

Agroforestry and biodiversity

Reference 5

Torralba, M; Fagerholm, N; Burgess, PJ; Moreno, G; Plieninger, T. 2016 Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis. *Agriculture, Ecosystems & Environment* 230: 150-161. doi: 10.1016/j.agee.2016.06.002

Background and objective

Agroforestry has played an important role in Europe in the past, and traditional agroforestry practices, such as wood pasture and grazed or intercropped orchards, are still practised widely in Europe. During the 20th century, the area of many European agroforestry systems decreased while the remaining agroforestry practices are vulnerable. In 2005, the European Union provided opportunity for national and regional governments to financially support the establishment of new agroforestry systems. The study aimed at answering the following research questions: 1) Does European agroforestry enhance biodiversity and ecosystem services relative to conventional agriculture or forestry (natural and planted forest)?; 2) Which species groups and which categories of ecosystem services are most supported by agroforestry?; 3) What differences arise among different kinds of agroforestry (e.g. silvoarable systems, silvopastoral agroforestry)?; 4) Do biophysical system properties such as temperature and precipitation drive inter-site differences? Here, only results regarding biodiversity are reported.

Search strategy and selection criteria

The literature search was performed in August 2014 by generating combinations of keywords in three databases: ISI Web of Science; SCOPUS and CAB abstract. Additionally, the first 50 documents provided by Google Scholar were included and in the end of the process added five papers recommended by three experts in the field. The systematic literature mapping sought to include all scientific publications that provide quantitative data comparing agroforestry with an alternative land use system in a European study area and using indicators that assess biodiversity and ecosystem services.

Data and analysis

Effect sizes were used as dependent variables to construct a random-effect model (effect sizes nested within studies) and calculate the mean effect size assuming random variation among the observations. Hence 95% confidence intervals were calculated around the mean effect size with bootstrapping of 999 iterations. To assess the effect of the different response variables, sub-group analyses were performed using the explanatory moderators as independent variables

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
53 (31 silvopastoral, 13 silvoarable, 7 mixed)	Agricultural land, pasture, forestry land in the EU.	Agroforestry (silvoarable, silvopasture and mixed)	1)Agricultural land, 2)pasture land, 3) forestry land (natural and planted).	Logarithm of ratio of biodiversity parameters (taxa studied among plants/arthropods/fungi/birds) in agroforestry systems to biodiversity parameters in non-agroforestry systems.	81%

Results

- All species richness and abundance were higher in agroforestry systems (all types) than in (all) other land uses ($g = 0.874$; 95% confidence interval = 0.532–1.215).
- Agroforestry (all types) showed significant benefits in biodiversity, relative to forestry, while the responses were positive but not significant, relative to agricultural and pasture land.
- Significantly positive effects of agroforestry (all types) compared to all other land uses were observed for the Mediterranean and Pannonian biogeographical regions; the effects of agroforestry in the Continental, Alpine and Boreal regions were not significant.
- A positive trend of agroforestry (all types), compared to all other land uses was revealed in all the taxa, but the effect was only significant for birds
- Silvopastoral agroforestry compared to all other land uses showed significant benefits in biodiversity. Silvoarable and mixed systems showed increases, however non statistically significant.

Factors influencing effect sizes

Bioclimatic area, annual average rainfall, temperature, slope. there was a trend that the ecosystem service benefit of agroforestry tended to decrease with precipitation (slope = -0.001 mm^{-1}) and increase with temperature (slope = $0.164 \text{ }^{\circ}\text{C}^{-1}$)

Conclusion

Agroforestry generally enhances biodiversity relative to conventional agriculture and forestry in Europe. However, the substantial variation in results also highlights that the responses are dependent on biophysical and land-use conditions.