Woodland Trust Research Briefing

Examining the impacts of integrating trees into arable fields on pest control and pollination.

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Summary:

- **Silvoarable agroforestry – planting trees in arable fields – can improve agricultural productivity and sustainability.**
- **This PhD research project investigates how insects and other wildlife in agroforestry affect pest control and pollination which are important for agricultural sustainability.**
- **Previous evidence suggests that agroforestry generally benefits pollinators and the predators of pests.**
- **Most pests are suppressed in agroforestry, but some challenges are apparent.**
- **The research will also focus on the costs and benefits of wildlife in agroforestry and how best to manage them.**

A young silvoarable agroforestry system, where apple trees are intercropped with cereals. The alley widths are 24m wide to facilitate access by standard machinery. Photo: Stephen Briggs.

Introduction

Silvoarable – an example of agroforestry – is a farming system where trees are planted in rows within arable fields. The trees are grown to produce fruit, nuts or timber and deliver a range of environmental benefits, including: soil and water retention, capture of atmospheric carbon and improvement in biodiversity[1]. Agroforestry can be more productive than growing an arable crop alone[1].

Biodiversity has declined dramatically over the past few decades, and conventional agriculture has become reliant on pesticides to control pests, and managed honey bees to provide pollination. However, there are concerns about the sustainability of these tactics (Box 1). Encouraging beneficial wildlife on farms, such as the natural predators of pests, and wild pollinators, could be a more sustainable solution.

This research project investigates whether the biodiversity of agroforestry systems could benefit farmers by boosting beneficial insects, such as pollinators and the predators of pests, and how this might improve crop productivity, resilience and profitability.

Examples of beneficial wildlife: a pollinating hoverfly (top) and an aphid-eating ladybird (bottom).

Box 1.

Threats to the success of conventional tactics for pest control and pollination include:

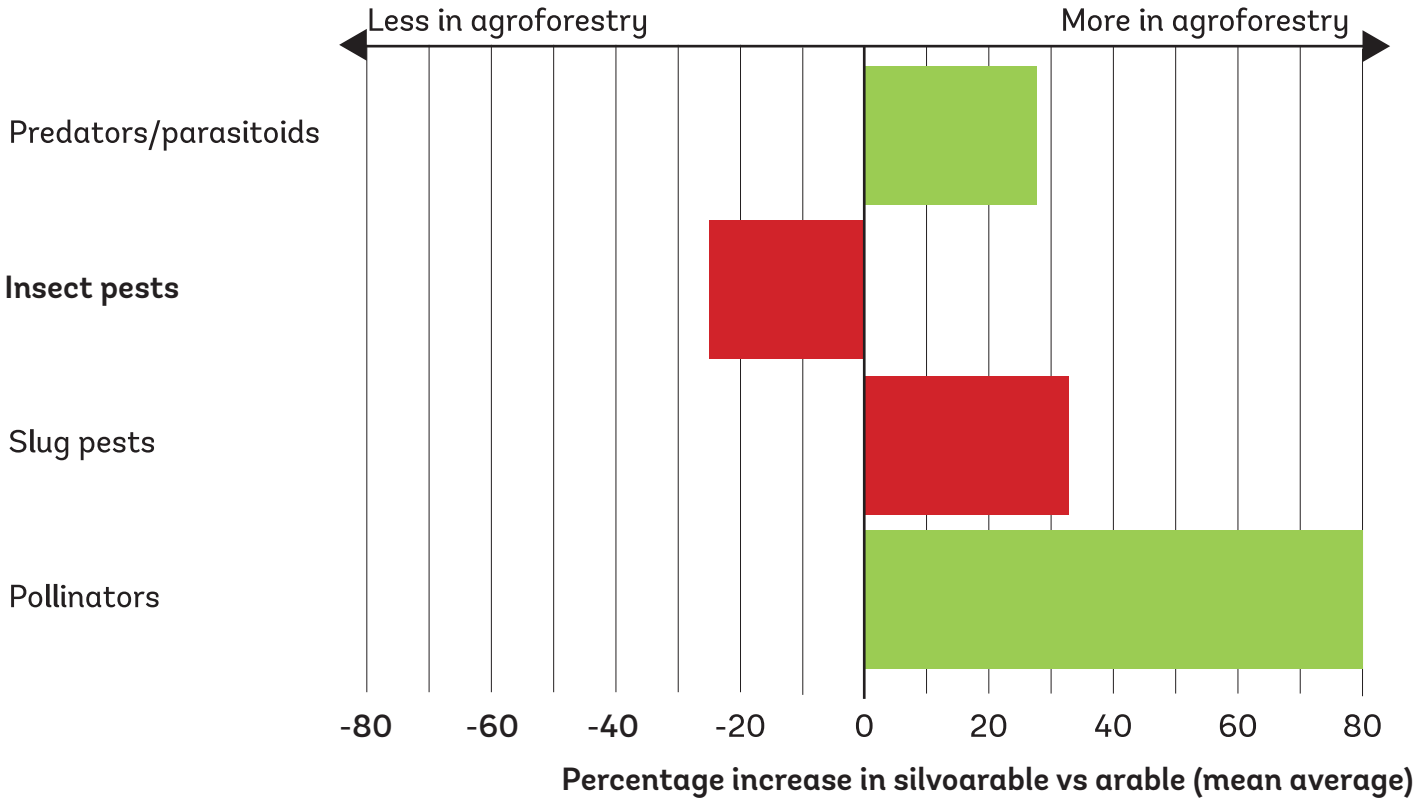
- pesticide resistance
- tighter regulations on pesticide use
- consumer awareness regarding potential environmental and health risks from pesticides
- honey-bee-colony collapses or growth deficits.

Current evidence

Although there are a limited number of previous studies, a review of the scientific literature conducted as part of this PhD has found that beneficial insects are generally more abundant in agroforestry compared to arable fields without trees. For example, an experimental silvoarable system at the University of Leeds, which is perhaps the best-studied system, found a higher abundance of predatory spiders, flying-insect predators and parasitic wasps in silvoarable compared to arable plots[2,3]. They also found lower cereal-aphid pest densities in the silvoarable plots[4]. A detailed study of pollinators across six agroforestry sites (two of which were silvoarable) was recently undertaken during a PhD at the University of Reading. Solitary bees, bumblebees and hoverflies were more abundant in agroforestry compared to arable fields, and potted California poppy plants produced more seeds in agroforestry, suggesting higher levels of pollination[5,6].

Agroforestry is not without its challenges and research suggests that a key issue could be higher damage from slug pests, although only two studies are available. One of these found that slugs were more abundant in silvoarable than arable at two sites, but more abundant in arable at a third site[7]. Weeds could also present a challenge, but again they have been scarcely studied and results are conflicting.

Variation in effects between different sites and studies is a common theme. In another example, a study bucked the trend by finding fewer beneficial predators in silvoarable compared to arable[7]. Factors affecting the variation in findings have not been examined, but could be influenced by differences in sampling methods and between farms, such as in soil type; agroforestry design and management; system maturity; and landscape context.



Agroforestry benefits helpful insects (in green), while suppressing potentially problematic insects (in red), but slug pests are more frequent. Data summarised from the available literature.

Evidence gaps and needs

- **Evaluating the pros and cons of wildlife in agroforestry**

Most previous studies have covered a limited range of species and sampling methods. More research is needed to understand the bigger picture of wildlife in agroforestry to inform overall cost-benefit assessments.

- **Measuring and valuing pest control and pollination**

Research is needed to understand the extent to which predators control pests in agroforestry and whether beneficial insects can reduce crop damage and improve yield.

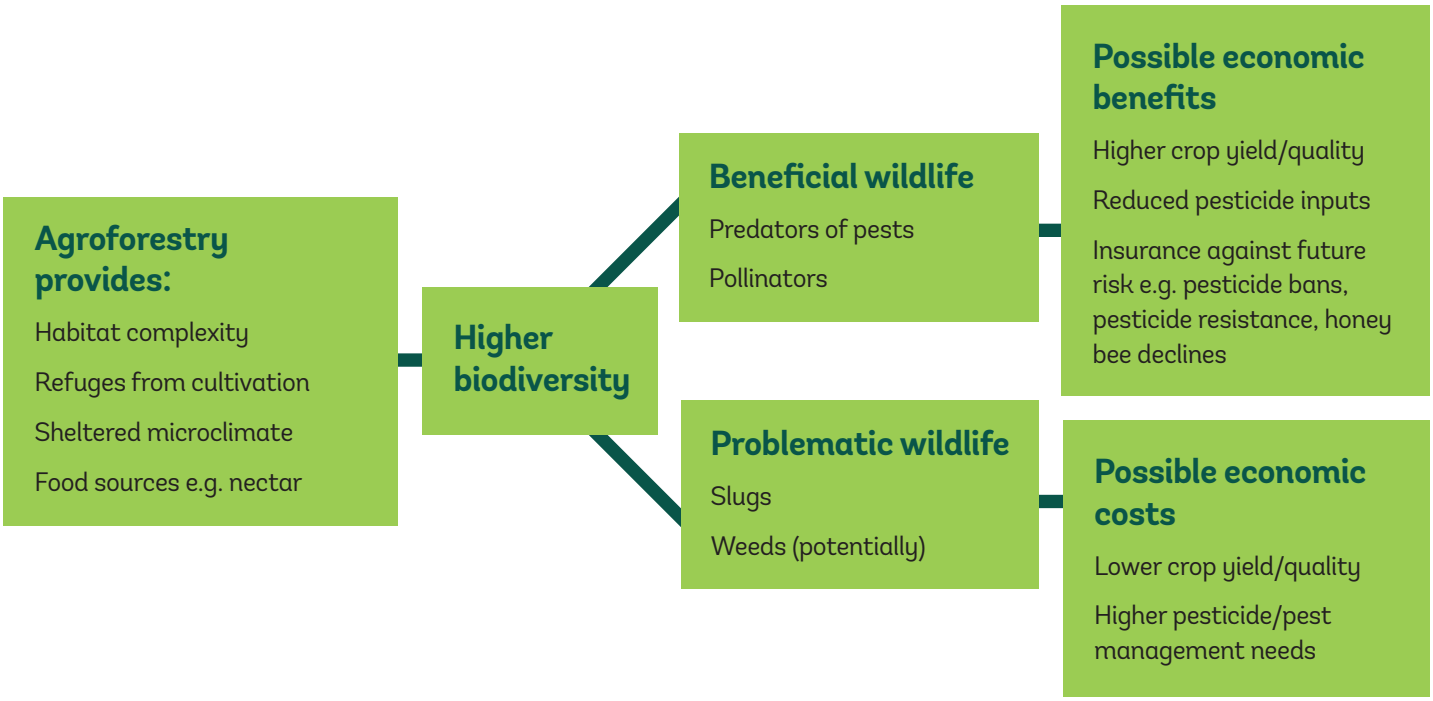
- **Explaining the variation between farms**

Why do previous studies of biodiversity in agroforestry differ in their results? Are the benefits of natural pest control and pollination more noticeable on some farms than others and what drives this?

- **Optimising pest control and pollination**

Research is needed to provide practical advice on how agroforestry systems should be designed and managed to get the best out of biodiversity while minimising problems, such as slug damage.

Slugs could be a problem at some agroforestry sites, but research is needed to investigate whether this affects productivity, and if so, how management can help control them. Photo: Christine Martin/WTML



Representation of the possible economic costs and benefits of higher biodiversity in agroforestry.

Ongoing research

Over the course of 2018, data was collected on insects, weeds and yield in silvoarable by comparing to arable fields without trees at three farms. A variety of sampling methods were used, including UV-bright pan traps and pitfall traps.

Initial results support the pre-existing evidence that silvoarable generally increases the abundance of beneficial insects, particularly predatory spiders, parasitic wasps and pollinating wild bees. Most pests, including pollen beetles in oilseed rape, and root flies, were recorded at lower abundance in silvoarable. However, slug abundance was higher in silvoarable at two of the sites with clay-rich soils, though this effect was most apparent in the spring, with little difference in autumn when the newly sown crops are most vulnerable to damage.

Thus far, strong differences in effects between the three sites have been found, despite using consistent sampling methods. The greatest beneficial effects appear to be at the longest-established farm, which might be due to the relative maturity of their system and/or the limited semi-natural habitat in the surrounding landscape which could make the benefits more noticeable.

Sampling insects in agroforestry: UV pan traps to sample flying insects. Photo: T Staton

One of the study sites, where fruit trees are intercropped with oilseed rape as part of a cereal rotation. Photo: T Staton

Next steps

For the remainder of the project, data will continue to be collected at each farm to see how the biodiversity changes as the systems mature. The aim is also to investigate the other gaps in our knowledge as identified above, such as how tree-row mowing influences the insect community and whether this could discourage slugs; the difference in predation rates of pests between agroforestry and arable; and an assessment of the implications of pest control and pollination for profitability.

The evidence so far suggests that agroforestry benefits pest control and pollination, but that some farms could face challenges, notably from slug pests and weeds.

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