PhD Project Advertisement

Project title: Increasing the value of silvoarable agroforestry using understory crops in the tree rows

Project No: FBS2024-023-Potts-rc

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Project description:

Silvoarable agroforestry is an innovative method that is gaining recognition for its potential to address the biodiversity and climate crises. Agroforestry refers to farming systems where trees are integrated into livestock or arable systems, and silvoarable agroforestry involves integrating tree rows (commonly fruit, nut, or timber trees) through arable fields, often undersown with flower strips. Compared to arable farming, the tree rows increase structural complexity and plant diversity, which can promote invertebrates, pest control, pollination, carbon sequestration, soil health, and food production. For example, a UK study found 10 and 4.5 times greater bee diversity and fruit set in silvoarable vs arable sites. Silvoarable systems may also be more resilient to climate-induced extreme weather as they buffer the microclimate from high temperatures via shade and the greater soil health and biodiversity promotes ecological redundancy. Therefore, this farming system is hugely promising.

Recognising its potential, the UK government made a statutory (legally binding) commitment to increase silvoarable area from 0.1% to 10% arable land by 2050 (an increase that is 55% the size of Wales). The Department of Environment, Farming, and Rural Affairs (DEFRA) will release new agricultural schemes in 2024 to pay farmers to adopt silvoarable farming, and private sector (e.g. construction companies) are also paying farmers to adopt silvoarable farming to offset biodiversity losses. These UK schemes align with growing interest globally. Therefore, silvoarable research can contribute directly into emerging policy and carbon/biodiversity markets.

Significant knowledge gaps remain for silvoarable systems, and management of the tree row understory (e.g. species, width) was identified as a key priority at a UK stakeholder workshop in 2018. Tree rows can use 25% of the field area depending on planting arrangement, with understories mostly under natural regeneration or flower planting, the latter of which can promote pest control and pollination. We argue that further benefits to biodiversity, ecosystem services, food production, and profits could be achieved by planting the row understory with carefully selected crops, such as herbs, mushrooms, or perennial vegetables or fruits (e.g. berries). We have found one study that tested this on one UK farm with cut flowers and rhubarb, and it showed that crops could help to offset the cost of purchasing trees, which is a primary barrier to silvoarable uptake. However, many knowledge gaps remain.

Silvoarable tree row understory could increase by 285,000 ha in England by 2050 according to tree planting targets. Maximising its potential value is therefore an urgent priority.

Hypothesis

Carefully selected tree-row understory crops will benefit the environment and production.

Objectives

1. Create a longlist of potential understory crops and their likely (dis)benefits to biodiversity, ecosystem functioning, production, profits, and farm management (e.g. labour) in different silvoarable contexts (e.g. soil types) by conducting a systematic review on temperate understory crops and interviews with industry (e.g. farmers and seed companies) and experts to identify additional crops. Record shade tolerance to identify crops suitable for young or mature systems.

2. Experimentally test the ecological and management impact of eight understory crops using a replicated field trial over the University of Reading's experimental network of silvoarable farms. Select crops from the longlist with farmer, partner, and researcher input and test them in young and mature silvoarable systems over two years. Measure biodiversity (e.g. pollinators), ecosystem functions (e.g. pest damage), yield (understory and adjacent crops), profits, and management impacts (e.g. equipment), with specific measures determined after crop selection.
3. Disseminate findings to the scientific community via publications and academic conferences, the farming industry and policy makers via a report and farmer conferences, and the public via social and wider media.

Outcomes

By determining the potential to use tree row understory for food cropping this study will promote food security by diversifying food production and increasing it by using land that would otherwise not be used for production. Silvoarable agroforestry provide many environmental and production benefits, and this study will promote its uptake by identifying additional sources of income for farmers during establishment, which is a primary barrier to uptake in the UK. By working with the partners of the Agroforestry Research Group at the University of Reading, including policy makers, NGOs, and farmers, the results will be disseminated widely for greatest impact.

Training opportunities:
You will be trained in ecology, agronomy, social science, experimental design, statistics, and paper writing. The University of Reading (UoR) will conduct a Learning Needs Analysis to identify relevant courses for you at Reading, and you will receive external training (e.g. statistics courses) if necessary. You will be invited to attend and present at several relevant seminar series in the School of Agriculture, Policy, and Development and the School of Biological Sciences at UoR, and will develop your networks and communication skills through this. You will also attend annual academic and farmer conferences with UoR supervisors and colleagues.

You will also have access to several large multi-partner projects (UKRI, H2020) via the supervisory team and will be invited to participate in workshops and networking events through this. Opportunities to sit on equality, diversity, and inclusion (EDI) committees and EDI training will be provided by UoR, such as specialist training in research communication with neurodiverse audiences.

Cranfield University will provide specific training on agroforestry and soil ecology, and access to strong links with other agroforestry networks across Europe.

Student profile:
You will have, or be nearing completion of, a relevant BSc in ecology, agriculture, environmental science, or social science. You will have an understanding of food production and ecology. You will have experience doing fieldwork. Some knowledge of UK agriculture is desirable.

Stipend (Salary):
FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2023/24 this is £18,622 and it will increase slightly each year at rate set by UKRI.

Equality Diversity and Inclusion:
The FoodBioSystems DTP is committed to equality, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the [FoodBioSystems DTP website](#).

In accordance with UKRI guidelines, our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

References:
[1] Kletty, F., et al. (2023) Agric Ecosyst Environ. 351. https://doi.org/10.1016/j.agee.2023.108480
[2] Smith, J., et al. (2017) AGROFORWARD REPORT. https://zenodo.org/record/2625719
[3] Staton, T, et al. (2021) Agronomy 11. https://doi.org/10.3390/agronomy11040651

For up to date information on funding eligibility, studentship rates and part time registration, please visit the [FoodBioSystems website](#).