchards have relied on both wild populations and ‘rented’ hives. Because pollinator decline has impacted on both sources of pollinators, decline presents a potentially serious risk.

- While a collapse of pollination services is outside the industry’s experience to date, it is at least conceivable and would present an existential threat to UK orchards.
- Perhaps more likely is a continuation of background losses, resulting in unreliable pollination. In either case, some degree of ‘pollination self-reliance’ would make sense for orchards.

3.12 **Crop protection**

Top fruit production is beset with a wide range of pests and diseases, and prevention, treatment, and losses all represent one of the most significant annual costs to fruit growers. Damage from the weather, in particular wind and frosts, is also a significant factor in orchard management. Weather damage can create direct damage and losses to trees and crops, as well as providing entry routes for pathogens and loss of vigour; both of which increase susceptibility to disease.

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\(^{30}\) AHDB-HDC, 2012.


Classic orchard diseases include:

- **Insect pests**, such as codling moth (*Cydia pomonella*), apple sawfly (*Hoplocampa testudinea*), winter moth caterpillars (*Operophtera brumata*), and aphids – notably rosy apple aphid (*Dysaphis plantaginea*)
- **Bacterial infections**, such as fireblight (*Erwinia amylovora*) and apple canker (*Neonectria galligena*)
- **Fungal infections**, such as apple scab (*Venturia inaequalis*) and brown rot (*Monilinia fructicola*)

Diseases represent both chronic and acute threats to orchard sustainability. There can therefore be direct on-going costs as well as the risk of crop failure, or even the loss of all growing trees.

Restrictions on the use of a wide range of pesticides (including neonicotinoids, which are suspected to be involved in pollinator decline) mean that it is increasingly difficult to use chemical means alone to control pests and diseases.

A secondary factor which makes pest control a sustainability issue is the risk – and perceived risk – to consumers from pesticide residues. In study in 2006 the most commonly occurring pesticides (found on >10% of samples tested) on apples were *chlorpyrifos*, *carbendazim*, *captan* and *diphenylamine*, and on pears were *carbendazim*, *captan*, *iprodione* and *dithiocarbamates*. The impact on human health represents a risk in itself. It also represents a reputational risk to growers and perhaps more particularly, retailers.

### 3.13 Labour

Orchards require a significant influx of labour at harvest time. Sourcing this sort of temporary labour presents a serious and on-going challenge to orchard businesses, as it does to other parts of the farming sector which rely on seasonal labour. This may be set to worsen depending on the policy relating to migrant workers, and with the long term implications of the discontinuation of the Seasonal Agricultural Workers Scheme SAW57.

The use of seasonal agricultural/gang labour also brings with it the risk of poor labour practices, and exploitation. Although there is relatively stringent gangmaster regulation, there continue to be high profile prosecutions relating to illegal and exploitative practices, usually by the agents or gangmasters involved in arranging the labour. The risks to the sustainability of the industry are therefore:

- Costs relating to high demand for a limited labour resource
- The risk of not being able to obtain sufficient labour to bring in harvests in a timely manner
- Reputational risks from being associated with illegal or exploitative working practices

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34 Apples, for example are top of the EWG Dirty Dozen list of crops with problematic levels of pesticide residue – see [http://www.ewg.org](http://www.ewg.org)
37 Migration Advisory Committee, May 2013, Migrant Seasonal Workers - The impact on the horticulture and food processing sectors of closing the Seasonal Agricultural Workers Scheme and the Sectors Based Scheme
38 See: [https://www.gov.uk/gangmasters-licensing-authority](https://www.gov.uk/gangmasters-licensing-authority)
3.14 Primary resources

Almost all agricultural activities are likely to be effected by increasing a demand and competition for primary resources, such as land, energy, and water\textsuperscript{39}. Orchards are particularly exposed to water scarcity, and the supply chain as a whole has some exposure to energy cost fluctuations:

**Water:** 1kg of apples (or pears) is estimated to have 700lt of embedded water\textsuperscript{40}. Where the fruit is grown in areas of high rainfall this is not necessarily a problem. But when fruit is grown in areas with low or unreliable rainfall then irrigation is often required, and this can create unsustainable demands on water reserves. Water scarcity has been a concern, for example at Boxford Farm, which produces apples for Copella, and is located in one of the driest regions in the UK - receiving half the UK average rainfall\textsuperscript{41}. The response of the industry is to invest in technologies such as micro-irrigation, rainwater harvesting, and input management/planning tools\textsuperscript{42}.

**Energy:** Energy cost exposure in orchards is not as severe as in parts of the farming sector that are heavily dependent on artificial fertilizer. However, mechanised field operations (for example pruning), supply chain logistics, and refrigeration are all dependent on energy. And orchard businesses themselves are likely often to be part of a wider farm system, for which energy will be a significant and volatile input cost.

3.15 Genetic diversity

According to Common Ground, “You could eat a different kind of apple every day for more than six years and still not come to the end of the varieties we can grow in the British Isles”\textsuperscript{43}. This level of diversity means that, for example, the apple season can theoretically last from July to May without the need for cold storage, and provides a genetic reservoir from which to source traits and adaptations to meet future tastes, markets, and environmental challenges. But the combination of a decline in traditional orchards, and the concentration of commercial orchards on a smaller range of top selling varieties – such as Cox, Braeburn, and Egremont Russet – means that much of this diversity is under threat.

3.16 Cultural heritage.

The loss of traditional orchard varieties, and of the wildlife associated with traditional orchards, has an impact on our potential to maintain cultural ties with orchards. This has long-term practical and economic sustainability implications.


\textsuperscript{42} For example PepsiCo’s i-crop tool - http://www.pepsico.com/Purpose/Environmental-Sustainability/i-Crop.html

\textsuperscript{43} Common Ground, The Apple Source Book, Hodder and Stoughton, 2007
3.17 Orchard biodiversity

The loss of traditional orchards has been associated with loss of significant valuable habitats and species from the British landscape. Traditional orchard have in particular been shown to provide habitat for a range of endangered ‘saproxylic’ (deadwood dependent) insects, such as the as the noble chafer beetle (*Gnorimus nobilis*) as well as supporting a host of epiphytic lichen and bryophytes, birds, bats and maybe most importantly, *horticultural diversity*.

Traditional orchards were added as a UK BAP priority habitat following 2005-2007 review for the following criteria: *key species* (especially saproxylic invertebrates) and *decline* (comparative figures suggest a 63% decline of English traditional orchards since 1950).

The establishment of modern productive orchards is not thought to be directly responsible for the loss or replacement of traditional orchards. However, many orchard businesses may have the opportunity to address the issue; either through the management of their productive orchards or because they have relict orchards and orchard features on their land holdings.

3.18 Climate change

Climate change is a source of uncertainty in all food production systems. In orchards this risk is exacerbated by the extended rotation of the crop – because it involves trees, growers can’t just switch varieties in a season to adjust to new conditions. Depending on how it manifests, climate change may bring some benefits to British fruit growers, such as longer springs or milder autumns. It could also bring problems, as outlined by Farming Futures:

- Inadequate winter chill for dormancy and vernalization
- Stop-start springs leading to weak blossom and poor fruit set
- Changes in pest/disease pressures
- Heat/drought stress reducing yield and fruit/juice quality
- Root death from winter water-logging
- Unpredictable summer weather affecting cropping patterns

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45 403 species are recorded in UK orchards, including 102 Red Data Book or Nationally Scarce species and 4 priority BAP beetles.


3.2 Which issues are most important?

Some issues are more pressing than others. The table below gives the assessment of the relative importance of the key sustainability issues, each being given a simple rank of 1 (most pressing) to 4, as set out in the two tables below. Unlike other rankings and scores in this report, which are based on a more systematic approach to definition and grading, these rankings require greater subjective judgement.

<table>
<thead>
<tr>
<th>Sustainability Issue and ranking</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop protection</td>
<td>4</td>
</tr>
<tr>
<td>Pollination</td>
<td>2</td>
</tr>
<tr>
<td>Genetic diversity</td>
<td>2</td>
</tr>
<tr>
<td>Labour</td>
<td>3</td>
</tr>
<tr>
<td>Natural resources</td>
<td>3</td>
</tr>
<tr>
<td>Orchard biodiversity</td>
<td>3</td>
</tr>
<tr>
<td>Cultural heritage</td>
<td>4</td>
</tr>
<tr>
<td>Climate change</td>
<td>4</td>
</tr>
</tbody>
</table>
3.3 How do trees measure up?

3.31 Tree Sustainability Pathways: matching non-cropping tree functions to orchard sustainability issues

The matrix matches sustainability issues against relevant tree functions and mechanisms. An assessment was made of the extent to which those relevant mechanisms could make a difference to the issue. This assessment was partly based on the ‘effectiveness ranking’ given in the league table in section 2.22 and partly on judgement of how the impact would measure up against the magnitude of the issue. The result is a systematically derived grade or score which summarises ‘scope for impact’. The ‘scope for impact’ grades are defined in the table below:

Analysis 2 – How do trees measure up?

<table>
<thead>
<tr>
<th>Sustainability Issue, and ranking</th>
<th>Relevant mechanisms, and ‘league table’ category</th>
<th>Scope for impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop protection 1</td>
<td>Providing shelter for crop trees 1</td>
<td>Taking the combination of mechanisms, non-cropping trees have an important role to play in crop protection. In the first instance, they have proven value – when used correctly – in protecting orchard trees from the elements. They have additional potential to be used, in combination with other habitat features, to support wild populations of species which can help with pest population management, as part of a IPM strategy. 1</td>
</tr>
<tr>
<td></td>
<td>Reducing pesticide drift 1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Supporting IPM 2</td>
<td>2</td>
</tr>
<tr>
<td>Pollination 2</td>
<td>Providing shelter to crop trees 1</td>
<td>Non-cropping trees, established in combination with related ‘tree habitat’ has the potential to make a significant contribution to supporting pollinator populations. For an orchard to be ‘self-reliant’ for pollination, other strategies will almost certainly also be needed. 2</td>
</tr>
<tr>
<td></td>
<td>Supporting pollinator populations 1</td>
<td>x</td>
</tr>
<tr>
<td>Genetic diversity 2</td>
<td>Producing woodfuel 1</td>
<td>No role, unless ‘non-cropping’ traditional orchard varieties are used as part of a strategy x</td>
</tr>
<tr>
<td>Labour 3</td>
<td>Producing woodfuel 1</td>
<td>A woodfuel operation, in association with the orchard, has the potential to provide some out-of-season labour – though this will only make a small difference to the seasonality of top fruit labour requirements 4</td>
</tr>
<tr>
<td>Natural resources 3</td>
<td>Producing woodfuel 1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Hydraulic lift 4</td>
<td>4</td>
</tr>
<tr>
<td>Orchard biodiversity 3</td>
<td>Supporting wildlife habitats 1</td>
<td>Non cropping trees will deliver wildlife benefits, and will increase the biodiversity value of the orchard. But their role in helping to conserve specific orchard biodiversity may be marginal 3</td>
</tr>
<tr>
<td>Cultural heritage 4</td>
<td>Improving landscape quality 3</td>
<td>The wildlife and landscape value of non-cropping trees has the potential to play a marginal role in maintaining or enhancing the cultural value of orchards 3</td>
</tr>
<tr>
<td></td>
<td>Providing wildlife habitats 1</td>
<td>3</td>
</tr>
<tr>
<td>Climate change 4</td>
<td>Carbon sequestration 4</td>
<td>It is difficult to see how non-cropping trees might enhance the carbon sequestration potential of orchards. Non cropping trees may conceivably have a role in ameliorating climate change impacts, though the precise mechanism is as unpredictable as the climate. x</td>
</tr>
</tbody>
</table>

Scope for impact:

1. The potential to substantially address the sustainability issue in question
2. The potential to make an important, but not game-changing contribution to addressing the issue
3. Scope to play a marginal role in addressing the sustainability issue in question
4. Scope to address the sustainability issue to an appreciable but not significant extent, in comparison to the magnitude of the issue
3.4 **Summary: which tree functions work best against the most important sustainability issues?**

A fairly clear picture emerges from the analysis:

1. Non-cropping trees already play a practical role in orchards – predominantly as shelter from the elements.
2. The existing role of non-cropping trees could be significantly enhanced to include a supporting role for pollinators and also for beneficial insects and birds as part of an integrated pest management strategy.
3. In both cases tree establishment would need to be planned carefully, to integrate with existing orchard management functions, and to avoid adverse outcomes – such as wind tunnelling, the harbouring of disease, and the creation of frost pockets.
4. If trees are to be used to support habitat for beneficial organisms, they should be seen in the context of the habitat complexes they can be associated with – banks, ditches, shrubs, climbers, herbaceous hedge-bottoms, scrubby edges. Establishing ‘woody habitat features’ rather than just planting trees will be functionally important.
5. Other, ancillary benefits of trees could include the production of woodfuel. Cutting of trees will be useful to control height and spread. Use of the arising woodfuel could make practical and economic sense. Realising the value of ‘linear features’ for woodfuel is gaining currency as a practice, and reflects ‘bocage’ management practices found in northern France.
6. Biodiversity is another ancillary role. Non-cropping trees will undoubtedly increase the wildlife value of a commercial orchard, but may not directly address some of the specific ‘orchard biodiversity issues’ identified in the UK Biodiversity Action Plan.
7. There are several significant orchard sustainability issues for which non-crop trees are likely to have a minor role. These include heritage, landscape, and climate change.
4. Implementation

4.1 Key practical considerations

Non-cropping trees can clearly play several valuable roles in orchards. However, their introduction should be planned as part of a clearly analysed, integrated strategy.

4.1.1 Analysing objectives

Commercial orchards are capital intensive operations, and so incorporating non-cropping is likely to involve trading off benefits against losses in light or cropping area. Functions such as supporting IPM, providing habitat for pollinators, and providing windbreaks all require fairly specific and technical conditions to be successful. Tree establishment should not, therefore, be assumed to be automatically beneficial, and should be planned around a set of clearly defined and realistic objectives.

4.1.2 Taking advantage of synergies

For the sake of efficient utilisation of space doubling up of functions makes sense when tree habitats are planned. Clear potential synergies exist, for example:

- Windbreaks double up as barriers to spray-drift.
- Properly planned and established, semi-natural tree habitat belts have the potential to double up as ‘natural windbreaks’.
- Providing habitat and resources for pollinator is also likely to support species which have benefits in pest management, and vice versa. In both instances there will be benefits to wildlife.
- Cutting hedgerows and windbreaks for woodfuel will help control their height and spread.

4.1.3 Avoiding adverse outcomes

Careful consideration should be made to the establishment of non-cropping trees to avoid adverse outcomes. Pitfalls can be thought of in three categories:

- Competition with the orchard crop, for light, space, and water;
- Harbouring of pests and diseases – classically this includes diseases such as fireblight. They may also set up species assemblages which hinder rather than help with pest control;
- Producing adverse microclimate – for example funnelling wind, creating frost pockets, increasing the incidence of temperature inversions, or producing the warm, still, humid conditions associated with the establishment of fungal infestations.

4.1.4 Context – making sure tree establishment links up to other management strategies

Trees and tree habitat should be seen as a means to an end, not a starting point. Most of the functions for which they might be established will already be under consideration in an orchard, and may be being addressed through other measures. Delivery of the function – pest management, pollination, microclimate, should be the starting point for planning management. The establishment of trees should be seen as a potentially useful tool – or range of tools – to have available.
4.15 Establishment options

Tree establishment should be planned from the ground-up – designed around delivering a set of clearly defined objectives. So it is unhelpful to provide a generic prescription for how non-cropping trees should be used in orchards. However, the following ‘components’ may for part of an integrated strategy which involves the establishment of trees:

- **Natural windbreaks** – windbreaks established with a range of semi-natural species and associated habitats.
- **Tree habitat belts** - running through or around orchard stands specifically integrating ‘tree habitat’ such as larger maidens, shrubs, hedge-bottom vegetation.
- **Boundary trees** – allowed to reach maturity and scale – ideally at the shade side of any crop.
- **Copeses and small woods** – in close proximity to the orchard can confer pollination and pest management benefits.
- **Hedgerows** – for example as encouraged through an initiative of Bulmers.  

4.2 Engaging the supply chain

The fact that non-cropping trees may make sense and provide practical benefits in and around orchards does not mean that they will automatically be used for those purposes. Like with any initiative or policy instrument, implementation requires those who are to take action to recognise benefits in terms of their business objectives, and more specifically, their bottom line. It is also critical to understand that the people or agencies with an interest in (and influence on) the way things happen on the land are not just the farmers or orchard-growers. Demand, expressed through the supply chain, exerts a potent influence on land management decisions.

4.21 Structure of the industry – who is influential?

The orchard industry is relatively small by agricultural standards, but at the same time it has some big players in it. For example, Bulmers uses 100,000 tonnes of bittersweet apples a year from Herefordshire in its cider production – over a third of all apples grown in the UK. According to PepsiCo, Copella uses 40,000 tonnes of 50 different apple varieties for its juices. The key types of players in the orchard supply chain are summarised in Fig 2, below:

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48 [http://www.edie.net/library/view_article.asp?id=6086andtitle=Bulmers+aims+to+brew+a+better+future](http://www.edie.net/library/view_article.asp?id=6086andtitle=Bulmers+aims+to+brew+a+better+future)
49 [http://www.heineken.co.uk/resp_hukcares-sustainable_agriculture.php](http://www.heineken.co.uk/resp_hukcares-sustainable_agriculture.php)
### 4.22 Stakeholder analysis

**Analysis 3 – Stakeholder analysis. Who has an interest in the benefits that trees can bring?**

To understand who in the supply chain might be interested in the sustainability issues that trees can address, a ‘stakeholder analysis’ was undertaken. This widens the scope beyond those with direct influence on the supply chain, to include local populations and businesses. The analysis focuses on the most effective ‘tree sustainability pathways’ identified. We then considered the extent to which different stakeholders are likely to have an interest in each of these pathways. The table below shows the assessment of key stakeholders’ interests in the ‘tree sustainability pathways’. Darker shading denotes areas where it is judged there to be greater interest.

<table>
<thead>
<tr>
<th>Tree-sustainability pathways</th>
<th>Stakeholders – why are they interested, or (potentially interested)?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Issue (and rank)</strong></td>
<td><strong>Mechanism (and scope for impact)</strong></td>
</tr>
<tr>
<td><strong>Crop protection</strong></td>
<td>1. Providing shelter for crop trees</td>
</tr>
<tr>
<td>1. Providing pesticide drift</td>
<td>Water industry – pesticide impacts on water quality</td>
</tr>
<tr>
<td>1. Supporting IPM</td>
<td></td>
</tr>
<tr>
<td><strong>Pollination</strong></td>
<td>2. Providing shelter to crop trees</td>
</tr>
<tr>
<td>2. Supporting pollinator populations</td>
<td></td>
</tr>
<tr>
<td><strong>Labour</strong></td>
<td>3. Producing woodfuel</td>
</tr>
<tr>
<td>3. Hydraulics</td>
<td>Some energy cost risk offset potential</td>
</tr>
<tr>
<td><strong>Natural resources</strong></td>
<td>3. Producing woodfuel</td>
</tr>
<tr>
<td>3. Hydraulic lift</td>
<td>Renewable energy commitments</td>
</tr>
<tr>
<td><strong>Orchard biodiversity</strong></td>
<td>3. Supporting wildlife habitats</td>
</tr>
<tr>
<td>3. Providing wildlife habitats</td>
<td></td>
</tr>
<tr>
<td><strong>Cultural heritage</strong></td>
<td>4. Improving landscape quality</td>
</tr>
<tr>
<td>4. Providing wildlife habitats</td>
<td></td>
</tr>
</tbody>
</table>
4.23 **Instruments and opportunities**
The stakeholder analysis gives a strong pattern for where stakeholder interests and the most promising tree sustainability pathways coincide. These can be characterised into three agendas, or action themes:

1. **The self-reliant orchard**
Many of the benefits of non-cropping trees relate specifically to the orchard business—supporting pollinators and other beneficial organisms; and in more marginal ways, providing alternative sources of income, or even providing a genetic repository of fruit tree varieties, if traditional orchard varieties are used as non-cropping options. These outcomes can be seen as means to insulate the orchard business from uncertainties in the wider landscape - for instance, being less reliant on ecosystem functionality in the wider landscape, or being more insulated from energy price fluctuations.

The functions of non-cropping trees that might be relevant to this agenda are:
- Supporting crop protection
- Supporting pollinator populations
- Producing woodfuel

2. **Resilient supply chains**
Uncertainty in the fruit growing business not only has an impact on orchards, it also influences their business customers. Even though many fruit buyers can and do look to international markets, it is still in their interests to maintain domestic sources. This may be as a hedge against supply risk in international markets, as a means of increasing transparency, or as a means of engaging customers and developing a brand identity. As a result, many processors have their own orchards, or are heavily reliant on local and dedicated sources - for example Bulmers and Copella. This investment in UK production from across the supply chain means that all the parties involved will be interested in maintaining UK orchard viability. They may, as part of doing this, look to use non-cropping trees – for example to support pollinators. This may have valuable side-benefits, as a ‘good news’ marketing story.

The functions of non-cropping trees that might be relevant to this agenda are:
- Supporting pollinator populations
- Supporting crop protection

Stakeholders who might be most interesting in taking part are:
- Orchard businesses
- Processors
- Retailers
- Government

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50 The previous government’s Fruit and Vegetables Task Force set a target for the UK to source 50% of its fruit indigenously. It is less clear what current policy is on this matter.
3. **Local accountability**

Taking care of the landscapes in and around a company’s supply catchment makes strategic sense. For orchards the case is straightforward; it helps with local relationships, reputation, and potentially with customers. Companies further along the supply chain are also interested, for all the same reasons. While this might be more the case with companies with a strong regional presence, the need for local accountability and for a ‘landscape approach’ to sustainable sourcing is starting to be recognised more widely within the food and drink sector\(^{51}\). Other types of organisations, such as local authorities and conservation NGOs will also have a potential interest in this agenda – creating scope for valuable partnership working.

The issues that might be addressed under this agenda are:

- Providing wildlife habitats
- Improving landscape quality
- Reducing pesticide drift

The stakeholders who might be most interesting in taking part are:

- Orchards businesses
- Local authorities
- Local and national NGOs (Wildlife Trusts, CPRE, National Trust, Woodland Trust)
- Local communities
- Processors (especially those with a regional focus)
- Retailers

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This report was produced for the Woodland Trust by Best Foot Forward, sustainability consultants

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