SINGLE-IMPACT FICHE – AGROFORESTRY

IMPACT: CROP YIELD

Data extracted in June 2020

Note to the reader: This fiche summarises the impact of Agroforestry on CROP YIELD. It is based on a review of 9 peer-reviewed synthesis research papers, each involving 21 to 138 primary research studies.

1.WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  Out of the 9 synthesis papers dealing with this type of impact, four show positive effect of agroforestry on crop yield (**Table 1**): three compared to non-agroforestry practices on cropland in Africa and global scale, and one on coppicing compared to control without trees in Africa. Five synthesis papers report no effect on yield: four for crop production (one for parkland compared to control without trees in Africa, one compared to groundnut unshaded monoculture at global scale, one compared to forestry and pastureland) and one for timber production compared to forestry in Europe. Two synthesis papers report an uncertain effect in Western Africa. Two synthesis papers report a negative effect compared to monocultures 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 yield	Land use without trees	4 (3)	2 (1)	3 (2)	1	0	0	2	0
	Forests	0	0	1	0	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 9 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 crop yield.

	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
1	Kuyah, S; Whitney, CW; Jonsson, M; Sileshi, GW; Oborn, I; Muthuri, CW; Luedeling, E. 2019	Agricultural systems in sub-saharan Africa.	Sub-Saharan Africa	Agroforestry practices: alley cropping, dispersed intercropping, hedgerow, planted fallow, and crops planted under tree canopies in parkland agroforestry systems.	Non-agroforestry practices (includes sole cropping, continuous cropping without trees, and plots outside tree crowns in the case of parklands).	The findings provide evidence that agroforestry can significantly increase crop yield.	81%	Positive, compared to non-agroforestry practices on cropland.
2	Felix, GF; Scholberg, JMS; Clermont-Dauphin, C; Cournac, L; Tittonell, P. 2018	Cropping systems with trees.	Semi-arid west Africa (Sudano-Sahelian Africa, including Senegal, The Gambia, Mauritania, Mali, Burkina Faso, Northern Benin, Niger, Nigeria, and Northern Cameroon)	Plots under or at the vicinity of tree canopy. Plots receiving ramial wood as soil amendment.	Plot outside the area of canopy influence. Plot not receiving ramial wood as soil amendment.	Presence of trees, shrubs and ramial wood amendments had overall positive effects on crop yields.	50%	Uncertain.
3	Rosalien, EJ; Pita, AV; Maria, JS; Rene, GAB 2017	Cocoa and coffee cultivation in tropical lands	Global, restricted to tropical	Tree-shaded coffee and cocoa.	Monocropping (Cocoa and Cofee)	Lower average yield of the main cash crop (–26%) was found for shaded systems in comparison to	56%	Negative, compared to conventional systems.

			climates.			conventional systems. Yields don't account for other products obtainable by co-crops in shaded systems.		
4	Torralba, M; Fagerholm, N; Burgess, PJ; Moreno, G; Plieninger, T. 2016	Agricultural land, pasture, forestry land.	Europe	Agroforestry (silvoarable, silvopasture and mixed)	1)Agricultural land, 2)pasture land, 3) forestry land (natural and planted).	The meta-analysis shows that agroforestry systems can provide similar levels of food and timber as forestry, and similar levels of food production as pasture land. No comparison is available with agricultural land.	81%	No effect for food production, compared to forestry and pastureland. No effect for timber production, compared to forestry.
5	Sileshi, GW. 2016	Faidherbia trees on arable land.	Global	Agroforestry: Scattered Faidherbia albida trees in crop systems	Open area or patches taken furthest from the tree trunk, in the same field as the intervention.	Faidherbia induces significant changes in soil properties and fertility under its canopy, leading to significant increases in yields for maize and sorghum under canopy. Groundnut yields were not influenced (under above-average conditions)or reduced (under below-average conditions).	44%	Positive, compared to sorghum and maize unshaded monocultures. No effect or negative, compared to groundnut unshaded monoculture.
6	Sinare, H; Gordon, LJ. 2015	Cropland and pastureland in Sudano-Sahelian zone of West Africa.	Sudano-Sahelian zone of West Africa.	Presence of woody vegetation	Not specified	No clear conclusion available.	50%	Uncertain.
7	Rivest D; Paquette, A; Moreno, G; Messier C. 2013	Scattered trees on pastures	Global	Pasture directly beneath the canopy of scattered mature trees.	Pasture away from tree crowns in open areas.	The meta-analysis provides evidence that the net effect of trees on pasture yield was nul across the four studied tree functional groups, i.e. pasture yield beneath and outside the canopy of scattered trees did not differ.	75%	No effect, compared to pasture without trees.
8	Bayala, J; Sileshi, GW; Coe, R; Kalinganire, A; Tchoundjeu, Z; Sinclair, F; Garrity, D. 2012	Conservation agriculture with and without trees	Burkina Faso, Mali, Niger and Senegal.	Six different forms of conservation agriculture, including parkland trees and coppicing trees	System without conservation agriculture (in particular, no tree)	Coppicing increases yields of cereals in average, but not parkland systems. Yield response variability is high and could be partly explained by rainfall and site quality.	50%	Positive for coppicing, compared to control without tree. No effect for parkland, compared to control without tree.
9	Akinnifesi, FK; Ajayi, OC; Sileshi, G; Chirwa, PW; Chianu, J. 2011	Maize with fertiliser tree systems (Faidherbia Albida, Sequential Tree Fallow, Annual Relay Intercropping and Gliricidia Intercropping)	Southern Africa.	Agroforestry with fertiliser trees (Gliricida, Sesbania and Tephrosia)	Unfertilised maize grown continuously	The meta-analysis provided conclusive evidence that with good management, fertiliser trees can double maize yields compared with local farmer practices of maize cultivation without addition of external fertilisation.	19%	Positive, compared to unfertilised maize grown continuously.

3. KNOWLEDGE GAPS

- Few data available for Europe.
- Factors explaining yield response variability. Key concern in most studies is the failure to include tree size as a variable in the study design and analyses.
- The number of observations in the open area are fewer than under the canopy.
- Studies comparing the full amount of food, timber, or biomass produced.