



Data extracted in June 2020

Note to the reader: This general fiche summarises all the environmental and climate impacts of agroforestry found in a review of 33 synthesis research papers. It provides the highest level of synthesis – symbolised by the top of the pyramid -. As each synthesis paper¹ involves a number of individual papers ranging from 21 to 138, the assessment of impacts relies on a large number of results obtained mainly in field experiments (carried out in situations close to real farming environment), and sometimes in lab experiments or from model simulations.

In addition to this general fiche, single-impact fiches provide a deeper insight in each individual impact of Agroforestry (e.g., on carbon sequestration, on biodiversity etc.), with more detailed information – medium part of the pyramid -. Finally, individual reports provide fuller information about the results reported in each synthesis paper, in particular about the effects of factors related to soil, climate and management practices – base of the pyramid -.

This general fiche on agroforestry is part of a set of similar fiches providing a comprehensive picture of the impacts of farming practices on climate and environment. All pyramid symbols () include hyperlinks to follow, when the reader need deeper insights on information.

1. DESCRIPTION OF THE FARMING PRACTICE

<p>Description</p>	<p>Agroforestry is a particular type of land-use system and technology where woody perennials (trees, shrubs, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals.</p> <p>There are many types of Agroforestry. In Europe, six agroforestry practices are identified: Silvoarable agroforestry, Forest farming, Riparian buffer strips, Improved fallow, Multipurpose trees and Silvopasture (Mosquera-Losada et al., 2009)².</p> <p>Agroforestry can be considered as a “farm practice”, a group of farm practices, or in some rare cases as a “farming system” (den Herder et al, 2015)³.</p>
<p>Key descriptors</p>	<p>Agroforestry is a form of multiple cropping which satisfies at least three basic conditions:</p> <ol style="list-style-type: none"> 1. There are at least two species that interact biologically; 2. At least one of the species is a woody perennial; 3. At least one of the plant species is managed for forage, annual or perennial crop production. <p>Agroforestry can be considered at a range of scales: field-scale, farm-scale and landscape scale.</p>

¹ Research synthesis papers include meta-analysis or systematic reviews.

² Mosquera-Losada M.R., McAdam J.H., Romero-Franco R., Santiago-Freijanes J.J., Rigueiro-Rodríguez A. (2009) Definitions and Components of Agroforestry Practices in Europe. In: Rigueiro-Rodríguez A., McAdam J., Mosquera-Losada M.R. (eds) Agroforestry in Europe. Advances in Agroforestry, vol 6. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-8272-6_1

³ den Herder, M., Burgess, P.J., Mosquera-Losada, M.R., Herzog, F., Hartel, T., Upson, M., Viholainen, I., Rosati, A., 2015a. Preliminary stratification and quantification of agroforestry in Europe. Milestone Report 1.1 for EU FP7 AGFORWARD Research Project (613520). <http://agforward.eu/index.php/en/preliminary-stratification-and-quantification-of-agroforestry-in-europe.html>


2. DESCRIPTION OF THE IMPACTS OF THE FARMING PRACTICE ON ENVIRONMENT AND CLIMATE










Agroforestry impacts are overall compared to two comparators: land use without trees -including cropland, pastureland and sometimes fallow land; or forests - either natural or planted -. Depending on the chosen comparator, different questions can be addressed. For example, Comparator 1: Does agroforestry perform better than croplands without trees? Comparator 2: Does agroforestry perform better than forest? The numbers in the table correspond to the numbers of synthesis papers reporting positive effect, negative effect, no effect and uncertain effects. The numbers between parenthesis were obtained including only synthesis papers with a quality score of at least 50%; when there is no number, it means that all meta-analyses have a quality score higher than 50%.

For each pair impact-comparator, the effect with the higher score is marked in bold and the cell coloured. We differentiate between the effects based on all available synthesis papers - even those including no trial in Europe- (all studies), and synthesis papers including European trials (only studies including EU).

Impact	Comparator	Effects (all studies)				Effects (only studies including EU)			
		Positive	Negative	No effect	Uncertain	Positive	Negative	No effect	Uncertain
Increase soil nutrients 	Land use without trees	4 (3)	0	0	2 (1)	0	0	0	0
	Forests	1	0	0	0	1	0	0	0
Increase carbon sequestration 	Land use without trees	10 (8)	0	0	1	5	0	0	1
	Forests	0	2	0	1	0	2	0	1
Soil erosion control 	Land use without trees	2	0	0	0	0	0	0	0
	Forests	1	0	0	0	1	0	0	0
Reduction of greenhouse gas emissions 	Croplands without trees	1	0	0	0	1	0	0	0
Pest- and disease- control 	Croplands without trees	2	0	0	1	2	0	0	1
Increase pollination 	Croplands without trees	1	0	0	0	1	0	0	0
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
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)
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

3. DESCRIPTION OF THE KEY FACTORS INFLUENCING THE SIZE OF THE EFFECT

Only the factors explicitly studied in the selected synthesis papers are reported below. Details regarding the factors can be found in the individual reports summarizing the relevant synthesis paper/s, following the hyperlinks ().

IMPACTS	FACTORS
Increase soil nutrients 	Pre-existing soil nutrient richness (ref2); distance from tree trunk (ref2); Climate (precipitation, temperature) (ref3); agroforestry type (ref6); presence of N-fixing species (ref5); soil type (ref6,7); soil organic matter (ref6).
Increase carbon sequestration 	Agroforestry type (ref3, 5, 6, 7, 8, 9, 10); Land use before agroforestry (ref9,10,11); Tree age (ref1, 3, 6, 9, 10); Soil depth (ref1, 10, 11); Climate/agroecological zone (ref9,10); Soil type (ref4, 7, 8, 9, 10, 12, 13); Soil nutrient content (ref4); Distance from tree trunk (ref4); complex interactions among these factors: soil properties (texture, pH and P and N content), climate (temperature and precipitation) and vegetation (tree density and cover percentage) (ref6, 10); perennial species (ref11); tree management (e.g. pruning) (ref6, 7, 9).
Increase soil erosion control 	Climate (ref2); Soil type (ref1); type of perennials (ref1).
Reduction of greenhouse gas emissions 	Agroforestry type (ref1); Soil structure (ref1).
Increase pest- and disease- control 	Pest type (ref1); Crop type(ref1); Agroforestry type (ref1); perennial species (ref1); Presence of insectivorous species (birds) (ref2); Proximity of landscape features (forests or border hedgerows) (ref3); Soil type (ref3); Alley width (ref3).
Increase pollination 	Proximity of landscape features (forests or border hedgerows) (ref1); Soil type (ref1); Alley width (ref1).
Increase water retention 	Climate zone (ref6); Aridity index (ref5); Soil type/structure (ref4, 5); seasonal variations (ref2); tree management (e.g. ramial wood amendments) (ref3).
Increase biodiversity 	Geographic location (ref1, 4, 6, 10); Habitat heterogeneity (ref1, 2, 9); Land use before agroforestry (ref8); Taxa (ref3, 4, 6); Climate/ecosystem zone (ref1, 6, 7, 9); Type of agroforestry (ref2, 4, 10, 11); landscape structure (ref7, 9); tree age (ref8).
Increase yield 	Type of agroforestry (ref2,9); Tree age (ref1); type of perennials (ref3, 8); Climate and soil type (ref1, 3, 8, 9); Type of crop (ref2, 4); Distance from tree trunk (ref5); Soil nutrient richness (ref5, 9).

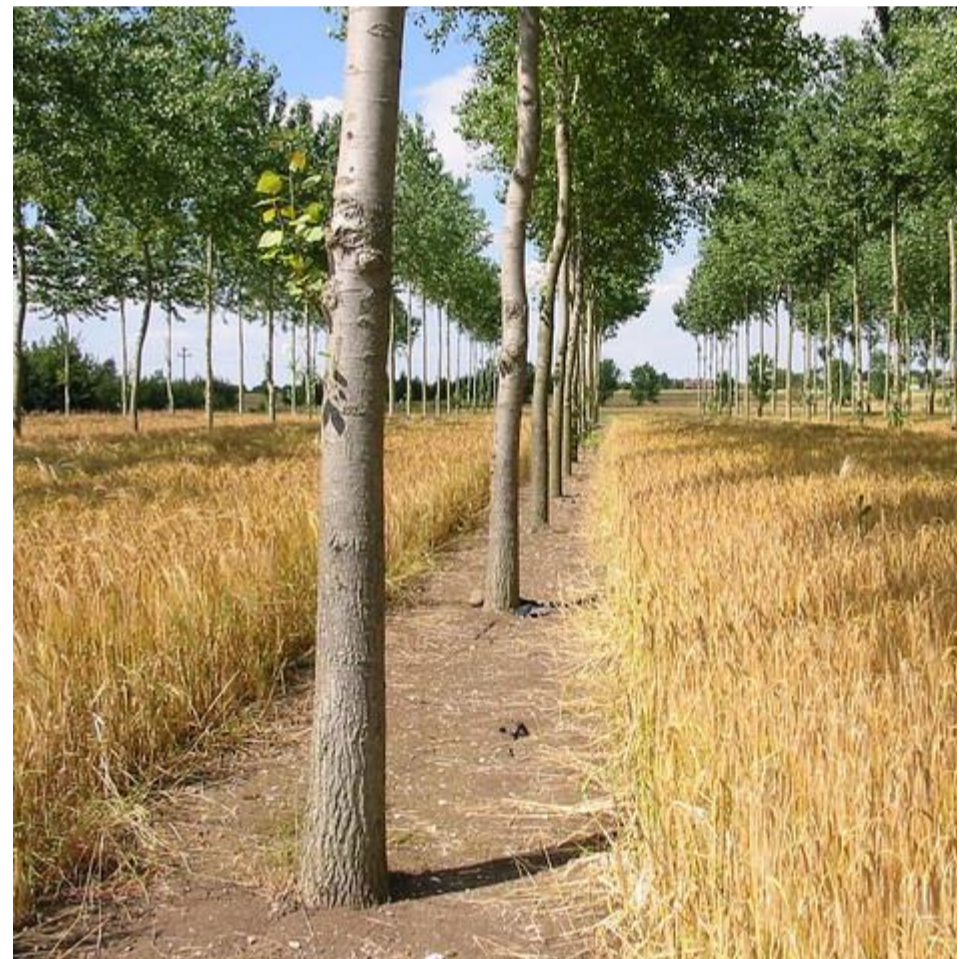
4. IMPLEMENTATION IN THE PERIOD 2014-2020

GAEC Cross compliance	Agroforestry is not included under the standards on Good agricultural and environmental conditions (GAEC).
Greening	Agroforestry is an Ecological Focus Area: it was selected by 10 MS in 2018 (BE Flanders, DE, ES, FR, IT, CY, LU, HU, PT, UK northern Ireland and Scotland) with a very low uptake of 199 ha, mainly located in 2 MS (FR, BE Flanders).
Rural development measure – submeasure	<p>Measure 8 - Investments in forest area development and improvement of the viability of forests includes 6 sub measures, where 8.2 – Support for establishment and maintenance of agro-forestry systems is specific for agroforestry.</p> <p>This sub measure was programmed in 8 MS and 26 RDP, for 84 million of planned expenditures (1% of measure 8) and a total programmed output of around 60000 ha (0,03% of total UAA). In the beginning of the period, the measure was programmed in 34 programmes, reduced to 26 with following modifications.</p> <p>The following MS/RDPs programmed the sub measure 8.2: BE, ES, FR, EL, HU, IT, PT, UK.</p>

5. PICTURES



Source: Agforward



Source: Groen Kennisnet

6. LINKS TO OTHER RELEVANT COMPLEMENTARY INFORMATION

We include in this section the links to other complementary sources of information (not peer-reviewed meta-analyses or systematic reviews), provided by AGRI or other stakeholders.

- EIP Focus Group report Agroforestry “Introducing woody vegetation into specialised crop and livestock systems”, including 9 relevant mini-papers https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fg_agroforestry_final_report_2017_en.pdf
- AFINET <https://euraf.isa.utl.pt/afinet>
- AGFORWARD <https://www.agforward.eu/index.php/en/>
- European Agroforestry Association <https://euraf.isa.utl.pt/welcome>