

## What can biodiversity do for agroforestry?

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The benefits to farmland biodiversity of integrating trees and agriculture is highlighted as one of the main selling points of agroforestry. Research comparing biodiversity in European agroforestry and conventional farming has been going on for decades now, leading to a good understanding of the overarching differences between agroforestry and monoculture systems (Torralba et al, 2016; Kletty et al, 2023), primarily reflecting higher system complexity. However, there are still some research gaps, with certain, more challenging, taxa underrepresented in previous research (e.g. bats, soil biota), and the influence of the surrounding landscape and temporal dynamics rarely considered, although recent research aims to address some of these gaps (see abstracts by Ido et al, 2024, and Olaves, 2024, in this book of abstracts).

With a strong evidence base that confirms the value of agroforestry for biodiversity, research is moving now towards a greater focus instead on what biodiversity can do for agroforestry, such as natural pest control, pollination, and nutrient cycling. This is particularly important to provide evidence to farmers who are under pressure to adopt more sustainable practices such as reduced usage of pesticide and synthetic fertilisers, while also facing higher prices for such inputs. Studies show higher abundances of natural enemies and pollinators and lower abundances of pests in some agroforestry systems, but it is more challenging to demonstrate how these differences translate to improved pest control and pollination (Staton et al, 2019). Knowledge on the role of soil organisms to support nutrient cycling, improved soil structure and plant health in European agroforestry systems is also sparse (Rolo et al, 2023), although studies report higher soil microbial biomass, a general indicator of soil health, in agroforestry systems compared with treeless systems (Beule et al 2023). The subsequent impacts of functional biodiversity, the services they provide, and potential trade-offs, on productivity and financial performance at the farm-level is currently lacking, although see Staton et al, 2022.

Going forward, there should be greater consideration of how the design and management of agroforestry systems can be optimised to support functional biodiversity and the delivery of these ecosystem services. For example, what is the best alley width that combines efficient mechanical harvesting of crops with foraging distances of pollinators or predators from tree understoreys? What combinations of tree species and understorey species would provide maximum flowering resources throughout the season for pollinators? Can we increase pest control services by providing nest boxes for birds and bats in new and young agroforestry plantings? What is the best way to manage tree understoreys to support pollination and pest control services? Work by Staton et al, 2021, showed that by reducing the cutting of understorey vegetation to allow flowering, apple trees had fewer aphid-damaged fruit which, combined with reduced mowing costs and additional income from government grants for flower rich areas, increased farm income compared with mown understoreys. Providing such evidence to both farmers and policy makers is key to making the case for agroforestry, not just as a practice that benefits biodiversity, but as a sustainable land use that, through enhanced ecosystem services provided by biodiversity, reduces the need for external inputs or interventions.

### Bibliography

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