




Data extracted in June 2020

This fiche summarises the impact of Agroforestry on WATER RETENTION. It is based on a review of 7 peer-reviewed synthesis research papers, each involving 4 to 138 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 7 synthesis papers dealing with this type of impact, 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 the table below for details.

| 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. 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 44% to 100%, with only one synthesis paper with a quality score lower than 50%. The least frequently satisfied quality criteria were those related to the presentation of individual effect sizes (2 out of 7) and dataset availability (3 out of 7).

- NUMBER OF SCIENTIFIC PAPERS:** The number of papers included in each synthesis paper ranges from 4 to 138.

### 2. IMPACTS

The main characteristics and results of the 7 synthesis papers are summarized in the table presented below. For details follow this link 

| Reference                                                                                                        | Population                                   | Geographical scale                             | Intervention                                                                                                                                                                                                                                                                                                                                      | Control                                                                                                               | Conclusion                                                                                                                                                                                                                                                                                                                                                           | Quality score | Global effect                                                 |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------|
| 1<br>Muchane, MN;<br>Sileshi GW;<br>Gripenberg, S;<br>Jonsson, M;<br>Pumariño, L;<br>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<br>Kuyah, S;<br>Whitney, CW;<br>Jonsson, M;<br>Sileshi, GW;<br>Oborn, I;<br>Muthuri, CW;<br>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) | 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. |

|   |                                                                                          |                                                                                |                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                 |      |                                                                                                                     |
|---|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------|
|   |                                                                                          |                                                                                |                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                           | in the case of parklands).                                                                                              |                                                                                                                                                                                                                                                                                                                                                 |      |                                                                                                                     |
| 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.

### 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 water retention; (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 7 meta-analysis. |