Lessons learnt: Poultry agroforestry in the UK

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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. It contains results of the studied innovations from one of the livestock agroforestry systems being studied within work-package 5. Together with other reports, this document will contribute to Deliverable 5.14 on lessons learnt from agroforestry for livestock farmers. Similar reports exist for agroforestry of high nature and cultural value, agroforestry with high value trees, and agroforestry for arable systems.

2 Background

The initial stakeholder reports (Smith 2014a and 2014b), the research and development protocol (Smith, 2015), and the system description report (Smith et al, 2016) provide background data on poultry agroforestry systems in the UK.

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 at the ground; 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 of the research was to develop a shade-tolerant understorey sward 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'. A manuscript on the full results has been published and will be included in a special issue of Agroforestry Systems. This report is in the form of an extended abstract which summarises the key results.

3 Performance of three sward mixtures in a silvopoultry system - main findings

The learnings described in the following are an extended abstract from the paper:
Westaway S, Kling C, Smith JA (2017). A comparison of the performance of three sward mixtures sown under trees in a silvopoultry system in the UK. Agroforestry Systems. https://doi.org/10.1007/s10457-017-0142-1

3.1 Introduction

Establishment of trees in the range as part of a silvopoultry system is considered to improve poultry welfare and reduce stress for the animals by enabling poultry to follow their natural behaviour (Figure 1).

Figure 1. Silvopoultry system (FAI, summer 2015)

Silvopoultry systems are an example of a multifunctional land use allowing eggs or meat to be produced along with tree products from the same area of land, as well as associated wider environmental benefits from the trees including the regulation of soil, water and air quality, supporting biodiversity and increasing carbon sequestration. However, one management challenge identified by farmers who have integrated trees into the chicken range is the inability to maintain a viable sward under trees. This paper outlines the results of a trial on an organic poultry unit in southern England. The trial aimed to identify which mixture performed best under trees. The data was analysed according to the following hypotheses:

1. Mixtures containing a higher percentage of grasses and shade tolerant species will show higher rates of establishment under shade conditions,
2. More diverse mixtures will show higher sward productivity in terms of overall biomass due to complementarity of resource use, and
3. The sward will put on more growth and show better persistence where the number of chickens using the area is lower.

3.2 Methods

The experiment was carried out in a silvopoultry system on a commercial organic research farm, managed by FAI, in Oxfordshire, England (51.78392°N, 1.321340°W), from April 2016 to October 2016. Three sward mixtures were sown in replicated 15 year old mixed broadleaf plots and compared with a natural regeneration control (Figures 2 and 3).

Figure 2. Ground preparation prior to seeding, April 2016

Figure 3. Control plot (left) and trial seed mixture (right)

Mix 1 was a commercially available standard sward mixture for chicken enclosures, Mix 2 was a customised grass-only sward mixture with shade tolerant species and Mix 3 was a diverse sward mixture including grasses, legumes and forage herbs (Figure 4). Chickens were excluded for the first three months to allow sward establishment and then introduced for a six week period at two densities and compared with control plots without chickens (Figure 5). Growth and establishment of

the sward mixes along with the presence and abundance of unsown plants and unpalatable weeds was assessed weekly over the six week establishment period, then repeated in August before the chickens were introduced, and again six weeks after introduction. Productivity of the mixtures was quantified as above ground biomass, cut as close to the ground as possible in three quadrats (50 cm x 50 cm) per treatment plot in June six weeks after seeding, and repeated in September in the high and low chicken pressure blocks six weeks after the chickens were introduced.

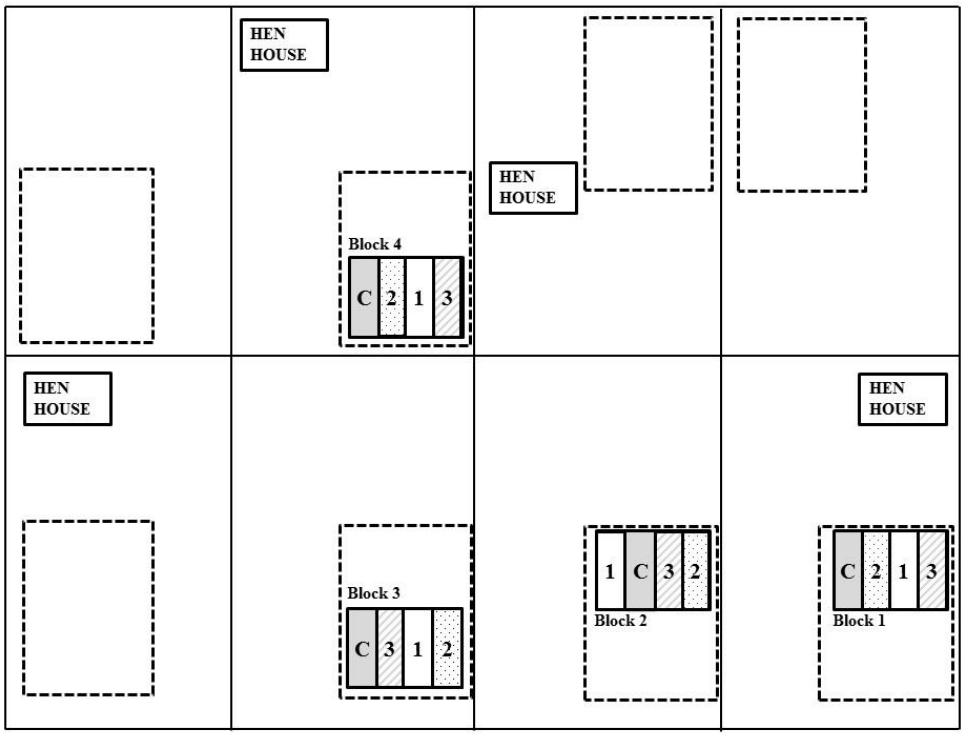

Figure 4. Trial design, showing four replicated trial blocks with the different mixtures; standard sward (1), grass only sward (2), diverse sward (3) and control (C). The boxes with the dashed lines show the positions of the tree blocks.

Figure 5. Trial seed mixture without (left) and with (right) chickens

3.3 Results

All three mixtures established well under trees and didn't show significant differences in the percentage cover of sown plants after six weeks (Figure 6a). After Week 3 sward establishment rates increased in all mixtures, and six weeks after sowing showed an average percentage cover of sown plants between 37% and 42%. This increased to between 65% and 83% after 19 weeks. Sowing any of the sward mixtures reduced the abundance of unpalatable weeds compared to the control which had the highest cover of unsown plants (Figure 6b), dominated by the unpalatable weed *Urtica dioica*, from the first week and consistently throughout the trial. The commercially available standard sward mixture performed comparably to the other mixes, and showed significantly higher biomass production by week six (Figure 7). Following the introduction of chickens, the sward mixtures survived only in the block with lower chicken pressure, measured by distance from house (Figure 8).

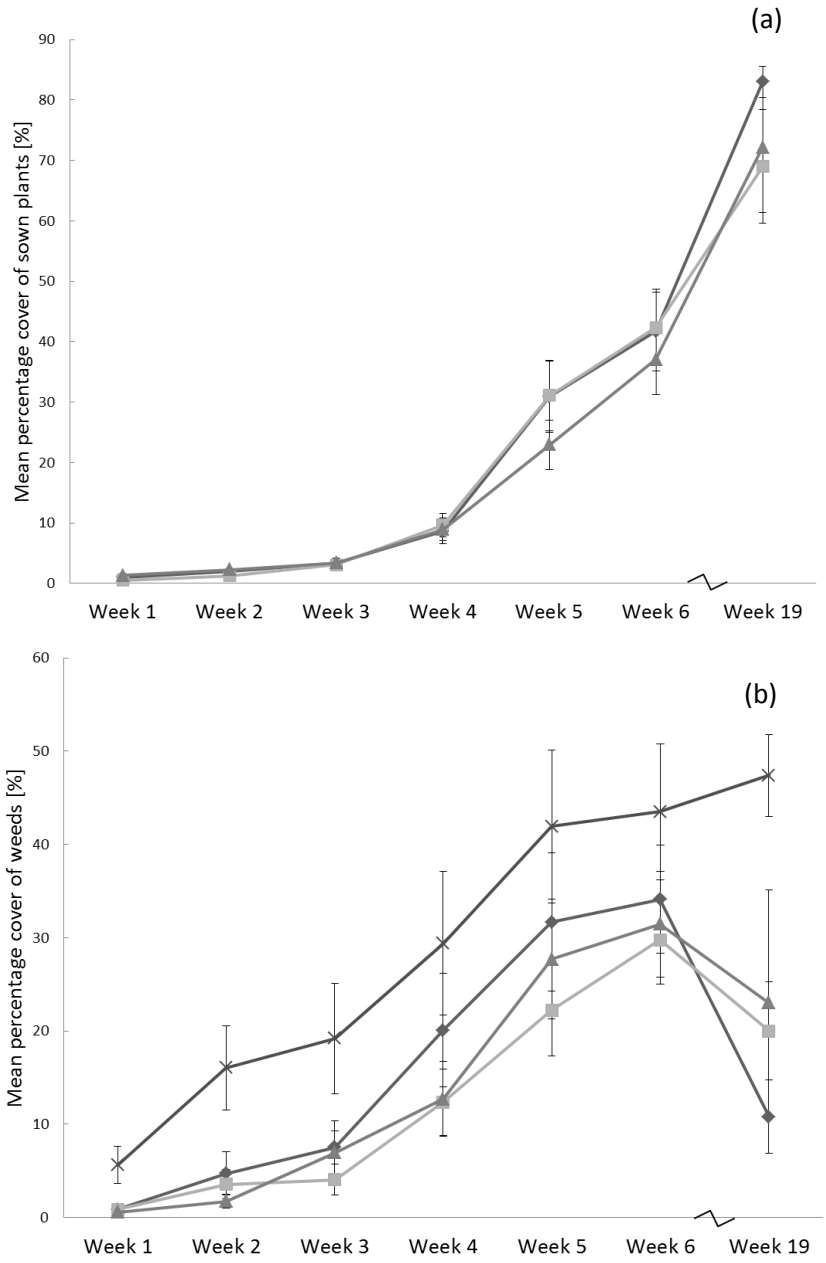

Figure 6. Mean percentage cover (+/- S.E.) of (a) sown plants and (b) unsown plants over the initial six week establishment period and then at Week 19 (n = 4). Mixture 1: standard sward (diamonds), Mixture 2: grass only sward (squares), Mixture 3: diverse sward

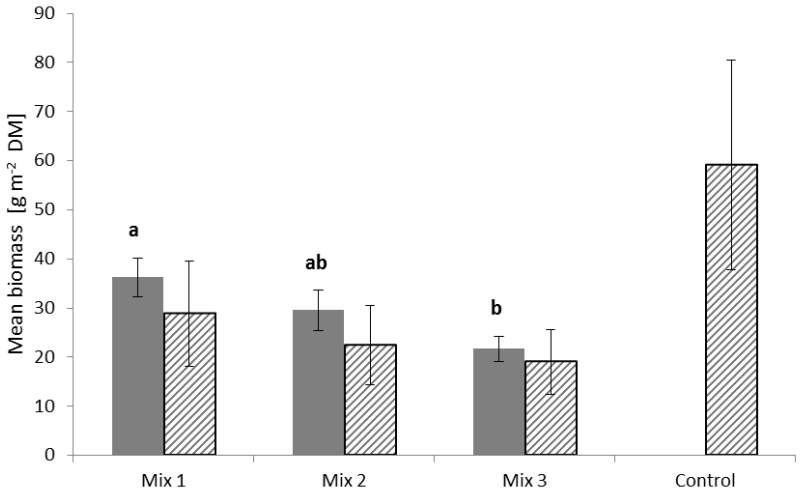

Figure 7. Mean biomass (g m^{-2} DM) of sown plants (solid bars) and unsown plants (diagonal shading) per mixture in Week 6 after the initial establishment period (n = 4). Error bars indicate standard error. Different letters indicate significant differences.

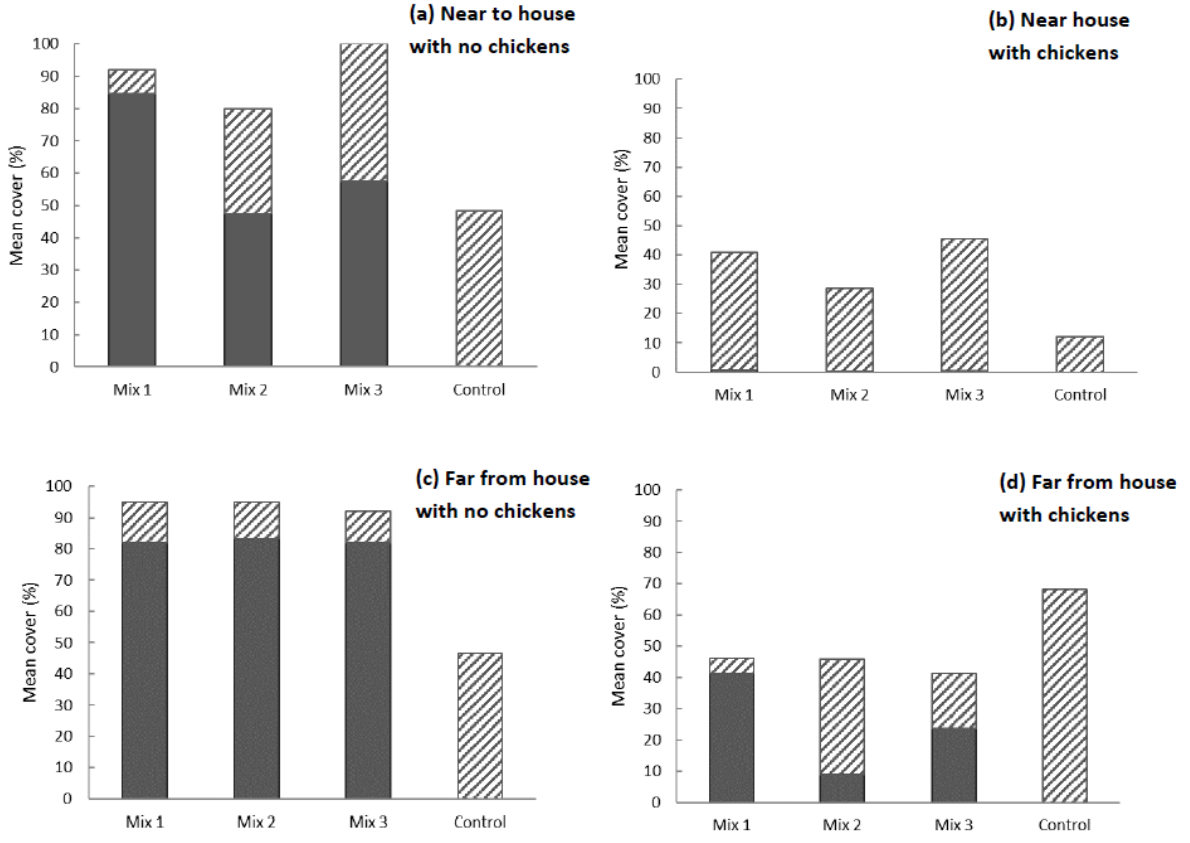

Figure 8. Mean percentage cover of non-sown (diagonal shading) and sown plants (solid shading) in each of the three seed mixture treatments and the control in September 2016, 6 weeks after the chickens were reintroduced in blocks close to the house with (a) chickens excluded or (b) with chickens, and in blocks far from the house with (c) chickens excluded or (d) with chickens.

4 Main lessons

Despite the benefits to animal welfare, silvopoultry systems are not yet widespread and the interactions between chickens, trees and the sward are not yet fully understood. Findings from this trial demonstrate that:

- Establishing a sward under the trees is possible but the challenge is to maintain the sward in the presence of chickens. Optimising chicken pressure appears to be the key to maintaining a sward.
- Once the trees are thinned, commercially available seed mixtures can be sown to provide ground cover. This has economic implications for poultry keepers as the more specialised mixtures are likely to have higher seed prices as the seed is more expensive to source.
- Sward establishment rates increased one month after sowing for all mixtures, indicating higher weed suppression potential after four weeks and minimum growth time required for establishment.
- In order to develop systems that are beneficial for both farmers and chickens further research is needed into how to distribute the flock more evenly spreading the pressure across the range.

5 Acknowledgements

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