

Agroforestry Guidance

Note 2: Introduction to walnut silvopastoral systems.

Hampshire Forest Partnership was established by Hampshire County Council in 2022 with a goal to plant one million trees by 2050. The vision for the partnership is to facilitate tree planting by working with communities, landowners, businesses, and organisations across Hampshire.

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Any financial information presented should be checked in relation to local costs, yield potentials and sales prices.



**HAMPSHIRE
FOREST
PARTNERSHIP**



BioDiversity International Ltd



Introduction

Hampshire Forest Partnership will seek to provide opportunities for and deliver projects that meet six strategic priorities, shown below:-

1. Public benefit, amenity value, health and wellbeing
2. Climate change mitigation and resilience
3. Biodiversity and local nature recovery
4. Landscape character, cultural and heritage development
5. Learning, awareness, and educational opportunities
6. Sustainable development of the rural economy.

Hampshire Forest Partnership recognises that there are many opportunities for tree planting on farmland and to help farmers reach net zero, improve soils, and enhance biodiversity. Agroforestry has seen a recent surge in interest amongst farmers, yet there remains confusion about how best to integrate tree planting within farming systems. These guidance notes will aim to break down the barriers and improve understanding of how tree planting can be developed on farms.

Agroforestry

Agroforestry can be defined as “a collective name for land use systems and technologies where woody perennials (trees, shrubs, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals, either in some form of spatial arrangement or temporal sequence.”

In agroforestry systems, there are both ecological and economic interactions between the different components. In many cases agroforestry is a profitable activity even in the absence of subsidies or grants. The major agroforestry sub-types in the UK can include:

Silvopastoral systems (livestock component linked to pasture or swards)

Silvoarable systems (arable component)

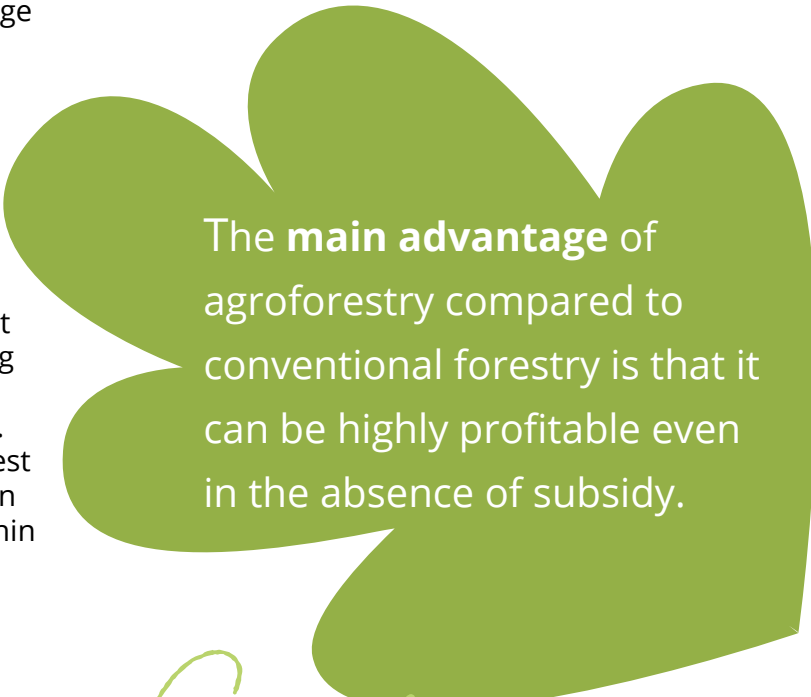
Environmental agroforestry e.g., riparian strips or buffer areas

Food forests (large garden forms for food production in the urban or peri-urban context)

Forest farming e.g. wood pasture in the New Forest

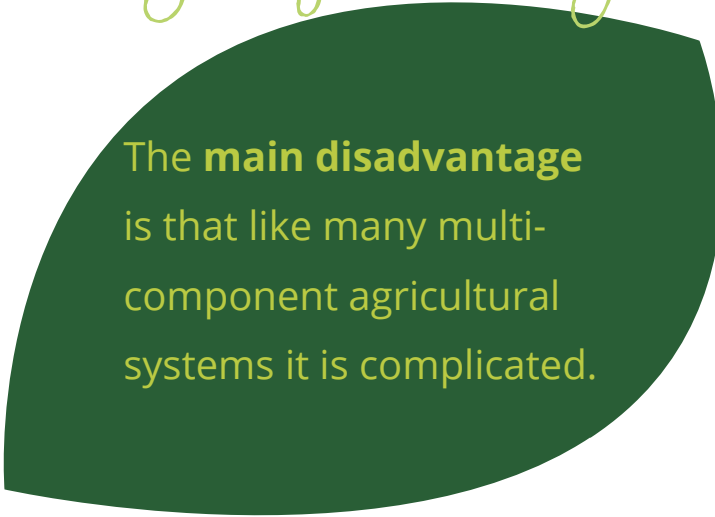
Orchard intercropping

Agroforestry is an old practice recently developed in the UK after 40 years of intensive research based on national network trials. It has only recently been recognised by agricultural and forestry policy in the UK.



The **main advantage** of agroforestry compared to conventional forestry is that it can be highly profitable even in the absence of subsidy.

Agroforestry



The **main disadvantage** is that like many multi-component agricultural systems it is complicated.

In the past there have been too few competent advisors. The situation is improving however and there is a new breed of partner advisors with key value chain knowledge/contacts and an incentive to make the system work.

Suggested Agroforestry species

Tree species	Key management suggestion	Products and markets	Site notes/preferences
Cricket Bat Willow <i>Salix alba "Caerulea"</i>	Plant large high-quality sets	Timber for production of cricket bats for domestic use and export	Will tolerate short term flooding
Hazel <i>Corylus avellana</i>	Manage as single stem tree for mechanical harvesting	Hazel nut flour, nuts, nut milk, oil etc	Shelter is important.
Walnut <i>Juglans regia</i>	Use late flowering (spring frost avoiding) lateral bearing grafted trees.	Nuts, nut oils, walnut flour, walnut butter	Prefers deep sandy loams and shelter, but will grow in many local soil types with proper drainage
Quince <i>Cydonia oblonga</i>	Needs special processing equipment	Preserves, beverages and membrillo	Will tolerate short term flooding and is also drought tolerant
Mulberry <i>Morus nigra</i>	Use named varieties selected for flavour and precocity (early bearing) e.g., at 1-3 years old	Preserves, and beverages	Prefers shelter and deep, moisture-retentive but well-drained soil.
Stone pine <i>Pinus pinea</i>	Requires specialised processing equipment.	Nut kernels	Shelter is important
Chestnut <i>Castanea sativa</i>	Use named varieties	Nuts, flour, and milks	pH less than 7
Oak <i>Quercus spp</i>	Use varieties with improved precocity as acorns are the economic product	Acorn flour	Shelter is important
Elder <i>Sambucus spp</i>	Use a mixture of species and varieties for elderflowers and berry products	Elder flowers/berries for beverages	Shelter is important
Hawthorn <i>Crataegus spp</i>	Use species with large fruit and good juicing properties	Beverages and health products (e.g. hawthorn tincture)	Shelter is important

Setting objectives and a rule of thumb

Before establishing agroforestry there is a need to set objectives and timescales for achieving a return on investment. This will depend on land tenure and if the intention is to grow for wholesale or localised value-added markets. In general, a site of greater than 10 acres is required for a commercial agroforestry operation.

For many UK agroforestry systems trees occupy c. 10-20% of a land parcel spatially arranged in groups, rows, or as individual trees. Agroforestry is dynamic and as trees grow, management will need to adapt.

As a rule of thumb shade levels below 50% will not have a major effect on the growth of an understorey and late leafing trees are preferred to allow an understorey to obtain some light early in the season.

Livestock benefits in a silvopastoral system

For livestock, the provision of shade and shelter from extreme heat and cold is becoming increasingly important with climate shifts. If livestock experience extreme heat or cold, the live weight gain will be adversely affected. In dairy cattle, milk production is affected. As the ambient temperature increases above the Upper Critical Temperature (UCT) which is 25 degrees Celsius, milk yields can fall by as much as 20%. There will also be a reduction in fertility, including an increase in embryonic loss (sheep are also affected by this). There is also evidence of an increase in the risk of clinical mastitis.

There are many nutritional and health benefits from providing browse and fodder from trees and hedges. The figure below shows the nutritional profile of a range of tree species. This can be comparable or better than meadow hay and red clover silage.

Leaf nutrition in tree species compared to herbaceous fodder (%). Taken from Birks *et al* 1989.

Species	Moisture	Ash	Fat	Sugar	Protein	Fibre
Rowan	11.9	5.9	6.5	50.4	9.9	15.4
Goat willow	11.5	6.1	3.8	50.3	11.6	16.7
Aspen	10.8	8.5	6.0	43.5	13.3	20.9
Grey alder	11.9	3.9	5.9	43.6	17.6	17.4
Birch	11.7	3.9	7.0	49.2	12.0	16.2
Meadow hay	15.0	5.4	2.2	44.4	8.5	24.6
Red clover	15.7	5.1	1.9	35.8	11.0	28.6

Impact of silvopastoral systems

Environmental impacts include land and water decontamination, increased biodiversity, and reduced flooding. Social benefits especially in peri-urban areas include increased access to green space and educational benefits.

Grants for silvopastoral systems

Given the low planting density, most Forestry Commission tree establishment grants would not currently be appropriate.

Hampshire Forest Partnership have several funding schemes for farmers and landowners, please the website for further information **Farmers and landowners | Hampshire County Council (hants.gov.uk)**

If your project involves the local community, Hampshire Forest Partnership have several schemes available. Visit **People and communities | Hampshire County Council (hants.gov.uk)** for further details.

The Woodland Trust is supporting agroforestry establishment and will cover most costs. This is available on a first come first served basis.

Many Environmental Land Management (ELM) payments can be appropriate and if stacked could be attractive. Agroforestry payments will be available as part of the **Sustainable Farming Incentive (SFI)**. These may require Environmental Impact Assessments (EIA). Walnut agroforestry may be eligible if it's a part of meadow habitat creation under the **Biodiversity Net Gain** scheme.

Hampshire Forest Partnership may also be able to provide funding support e.g. in relation to their programme "Shoots Along the Routes". **Shoots Along the Routes | Hampshire County Council (hants.gov.uk)**. They can also supply free elm trees as part of a scheme to reintroduce disease resistant hybrids to Hampshire to benefit nature recovery (available each year on a first come first served basis).

Walnut silvopastoral systems

The two main types of walnut used in agroforestry are Persian walnut also known as English or common walnut (*Juglans regia*) and black walnut (*Juglans nigra*). The former is primarily grown for nuts and the latter for timber.

Research on walnuts for nuts in the UK started in the 1920s (East Malling) and was picked up again in the 1980s (Open University).

The Open University research showed that it is possible to obtain nuts after 1-2 years from grafted trees (see photo below) and that the most productive varieties were those that were late leafing/flowering to escape late spring frosts and lateral bearing (producing nuts on both tip and lateral branches).



Varieties

The following varieties show promise in the UK; Lara, Jupiter, Fernor, Fernette, and Geisenheim 139. It is best to plant a mixture to ensure good pollination. It is also useful to plant Franquette due to its excellent taste and because it is commonly used as a marker for the phenology of flowering e.g., variety X bears female flowers Y weeks after Franquette. For a full list of walnut varieties see Crawford (2016).

Site requirements

Walnuts require sheltered sunny sites (avoid excess shade which can affect the quantity and quality of any nuts produced) with deep soils e.g., sandy loam with a pH between 6-7. Sites should have good drainage. Very wet soils with heavy clay are to be avoided. Avoid valley bottoms or landscape dips as frosts may linger which can damage walnuts in spring.

Establishment and management

Grafted trees 1-2m can be planted at a density of 100 stems per ha and need to be staked with 2m stakes. Ideally two are used to support the tree, protection shown below. This is adequate for protection against sheep damage.

Mulch is used to stop grass growth around 1m radius of the planted tree. Most graziers use mowers to control thistles so it may be useful to change the spacing of the tree planting to allow mowing. The exact measurements will depend on the width of the machines.

The planting arrangement that would provide 100 stems per hectare would be 5m x 20m.

It is best to prune away lower branches during the first 10 years and leave 4-6 main framework branches in a goblet shape. Walnuts will benefit from fertilisers (N+P) and irrigation.

Harvesting

Nuts will fall to the ground and livestock should be removed one week before nut fall. There are several simple hand-held roller harvesters on the market. Nuts should not be allowed to stay on the ground for more than 48 hours and should be de-husked, cleaned and dried.



Harvesting



Pests and diseases

There are no major insect pests of walnut in the UK and diseases such as leaf blotch *Gnomonia leptostyla*, blight *Xanthomonas arboricola* pv. *juglandis* and honey fungus *Armillaria spp* can be prevented or reduced by removing leaf and branch litter.

Outcomes at the plot scale

Most growers would see income from the trees as the main purpose of the venture and this can be substantial.

A high yield scenario based on global experience of countries with a similar climate gives the start of nut bearing in year 3 with 1kg per tree. At year 10, 10kg per tree is obtained. At year 25, 52kg per tree is obtained as in Crawford (2016). The model is based on 100 stems per hectare. A conservative and simple target for yields of walnut in agroforestry in the UK could be 3.5 tonnes per hectare averaged over the life of the trees. The productive life of the trees could be over 50 years depending on management and site. Additional income streams are possible from grazing, environmental stewardship, and any remaining tree biomass. Shell by-products are an exciting area to consider moving forward, with applications in mulching, fertilisers and even hand creams.

Experience shows that 100% grazing income is possible for the whole rotation as at 100 stems per hectare, shading is minimal. Benefits to livestock include reduction of high and low temperatures due to shade effects.

Outcomes at landscape scale

Working at the landscape scale offers the greatest potential for the delivery of optimised ecosystem services. Areas of walnut agroforestry can be used to remove phosphate and nitrate annually as nuts contain high levels of phosphorus and nitrogen.

Conversion of arable areas into silvopastoral systems linked to tree roots blocking land drains could help to increase carbon sequestration and improve biodiversity linked with meadows and wetlands. Riparian planting could also serve to reduce river pollution. It is also important to check whether your land is designated or a priority habitat, as planting these trees may not be appropriate for all sites. At this scale it is very appropriate to consider forming a tripartite environmental partnership consisting of (1) a grower, (2) a government agency or utility and (3) a private sector philanthropic entrepreneur/broker. A 25-year environmental stewardship contract could deliver decontamination, biodiversity, carbon offsetting, and or green infrastructure benefits (e.g., reduced flooding).

Market considerations

Walnut products derived from UK crops should be viewed as a premium product and not compared to imported goods. For instance, fresh in-shell nuts have a milder taste and may have greater health benefits than many imported nuts. Fresh nuts will have higher levels of vitamin C than dried nuts for instance. Eventually, as the production increases there will be increased prices paid for the crop if it is labelled as a product of designated origin (PDO).

Gross margin model

The gross margin data presented focusses on the tree component only. The wide spacing of the trees and the moderate beneficial shade cast means that a target of 100% intercrop yield is expected on average over the life of the system. Beneficial interactions mean that in many cases the loss of the land area under the tree strip is totally compensated for.

Variable per hectare	Walnut
Tree density	100
Target average yield (tonnes)	3.5¹
Price per tonne	£15,000 ²
Total Output	£52,500
Variable Cost (£)	
Orchard depreciation (establishment)	£840 ³
Pruning/clearing	£50
Organic fertiliser/sprays	£81
Crop sundries e.g. tree ties	£20
Harvesting (labour)	£200 ⁴
Processing	£500
Storage/ bin hire	0
Packaging e.g. boxes	£111
Transport	£90
Marketing and sales	£100
Commission/levies	0
Total variable cost	£1,992
Tree crop gross margin	£50,598

The gross margin of £50,598 per hectare for the walnut component compares to £1,335 for high yields of milling wheat and £13,052 dessert apples as outlined in Nix (2023).

1 Based on full crop data in Crawford averaged over the life of the orchard (2016)

2 Assumes a high value product e.g., English walnut oil. It is not a wholesale price and bears no relation to global prices.

3 Over 5 years based on the life of the establishment materials (tree guards, and stakes etc) and not the life of the tree.

4 This is the only labour that is contracted. All labour for other operations is assumed to be farm staff which is part of the fixed costs of the operation.

Products

It should be noted that most walnut veneer for luxury cars now comes from *Juglans regia* grown for the nuts in commercial orchards in the USA. Figured timber (interesting grain pattern for using as veneer) only occurs however in about 0.1% of the trees and the reasons for the figuring are not fully understood. Valuable timber is a possible by-product of UK walnut orchards, but any financial assessment should be based on the nuts alone. A range of products produced in France is shown in the photo below.



Advice on walnut trees

Major nurseries are now selling grafted walnut trees and can give advice on varieties.

Walnut is also suitable for silvoarable systems and forest gardens.

Services available from Hampshire County Council can be found at [Agroforestry | Hampshire County Council \(hants.gov.uk\)](https://www.hants.gov.uk).

Hampshire County Council have created a new Facebook group, **The Hampshire Agroforestry Forum**, to enable farmers, growers, and food entrepreneurs to link with each other to facilitate new markets for tree products. [Hampshire Agroforestry Forum | Facebook](https://www.facebook.com/HampshireAgroforestryForum). If you have products to sell or you are looking for products produced from trees, please add your details to the group. You could also pose any questions and queries about agroforestry for others to answer.



Sources of information

Birks et al. (1989) 'The Cultural Landscape: Past, Present and Future, Cambridge University Press.

Crawford M (2016) How to grow your own nuts. Green Books

Nix (2023). John Nix pocket book for farm management edited by Graham Redman ISBN 978-1-9196545-1-5

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(cabidigitallibrary.org)

soilassociation.org/media/19141/the-agroforestry-handbook.pdf



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