

SINGLE-IMPACT FICHE – AGROFORESTRY

IMPACT: SOIL WATER RETENTION

Data extracted in June 2020

Note to the reader: This fiche summarises the impact of Agroforestry on SOIL WATER RETENTION. It is based on a review of 7 peer-reviewed synthesis research papers, each involving 4 to 138 primary research studies.

1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:** Out of the 7 synthesis papers dealing with this type of impact (**Table 1**), 6 show positive effect of agroforestry on water retention: 5 compared to land use without trees (cropland) at the global scale (mainly in Tropical zones in Africa and Asia), and one compared to forest plantations in China. Two synthesis papers report an uncertain effect in West Africa (one compared to cropland and one unspecified). One synthesis paper reported no effect compared to different types of forest in the control (e.g., plantations, unmanaged forests). 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.

Impact	Comparator	Effects (all studies)				Effects (only studies including EU)			
		Positive	Negative	No effect	Uncertain	Positive	Negative	No effect	Uncertain
Increase water retention	Land use without trees	5	0	0	1 (0)	0	0	0	0
	Forests	1	1	0	0	0	0	0	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 7 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 soil water retention.

Reference	Population	Geographical scale	Intervention	Control	Conclusion	Quality score	Global effect
1 Muchane, MN; Sileshi GW; Gripenberg, S; Jonsson, M; Pumariño, L; Barrios, E. 2020	Crop production systems in tropics.	Humid and sub-humid tropics in all continents.	1) simultaneous agroforestry where trees and crops occur on the same piece of land during the same cropping season (e.g. alley cropping, intercropping, multi-storey agroforests); and 2) sequential agroforestry where trees and crops occur on the same piece of land but in a temporal sequence as part of a rotation (e.g. improved fallows).	Crop monoculture	Agroforestry practices significantly improve water infiltration rates, compared to crop monocultures. The provision of organic inputs by agroforestry trees through litterfall and prunings contributes to soil cover. This combined with the predominance of reduced/no-tillage practices in agroforestry is likely an important reason for better soil properties.	75%	Positive, compared to crop monocultures.
2 Kuyah, S; Whitney, CW; Jonsson, M; Sileshi, GW; Oborn, I; Muthuri, CW; Luedeling, E. 2019	Agricultural systems in sub-saharian 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).	Agroforestry practices significantly improves water regulation, compared to non-agroforestry practices. This happened for all types of agroforestry, ecological zone, elevation, type of perennials used.	81%	Positive, compared to non-agroforestry practices on cropland.

3	Basche, AD; DeLonge, MS. 2019	Agricultural systems	Global	Introducing perennials (perennial grasses, agroforestry, managed forestry) as water retention soil managing practices.	Conventional management of annual crops in cropland.	The overall trend quantified by this analysis is a clear potential for improve water infiltration rates in response to introducing perennials.	94%	Positive, compared to cropland.
4	Sun, D; Yang, H; Guan, DX; Yang, M; Wu, JB; Yuan, FH; Jin, CJ; Wang, AZ; Zhang, YS. 2018	Land use change between grassland, cropland, forest and agroforestry in China.	China	Agroforestry	Cropland, forest (natural forest, secondary forest and plantation forest, coniferous forest, broadleaf and mix forest).	1) Conversion from cropland to agroforestry is in favor of improving soil infiltration rate. 2) Establishing agroforestry does not significantly alter soil infiltration rate of forest except that condition of increasing soil infiltration rate for forest plantations.	88%	Positive, compared to cropland. No effect, compared to forest (any type). Positive, compared to forest plantations.
5	Felix, GF; Scholberg, JMS; Clermont-Dauphin, C; Cournac, L; Tiftonell, P. 2018	Cropping systems with trees in Semi-arid west Africa.	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 water use efficiency. Woody perennials in agroforestry systems locally create resource islands or fertility hotspots around their base, related to both aboveground (i.e. litter addition) and underground (i.e. hydraulic lift and root decay) processes.	44%	Uncertain
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	Ilstedt, U; Malmer, A; Elke, V; Murdiyarsso, D. 2007	Tree plantations in tropics.	Tropics in Africa and Asia.	Afforestation and agroforestry. Forest was defined broadly as any area of trees with more than 10% crown coverage. Afforestation denoted plantation on open land that had been free from forest cover as a result of prolonged agricultural use, failed reforestation by active replanting or delayed natural secondary succession. This included pastures, grasslands (non-fallow and fallow) and permanent cultivation.	Deforested land including pastures, grasslands (non-fallow and fallow) and permanent cultivation.	The meta-analysis confirms the beneficial effect of tree planting on soil infiltrability over a wide range of humidity levels.	100%	Positive, compared to cropland or pastureland.

3. KNOWLEDGE GAPS

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

- No data available for Europe. Scarcity of studies examining the effects of afforestation on soil physical properties in the tropics generally, and in particular with a sufficiently robust methodology for a statistical synthesis.