# Investigating the feasibility for an Agroforestry Carbon Code – NEIRF Phase 2 – Final report and recommendations

## Introduction

This is the final report from the Natural Environment Investment Readiness Fund Phase 2 project to investigate the feasibility for an agroforestry carbon code. The report is structured as follows:



This final report is supported by two additional sub-reports:

*Agroforestry Carbon Code Project - NEIRF Phase 2 - Pilot Summary report

**Investigating the feasibility for and Agroforestry Carbon Code - NEIRF Phase 2 - Financial Appraisal report

## 1. Project Design and Delivery

In June 2022, a consortium was awarded funding from the Natural Environment Investment Readiness Fund (NEIRF) managed by the Environment Agency, on behalf of Defra, to explore the feasibility for agroforestry systems to potentially be supported by carbon finance to help bridge implementation costs.

It is important to note that although there are many potential agroforestry systems, this project focused on systems based on in-field trees. This is because many of the woodland based agroforestry systems, such as shelterbelts or riparian buffers are already eligible or potentially eligible projects within the Woodland Carbon Code. Furthermore, hedgerow-based agroforestry systems were also excluded from scope, based on the understanding that NEIRF Phase 1 had funded development work for a Hedgerow Carbon Code.

The consortium included Woodland Trust (WT), Organic Research Centre (ORC) and Finance Earth (FE). In addition, the consortium was supported by specialist input from the Scottish Rural College (SRUC), Scottish Forestry (SF) and Soil Association Certification (SACL). The consortium was project managed by the Soil Association (SA), who had applied for the funding as lead applicant on behalf of the consortium.

The feasibility was explored by the following workstreams:

1. Development of a predictive carbon measurement methodology to facilitate understanding of the likely amount of carbon sequestered and stored in agroforestry systems. ORC led this workstream and a full explanation of the initial analysis and proposed methodology can be found in section 2.

2. Development of high-integrity requirements for agroforestry carbon projects. SRUC undertook an initial analysis of potential requirements, which were considered by the wider project team. Inputs from SF as the managers of the Woodland Carbon Code (WCC) and SACL as accredited validators/verifiers of WCC projects and also Peatland Code (PC) projects, were important to this workstream, as was testing farmer attitude towards key requirements.

3. Piloting of proposed methodology and potential requirements - Six pilots were taken forward in England and two further pilots in Scotland (funded additionally by Scottish Government). All partners were involved in delivering

the pilots, with WT and SA leading on the farmer engagement and site-based information collection, ORC leading on carbon assessment and FE undertaking a detailed financial appraisal of each project based on the information collected. These pilots were multi-faceted and a summary of the piloting can be found in section 3 and of the financial appraisal in section 4.Both these sections are supported by detailed standalone reports (see introduction). In summary, the following were the key components and sequencing for the pilots:

i. Initial contact with farmers to ascertain interest and potential relevance of the agroforestry project for a detailed pilot.
ii. Once a pilot had been selected, detailed information was collected regarding project details, project costs (actual or planned), management and cashflow projections. In addition, wider farm level information was collected, including farming systems, objectives of the agroforestry and any other wider projects on-farm that may sequester and store carbon e.g. new woodland and hedgerow establishment/management.
iii. Site-based data collection included applying the predictive carbon methodology through tree measurement and assessment, as well as detailed interviews with project managers (usually the farmer), to test attitude towards proposed high integrity requirements.
iv. Development of a site-based carbon model by ORC, based on tree measurements to predict the carbon sequestration profile of the trees in the agroforestry system.
v. Financial analysis by FE using the carbon quantification and project costs/cashflow to understand the potential contribution of carbon finance and therefore the overall investment potential of agroforestry projects through carbon finance.

4. The project team have used the results from the pilots to help provide a conclusion on the feasibility for carbon finance to help accelerate the establishment of new agroforestry projects (see section 6). Based on the conclusions, the project team has made a series of recommendations that can be found in section 7.

## 2. Predictive Carbon Measurement Protocol

### Introduction

Key to the development of an Agroforestry Code is a robust method for estimating the carbon sequestration potential and greenhouse gas emissions budget of agroforestry systems. To this end a carbon modelling methodology was scoped and developed. In this report we describe our review of the different approaches to this challenge and then describe the methodology that was developed and tested on the pilot farms. The results of this trialling are presented.

### Alternative approaches to carbon modelling

We reviewed the potential application and adaptation of the WCC carbon calculator for estimating carbon sequestration in agroforestry system alongside five other approaches (Table 1). The WCC calculator depends on yield tables developed for trees growing in forest stand conditions, whilst trees growing in open conditions will exhibit different tree growth rates and morphologies. This is illustrated by a comparison of biomass allocation to leaves, branches and stems of Eucalyptus globulus growing as isolated trees, in rows and in blocks showing differences of a factor of two in those allocations (Henskens et al, 2001). Furthermore, the WCC calculator doesn't include many trees commonly targeted in new agroforestry projects, notably fruit and nut trees. For these reasons we conclude that the WCC look up tables are not currently fit for direct application to agroforestry. At the same time, information on the rates of carbon accumulation in soils and trees in farmland settings is lacking, though an active focus of research for Forest Research, universities and other research organisations.

**Table 1**: comparison of the suitability of different methodologies for modelling carbon in agroforestry systems.

| Methods | Advantages | Disadvantages |
|---|---|---|
| Woodland carbon code look-up tables | Based on extensive research of growth performance of a range of trees under different site characteristics (applying yield classes) | Applicable to forest rather than more open field conditions; not all agroforestry species are included in the tables |
| YieldSafe model (Burgess & Graves @ Cranfield University) | Accessible spreadsheet format; detailed tree-crop interactions; many ecological parameters can be modified (e.g. soil type, temperature) | Very few tree species are included; would require considerable additional work to produce carbon lookup tables |

| | | |
|---|---|---|
| HighSafe model (Dupraz group @ Montpellier University | Exceptionally detailed model of tree crop interactions; large range of ecological parameters modifiable; expertise in its use within ORC | More complex command-line structure; very few tree species currently (new ones in process of being added); considerable additional work needed to develop lookup tables |
| Statistical modelling from the literature | Can draw on extensive and growing list of studies; GLM and polynomial modelling capability is easy to access | Though potentially powerful, represents a “black box” approach less intuitive to the typical user |
| Tree growth and allometric modelling | Based on tried-and-tested allometric relationships between tree girth and biomass/carbon; can work up from trees to fields and farm systems; data collected by farmers could be used to build up a national database and support future model refinement | Paucity of data on tree growth performance for different tree species across different site characteristics relies on farmer involvement |

Of the alternative approaches (Table 1), we propose the option of tree growth and allometric modelling, estimating tree biomass and carbon from individual tree to field and system level. This has the advantage over the other approaches of being a calculation that is transparent and accessible to the farmer/grower. It is currently a more realistic approach for fruit trees (not included in the WCC and HiSafe models) and is also an approach that can be refined over time with the collection of more and more tree growth data from different sites around the country.

**Tree growth and allometric modelling**

Our proposal relies on documented tree growth relationships and tree allometries:

- Tree growth: the relationship between age and tree girth (measured as diameter at breast height, 1.3 m, DBH)
- Tree allometry: the relationship between DBH and above ground biomass.

Whilst tree growth rates will be specific to tree species and site characteristics, we propose that for tree allometry a generic regression equation is robust enough to work across a range of species. That of Bunce (1968) is initially proposed (Eq 1) although other candidate equations are being explored. Bunce’s equation derives from the sampling of five deciduous broadleaved tree species in Cumbria and – like some other equations - uses tree girth rather than height, considered to be a more stable character, especially in an agroforestry context. The Bunce equation has been compared with other equations with little difference in the predictions obtained; it is considered robust across a wide range of species (see e.g. Robertson et al. 2012).

| Regression equation | Definitions |
|---|---|
| Bunce (1968), mixed deciduous trees<br><br>$\log_e y = a + b (\log_e x)$ | $y$ = tree dry weight, kg, (trunk + branches), $x$ = tree girth at 1.3 m. $a$ = -5.445, $b$ = 2.507 |

Eq 1: Allometric equation of Bunce (1968).

The steps in the methodological approach we developed involve:

1. Selecting the target species and deciding in planting design for each cohort, to derive tree numbers/densities.
2. Generating a tree growth model for the same or similar species (see description below)
3. Applying the Bunce (1968) regression to estimate, from the chosen tree growth model, above ground biomass (AGB) accumulation over the project period on a tree-by-tree basis
4. Estimating root biomass from published above/below ground allometric assumptions. Here we propose either using the mean root to shoot ratio for temperate broadleaf forest/plantation (0.326, CI ± 0.070907, n = 7, (IPCC, 2000)) or the Woodland Carbon Assessment Protocol that applies different equations for DBH less than and greater than 30 cm.
5. Converting tree dry mass to carbon and $CO_2e$ estimates using the carbon content ratio of 0.5, as applied in the Woodland Carbon Code calculator. This compares with the conversion standard of 0.48 recognised by the IPCC for broad-leaved trees growing in temperate climates (Aalde et al., 2006).
6. Calculating field- and system-level totals for the project period as the average stored C and $CO_2e$ values over the project period, taking into account any thinning and harvesting management operations.

***Generating a tree growth model***

Models of tree growth for woodland and urban environments are well advanced but scant for trees in rural, open field conditions in the UK. To be able to account for different growing conditions (edaphic, climatic) around the UK, we are therefore proposing a scheme relying initially on making new project-specific tree measurements. This approach has the dual purpose of creating a tree growth model specific to the environmental conditions of the project concerned whilst, over time, contributing to the development of a database of measurements that – with sufficient coverage of species and geography – will avoid the need for further mensuration in the case of future projects. An additional benefit of the approach is to encourage the farmer to consider what trees are locally well adapted. The following two steps are proposed:

1. The farmer is encouraged to gather tree diameter measurements from target trees of known approximate age within the vicinity of their project. The location should be as near as possible to the project site (say, within 5 km and ideally 1.5 km) such that the environmental conditions (climate and soil conditions) are as similar to the project. Distances of measured trees to the project site will be recorded as one indicator of model confidence. The current MS Excel spreadsheet implementation allows applicants to enter (for each tree species they will plant) diameter at breast height (DBH, 1.3 m) for a target number of 10 trees per age category for a range of different ages. At least

three ages/development stages will be needed, with a minimum of three years and including trees at maturity. While very old trees may be of minimal relevance to carbon crediting of new plantations, we will allow applicants to enter details of trees of up to 150 years age as this allows quantification of carbon accumulation asymptote in the model described below.

2. The tree measurements are used to parameterise a simple tree growth model. Much research work has been done to quantify DBH-age relationships in urban trees and we use this work as a model for agroforestry systems as trees tend to occur in lower densities than forests in both systems. We use the formula $DBH=B0\ (1-e^{(B1)(Age)})^{B2}$ to describe the DBH-age relationship here. This model has been successfully fitted to numerous urban tree species from 0 to around 40 years across multiple US cities (McPherson and Simpson, 1999), however initial experimentation with the formula suggests it has stable behaviour beyond this range, tends to asymptote, and likely represents DBH-age relationships beyond this range. The model additionally is mildly sinusoidal, describing the accelerating tendency of carbon accumulation during early-year growth. Many additional models have been suggested in the urban tree literature (see refs in (Peper et al., 2014)) but most are complex (typically high order polynomials) and have unpredictable behaviour beyond the data range. Parameters B0 B1 and B2 in the formal are optimised in our spreadsheet implementation to available data using machine learning implementation in the Excel Solver add-on which is initiated using a button that starts a recorded macro.

### *Modelling other significant contributions to the GHG balance of an agroforestry system*

Table 2 compares significant contributions to the GHG balance of woodland and agroforestry systems. They comprise changes to carbon stored in components of the system (biomass, soils) and emissions associated with management operations. The overlap between woodland and agroforestry is significant in both aspects but a number of tree management operations (pruning, fruit/nut harvesting) are unique to agroforestry. We decided that in the immediate term, calculations embedded within the Woodland Carbon Code calculator could be used to model some of the agroforestry carbon balance components, whilst other components require development of bespoke agroforestry methods.

**Table 2:** Break down of the contributions to the GHG balance of woodland and agroforestry systems.

| **Contribution to GHG balance**<br><br>1- Changes in biomass/C<br><br>2- Operational emissions | **Included in the WCC calculator** | **Relevance to agroforestry** | **To be included in the agroforestry carbon calculator** | **WCC calculator applicability** | **Need for an alternative methodology** |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Emissions due to ground preparation[1,2] | ✓ | ✓ | ✓ | ✓ | × |
| Production of seedlings in nursery[2] | ✓ | ✓ | ✓ | ✓ | × |
| Herbicide application for weed control[2] | ✓ | ✓ | ✓ | ✓ | × |
| Fencing materials and tree guards[2] | ✓ | ✓ | ✓ | ✓ | × |
| Tree guards[2] | ✓ | ✓ | ✓ | ✓ | × |
| Gain/loss in debris and litter carbon[1] | ✓ | (✓) | × | × | × |
| Change in soil C[1] | ✓ | ✓ | ✓ | ✓ | × |
| Thinning of trees[1,2] | ✓ | (✓) | × | × | × |
| Pruning and/or pollarding[2] | × | ✓ | ✓ | × | ✓ |
| Coppicing[2] | × | ✓ | × | × | × |
| Harvesting of fruit/nuts[2] | × | ✓ | ✓ | × | ✓ |
| Clear felling/removal of trees (harvesting for timber) [2] | ✓ | ✓ | ✓ | × | ✓ |
| Emissions savings from land taken out of cultivation[2] | × | ✓ | × | × | × |

*<u>Emissions due to ground preparation</u>*: We used the WCC calculator. Mechanised site preparation (e.g. ploughing, mounding) implies fossil fuel use, usually diesel.

Estimates of direct emissions at the point of use of a fuel and indirect emissions prior to its use have been compared and contrasted from a range of studies, to generate scaled-up estimates at devolved country level (Morison et al, 2012, Table 4.10). The WCC calculator produces an estimate of ground preparation associated emissions (in $tCO_2e$/ha) based on area information. For the agroforestry calculation we propose using the WCC calculator by applying an effective area approach (summing the area of the tree rows).

*Production of seedlings in nursery*: We used the WCC calculator. The state of science on carbon costs of seedling production has been reviewed by Morison et al (2012), although such studies are scant. This estimation of the C and GHG contribution uses a near life-cycle assessment approach to take into account transportation, on-site energy use, infrastructure construction and other factors. The WCC calculator produces an estimate (in $tCO_2e$/ha) based on information on number of trees (spacing, field area). This pro rata approach makes it readily usable for the agroforestry calculation.

*Herbicide application for weed control*: We use the WCC calculator. The estimation of this within the WCC calculator takes into account the direct emissions of herbicide broadcasting (diesel consumption) and indirect emissions associated with the active ingredients, their manufacture and decomposition, on an area basis. For the agroforestry calculation we propose using the WCC calculator by applying effective area approach (summing the area of the tree rows).

*Fencing materials*: We used a refinement of the current WCC calculation. Emissions associated with the construction of fencing depends on the materials and the design (area, shape) of their installation. In the CSORT model, a nominal rectangular shape and an area of 5 ha is used for scaling purposes. Fencing is assumed to be steel-wired, and the wood of the fence posts is not included (being indirect, taken into account in the utilisation of harvested wood products). Emissions associated with transport to and erection on site are included. The refined version (Vicky West pers comm.) calculates the emissions on a linear basis and distinguish between stock and deer fencing, making it more usable and adaptable for agroforestry purposes.

*Tree guards*: We used a refinement of the current WCC calculation. The calculator currently uses an area-based proxy. A refined methodology using different types of guard is currently being worked on and will be shared (VW pers comm).
Gain/loss in debris and litter carbon: We propose not including this component in the agroforestry calculator. Debris and litter contributions to the carbon balance are also modelled in the WCC and potentially relevant to agroforestry, but the ecological processes are likely to be different in scale and nature and we suggest, conservatively, leaving out this component in the prototype calculator.

*Change in soil C (long term)*: Some data provides evidence of an accumulation of carbon in soils in agroforestry systems, but the science is uncertain and, taking a conservative approach that follows the WCC, we limited our inclusion of a soil carbon component to the specific case of where the agroforestry is established on previous arable land use of mineral soils. The WCC calculator was applied on the area of the tree rows.

*Thinning of trees*: We decided not to include this component in the agroforestry calculator. Agroforestry designs tend to use planting intervals that do not require subsequent thinning. Any thinning that takes place is likely to be for the productive use of the extracted timber and can be taken into account in that module (see below).

*Pruning and/or pollarding*: We developed a bespoke agroforestry calculation. This will be based on published evidence of emissions associated with the mechanised management of tree rows. Possible proxy activities associated with hedgerows or orchards may be drawn upon initially.

Coppicing: We propose not including this component in the agroforestry calculator. Short rotation coppice production is often associated with biomass production for which the agroforestry carbon code will not be suitable.

*Harvesting of fruit/nuts*: We propose developing a bespoke agroforestry calculation. See above for pruning/pollarding. Evidence from orchard management will be sought to develop a calculation that can be used on a linear length or per-tree calculation. Clear felling/removal of trees (harvesting for timber): We propose developing a bespoke agroforestry calculation. See above for pruning/pollarding. The carbon embodied in timber products will not be accounted for in the overall carbon budget of agroforestry systems, as per the Woodland Carbon code.

*Emissions savings from land taken out of cultivation*: We propose not including this component in the agroforestry calculator. The assumption we are adopting here is that by not including such emissions savings in the calculation, neither does potential leakage need to be taken into account.

## Results and discussion

### *Experience of applying the methodology*

The carbon modelling was applied to the eight pilot sites participating in this project (six in England funded by NEIRF and two in Scotland funded by the Scottish Government; see section below for locations and details of the agroforestry systems). A data collection protocol and data entry template were used by the pilot site teams visiting these farms to collect all the data needed for the modelling, focussing on system design (tree species, numbers of trees, areas) and establishment and management activities and materials (see Annex 1). The protocol was successfully followed and allowed for the calculation of carbon sequestration estimates (average over a 30-year period) for all sites, albeit with poor model quality in some cases. Some sites were too complex or heterogeneous to model in their entirety, and in these cases simplified model systems were the focus. Table 3 describes the systems modelled across the pilot sites. In respect to the biomass/ model quality, this varied depending on the comprehensiveness of the tree DBH sampling over different tree ages that was possible for all the target species. The aim was at least 10 measurements of three ages spanning the modelling period (30 years) at the farm site or in near vicinity, but this sometimes proved impossible, at least within the time constraints of the site visits. Reference sites in the locality were used for most of the sites, although in the case of Wood Advent Farm and Woodlands Farm these were more distant than ideal. In total, 595 DBH measurements were made of 13 different tree species: apple, pear, mulberry, medlar, walnut, hazelnut, sweet chestnut, silver birch, cricket bat willow, alder, oak, bird cherry and Scot's pine. Literature sources were used in extreme cases to bring in "anchor" data points to constrain models within realistic boundaries; in a few cases, particular trees in an agroforestry system lacking data were swapped for another species (of assumed equal or lower growth potential) to make up tree numbers. There were several instances of tree ages being uncertain. Occasionally this could be resolved by referring to Google Earth time series imagery.

**Table 3**: Agroforestry systems at the pilot sites that were subject to carbon modelling, and the hedgerows/woodlands modelled in comparison at the same sites.

| Pilot site | Agroforestry system(s) modelled | Hedgerows and woodlands modelled |
|---|---|---|
| FarmEco (Notts) | "Labyrinth" of silver birch: 160 trees interplanted with coppiced lime/hazel | Three types of established hedgerow, (total length 720 m); two types of broadleaved woodland (total area 2.5 ha) |
| | Fruit/nut silvoarable with 450 apples, 125 walnuts, 125 sweet chestnuts and 125 elders | |
| RegenFarmCo (Yorks) | Fruit/nut silvoarable with apple, pear, medlar, mulberry and hazel | Established hedgerows (2200 m); established and new woodland (12 ha). |
| Spains Hall Estate (Essex) | Timber and nut system with 1250 oaks, 360 walnuts and 300 hazelnuts | Established and new hedgerows (59.3 km); multiple areas of woodland (97 ha) |
| Riverford Dairy (Devon) | Alders planted in two in-field rows | Oak/willow riparian woodland (1.9 ha); mixed hedge (640 m) |
| | Nut system with 85 walnuts and 243 hazelnuts | |
| | Orchard of 65 apple trees | |
| Wood Advent (Somerset) | Nut system with 64 chestnuts | Old growth hedgerow (14,400 m); new hedgerow (1000 m) |
| Woodlands (Devon) | Shelter belt of oak silver birch, blackthorn and hazel | Established hedgerow (38,600 m) |
| Parkhill Farm (Scotland) | Silvoarable with 709 apples | Three beech and mixed woodlands (10 ha) |
| Main of Fincastle | Silvopasture with oaks mixed with other species | Scot's pine (2 ha) and sitka spruce (40 ha) |

Additional practical challenges were encountered including dealing with trees that were multi-stemmed below the breast height measurement (in this case the widest stems up to a maximum of 6 were measured and then converted to a single DBH using the quadratic sum equation[1]) and making an accurate measurement where the tree is closely protected by a rigid, enveloping tree guard.

To complement the modelling process, the Project Delivery Team agreed that some approximate estimations should be made of the carbon sequestration potential of other woody features on the sites, including hedgerows and farm woodland, to support a ‘farm-level’ financial appraisal (see data form 3, Annex 1). The hedgerow carbon calculation methodology developed under the hedgerow carbon code project was not available to us, but instead the Farm Carbon Toolkit online calculator was used to generate estimates. In the case of hedgerows, this was based on hedgerow dimension data and a ‘structural density’ (volumetric) approach. In the case of woodlands, it was based on generic values for woodlands of different broad tree composition classes and ages. In the case of new hedgerows and woodlands, for the purposes of the FCT calculator an age of 15 years was specified, although carbon sequestration at this median age may not equate to the mean for the first 30 years of the system in question. A brief description of the hedgerows and woodlands included in the modelling is included in Table 3.

*Carbon sequestration estimates*

The carbon sequestration estimates for ten agroforestry systems on the eight pilot sites are given in Table 4. See Annex 2 for a more detailed presentation of the biomass carbon modelling. The average net carbon sequestration rates for the modelled project duration (30 years; 100 years for Mains of Fincastle) ranged between -0.09 tCO2e/ha/yr (a fruit system at Riverford Dairy) and 10.98 tCO2e/ha/yr (a shelterbelt at Woodlands Farm in Devon), with an average of 2.77 tCO2e/ha/yr. This diversity of values reflects differences in tree species and their growth rates, tree density, management intensity (and therefore amount of related emissions) and site characteristics, including climate. In the five cases where previous land use was arable cultivation, there was an estimated accumulation of soil carbon of between 0.01 and 0.55 tCO2e/ha/yr, depending on the area of the tree row as a proportion of the total field area, which contributed to the overall net carbon sequestration potential.

Six of the ten modelled systems had estimated carbon sequestration rates of between 0.43 and 1.35 tCO2e/ha/yr. Although these are net values that take into account management emissions, these estimates are at the low end of the range of published values in the scientific literature. To investigate his issue more formally we have quantitatively compared our findings with the recent international review of biomass carbon sequestration in agroforestry systems by Cardinael et al. (2018). The findings are shown in Figure 1. We have used biomass carbon sequestration figures (i.e. figures before emissions are taken into account; Table 4 column 4), for 8 of the 10 pilot agroforestry parcels in which grazing is practiced within the agroforestry system (at least some of the time) and have compared these to the 10 international temperate silvopastoral sites covered in the literature review. While

[1] https://www.sciencedirect.com/science/article/pii/S1618866718305818

silvoarable is extensively reviewed in Cardinael et al. (2018), only two of our pilot parcels are exclusively silvoarable and so this type of agroforestry is not compared.

**Table 4 (next page)**: Estimated carbon sequestration potential of modelled agroforestry systems on pilot sites.

| Site | System | Area modelled | Whole AF system area | Biomass carbon sequest | Biomass carbon sequest across all areas modelled | Tree row soil sequest (LU conversion from arable only) | Establishment & management emissions | Net sequest | Net sequest | Farm woodland and hedgerow sequest | Biomass carbon sequest WCC prediction [4] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ha | ha | tCO2e/ha/yr | tCO2e/ha/yr | tCO2e/ha/yr | tCO2e/ha/yr | tCO2e/ha/yr | tCO2e/yr | tCO2e/yr | tCO2e/ha/yr |
| RegenFarmCo | Fruit and nut | 1.9 | 1.9 | 1.59 | 1.59 | 0 | 0.24 | 1.35 | 2.57 | 92.6 | 1.44 |
| FarmEco | Fruit and nut | 6.1 | 18.21[1] | 0.79 | 1.24 | 0.09 | 0.57 | 0.31 | 1.89 | 35.2 | 0.66 |
| | Birch labyrinth | 0.6 | | 5.74 | | 0.22 | 0.51 | 5.45 | 3.27 | | 2.52 |
| Spains Hall | Oak and nut | 59.1 | 59.1 | 1.23 | 1.23 | 0.04 | 0.25 | 1.02 | 60.28 | 378.2 | 0.15 |
| Riverford Dairy | Alder | 16.0 | 18.8[2] | 7.67 | 7.29 | 0.01 | 0.34 | 7.34 | 117.44 | 11.0 | 0.28 |
| | Fruit | 0.9 | | 0.54 | | 0 | 0.63 | -0.09 | -0.08 | | 0.33 |
| Wood Advent | Chestnut | 4.3 | 4.3 | 0.82 | 0.82 | 0 | 0.03 | 0.79 | 3.40 | 117.3 | 0.070 |
| Woodlands | Shelter belt | 0.3 | 0.3 | 13.60 | 13.60 | 0 | 2.62 | 10.98 | 3.29 | 42.5 | 3.44 |
| Mains of Fincastle | Timber & woodchip | 4.0 | 4.2[3] | 0.83 | 0.83 | 0 | 0.4 | 0.43 | 1.72 | 314.4 | 0.38 |
| Parkhill Farm | Fruit | 6.5 | 6.5 | 0.12 | 0.12 | 0.55 | 0.59 | 0.08 | 0.52 | 91.8 | 0.53 |

[1] One of three parcels ("Food Forest") could not be modelled due to lack of appropriate data.

[2] One of three parcels ("Nut Trial") could not be modelled due to lack of appropriate data.

[3] Only the oak component of this system could be modelled (1/4 of all trees) due to lack of appropriate data. 1680 Oak were modelled over 100 years with thinning at 15 and 30 years to give a final density of 70/ha.

[4] Fruit and nut species modelled as mixed broadleaf, yield class 2. Other species modelled to species at yield class 4.

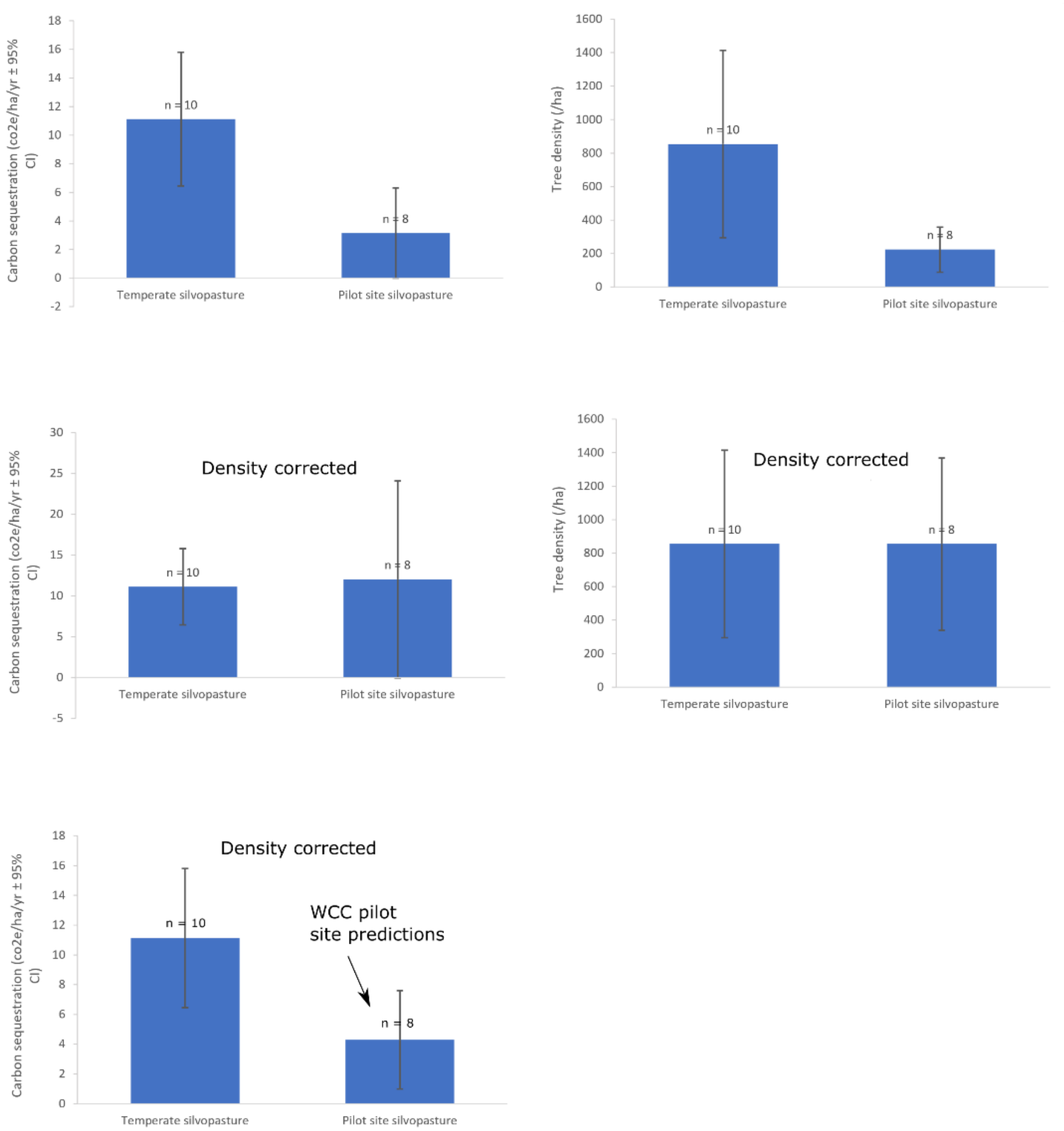


**Figure 1:** Biomass sequestration rates at 11 international temperate silvoarable sites from Cardinael et al. (2018) and the 8 of our 10 UK agroforestry parcels practising silvopasture. Bottom left show predictions generated by the Woodland Carbon Calculator. Conventional error propagation formulas have been used during scale equalisation and density correction.
We have also also plotted prediction generated by the Woodland Carbon Calculator (https://tinyurl.com/5n86mawd, see also footnote 4 of Table Y).

Figure 1 shows that carbon sequestration occurs at around a third the rate it does in the international temperate sites reviewed (top left plot), however density of trees is much lower in our pilot sites (top right plot). When figures are corrected for density (bottom left plot), carbon sequestration rates are strikingly similar. We conclude that the superficially low carbon sequestration rates found in our pilot sites are due entirely to the relatively low density of trees planted in our UK sites. Such sites planted at the higher densities are typical of international temperate agroforestry sequester carbon at the same rate.

Figures generated by the Woodland Carbon calculator (bottom left) are conservative relative to those generated by our method and a worse fit to published agroforestry data. This confirms our preliminary assertion that agroforestry requires a carbon calculation method independent of those used for woodland due to the different way in which trees grow in these systems. Examination of Table 4 suggests that the largest discrepancies between the Woodland calculator and our method are for sites in the far south of England.

The hedgerow and woodland carbon sequestration estimates are also shown in Table 4 and placed in context the carbon sequestration potential of the agroforestry system. Of importance to note in this comparison is that in the cases of more complex systems, only a portion of the agroforestry is modelled and it is therefore under-represented. Nevertheless, the sequestration rate per year per farm for woodlands and hedgerows dwarfs that of the agroforestry component.

## Limitations and future work

The main limitation of the approach that was developed and tested was the gathering of sufficient data on tree DBH for the target species and range of ages. This was more successful for some pilot sites than others, and with more time to plan and conduct visits it is likely that the models could be better parameterised and give results of higher confidence. Sensitivity analyses (comparing model results achieved with more or less data) and also comparison of results using other methodologies of estimation would be valuable to understand the degree to which model improvement is possible. In the longer term, the gathering of data from an increasing number of sites and site conditions would create a valuable database of tree growth data and enable relevant default values to be used in the absence of local measurements.

There are a number of ways in which the methodology developed and tested in this project can be further refined, for example incorporating rootstock and varietal data, and wood densities. The identification and use of different allometric equations for multi-stemmed and pollarded trees would represent a further improvement. Ongoing work using terrestrial laser scanning to develop better models for standard trees will also be important for the development of more robust models in the future.

## Conclusions

Our proposal for predictive carbon modelling for new agroforestry projects focuses on estimation of the emissions associated with establishment and management activities and sequestration of carbon in tree biomass. Pending more evidence of changes in agroforestry systems, the soil carbon component was not included in the carbon prediction protocol beyond the specific case of systems developed on mineral soil which was previously in arable land use, for which the Woodland Carbon Code calculation was applied pro-rata to the area of the tree rows. Farming operations within the matrix of land between/around the trees (e.g. livestock grazing, cereal cropping, vegetable growing) were not included.

This approach is based on tried-and-tested allometric relationships between tree girth and biomass/carbon; it works up from trees to fields and farm systems. However, there is a paucity of data on tree growth performance for different tree species in open field environments across different site characteristics, Our proposal therefore relies on farmer involvement to collect data to parameterise bespoke, localised tree growth models and in so doing helping to build up a national database of tree growth data to support future model refinement.

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## 3. Piloting of Agroforestry Carbon projects - Summary

This section is a brief summary of the findings from collecting and analysing pilot data from six pilot sites in England and two pilot sites in Scotland visited between February and April 2023. Pilot sites were identified through contacts in agroforestry known to the Woodland Trust and Soil Association. Both charitable organisations reached out to farmers and landowners to ensure there was a good geographical spread of sites across the UK and a wide variation of tree species and agroforestry systems suitable for data collection. Site visits combined collecting DBH measurements of eligible trees and whole farm woody biomass networks following guidance provided by ORC as well as pre-visit desk research. In addition, a pilot questionnaire was conducted to draw out farmer attitudes towards the sale of carbon credits through voluntary carbon markets.

## Methodology

A summary of the data collected and qualitative answers to the carbon attitudes questionnaire has been presented in a separate report titled Pilot Summary Report. The 8 pilot sites included in the report are:

- Spains Hall Estate, Essex
- Wood Advent Farm, Somerset
- Woodlands Farm, Devon
- Riverford Organic Dairy Farm, Devon
- FarmEco Ltd, Nottinghamshire
- RegenFarmCo, Yorkshire
- Parkhill Farm, Fife
- Fincastle, Perthshire

All pilots followed the same visit agenda and questionnaire (Annex 4) on carbon attitudes. The site visit agenda comprised of 3 separate items:

1. Tour of agroforestry fields, existing woodland and hedgerow network
    a. Demonstration DBH measurements
    b. Locate other aged trees within 5km of agroforestry measured
2. Sit down session
    a. ORC data collection sheet
    b. Finance Earth costs and income template
    c. Farmer pilot attitudes questionnaire
3. Return to collect any remaining measurements:
    a. Measure DBH of same species in samples of 10 within 5km
    b. Take pictures

The pilot summary report seeks to provide this project and the participating pilots with the information collected on their sites and importantly, the outputs from project partners in an accessible format. Pilots have consented they are happy with the report and the information in it which can be shared with NEIRF colleagues.

## Conclusions

Participating pilots were willing to give time to share their plans and data on their agroforestry projects along with filling in requested data forms and hosting project team members on site for a minimum of one day, but in most circumstances two days to participate in interviews and measurements. Pilots either had existing or very new agroforestry schemes which did not have the prior opportunity to take up carbon finance. Schemes were anticipated to be financially viable when productive maturity is reached and in most circumstances, were privately funded by the farmer at risk, due to limited availability of grant funding. The pilots included in this study can be described as advocates for agroforestry within their local farming networks and in some cases nationally, and are enthusiastic to hear about research into future funding sources for agroforestry, hence their willingness to be involved and give time to this project.

Conclusions from the pilot site visits and questionnaire contained common themes. Within the pool of pilots, carbon literacy and interest in carbon markets varied significantly. Only one of the pilots could provide an approximate carbon figure for their farm produce which was taken at the farm enterprise level. All pilots cited a lack of research on the productivity, density, management, maintenance and lifetimes of smaller tree species such as fruit and nut trees commonly found in in-field agroforestry systems as a barrier to implementing agroforestry in the UK. More research into densely planted commercial systems can be found in European literature where models are successfully operating but which don't always apply to novice practices in the UK. This lack of research in the UK context is also hindering knowledge on carbon sequestration rates of these tree species and systems which can be modelled on tree growth rates.

It was clear that all pilots were focusing on financial viability either through the sale of tree products or through generating savings in other farming enterprises e.g. improved livestock welfare. Therefore, a critical point for all farmers was that the carbon income must be sufficient to reward any time or costs involved in generating carbon credits and then some. All were willing to self-monitor projects and half of pilots were planning to do this without requirement from a carbon standard at varying frequencies, in most cases every 5 years as a minimum.

The commitment to a project duration varied amongst pilots and reflected the understood minimum productive timeframe of the shortest rotation species in the mix. The lowest quoted commitment period was based on fruit trees with a theoretical timeframe of 25 years. Farmers were happy to sign contracts for their preferred project length, having already overcome barriers in committing to putting their agroforestry scheme in the ground. A couple of pilots noted that legal contracts could be a deterrent for farmers, in particular being contractually locked into environmental schemes for long periods of time can be off-putting.

### Potential sale of carbon units

Due to the retrospective nature of the pilot project which required data collection on existing agroforestry trees and in the absence of an existing applicable carbon standard, pilots had understandably not considered or prioritised the potential future income from the sale of carbon credits. When asked hypothetical questions, all but one pilot wanted to know about the buyer of their credits. Most pilots would prefer to communicate directly with the buyer(s) with the opportunity to add value in offering volunteering opportunities and biodiversity benefits from the project. Several pilot farmers started to consider whether they could increase the price of their credits through story-telling and building a closer relationship with potential buyers, particularly in circumstances where the buyer has project exclusivity. Regarding the ethical nature of the buyer, there was a consensus that ethical buyers are preferable with the acceptance that ideal customers and access to buyers is not always accessible and transparent in the current market.

# 4. Financial Appraisal of Agroforestry Carbon projects - Summary

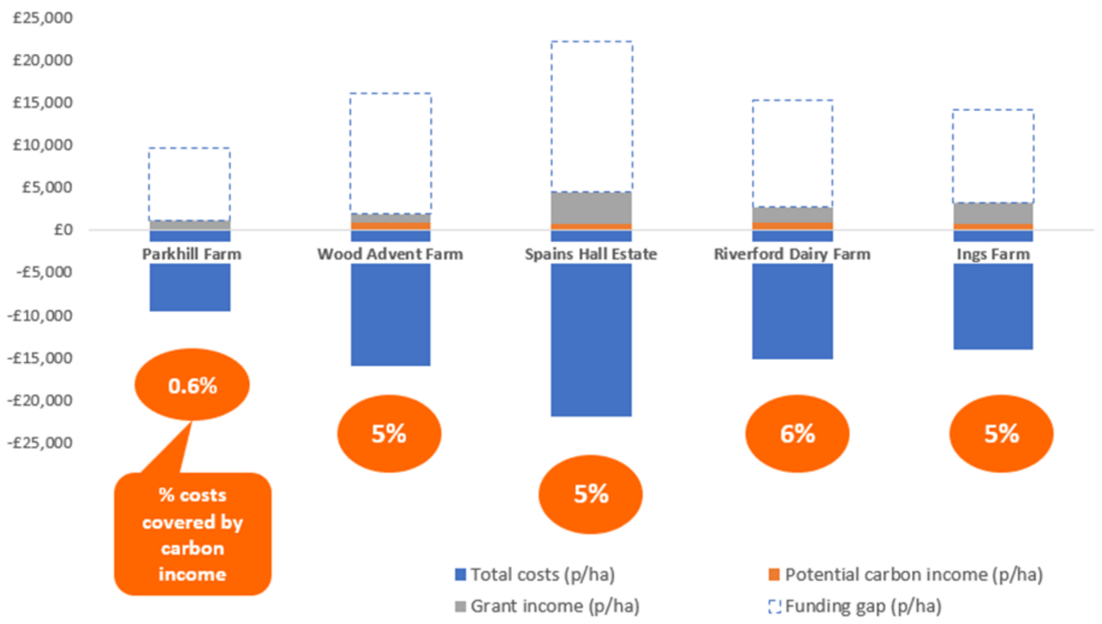
This section aims to provide a financial appraisal of the role that an Agroforestry Carbon Code could play in supporting the commercial viability of agroforestry projects, through answering four key questions:

1. **What role can carbon income play** to support delivery of agroforestry projects based on the latest available science?
2. What **blend of carbon income, grant funding and agroforestry product revenues** is needed to deliver financially viable agroforestry projects?
3. Is there a **commercial case for an Agroforestry Carbon Code**?
4. Is there likely to be **demand** for Agroforestry Carbon Units (ACUs)?

To carry out the financial appraisal, cost and revenue data was gathered from five agroforestry pilot sites to model the potential at each site to blend carbon income, grant funding and revenues from the sale of agroforestry produce (e.g. fruit and nuts). Finance Earth assessed the financial viability of each pilot site and the importance carbon unit revenues played in covering lifetime project costs, as well as the potential to attract repayable investment to accelerate delivery of agroforestry across the UK. The five pilot sites for which financial information was included were: Parkhill Farm, Wood Advent Farm, Spains Hall Estate, Riverford Dairy Farm and Ings Farm (RegenFarmCo). The analysis was based on specific agroforestry interventions across the pilots and did not consider the overall impact on the farm-level business model.

For simplicity, the models were based on the adoption of an upfront Pending Issuance Unit (PIU) sales strategy. A PIU represents a contractual promise from a land manager to deliver to a buyer a verified carbon unit in the future, based on a predicted projection of carbon sequestration or emission reductions. Under this approach, the pilot site cashflow profiles indicate that carbon revenues have the potential to cover 0.6-6% of project costs (on a present value basis). This is a result of the low site level sequestration rates modelled at the pilot sites included in the financial appraisal (0.08-1.35 $tCO_2e$/ha/yr), which are lower than seen in published literature due to the reduced stocking density seen in UK agroforestry projects. The low carbon quantum suggests that the financial contribution of carbon revenues to determining financial viability is uncertain. However, the appraisal also highlighted that the timing of potential carbon revenue is important in supporting the financial viability of a project and that carbon income early in the project lifetime has a key role to play in covering capital costs for some of the pilot sites before agroforestry systems become productive and alternative revenue streams are available.

*Figure 1. Funding need across agroforestry pilot site projects before income from the sale of agroforestry produce (e.g. fruit, nuts, timber) is assumed*




For five pilots, two scenarios were modelled to assess the impact of carbon income on project financial viability using site data and consistent assumptions in each case:

1. Baseline scenario: carbon revenues (upfront PIU sales) modelled based on carbon sequestration rates at pilot sites, project costs, and public grants received for agroforestry schemes. Assumed revenues from the sale of agroforestry produce were excluded.
2. Agroforestry revenue scenario: cashflow from the baseline scenario with the inclusion of income from the sale of agroforestry produce. The analysis also considered the impact of the inclusion of and removal of the carbon income under this scenario to assess the project viability without carbon income.

To attract repayable private investment, agroforestry projects need to generate sufficient revenues to cover lifetime costs and meet the minimum return requirements of investors. Considering the baseline scenario in which only carbon income and public grants are available, the analysis shows that the pilot sites included in the financial appraisal are not investible as the baseline revenues are insufficient to cover project costs over the lifetime. However, when carbon income is considered alongside modelled revenues from the sale of agroforestry produce (e.g. fruit and nuts), most of the pilots are financially viable and some may meet the return requirements of certain investors. The relatively small-scale nature of agroforestry projects means that aggregation of multiple projects is likely to be needed to meet scale requirements for private investors.

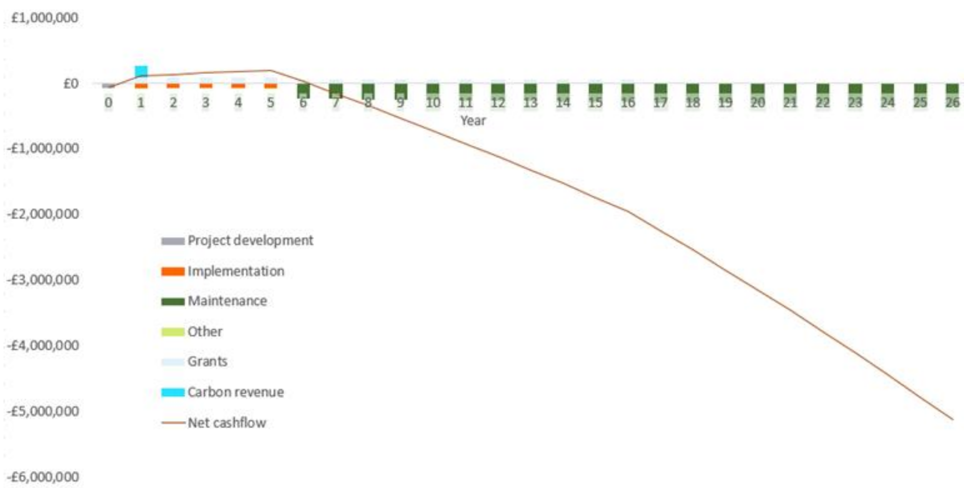
**Pilot site example: Spains Hall Estate**

For Spains Hall Estate, the baseline scenario (excluding modelled nut revenues) demonstrates that carbon income may be important to cover the implementation costs of the agroforestry project from Year 1 to Year 5. However, the project remains unviable over its lifetime as net cashflows cease to be positive once grant funding expires, with negative net cashflow occurring beyond Year 6.

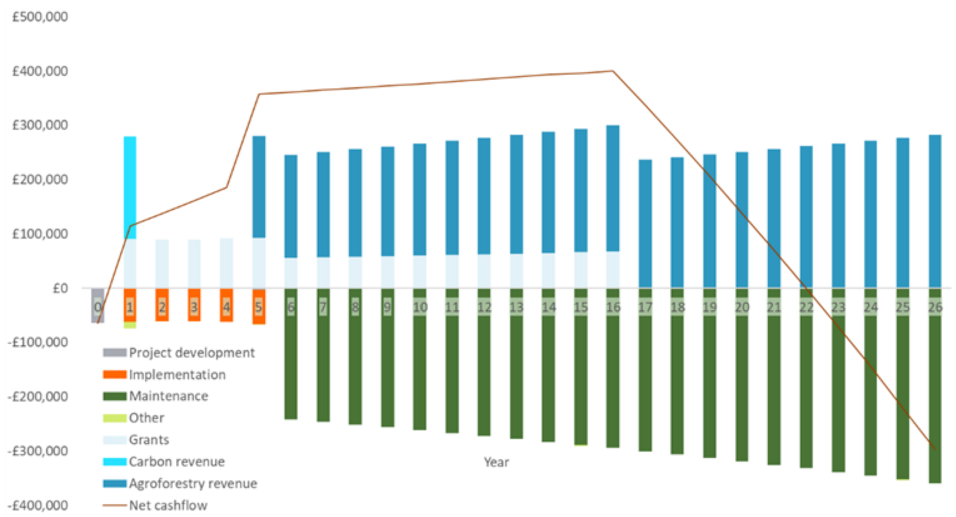
Under the agroforestry revenue scenario, a blend of income from ongoing public maintenance grants through Environmental Land Management (ELM) schemes and revenue from the sale of walnuts and hazelnuts is modelled to support high ongoing maintenance costs. This scenario shows the project will be reliant on public grants beyond the current 10-year period of grant contracts to remain financially viable in the long-term.

To illustrate a viable scenario at this site, an additional 'high-case' scenario was modelled with an assumed higher sequestration rate of 2.5 tCO2e/ha/yr (based on an increased stocking density) and an extended period of public grant support to the end of the project.

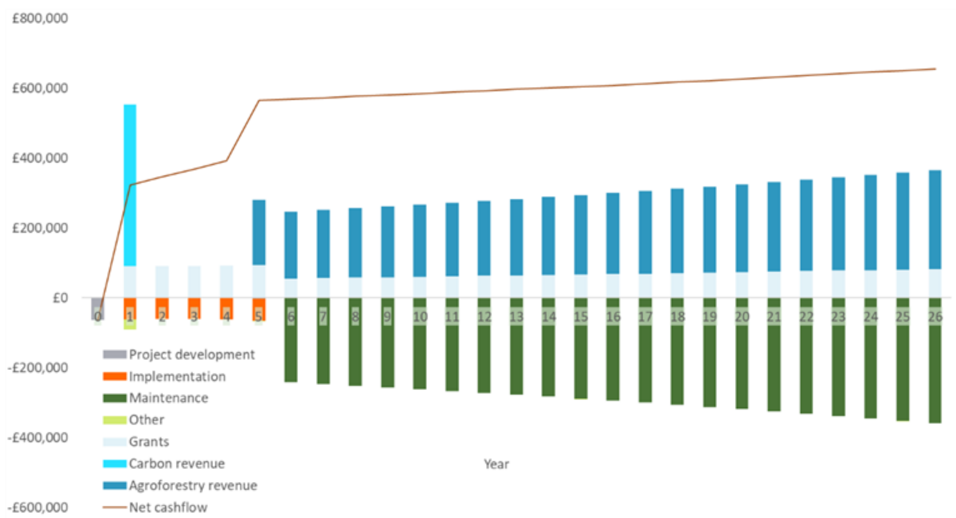
*Baseline scenario: Modelled project cashflow using site-level carbon sequestration rate (1 tCO2e/ha/yr) to determine potential carbon revenues alongside project costs and grant income. Agroforestry product revenues excluded from cashflow.*




*Agroforestry revenue scenario: Baseline project cashflow with the addition of income from the sale of agroforestry produce.*




*High-case 'investible' scenario: Modelled project cashflow including income from the sale of agroforestry products, a higher carbon sequestration rate (2.5 tCO2e/ha/yr) to determine an upper level of carbon revenues and an extension of public grants to Year 26.*




The financial viability for the other pilot sites was assessed using the same baseline and agroforestry revenue scenario approaches. The financial outputs show significant variation between the delivery costs per hectare and the carbon sequestration rates for the pilots. However, across the pilots, a consistent conclusion is that carbon income alone will not support financially viable projects and agroforestry product income is the primary driver.

## Key findings

The findings relating to our key questions for the financial appraisal of the five pilot sites are outlined below.

## 1. Role of carbon income in supporting agroforestry project delivery

The financial appraisal conducted across the five sites highlighted significant variations relating to establishment and maintenance costs, stocking density, type of agroforestry system and ultimately the potential carbon sequestration rates achieved. The primary driver of a project's financial viability was agroforestry product revenues, harvested and sold produce after the initial period of establishment and crop maturation (~5 years). The analysis showed that carbon revenues, modelled using a PIU approach would generate ~0.6% - 6% of project lifetime costs and confirmed that carbon income was not a primary driver of project viability.

Carbon income could play a role in addressing key market barriers by supporting initial capital expenditure and provide an additional diversified income source to incentivise project delivery over the lifetime. Further engagement with land managers is required to test the attractiveness of the carbon revenue in incentivising agroforestry project delivery.

The conclusion from the pilot sites is that a blend of funding is needed to support projects as carbon income alone is not sufficient to determine financial viability irrespective of the variation in carbon sequestration rates across sites. Public funding and agroforestry product revenues are required to establish financially viable agroforestry projects and carbon income could act as an additional support mechanism to de-risk the financial viability.

## 2. Opportunity to deliver a financially viable agroforestry project through blended funding

A significant funding gap exists across the five project sites assessed, even with the inclusion of the anticipated public funding mechanisms given the establishment and lifetime maintenance costs. The combination of carbon income and public funding alone are unlikely to cover these costs and projects only become viable when revenues are included from the sale of agroforestry products. However, these revenues are only generated once the crop has matured after several years resulting in an initial funding gap.

The sale of carbon units could provide a partial solution to the initial funding gap if a portion of PIUs are sold and could provide an incentive for land managers to deliver schemes through lowering the capital required on implementation. However, the PIU sales approach leads to market integrity risks due to the limited agroforestry science/data on carbon sequestration, risk of project failure and cost inflation risk, and limits the potential for the land manager to benefit from future carbon price growth. Alternatively, the sale of verified ACUs could generate additional carbon income (up to 8% of the pilot project costs) to provide a long-term income stream to cover costs over the project and build market integrity. However, neither the PIU or ACU sales approach supports a financially viable agroforestry project based on carbon income alone, and blended funding is needed in all cases.

This analysis also assessed the opportunity to attract upfront private finance to deliver agroforestry projects based on sales of verified ACUs and agroforestry produce. In certain cases, the project revenues may be sufficient to cover costs and provide an investor return but scale may be a limiting investment factor. Private finance is more likely to be suitable for relatively large-scale projects with higher stocking densities or will require aggregation of multiple smaller sites or delivery of interventions across a farm to reach a scale that delivers transaction cost efficiencies.

While not specifically modelled, it is important to acknowledge the potential co-benefits and additional income or cost-savings that may arise from incorporating agroforestry trees into land management practices. Implementation of agroforestry systems can lead to an increase in productivity across the farm, which can provide additional incentives to incorporate agroforestry into wider land management. Delivery and financing of agroforestry systems should be considered as part of its role in the wider farm business model.

## 3. Commercial case for an Agroforestry Carbon Code

The limited carbon income generated through agroforestry suggests that a standalone Agroforestry Carbon Code is unlikely to be viable, given the associated running costs of an accreditation scheme and ongoing verification requirements. A preferred route forward would be for an agroforestry carbon methodology to be bolted onto an existing code, such as the Woodland Carbon Code or nascent Hedgerow Carbon Code. Agroforestry could also be included in wider nature frameworks, such as the BSI Nature Standard, to support market robustness and quality. The results suggest that there is a potential need to develop a whole-farm approach to carbon accreditation with agroforestry included within a portfolio of opportunities and accreditation delivered at the farm level. A farm-level framework or aligned governance across codes may improve the viability of a whole farm carbon sales approach through delivering cost efficiencies.

The measurement of carbon could also play a supporting role in delivery of agroforestry across the UK through alternative mechanisms outside of an Agroforestry Carbon Code. For example, the measurement of carbon could be used to justify higher premiums on agricultural and agroforestry produce or provide a route for supply chain insetting opportunity for the farmer.

## 4. Demand for Agroforestry Carbon Units

Market research and engagement with potential carbon credit buyers was carried out throughout the project to test market demand for UK voluntary carbon credits. Given the limited availability of scientific data on carbon sequestration from agroforestry systems and the early stage of the Agroforestry Carbon Code development, engagement focused on understanding the demand for broader nature-based carbon credits, such as peatland and woodland carbon, alongside new markets, including agroforestry.

Market evidence suggests that demand for carbon credits far exceeds the supply of credits available and there is strong demand for the development of high-integrity nature-based projects in the UK which deliver additional co-benefits beyond carbon.

Agroforestry schemes can deliver a broad range of environmental co-benefits, including improved soil structure, resilience to climate change, water quality improvements, and creating biodiversity corridors, with wider community benefit opportunities through volunteer engagement in project delivery and management. However, agroforestry projects present some potential market integrity risks, including the permanence of the carbon sequestered in shorter duration schemes and the additionality of carbon income, which may reduce buyer demand or pricing for ACUs.

The agroforestry carbon methodology could be well-suited to supporting supply chain carbon measurement approaches and insetting strategies, as an alternative to the carbon offsetting market. Supply chain actors should be engaged to assess appetite for insetting through agroforestry and measurement requirements. Alignment to a carbon verification standard and approved methodology would support a robust insetting approach.

# 5. High-integrity requirements for agroforestry carbon projects

In this section, the project team has proposed either actual or potential requirements that would need to be considered for robust, high-integrity agroforestry carbon projects. This was informed by a study completed by Professor Mark Reed from the Thriving Natural Capital Challenge Centre, Scotland's Rural College (SRUC).

## Insights from a comparative analysis of international agroforestry codes

*Professor Mark S Reed*

*Thriving Natural Capital Challenge Centre, Scotland's Rural College (SRUC)*

### Introduction

There is increasing evidence that agroforestry can help contribute to net zero targets in the land use sector whilst delivering other co-benefits for nature and farm businesses (e.g. Chapman, 2020). However, there are a number of barriers to the adoption of agroforestry systems (Reed, 2007) and adoption remains low in the UK (Newman et al., 2018), due to a combination of financial barriers and lack of knowledge (Tosh and Westaway, 2021). Additional income streams from carbon markets may make agroforestry a more viable option for farm businesses, but there is currently no route to market. Therefore, to explore the viability of a UK Agroforestry Code, this report:

1. Provides a comparative analysis of existing international agroforestry codes and UK Woodland Carbon Code, to assess potential for UK application and identify elements that could be adapted for a UK code
2. Assesses requirements for new methodologies under Woodland Carbon Code
3. Aligns with best practice guidance from ICVCM and forthcoming core principles and minimum requirements for UK carbon codes
4. Provides draft governance components of a UK Agroforestry Code for consultation, to which MRV components can be added

### Methods

There is wide variety in the terminology used by organisations involved with the voluntary carbon market. For the purposes of this analysis, a "code" is a document, or set of documents, detailing the requirements and rules to establish and run a project that aims to generate verifiable carbon credits under the auspices of a certification programme and registry (c.f. Black et al., 2022). Codes were included in this comparative analysis if they:

- Provide detailed guidance on both governance and methods for measurement, reporting and verification (MRV); and
- Are publicly available and open access online.

This led to the selection of three codes for analysis:

- Rabobank's Acorn Framework, certified by Plan Vivo
- Gold Standard's Land Use and Forestry Requirements, dual certified by the Forest Stewardship Council, which include agroforestry
- Verra's forthcoming afforestation methodology that will include agroforestry

To compare the codes, we adapted the analytical framework developed by Black et al. (2022) consisting of components and sub-components within key domains that can be used to analyse and systematically compare codes (Table 1). The text below provides a summary of key differences between the three codes, organised by the first four of the analytical domains in Table 1. No information was provided about the market place in the codes reviewed, and this would need to be collected via additional documentary review and/or interviews. Numbers in parentheses refer to section numbers in each code (where these are in linked, accompanying documentation this is specified).

**Table 1.** Analytical framework showing components and sub-components within domains that can be used to compare soil carbon MRV methods and associated codes.

| **Analytical domain** | **Component** | **Sub-components** |
|---|---|---|
| Project eligibility and rules | Project ownership and rights | Project ownership, project land relationship |
| | Eligible and ineligible | Eligible land use, ineligible land use, eligible practices/interventions |
| | Additionality rules | Types of additionality (common practices, project practices, financial, legal, other) |
| | Permanence rules | Permanence, reversals and leakage rules |
| | Other rules / compliance | Social or environmental no-harm; regulation or ethical considerations, co-benefits |
| Project administration and credit issuance | Registration process | Registration review process, costs, URL for open registry |
| | Project contracting | Contract duration, land management strategy required, data ownership, data disclosure policies, allowable changes. |

| | | |
|---|---|---|
| | Complaints / disputes | Dispute procedures, project disqualifications |
| | Crediting period | Qualifying payments, start of crediting period |
| | Retrospective crediting | Past carbon credits |
| | Credit unit | Name |
| | Uncertainty | Is this reflected in credit issuance? |
| | Buffer/clawback/insurance | Are buffer funds required? |
| Measurement, reporting and verification | Documentation and status | Official method title, version, approval status |
| | | Free-to-access source of documentation |
| | Context for MRV method | Overarching Code, Owner organisation |
| | | Code sponsors, Market approval for code, Code aligned to recognised Standards body |
| | Method scope | Terminology used, Quantification approach, Intended geographic coverage |
| | Geographic coverage and active projects | Geographic coverage, number of active projects, location and area of projects |
| | Project Activity using MRV methods | Active projects, locations, tonnes CO2e, area covered (ha), verified credits issued, credits retired |
| | Sampling | Sampling strategy, min. depth, sampling to depth |
| | Carbon stock measurement | Analytical methods, calculations, bulk density |
| | Modelling: SOC stock and GHG emissions | Approved models, soil GHGs, non-soil GHGs, model approval, reference datasets, emission factors, calibration, validation, timescales |
| | Uncertainty | Model, sampling, analytical |
| | Frequency of reporting | Frequency, data management, responsibility for verification and reporting, certification bodies, standards for certification bodies |
| | Other aspects of reporting | Templates, data management tools, farmer records, dispute or complaints |
| Project baselines | Setting the baseline | Type, historical look-back period |
| | Allowable data sources | Regional, farm, modelling, literature data sources |
| Market place | Buyers | How are units sold, buyer information, know your buyer checks |

| | | |
|---|---|---|
| | Price | Carbon prices, how are prices determined, floor price guarantee |
| | Payment schedule | Payment triggers, project payments |
| | Project costs | Project registration and operation costs, credit transaction fees, financial support, project account costs, other project costs e.g. farm management. |

## Proposed high-integrity requirements

Based on these insights, the next section of this report proposes requirements for agroforestry carbon projects largely based on Woodland Carbon Code requirements with relevant adaptions to reflect the specific context of agroforestry systems.

### Eligibility proposals

**Scope:** This text sets out eligibility, management and MRV requirements for voluntary projects that sequester carbon through agroforestry in the UK. It accounts for carbon sequestration and emissions from the management unit that integrates trees. It does not account for carbon stored in wood products or the carbon saved when substituting wood products for other products with a larger carbon footprint. It does not apply to agroforestry systems on organic soils or tidal wetlands.

*Source: adapted from WCC and Verra.*

1.1 Key project dates

**Requirement:** All projects (whether single or part of a group) shall be registered before work begins onsite (the project implementation date). Single projects shall be validated within three years of registration. For groups, projects can be added to a group (subject to group rules) up to the point of validation. Group validation shall be carried out within three years of the date of the first registration within the group. For single projects or groups, a validation extension may be given in extenuating circumstances. Validation Statements shall only be issued once planting is completed (the project start date). Projects shall have a clearly defined duration and shall not exceed a hundred years. For the first two years of the Code's operation, retrospective crediting of projects will be possible for projects commencing since July 2022*, providing all the eligibility criteria can be met and there is documented evidence that potential carbon finance was a consideration in the decision to proceed.

**date of the start of the NEIRF Agroforestry Carbon Code project*

**Means of Validation:** Project Design Document.

**Means of Verification:** Not required unless changes are made to the project duration.

*Source: adapted from WCC and minimum requirements for high-integrity soil carbon markets.*

1.2 Eligible land

**Requirement:** A project boundary shall be established with evidence of legal ownership, or tenure of the project area for the duration of the project, and evidence that the site did not include agroforestry which was reversed prior to the project:

- If the land within the project area is under tenure, written consent shall be obtained from the landowner, including agreement that the obligation for delivery of the project shall be transferred to the landowner should the tenancy end before conclusion of the project. Consent should be "Free, Prior and Informed". If the land is sold, the current landowner must inform the future landowners of the commitment to the Woodland Carbon Code or Agroforestry Code and any carbon contracts.
- Any form of forestry, including agroforestry should not have been implemented and then reversed in the project area in the five years prior to the commencement of the project. This is to prevent agroforestry being reversed with the objective of implementing practices in the future to participate in carbon markets. Any land with reversed practices shall not be eligible for crediting within the Code.
- A geographical project boundary must be established.

**Means of Validation:** declaration in Project Design Document detailing nature of ownership and landowner/tenant contact details and if leased, tenure documentation and landlord's consent; Solicitor's letter; title deeds; land registry records; Certified copy of lease (if tenanted); remote sensing imagery from five years prior to the project start date showing the absence of agroforestry practice in the project area; map or GIS layer showing geographical location of the project area.

**Means of Verification:** Confirmation of landowner/tenant contact details, with evidence as per validation if landowner has changed.

*Source: adapted from WCC, Peatland Code, Verra and minimum requirements for high-integrity soil carbon markets.*

1.3 Compliance with the law

**Requirement:** Projects shall comply with relevant local, regional, national or UK laws and regulations.

**Means of Validation:** Statements in Project Design Document that the project complies with all relevant laws; Project Design Document outlines a system or procedures for being aware of and implementing requirements of new legislation; signed commitment from the landowner to comply with the law; no evidence of non-compliance.

**Means of Verification:** Statements in the Project Progress Report that the project continues to comply with all relevant laws; other evidence as per validation.

*Source: adapted from WCC and minimum requirements for high-integrity soil carbon markets.*

1.4 Eligible activities and carbon pools

**Requirement:** Eligible activities are agrisilvicultural, silvopastoral, agrosilvopastoral on non-organic soils. The main carbon pools are the above and below ground woody biomass. The soil carbon pool is currently included for the soil within the tree rows, when planting into soils previously growing arable crops. Emissions resulting from the establishment and management of the trees should be assessed and accounted for. In the case of the unlikely removal of biomass before establishment, this will also need to be considered on a case-by-case basis.

**Means of Validation:**

- For conversion of open ground to agroforestry: statement on land use and management in Project Design Document; land use and management records; reference to historical maps, images or other sources; signed attestation from independent expert.
- For soil type: Statement on soil type in Project Design Document; results of field survey for soil type; and soil maps.
- Means of validation for carbon pools are provided in Section 2.

**Means of Verification:** Not required (means of verification for carbon pools are provided in Section 2).

*Source: adapted from WCC and Acorn and Verra.*

## Registry and avoidance of double counting proposals

**Requirement:** Projects and carbon units shall only appear on one carbon registry – anticipated to be the **UK Land Carbon Registry**.

For group validation/verification, the group and its constituent projects shall be entered on the registry as a 'master project' and 'subprojects' respectively.

All projects, project documentation, carbon units, **assignments** and **retirements** shall be visible in the 'public view' of the UK Land Carbon Registry.

Upon validation, if the landowner/tenant wishes to sell credits before verification, **Pending Issuance Units** (PIUs) shall be listed for all carbon units in the project, .

Any **Pending Issuance Units** sold in advance of verification shall either be transferred to the relevant buyer's account or 'assigned' to that buyer. Sale of PIUs will be based on either the predicted validated project total or the Woodland Carbon Code value (based on SAB YC 2, pro-rated by the number of trees per hectare), whichever is lower.

At each verification, **Pending Issuance Units** for that **vintage** shall be cancelled and the verified number of **Woodland/Agroforestry Carbon Units** (W/ACUs) issued.

Prior to using **Woodland/Agroforestry Carbon Units** in any reports, they shall be **'retired'** from the **UK Land Carbon Registry**.

Projects shall not accept any tree donations or other sponsorship where this creates a double claim between the WCC and the donation regarding the carbon benefit.

**Project developers** shall comply with the Registry Rules of Use and shall only sell carbon units which are validated & verified to a standard which is endorsed in the UK Environmental Reporting Guidelines.

**Mean of Validation:**

The landowner, project developer or group manager has an account on the UK Land Carbon Registry. The project is recorded on the UK Land Carbon Registry.

Signed commitment that the project developer will ensure the project and carbon units are accurately represented on the registry, and that the project developer only sells carbon units which are validated & verified to a standard which is endorsed in the UK Environmental Reporting Guidelines.

**Means of Verification:**

- Confirmation in Project Progress Report that the project is not verified/approved by another carbon standard and has not accepted any tree sponsorship or donations for the carbon benefit.
- Pending Issuance Units are listed, Woodland/Agroforestry Carbon Units are issued and units appear in the public view in the account of the current owner, or are assigned to the current owner, on the UK Land Carbon Registry.
- No evidence from the landowner or project developer's websites that they are selling carbon sequestration/emissions reduction which is not validated/verified to a standard which is endorsed in the UK Environmental Reporting Guidelines.

Carbon units are shown as retired from the UK Land Carbon Registry upon use.

## Carbon Leakage proposals

**Requirement:**
The land manager shall confirm any intention to change or intensify the use of land elsewhere on the holding as a consequence of the **agroforestry project.**

If **leakage** (land use change/intensification outside the project boundary but within the UK) is proposed, then projects shall carry out an assessment to determine whether this will result in GHG emissions.

If significant GHG emissions occur they shall be quantified for the duration of the project and accounted for in 'net carbon sequestration' (See Section 3.4). Otherwise **leakage** is assumed to be 'No change over time'.

**Means of Validation:**

- Statement in Project Design Document of intention by the land owner to replace the previous land use or activity elsewhere.
- **Leakage** assessment in Project Design Document.
- Mapping or field observation of current land uses and the likelihood of displacement of activities.
- Further calculations of **leakage**.

**Means of Verification:**
Confirmation in the Project Progress Report of current assessment of level of **leakage** from the project.

**Additionality proposals**

**Requirement:** Legal and Common Practice tests shall be passed to demonstrate additionality. If, and when, agroforestry becomes more commonly practised then a financial test will be required to help judge the additionality of the carbon finance.

**i) Legal test:** There are no laws, statutes, regulations, court orders, environmental management agreements, planning decisions or other legally binding agreements that require that trees should be planted. This includes compensatory planting.

And

ii) **Common Practice test** – Until reviewed, all agroforestry projects will be automatically deemed to meet the common practice test as implementation is currently not common in the UK and until levels of adoption are much greater, and agroforestry becomes common practice, then all projects will meet this test.

In future a financial test in line with draft text below may be required to judge additionality.

***Potential Future Financial test:*** *Projects shall demonstrate that carbon finance plays a role in the positive financing of the agroforestry project, therefore helping to scale up agroforestry implementation.*

*A project must demonstrate compliance with both the legal and financial test.*

*There may be no set level of carbon finance that automatically demonstrates that the financial test has been met, as each agroforestry project will have a unique cashflow projection. The only requirement is that carbon finance is a factor in the cashflow for the project and can be said to give the project developer additional confidence to take forward the project. Financial analysis tools such as Net Present Value (NPV) and Internal Rate of Return (IRR) might be used to demonstrate this positive impact and costs and revenues used within the financial analysis should be based on current prices.*

*Projects with other sources of income including grant aid under a government-funded initiative, timber/other income or charitable donations, are eligible provided the financial test is passed.*

Carbon units provide wider benefits which are currently ‘bundled’ with the carbon unit at point of sale. In future, provided certain criteria are met, it may be possible to ‘stack’ (sell separately) units for different ecosystem services from an agroforestry project.

**Means of Validation:** Statements in Project Design Document demonstrating that the legal test is met.

**Means of Verification:** Not required.

*Source: adapted from WCC, Peatland Code and minimum requirements for high-integrity soil carbon markets.*

## Durability and Buffer proposals

Commonly used in current market standards is the concept of permanence. Considering the inherent characteristics of agroforestry systems, permanence will be difficult to guarantee, as agroforestry is a farming system and therefore sequestration has a material risk of reversal. To recognise this reality, this requirement refers to the concept of durability. Durability is defined as a period of retention of the level of sequestered CO2 that was sold as Woodland/Agroforestry Carbon Units, combined with the requirement to compensate for any negative emissions during the project duration.

This requirement is designed to facilitate agroforestry systems that have short-rotations, allowing management, and removal/replacement based on the concept that the credit must be replaced.

There are two possible options for a durability requirement:

Option 1 – Temporary crediting period approach

**Requirement:** The project shall have a clearly defined duration, during which credits will be issued, and must maintain carbon pools for each credit for the minimum durability period of 30 years commencing from when the verified credit is generated. Risks should be identified and managed via a risk assessment and management plan and a 20% contribution to a pooled risk buffer.

The minimum crediting period shall be 30 years after project start date. The minimum durability period shall therefore be 30 years from the project start date. For example, project that issues credits for 30 years would have to maintain carbon pools for a minimum of 30 years after each credit is issued, with carbon pools for the last credits issued maintained up to 30-60 years after the first year of credit issuance. These are minimum requirements and projects may have much longer crediting periods.

Option 2 – Adoption of Woodland Carbon Code approach

**Requirement:**

- The landowner shall demonstrate a commitment to durability by:
- Identifying risk factors and developing appropriate mitigation strategies as set out in the project's risk assessment
- Contributing to the Buffer

- Ensuring re-planting where projects involve removal of trees (this replanting may be on similar but spatially different sites within the management control of the landowner.
- Managing as per the longer-term management intentions for the project duration and beyond

**Applicable to both options**

All agroforestry projects shall be monitored on their durability commitment at least every 10 years until the durability period is completed. If a negative biomass measurement occurs in the durability period, annual monitoring will be applied until the negative biomass is compensated.

The landowner shall identify risks to the project and develop appropriate mitigation strategies in the project's risk assessment and management plan, ensuring replanting should trees be lost due to wind, fire, pests, diseases, development or any other cause. Should a project experience a loss of carbon, the landowner shall inform the Code Secretariat immediately and submit a Loss Report to the Secretariat within six months of discovery of the loss.

Durability will be ensured via:

- Binding legal contracts between buyers, landowners and any relevant third parties (e.g. intermediaries), covering both credit issuance and durability periods for each credit; AND
- A pooled risk buffer of 20% of verified credits to protect against unintentional reversals.

Future landowners should be informed of any carbon contracts and associated commitments under the Code.

In addition to this, buyers and/or projects may purchase insurance products to protect against unintentional reversals. Durability during and beyond the minimum permanence period may be provided via a Conservation Covenant (England and Wales) or Easement (Scotland) if agreed with the buyer and landowner.

**Means of Validation:** evidence should be provided to confirm assessment of risk, and the risk buffer should be clearly subtracted from the project total in the Project Design Document; evidence of contracts with or a signed commitment statement from the landowner.

**Means of Verification:** details of any new or increased risks in the Project Progress Report; any loss reports are submitted as set out above, and the magnitude of any loss is quantified during the subsequent verification survey and in the Project Progress Report.

*Source: adapted from Acorn and Gold Standard and minimum requirements for high-integrity soil carbon markets.*

## Monitoring, Reporting and Verification (MRV) proposals

Net project carbon sequestration shall be calculated based on carbon calculation spreadsheet and the predicted number of carbon units shall be divided into the contribution to the buffer and the claimable units. This approach to credit conversion will be the key risk management strategy to ensure high integrity for total units claimed.

**Requirement:** Projects should be reviewed at year 5 and then at least every 10 years after the project start date (for single projects) or the group start date (for groups).

At year 5, the 'Year 5 Monitoring Protocol' shall be followed for all projects, whether 'standard' or 'small' projects. Monitoring shall start 12 months prior to the end of the vintage/ verification due date. Single projects or groups shall submit a Project Progress Report alongside the relevant Monitoring Report.

After year 5, there are three options for monitoring and either verification or self-assessment. At the end of each vintage, projects shall complete one of the following:

- undertake full monitoring and third-party verification (any project). This leads to the conversion of Pending Issuance Units to Agroforestry Carbon Units. Single projects or groups shall submit a Project Progress Report alongside the relevant Monitoring Report for third party Verification. Upon verification, the single project or group will be marked Verified and Pending Issuance Units realised will be converted to verified Agroforestry Carbon Units.
- undertake basic monitoring and third-party verification (small projects only). This leads to the conversion of Pending Issuance Units to verified Agroforestry Carbon Units. Single projects or groups shall submit a Project Progress Report alongside the relevant Basic Monitoring Report for third party Verification. Upon verification, their single project or group will be marked Verified and Pending Issuance Units will be converted to verified Agroforestry Carbon Units. All Pending Issuance Units will be converted provided the extent and health of the project is demonstrated.
- undertake basic monitoring without third party verification (standard or small projects). In this case units will not be converted – they will remain as 'Pending Issuance Units'. Single projects or groups shall submit their project as Self-Assessed with the relevant Project Progress Report alongside the relevant Basic Monitoring Report to the ACC Secretariat. Once checked, the project will be marked Self Assessed and no units will be converted.

Basic monitoring/Self-Assessment shall only be undertaken in a limited number of circumstances, set out in guidance. If there are extenuating circumstances for a delay, the project shall seek the approval of the ACC Secretariat. If approval is granted, a Verification Extension Approval shall be uploaded to the UK Land Carbon Registry. Corrective actions shall be undertaken if establishment and/or tree growth and carbon sequestration rates do not meet predicted and validated amounts.

**Means of validation:** Monitoring plans set out in the Project Design Document. Signed commitment from the landowner or project developer to monitor and maintain verification for the project duration (See Section 2.1).

**Means of verification:** Project Progress Report shows continuing compliance with the Agroforestry Carbon Code. Monitoring Reports show progress of carbon sequestration. Other evidence as specified in the relevant monitoring protocol. Other evidence to show that corrective actions have been undertaken.

**Means of self-assessment:** Project Progress Report shows continuing compliance with the Agroforestry Carbon Code. Basic Monitoring Report containing photo evidence (aerial and from the site) confirms the extent and health of the agroforestry system.

**Guidance:** Monitoring is required to demonstrate successful woodland establishment and assess actual tree growth and carbon sequestration rates. Verification is due by the date indicated on the validation/verification Statement.

## 6. Key project conclusions

The project was focused on exploring one overarching feasibility question, namely can carbon finance help to support the implementation of new agroforestry systems in the UK? As discussed in this report, this feasibility question was explored in a number of different ways and in this section we set out our conclusions under a series of sub-questions:

1. **Is it possible to calculate and therefore provide a prediction for the carbon sequestered by in-field agroforestry systems?**

a. The methodology developed by ORC and piloted by project partners has successfully facilitated the prediction of carbon sequestration and associated emissions for the 8 pilot sites.

b. The methodology is quite labour intensive and requires data collection from beyond the eligible project area. Based on the limited number of pilots, it is difficult to conclude how receptive mainstream project developers would be to the required workload.

c. The carbon sequestration predictions are generally low, typically in the range of 0.43-1.35 tonnes of CO2e per hectare per annum (net values after taking into account emissions). These low volumes make the proposed methodology even more relatively burdensome and there may be an approach that allows some project developers to use the lowest level of CO2e per hectare as a conservative, proportional approach, without requiring site based predictive measurement.

2. **Is it possible to development high-integrity requirements for agroforestry carbon projects?**

a. The project team used the requirements within the current Woodland Carbon Code as the baseline. This meant in practice that if a requirement was equally eligible for agroforestry projects as it is for woodland projects, then no additional requirements are proposed. In summary, 80-90% of the requirements in the WCC would be unchanged, with just small changes in text required to include the word 'agroforestry' into the scope and to think about some of the specific WCC terminology that may need to be adapted e.g. WCU (woodland carbon units)

b. The key requirements where specific, new proposals have been drafted, include the Additionality tests and Permanence requirements.

c. Based on the low carbon sequestration levels for most in-field agroforestry systems, the importance of carbon finance is unlikely to be the main rationale for implementation. The project team judge this to have many positives, as it will prevent inappropriate project proposals that are chasing carbon finance alone. The reality is that agroforestry is still a very uncommon practice in the UK, with low levels of capability and confidence for successful implementation. Therefore, our proposal that all new agroforestry projects will automatically meet a Common Practice test is deemed appropriate. In the future, a financial test could be considered alongside a standard legal test to complete the additionality requirements. This financial test might just require demonstration that carbon finance provides a cashflow contribution for a project.

d. Requirements for permanent carbon reductions have been approached via a Durability requirement, recognising that carbon stored in agroforestry systems will be cycled and may be subject to rotation as part of a farming system. Two options have been set out for durability requirements. Option 1 proposes that the durability period for a carbon credit shall be a minimum of 30 years from registration of the credit. Option 2 mirrors the WCC approach and would require reestablishment of agroforestry systems that are removed as part of a farming system, with a commensurate reduction in carbon units in line with the long-term average. For both options, credits would be guaranteed by contracts between landowners and carbon unit funders/buyers and if the agroforestry is removed for production reasons, then the credit must be replaced.

3. **Will carbon finance prove beneficial and attractive to farmers and other landowners/project managers in facilitating new agroforestry projects?**

a. The financial appraisal led by Finance Earth demonstrated that based on the relatively low level of carbon sequestration for in-field agroforestry systems and consideration of the wider project costs and revenue from the system, that carbon finance might only provide 0.6-6% of the overall project funding based on current carbon credit prices.
b. As outlined elsewhere in this report, this small contribution may help with current barriers to agroforestry implementation. However, given the current low level of agroforestry implementation in the UK, there is no proposed financial test to demonstrate additionality. Instead a simple legal and automatic passing of the common practice test is proposed.
c. For those pilots that had also planted new woodland and hedgerows, the carbon numbers for an aggregated project are likely to be more significant. This is illustrated by the woodland and hedgerow carbon sequestration estimates for the pilot sites (Table 4, penultimate column). Comparison between the woodland/hedgerow and agroforestry carbon estimates needs to be treated with caution (not all components of the whole farm system could always be measured) but the former tended to be an order of magnitude greater and would contribute most significantly to an aggregated project.

d. Farmer attitude as assessed via the pilots, has helped to shape governance proposals, in particular for additionality tests and durability requirements.
e. The low level of carbon sequestration and therefore potential carbon finance for typical agroforestry projects, means that there is little financial scope to fund a standalone governance approach to agroforestry carbon projects. A standalone scheme could only be funded by a project levy, which would make the carbon finance contribution even more marginal. , as the necessary capacity would require a project levy (or similar) to fund a standalone approach.

# 7. Recommendations and Next Steps

**Proposed governance model for agroforestry carbon projects**

Based on the conclusions from the project, the project team have concluded that a standalone Agroforestry Carbon Code is neither practical nor likely to be helpful, in either facilitating agroforestry implementation or nature-based carbon projects. For a code to be viable as standalone scheme, there would need to be a funding model based on carbon sequestration and a minimum level of transactions. The conclusions regarding the modest levels of carbon sequestered by low density, in-field trees make this financial model questionable for project developers and therefore questionable for a scheme owner. In addition, at a project level, the carbon benefits do not outweigh the high-transaction costs of standalone projects.

However, the project team is optimistic that agroforestry projects, when aggregated with other farm or project level carbon projects such as woodland and hedgerows may be viable. There is also an exciting opportunity to aggregate projects based on different ownerships, at a group or landscape level. These conclusions point towards an aggregation of schemes to facilitate more integrated uptake.

Therefore the following next steps are identified to take forward the work developed by this project:

1. Recommend to the Woodland Carbon Code (WCC) Executive Board that the management team for the WCC picks up the work from the Agroforestry Carbon Code project, with the intention of widening the scope of the WCC to include trees in agroforestry projects and to facilitate aggregated projects with a mix of methodologies i.e. new woodland and new in-field agroforestry, as part of the same scheme/registration.

2. Make this report, including the methodology and proposed high-integrity requirements for agroforestry projects available as an open-source resource for wider application by other ‘carbon aggregator codes’ and other aggregated carbon approaches that are emerging in the nature-based voluntary carbon market.

3. Subject to adequate resourcing, the project team will continue to contribute to discussion and development projects aimed at facilitating more aggregated nature-based voluntary carbon projects for the UK’s farmed landscapes. i.e. aggregated projects for farm woodlands, agroforestry, hedgerows etc. at a farm-level and aggregation of small and medium sized farms to help achieve more viable projects.

## Annexes

Annex 1 – Data collection protocol and data entry forms (click on icon for PDF file)

Pilot site data
collection protocol.|

Annex 2 – Model fits, model quality, calculation summary and additional notes for carbon calculations undertaken on each pilot site (click on icon for PDF file).

Carbon calcs
21062023final.pdf

Annex 3 – Prototype Agroforestry Carbon Calculator (click on icon for Excel file).

Agroforestry
Carbon Calculator v

## Annex 4 – Pilot Carbon Attitudes Questionnaire

| | | | |
|---|---|---|---|
| 1 | What was the previous land use for the last 5/10/25 years? WCC require proof the land has not been wooded in the last 25 years, suggestion is agroforestry has not been removed in last 5/10 years | 8 | If you sold credits (or used them for your business), how long would you be happy to guarantee that the carbon will remain in the system? E.g. 20, 40, 60, 80, 100 years. |
| 2 | What funding did you receive, if any, to implement the agroforestry scheme? | 9 | Would the landowner be prepared to sign a contract or covenant for these lengths of time? Or take out insurance to compensate against any reversal of carbon storage during a set period? |
| 3 | How common is agroforestry adoption amongst farmers in this area? | 10 | Discuss any long-term objectives listed in your management plan? |
| 4 | What barriers have you encountered to establishing agroforestry *e.g., lack of funding, local attitudes, other grants more generous, lack of knowledge/ information etc* | 11 | Have you undertaken any stakeholder consultation – who/how did you consult? |
| 5 | Will there be any intensification happening elsewhere on the farm as a result of the agroforestry proposals? | 12 | Would you be willing to self-monitor the growth of the trees e.g. Measuring DBH of a representative population, and how frequently would you be happy to report? *E.g. every 1/2/5 years?* |
| 6 | What is the tenure of the land? If tenanted what are the terms? (Evidence of ownership – straightforward but relevant to permanence i.e. can the land manager commit to the long-term?) | 13 | Would you be willing to pay fees for up front & ongoing periodic verification? How often would you be willing to pay for third party verification? |
| 7 | What is the expected productive timeframe of the system? *Might this outlive the potential length of the agreement?* | 14 | If you are planning to sell credits in the future, how much would you want to know about the buyer of your units? Outline the sort of stipulations you would like a buyer of your units to have e.g. sustainability reputation etc. |