SINGLE-IMPACT FICHE
LANDSCAPE FEATURES

IMPACT: CARBON SEQUESTRATION

Data extracted in May 2022
Fiche created in December 2023

Note to the reader: This fiche summarises the effects of Landscape features on CARBON SEQUESTRATION. It is based on 5 synthesis papers[1], including from 9 to 103 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

Landscape features have an overall positive effect on carbon sequestration (i.e. increase of carbon sequestration) compared to cropland or grassland without landscape features.

The table below shows the number of synthesis papers with statistical tests reporting i) a significant difference between the Intervention and the Comparator, that is to say, a significant statistical effect, which can be positive or negative; or ii) a non-statistically significant difference between the Intervention and the Comparator. In addition, we include, if any, the number of synthesis papers reporting relevant results but without statistical test of the effects. Details on the quality assessment of the synthesis papers can be found in the methodology section of this WIKI.

- Field margins have a significantly positive effect on soil carbon sequestration compared to cropland and grassland without field margins, according to 1 synthesis paper.
- Hedgerows have a significantly positive effect on carbon sequestration compared to cropland and grassland without hedgerows, according to 3 synthesis papers; while they have non-significant effect, according to 1 synthesis paper. Another synthesis paper reported relevant results for carbon sequestration both in soil and in biomass, but these results were not statistically tested.
- Isolated trees are studied in one synthesis paper where authors report results on their effect on carbon sequestration in biomass compared to cropland and grassland without isolated trees, but this evidence is not statistically tested.
- Terraces have differing effects on soil carbon sequestration compared to cropland and grassland without terraces depending on the type of terrace (contour bound or stone terraces vegetated or not), according to 1 synthesis paper.

Out of the 5 selected synthesis papers, 4 included studies conducted in Europe (see **Table 2**).

Table 1: Summary of effects. Number of synthesis papers reporting positive, negative or non-statistically significant effects on environmental and climate impacts. The number of synthesis papers reporting relevant results but without statistical test of the effects are also provided. When not all the synthesis papers reporting an effect are of high quality, the number of synthesis papers with a quality score of at least 50% is indicated in parentheses. The reference numbers of the synthesis papers reporting each of the effects are provided in **Table 3**. Some synthesis papers may report effects for more than one impact or more than one effect for the same impact.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase carbon sequestration	Carbon sequestration	Field margins	No field margins	1	0	0	0
		Hedgerows	No hedgerows	3	0	1	1 (0)
		Isolated trees	No isolated trees	0	0	0	1 (0)
		Terraces	No terraces	1	0	1	0

QUALITY OF THE SYNTHESIS PAPERS

The quality of each synthesis paper was assessed based on 16 criteria regarding three main aspects: 1) the literature search strategy and primary studies selection; 2) the statistical analysis conducted; and 3) the evaluation of potential bias. We assessed whether authors addressed and reported these criteria. Then, a quality score was calculated as the percentage of these 16 criteria properly addressed and reported in each synthesis paper. Details on quality criteria can be found in the methodology section of this WIKI.

2. IMPACTS

The main characteristics and results of the 5 synthesis papers are reported in **Table 2** with the terminology used in those papers, while **Table 3** shows the reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**. Comprehensive information about

[1] Synthesis research papers include either meta-analysis or systematic reviews with quantitative results. Details can be found in the methodology section of the WIKI.

the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices, are provided in the **summaries of the synthesis papers** available in this WIKI.

Table 2: Main characteristics of the synthesis papers reporting effects on carbon sequestration. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref1	Croplands and grasslands	Global	9	Hedgerows	No hedgerows	Soil organic carbon stock	The establishment of hedgerows, especially on cropland, can be an effective option for C sequestration in agricultural landscapes.	100%
Ref4	Degradated landscape across several agroecology zones	Ethiopia	103	1) Contour bunds; 2) Terraces; 3) Vegetated contour bunds	No treatment, before treatment	Soil organic carbon	The mean effect of all land restoration interventions on soil organic carbon is positive, the highest effect being from "bunds + biological" (139%) followed by exclosure (90%).	62%
Ref8	Grazed dairy systems	Global	83	1) Shelterbelts; 2) Pasture trees	Grazed dairy pasture without trees	Carbon sequestration	Variable results with large increases in biomass C, but changes in soil C following reforestation of on-farm woody elements highly variable and uncertain. Reviewers' note: We labelled the results as uncertain due to the lack of statistical testing.	38%
Ref11	Croplands	Global	53	Hedgerows	No hedgerows	Soil organic matter content	Plant hedgerows can effectively increase soil organic matter content.	81%
Ref20	Arable crops	Global (temperate climate)	60	1) Grass strips; 2) Hedgerows	1) No grass strips; 2) No hedgerows	Carbon stock	Grass strips and hedgerows showed positive effect on the increase of soil carbon stock.	75%

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase carbon sequestration	Carbon sequestration	Field margins	No field margins	Ref20			
		Hedgerows	No hedgerows	Ref1, Ref11 and Ref20		Ref1	Ref8
		Isolated trees	No isolated trees				Ref8
		Terraces	No terraces	Ref4		Ref4	

3. FACTORS INFLUENCING THE EFFECTS ON CARBON SEQUESTRATION

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on carbon sequestration, according to the synthesis papers reviewed.

Factor	Reference number
Distance to field edge	Ref20

4. KNOWLEDGE GAPS

Table 5: Knowledge gap(s) reported by the authors of the synthesis papers included in this review.

Ref Num	Gap
Ref1	With the current dataset, it was not possible to identify an influence of hedgerow age, soil texture or climate on the effect of hedgerow establishment on SOC storage due to the small dataset.
Ref8	The number of publications supporting a given relationship between on-farm woody systems and ecosystem services was often relatively low.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

Table 6: List of synthesis papers included in this review. More details can be found in the summaries of the meta-analyses.

Ref Num	Author(s)	Year	Title	Journal	DOI
Ref1	Drexler, S; Gensior, A; Don, A	2021	Carbon sequestration in hedgerow biomass and soil in the temperate climate zone	REGIONAL ENVIRONMENTAL CHANGE, 21(3), 74.	10.1007/s10113-021-01798-8

Ref Num	Author(s)	Year	Title	Journal	DOI
Ref4	Abera, W; Tamene, L; Tibebe, D; Adimassu, Z; Kassa, H; Hailu, H; Mekonnen, K; Desta, G; Sommer, R; Verchot, L	2020	Characterizing and evaluating the impacts of national land restoration initiatives on ecosystem services in Ethiopia	LAND DEGRADATION AND DEVELOPMENT, 31(1), 37-52.	10.1002/ldr.3424
Ref8	England, JR; OGrady, AP; Fleming, A; Marais, Z; Mendham, D	2020	Trees on farms to support natural capital: An evidence-based review for grazed dairy systems	SCIENCE OF THE TOTAL ENVIRONMENT, 704, 135345.	10.1016/j.scitotenv.2019.135345
Ref11	Zheng, YL; Wang, HY; Qin, QQ; Wang, YG	2020	Effect of plant hedgerows on agricultural non-point source pollution: a meta-analysis	ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH, 27(20), 24831-24847.	10.1007/s11356-020-08988-7
Ref20	Van Vooren, L; Reubens, B; Broekx, S; De Frenne, P; Nelissen, V; Pardon, P; Verheyen, K	2017	Ecosystem service delivery of agri-environment measures: A synthesis for hedgerows and grass strips on arable land	AGRICULTURE ECOSYSTEMS AND ENVIRONMENT, 244 32-51.	10.1016/j.agee.2017.04.015

Disclaimer: These fiches present a large amount of scientific knowledge synthesised to assess farming practices impacts on the environment, climate and productivity. The European Commission maintains this WIKI to enhance public access to information about its initiatives. Our goal is to keep this information timely and accurate. If errors are brought to our attention, we will try to correct them. However, the Commission accepts no responsibility or liability whatsoever with regard to the information on these fiches and WIKI.