SINGLE-IMPACT FICHE – AGROFORESTRY

IMPACT: BIODIVERSITY

Data extracted in June 2020

Note to the reader: This fiche summarises the impact of Agroforestry on BIODIVERSITY. It is based on a review of 11 peer-reviewed synthesis research papers, each involving 18 to 287 primary research studies.

1.WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  Out of the 11 synthesis papers dealing with this type of impact, 6 show positive effect of agroforestry on biodiversity (**Table 1**): 3 for complex (multi-strata) agroforestry compared to simple agroforestry in Africa, Latin America and Asia, 1 comparing agroforestry to all land uses in Europe, 1 compared to open vegetation in sylvopastoral systems in the Mediterranean basin, and 1 compared to conventional agriculture in Atlantic Brazil. Seven synthesis papers report a negative effect compared to intact forests: six papers in Central and South America, Southeast Asia and Africa, and one specifying the negative effect on bird richness. Two synthesis papers report no impact on bird abundance compared to intact forest at the global scale. Two synthesis papers report an uncertain effect in Tropical areas at global scale. See **Table 2** for details.

Table 1. Summary of effects. The numbers between parenthesis indicate the number of synthesis papers with a quality score of at least 50%. Details on quality criteria can be found in the next section.

		Effects (all studies)				Effects (only studies including EU)			
Impact	**Comparator**	**Positive**	**Negative**	**No effect**	**Uncertain**	**Positive**	**Negative**	**No effect**	**Uncertain**
Increase biodiversity	Land use without trees	2	0	0	0	2	0	0	0
	Forests	1	6	2	1 (0)	1	0	0	1 (0)

- QUALITY OF THE SYNTHESIS PAPERS: *The quality score summarises 16 criteria assessing the quality of three main aspects of the synthesis papers: 1) the literature search strategy and studies selection; 2) the statistical analysis; 3) the potential bias. Details on quality criteria can be found in the methodology section of this WIKI*

2. IMPACTS

The main characteristics and results of the synthesis papers are summarized in **Table 2**. Summaries of the meta-analyses provide fuller information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices.

Table 2. Main characteristics of the synthesis papers reporting impacts of agroforestry systems on biodiversity.

	Reference	Population	Geographical scale	Intervention	Control	Conclusion	Quality score	Global effect
1	Santos, PZF; Crouzeilles, R; Sansevero, JBB. 2019	Land use in Brazilian atlantic forest.	Brazilian Atlantic Forest.	1)biodiverse agroforestry systems (>5 different plant species), 2) simple agroforestry systems(<5 different plant species), 3) conventional agriculture or pasture.	Old-growth forests	Biodiverse agroforestry systems are most similar to natural forests, in terms of biodiversity conservation. Results highlight the influence of the type of agroforestry system over the maintenance of biodiversity in the Brazilian Atlantic Forest. From an applied perspective, these similar results highlight the fact that agroforestry systems are an alternative method to recover degraded lands in human-dominated landscapes and can reconcile production and conservation.	62%	Positive, compared to conventional agriculture. Positive, for biodiverse agroforestry compared to simple agroforestry. Negative, compared to natural old-growth forests.
2	Bohada-Murillo, M; Castano-Villa, GJ; Fonturbel, FE. 2019	Forestry and agroforestry plantations.	Global (including Europe).	Forestry, oil palm plantations, agroforestry with coffee and cacao	Native forest stand.	Agroforestry plantations (coffee and cacao) have no effects on bird species richness and abundance worldwide, compared to native forests. Productive plantations (Palm oil) reduce both species richness and abundance of bird species, being insular species particularly susceptible.	100%	No effect, for Cacao/coffee agroforestry compared to native forest. Negative, for forestry and productive plantations, compared to native forests.
3	Plexida, S; Solomou, A; Poirazidis, K; Sfougaris, A. 2018	Different agrosilvopastoral ecosystems of the Mediterranean Basin area.	Mediterranean basin.	Dense(r) vegetation.	Less dense vegetation.	Open agrosylvopastoral habitats have fewer species than other closed wooded habitats.	81%	Positive, compared to open vegetation in agrosylvopastoral ecosystems.
4	Torralba, M; Fagerholm, N; Burgess, PJ;	Agricultural land, pasture, forestry land in the EU.	Europe	Agroforestry (silvoarable, silvopasture and mixed)	1)Agricultural land, 2)pasture	Agroforestry generally enhances biodiversity relative to conventional agriculture and forestry in Europe.	81%	Positive, compared to all land uses.

	Moreno, G; Plieninger, T. 2016				land, 3) forestry land (natural and planted).	However, the substantial variation in results also highlights that the responses are dependent on biophysical and land-use conditions.		
6	Chaudhary, A; Burivalova, Z; Koh, LP; Hellweg, S. 2016	Forests	Global	Managed forest (ten types of forest management, including agroforestry)	Unmanaged forest.	Management regimes not focusing on timber production are in general more harmful to species richness than timber producing regimes. A notable exception is agroforestry, which is associated with lower species loss than timber plantations.	75%	Negative, compared to forest.
7	Norgrove, L; Beck, J. 2016	Tropical agricultural systems.	Global, tropical zones.	Shifting cultivation (or "slash-and-burn," swidden), homegardens, improved fallows, alley cropping, agrisilviculture, shade commodities.	More studies contained forest controls (63 %) than agricultural controls (20 %), and only 19 % contained both types of controls.	Comparisons of biodiversity to those of control habitats suggest that agroforestry has more conservation potential than agriculture but that it cannot substitute oldgrowth forests. Management practices (mostly shading regime in commodity crops) were studied either in relation to farmer's benefits or to biodiversity, but rarely both. While shade was often associated with higher biodiversity, most studies fell short of fully evaluating economic effects for farmers. Resilience, in the sense of biodiversity recovery to old-growth levels, was studied mostly in shifting cultivation systems (i.e., using fallow age as predictor).	31%	Uncertain
8	De Beenhouwer, M; Aerts, R; Honnay, O. 2013	Coffee and cacao production in tropics.	Africa, Latin America and Asia.	Multistrata agroforestry (stratified and species-diverse tree layer).	1)natural forest (hereafter forest), 2) plantations with sparse shade trees, belonging to one or very few species (hereafter plantation). Plantations without shade trees ("sun plantations") were not included.	Results show negative effects of (i) the conversion of natural forest into coffee and cacao agroforestry systems and (ii) the intensification of cacao and coffee agroforestry into plantation, on species richness. Along with the conservation of natural forest, there is a clear advantage of conserving structurally complex (multistrata) agroforests from further intensification.	75%	Negative, compared to native forest. Positive, for multistrata agroforestry, compared to simple agroforest plantations.
9	De Beenhouwer, M; Aerts, R; Honnay, O. 2013	Cocoa and coffee agroforestry in tropics.	Central and south America, Africa, and Asia	Plantation with sparse shade trees (plantation) and Agroforestry with a stratified and diverse tree layer (agroforestry)	Natural forest	Our results show negative effects of (1) the conversion of natural forest into coffee and cacao agroforestry systems and (2) the intensification of cacao and coffee agroforestry into plantation.	81%	Negative compared to forest.
10	Palacios, CP; Aguero, B; Simonetti, JA. 2013	Agroforestry and forestry plantations.	Global	Plantation and Agroforestry (of simpler level of complexity when compared to complex plantation)	Native forest or Complex plantation	Among amphibians, species richness is lower in plantations than in forests while among reptiles there is no significant difference. The abundance of reptiles increases in plantations.	38%	Uncertain
11	Najera, A; Simonetti, JA. 2010	Forest and tree plantations with different structural complexity.	Global (not including Europe).	Simple plantations (with thinned or cleared undergrowth, scarce or no shrub cover, or single-species canopy cover) and Complex plantations (multiple vegetation strata, dense undergrowth, abundant scrub, or multispecies canopy cover).	Natural forest.	Structural complexity within plantations enhanced the avifauna assemblage and promoted increased bird species richness and abundance. Management practices that allow or promote structural complexity and understory growth should be promoted to aid in conserving biodiversity.	50%	Bird richness: negative compared to intact forest; Bird abundance: no impact compared to intact forest; Positive impact of complex tree plantations compared to simple plantations.
12	Nichols, E; Larsen, T; Spector, S; Davis, AL; Escobar, F; Favila, M; Vuline, K. 2007	Tropical forest land use categories.	Tropical forest from Central and South America, Southeast Asia and Africa.	Selectively logged forest (14–168 m3 wood extracted/ha; n = 4, late secondary forest (>15 yr; n = 7), early secondary forest (610 yr; n = 8), agroforests (coffee or cacao under native forest cover; n = 4) tree plantations (monoculture timber, sun coffee or cacao; n = 6), annual crops (predominantly corn fields; n = 3), cattle pastures (grass monocultures with no tree cover; n = 9) and clear-cuts (small clearings, often embedded within forest; n =7).	Intact forest.	Strong and negative response of tropical forest dwelling dung beetle communities to increasing modification of tropical forest and declining fragment size.	94%	Negative compared to intact forest.

3. KNOWLEDGE GAPS

- No data available for Europe. Only data regarding forestry plantations are located in the EU.
- Studies that test the relationship between biodiversity and resources provided by multiple vegetation layers in understory vegetation in plantations.
- Knowledge gaps related to a conspicuous lack of studies in Africa, and a general underreporting of ecosystem services and environmental variables related to agricultural intensification.
- Studies that consider the differences between agroforestry and plantation systems.
- The selection of inappropriate indicators of species richness in biodiversity studies might negatively affect overall biodiversity conservation. Stronger focus should be placed on how to manage forests, inappropriate farming practices, and the livestock more effectively.
- Insufficient information on study conditions and details, or poorly replications, which is common for biodiversity studies.