SINGLE-IMPACT FICHE – AGROFORESTRY

IMPACT: BIODIVERSITY

Data extracted in June 2020

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 individual papers.

This fiche is part of a set of similar fiches synthesising all the impacts of agroforestry presented in the general fiche

1.WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT: Out of the 11 synthesis papers dealing with this type of impact, six show positive effect of agroforestry on biodiversity: three for complex (multi-strata) agroforestry compared to simple agroforestry in Africa, Latin America and Asia, one comparing agroforestry to all land uses in Europe, one compared to open vegetation in sylvopastoral systems in the Mediterranean basin, and one 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 the tables below for details.

		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. The scores can be found in the Excel database with all the data extracted from the synthesis papers]

As shown in the "Quality score" of the table in section 2, the quality level ranges from 31% to 100%, with only two synthesis papers with a quality score lower than 50%. The least frequently satisfied quality criterion was dataset availability (2 out of 11).

- NUMBER OF SCIENTIFIC PAPERS: The number of papers included in each synthesis paper ranges from 18 to 287.

2. IMPACTS

The main characteristics and results of the 11 synthesis papers are summarized in the two tables presented below. For details follow this link .

	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

[They are extracted from each meta-analysis, synthesized and consolidated]

- 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.

4. SYSTEMATIC REVIEW SEARCH STRATEGY

Keywords	TOPIC: (agroforestry OR "agro-forestry") AND TOPIC: (meta-analy*)
Search dates	No time restrictions
Databases	Web of Science and Scopus, run on 15 May 2020
Selection criteria	Three main criteria led to the exclusion of a study: (1) the study does not deal with agroforestry; (2) the study does not assess the environmental and climate impacts of the farming practice on biodiversity; (3) the study is neither a meta-analysis nor a systematic review. Studies that passed the relevance criteria were subject to critical appraisal carried out on article by article basis. We finally selected 11 meta-analysis.