# System report: Poultry Agroforestry in the UK

| Project name | AGFORWARD (613520) |
|---|---|
| Work-package | 5: Agroforestry for Livestock Farmers |
| Specific group | Poultry Agroforestry Systems in the UK |
| Deliverable | Contribution to Deliverable 5.13 (5.1): Detailed system description of a case study system<br>Contribution to Milestone 28 (6.3): Database for description of agroforestry systems |
| Date of report | 18 Feb 2016 |
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| Approved | 25th March 2016 John E Hermansen |

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# 1 Context

The AGFORWARD research project (January 2014-December 2017), funded by the European Commission, is promoting agroforestry practices in Europe that will advance sustainable rural development. The project has four objectives:

1. to understand the context and extent of agroforestry in Europe,
2. to identify, develop and field-test innovations (through participatory research) to improve the benefits and viability of agroforestry systems in Europe,
3. to evaluate innovative agroforestry designs and practices at a field-, farm- and landscape scale, and
4. to promote the wider adoption of appropriate agroforestry systems in Europe through policy development and dissemination.

This report contributes to Objective 2, Deliverable 5.13: "Detailed system description of case study agroforestry systems". The detailed system description includes the key inputs, flows, and outputs of the key ecosystem services of the studied system. It covers the agroecology of the site (climate, soil), the components (tree species, crop system, livestock, management system) and key ecosystem services (provisioning, regulating and cultural) and the associated economic values. The data included in this report will also inform the modelling activities which help to address Objective 3.

# 2 Background

Integration of trees with crops and/or livestock production (agroforestry) has been identified as a sustainable way to increase the productivity of land and to provide a number of ecosystem services and environmental benefits compared to disaggregated agricultural and woodland systems (Smith et al. 2013). Organic and free-range poultry have, besides having access to a hen house, access to an outdoor run. In this respect, it is well known that poultry are more inclined to use the range when it is enriched with trees, and that in turn feather picking is reduced when more hens use the range (Bestman and Wagenaar 2003). Thus the establishment of trees in the outdoor run is considered to improve hen welfare.

One of the main issues with existing poultry agroforestry systems identified by producers of the Sainsbury's Woodland Chicken Development Group is the lack of vegetation under the trees due to a closed canopy reducing light levels; and where trees have been pollarded to open up the canopy, weeds have established rather than grasses (Smith, 2014a, 2014b). The development of a shade-tolerant sward mixture that could establish and survive under the trees plus offer potential nutritional (and perhaps medicinal) benefits for the chickens has been identified as a priority by the producers.

The objective is to develop a shade-tolerant understorey sward that that could contribute towards the nutrition/health of the birds by comparing the establishment and performance of three sward mixes and a natural regeneration 'control'.

## 3   Description of system

Table 1 provides a general description of silvoarable agroforestry systems. A description of a specific case study system is provided in Table 2. Missing data will continue to be sourced during 2016.

Table 1. General description of the silvoarable system

| General description of system | |
|---|---|
| Name of group | Poultry systems in the UK – Woodland chicken development group |
| Contact | Jo Smith |
| Work-package | 5: Agroforestry for livestock farmers |
| Associated WP | |
| Geographical extent | UK |
| Estimated area | 180 farms in the Sainsbury's Woodland Egg development group |
| Typical soil types | Varied |
| Description | Woodland chicken and egg systems. Sainsbury's first developed its Woodland brand for its free range and SO organic eggs in 2004, with 1 pence per dozen eggs sold donated to the Woodland Trust. This followed farmer John Widdowson's observations on how his hens preferred the shade and protection of trees. Sainsburys expanded the scheme to include meat birds in 2009, with 2 pence from every chicken sold donated to the Woodland Trust. All the free Woodland range and organic farms must be:<br>• planted with trees which cover at least 20% of the range area where the birds are free to roam outdoors<br>• planted with a mixture of fast growing and slower native trees which are indigenous to the local area<br>• have trees planted close to the house to encourage the hens outside to range<br>• RSPCA Freedom Food standard approved |
| Tree species | Traditionally native broadleaf and conifers but recently including fruit trees |
| Tree products | Trees planted primarily to benefit the poultry rather than provide a product but in some systems the trees produce woodchip for bioenergy and/or mulch/compost, and in some, fruit trees have been planted |
| Crop species | Grass species such as perennial ryegrass (*Lolium perenne*) |
| Crop products | |
| Animal species | Poultry, primarily chickens but also turkeys, ducks, geese |
| Animal products | Meat, eggs |
| Other provisioning services | |
| Regulating services | The trees can provide shade for livestock in summer, and shelter from wind in the winter. The poultry can promote nutrient cycling and pest/weed control. Above-ground, the trees will increase carbon storage. The tree rows support functional biodiversity that regulate pollination, pest control and decomposition services. Nitrogen-fixing trees such as alder (*Alnus glutinosa*) can increase soil fertility. |
| Habitat services and biodiversity | Tree species such as willow can provide additional resources for invertebrates such as bumblebees early in the season. The tree row represents a stable |

| | habitat so can provide shelter and resources for animals, as well as acting as corridors linking up other semi-natural habitat patches. These species may be beneficial, neutral or detrimental to provisioning services. |
|---|---|
| Cultural services | Introducing trees into a livestock system may increase job opportunities and skills with regards tree management. The landscape also changes from an open pastoral landscape to a partly wooded environment depending on design of the system. This landscape change can be both an improvement and degradation depending on the context and individual preferences. |
| Key references | |

Table 2. Description of the specific case study system

| Specific description of site | |
|---|---|
| Area | 2.4 ha |
| Co-ordinates | 51.78392°N, 1.321340°W |
| Site contact | Jo Smith or Sally Westaway |
| Site contact email | jo.s@organicresearchcentre.com sally.w@organicresearchcentre.com |
| Example photograph |   Figure 1. Silvopoultry at FAI, summer 2015    Figure 2. Laying hens in the coniferous tree plots, FAI, February 2016 |

Figure 3. Laying hens in the deciduous tree plots, FAI, February 2016
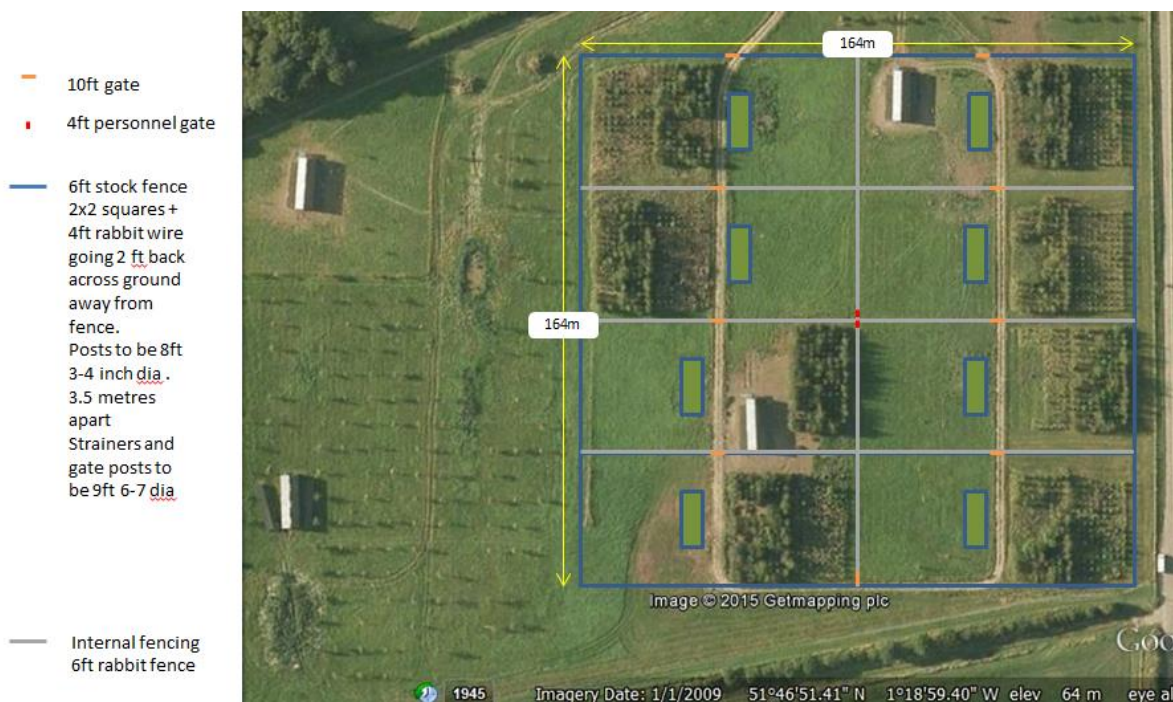
Map of system



Figure 4. Silvopoultry pen design, FAI. February 2016

| Possible modelling scenarios | |
|---|---|
| Comparison | Coniferous vs deciduous trees in silvopoultry systems<br><br>Different understorey seed mixtures vs control (natural regeneration) following tree thinning |
| Climate characteristics | |
| Mean monthly temperature | 10.7°C |
| Mean annual precipitation | 672 mm |
| Details of weather | Met Office weather station at Oxford, accessed from the Met Office website |

| station (and data) | on 25 March 2015 ([www.metoffice.gov.uk/public/weather/climate-historic](http://www.metoffice.gov.uk/public/weather/climate-historic)). |
|---|---|
| **Soil type** | |
| Soil type | |
| Soil depth | |
| Soil texture | Clay loam |
| Additional soil characteristics | |

| | P (mg/l) | K (mg/l) | Mg (mg/l) | pH | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|---|---|
| Plot 1 Deciduous | 153.2 | 719 | 144 | 7.4 | 46 | 30 | 24 |
| Plot 1 Coniferous | 183.0 | 705 | 155 | 7.3 | 43 | 32 | 25 |
| Plot 5 Deciduous | 78.4 | 566 | 149 | 7.7 | 45 | 31 | 24 |
| Plot 5 Coniferous | 70.6 | 409 | 149 | 7.2 | 44 | 31 | 25 |

Soil analyses of composite sample collected in each sub-plot and analysed by NRM in Nov 2015

| Aspect | Flat land |
|---|---|
| **Tree characteristics** | |
| Species and variety | **Deciduous plots**<br>Ash (*Fraxinus excelsior*), silver birch (*Betula pendula*), wild cherry (*Prunus avium*) and pedunculate oak (*Quercus robur*)<br><br>**Coniferous plots**<br>Corsican pine (*Pinus nigra* var. maritima), Douglas fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*).<br><br>Tree plots were originally 32 m x 18 m, each containing 144 trees each at a spacing of 2 m x 2 m (i.e. 9 trees by 16 trees). Plots will be thinned to 50% in February 2016. In the coniferous plots every other row will be felled; in the deciduous plots, selective thinning of poorly performing trees will be carried out. |
| Date of planting | October 2002 |
| Intra-row spacing | 2 m |
| Inter-row spacing | 2 m |
| Tree protection | 75 cm tree shelters |
| Typical tree yield | Not known |
| Typical increase in tree biomass | Not known |
| **Crop/understorey characteristics** | |
| Species | Trial of 4 understorey treatments (see Table 3) |
| Management | Occasionally grazed by sheep. |
| Typical grass yield | Not known |
| **Fertiliser, pesticide, machinery and labour management** | |
| Fertiliser | None |
| Pesticides | None |
| Machinery | |

| | |
|---|---|
| Manure handling | Poultry manure stored in temporary heaps on the farm, then mixed with other farmyard manure and spread pre-ploughing on arable areas. |
| Labour | 1 stockman for 2 houses of 840 birds, plus 1 part-time. |
| Fencing | 1.8 m stock fence with 1.2 m rabbit wire going 0.6 m back across ground away from fence. |

| Livestock management | |
|---|---|
| Species and breed | Laying hens: Currently leghorns, Hyline silvers and Lohmann Browns. Next round will be Hyline browns, Lohmann Browns and Brown Nicks. |
| Description of livestock system | A new house is populated with birds every 16 weeks. Birds start laying at 20-24 weeks old until 70-76 weeks (~52 weeks lay). After the birds have been removed, the land will be rested for 9 months. Pullets are bought in at 12-14 weeks of age. |
| Date of entry to site | Week 1 |
| Date of departure from site | Week 52 |
| Stocking density | 6.7 m$^2$ per bird or 1493 birds/ha Pens are 82 m x 41 m with mobile houses. |
| Animal health and welfare issues | None |
| Requirement for supplementary feed | Concentrate consumption |

| Technical data, livestock | |
|---|---|
| Production volume | 280 eggs/bird/year |
| Herd performance | 1.8% mortality |
| Feed consumption | 50 kg/bird/year. 95% organic layer mash, available ad-lib. |
| N-balance | |

## 4   Development of diverse sward mixtures for understorey trials

The selection of species for the seed mixes started with a review of literature on the various relevant properties of appropriate species (e.g. shade tolerance, nutritional and medicinal value for poultry, biodiversity value), and in consultation with seed companies. The seed mixes are being provided by Cotswold seeds and include a standard chicken sward mix, and two customised mixes one with shade tolerant grasses and one more diverse with additional herb and legume species (Table 3). Each broadleaf plot will be split into four sections and the three seed mixes sown in a one quarter each, one quarter will be left as a control.  Seed rates are 52 kg/ha.

Table 3. Composition of the three trial seed mixtures (kg/ha)

| | "Basic Chicken Scratcher Sward" | "Chicken Scratcher Sward Grass Only Shade tolerant" | "Diverse Chicken Scratcher Sward" |
|---|---|---|---|
| Balin certified **smooth stalked meadow grass** | 3.50 kg | 1.00 kg | 1.00 kg |
| Certified GONDOLIN ORGANIC **creeping red fescue** | 2.80 kg | 2.40 kg | 2.40 kg |
| Certified Lambada **creeping red fescue** | 5.00 kg | 7.00 kg | 4.55 kg |
| Certified FOXTROT ORGANIC **perennial ryegrass** | 33.60 kg | 28.00 kg | 28.00 kg |
| Certified Erecta **timothy** | | 1.00 kg | 1.00 kg |
| Certified Enhary **wood meadow grass** | | 0.50 kg | 0.10 kg |
| Certified Solo **rough stalked meadow grass** | | 2.00 kg | 1.00 kg |
| Certified NIVA ORGANIC **cocksfoot** | | 6.00 kg | 6.00 kg |
| Certified Fancy dwarf **perennial ryegrass** | 4.10 kg | 3.00 k | 3.00 kg |
| Certified **Highland common bentgrass** | | 0.50 kg | 0.50 kg |
| Certified **Penncross creeping bent** | | 0.60 kg | |
| Certified Contea **crimson clover** | | | 0.50 kg |
| Certified Neptune **lucerne** | | | 0.50 kg |
| **Ribgrass** forage herb | | | 0.20 kg |
| Certified Puna II **chicory** | | | 0.25 kg |
| **Yarrow** forage herb | | | 0.20 kg |
| Certified Julia **Phacelia** | | | 0.30 kg |
| Certified Jose **common vetch** | | | 2.00 kg |
| Certified Merviot **red clover** | 1.25 kg | | 0.25 kg |
| Certified Barblanca **white clover** | 1.25 kg | | 0.25 kg |
| Certified Rocco **birdsfoot trefoil** | 0.50 kg | | |

## 5    Plans for 2016

*Tree thinning*

Four broadleaf plots and three conifer plots have been thinned to approximately 50% of their original planted density (Figures 5, 6 and 7). The conifer plots have been line thinned with every other line removed and the broadleaf plots selectively thinned to remove the weaker trees. All brash material has been chipped and cord wood stacked off the ground in 1 m lengths within the chicken enclosures to be collected at a later date. Thinning work took place during the last two weeks of February. The Forestry Commission have granted a felling licence to thin all the tree plots. The licence is valid until 5 January 2021.



Figure 5. Tree plots thinned in February 2016



Figure 6.  Tree thinning in February 2016

Figure 7.  Removal of the three thinnings in February 2016

*Sward re-seeding*

The broadleaf tree plots will be seeded in early spring 2016; prior to seeding the ground will need some preparation to loosen up the soil. This will take place in April. The seed mixes are being provided by Cotswold seeds and include a standard chicken sward mix, and two customised mixes one with shade tolerant grasses and one more diverse with additional herb and legume species (Table 3). Each broadleaf plot will be split into four sections and the three seed mixes sown in a one quarter each, one quarter will be left for natural regeneration as a control.

The seed mixes will be broadcast by hand in mid-April (or when the ground warms up) and then rolled in. Where there are still chickens in the enclosures temporary fencing will be erected prior to the seed being sown. Growth and establishment of the mixes will be monitored over spring and summer 2016 (Table 4).

Table 4. Timeline for field operations in 2016

| What | When |
| --- | --- |
| Tree thinning | 15 – 27 February |
| Ground preparation | Mid-April |
| Sward reseeding | April or when ground warm enough |
| Sward monitoring | Monthly intervals from April through summer |

## 6    Acknowledgements

## 7   References

Bestman MWP, Wagenaar JP (2003). Farm level factors associated with feather pecking in organic laying hens. Livestock Production Science 80: 133–140.

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