SINGLE-IMPACT FICHE
LANDSCAPE FEATURES

IMPACT: CROP YIELD

Data extracted in May 2022
Fiche created in December 2023

Note to the reader: This fiche summarises the effects of Landscape features on CROP YIELD. It is based on 9 synthesis papers[1], including from 25 to 300 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect on crop yield per productive unit (i.e. not accounting for the crop area loss that the establishment of some landscape features may involve) differs among 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 crop yield (i.e. increase of crop yield) compared to cropland or grassland without field margins, according to 1 synthesis paper.
- Flower strips have a non-significant effect on crop yield compared to cropland or grassland without flower strips, according to 3 synthesis papers.
- Hedgerows have an overall significantly positive effect on crop yield compared to cropland or grassland without hedgerows, according to 1 synthesis paper, though the effect depends on the ratio between hedgerow distance to the productive area and hedgerow height.
- Isolated trees have a non-significant effect on crop yield compared to cropland or grassland without isolated trees, according to 2 synthesis papers.
- Terraces have differing effects on crop yield compared to cropland or grassland without terraces. 1 synthesis paper reported one significantly positive effect, one significantly negative effect and one non-significant effect depending on the typology of the terrace (vegetated contour bunds, contour bunds without vegetation, and stone terraces, respectively). In addition, 1 synthesis paper reported relevant results, but this evidence is not statistically tested.
- Trees in group have a significantly positive effect on crop yield compared cropland or grassland without trees in group, according to 1 synthesis paper.

Out of the 9 selected synthesis papers, 6 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 crop yield	Crop yield	Field margins	No field margins	1	0	0	0
		Flower strips	No flower strips	0	0	3	0
		Hedgerows	No hedgerows	1	0	0	0
		Isolated trees	No isolated trees	0	0	2	0
		Terraces	No terraces	1	1	1	1 (0)
		Trees in group	No trees in group or field copses	1	0	0	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

[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.

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 9 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 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 crop yield. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref2	Arable crops, vegetables and orchards in Europe, America, New Zealand and South Africa	Global	29	Field-edge flower plantings	Unplanted, unmanaged field edges; unplanted, managed field edges (e.g., herbicide or mowing); grass strips; bare ground; and crop fields with no edge	Crop yield	Results show that the influence of field-edge plantings on crop pollination and yield is inconsistent.	88%
Ref4	Degradated landscape across several agroecology zones	Ethiopia	103	1) Contour bunds; 2) Terraces; 3) Vegetated contour bunds	No treatment, before treatment	Crop production	For productivity, the highest effect was observed from bunds + biological intervention followed by conservation agriculture practices, with 170% and 18% increase, respectively. The other interventions (bunds, fanya juu, and biological) reveal negligible effect on productivity. This indicates the need for developing integrated land management practices that enhance multiple ecosystem functions and/or identifying appropriate practices and targeting where they can generate maximum benefit.	62%
Ref5	Cropland	North America, Europe, New Zeland	35	1) Flower strips; 2) Hedgerows	1) No flower strips; 2) No Hedgerows	Crop yield	This synthesis reveals inconsistent and highly variable effects of flower strips and hedgerows on crop yield.	62%
Ref10	Croplands and grasslands	Northern hemisphere	40	Sites with field margin floral enhancement (only restored edges and herbaceous plants)	Sites without field margin floral enhancement	Crop yield	Overall, there was no effect of field margin floral enhancements on crop yield.	81%
Ref19	Croplands in sloppy areas	India	25	Contour grass barrier	Without grass barrier	Crop yield	The relative yield gained of various crops through contour grass barriers at different slopes varied between 44 and 53 %.	50%
Ref20	Arable crops	Global (temperate climate)	60	Hedgerows	No hedgerows	Crop yield	All studies reported a similar trend, consisting of lower crop yield close to the HR and a gradually restoring crop yield when D/H increases.	75%
Ref22	Human-made terraces world wide (including crops of rice, grain, coffee, potato, viticulture or ancient cultivation)	Global	300	Terraces	No terraces	Production potential (biomass accumulation, crop yield, etc.)	This global synthesis suggested that diverse terracing practices played a positive role in ecosystem services provisions, particularly biomass accumulation. Reviewers' note: We labelled the results as uncertain due to the lack of statistical testing.	44%
Ref25	Pasture land	Global	27	Scattered trees	No scattered trees	Crop yield	The sign and magnitude of scattered tree effects on pasture yield did vary among tree functional groups and according to precipitation levels. This study suggests that, as drought pressure increases abiotic stress, tree facilitation by N2-fixing trees, and competition by Eucalyptus, will become the more common interactions between scattered trees and pasture.	75%
Ref28	Cereals in West Africa	West Africa	63	Parkland trees, coppicing trees	No trees	Crop yield	Parkland trees showed no effect on crop yields while coppicing trees increased crop yield of millet and maize while had no effect on sorghum.	62%

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 crop yield	Crop yield	Field margins	No field margins	Ref19			
		Flower strips	No flower strips			Ref2, Ref5 and Ref10	
		Hedgerows	No hedgerows	Ref20			
		Isolated trees	No isolated trees			Ref25 and Ref28	
		Terraces	No terraces	Ref4	Ref4	Ref4	Ref22

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
		Trees in group	No trees in group or field copses	Ref28			

3. FACTORS INFLUENCING THE EFFECTS ON CROP YIELD

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

Factor	Reference number
Buffer maturity	Ref2
Distance to field edge	Ref20
Rainfall	Ref28
Slope	Ref19
Tree functional group	Ref25

4. KNOWLEDGE GAPS

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

Ref Num	Gap
Ref2	Critical gaps in our knowledge of when and how plantings can improve ecosystem service provision and delivery. Determining if field-edge plantings affect pollinator population growth may clarify how plantings improve crop pollination, while further research on landscape context and crop type may define when this happens.
Ref22	There is insufficient knowledge regarding design, construction and maintenance alternatives of terraces.

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
Ref2	Lowe, EB; Groves, R; Gratton, C	2021	Impacts of field-edge flower plantings on pollinator conservation and ecosystem service delivery - A meta-analysis	AGRICULTURE ECOSYSTEMS AND ENVIRONMENT, 310, 107290.	10.1016/j.agee.2020.107290
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
Ref5	Albrecht, M; Kleijn, D; Williams, NM; Tschumi, M; Blaauw, BR; Bommarco, R; Campbell, AJ; Dainese, M; Drummond, FA; Entling, MH; Ganser, D	2020	The effectiveness of flower strips and hedgerows on pest control, pollination services and crop yield: a quantitative synthesis	ECOLOGY LETTERS, 23(10), 1488-1498.	10.1111/ele.13576
Ref10	Zamorano, J; Bartomeus, I; Grez, AA; Garibaldi, LA	2020	Field margin floral enhancements increase pollinator diversity at the field edge but show no consistent spillover into the crop field: a meta-analysis	INSECT CONSERVATION AND DIVERSITY, 13, 519-531.	10.1111/icad.12454
Ref19	Mandal, D; Srivastava, P; Giri, N; Kaushal, R; Cerda, A; Alam, NM	2017	Reversing land degradation through grasses: a systematic meta-analysis in the Indian tropics	SOLID EARTH, 8(1), 217-233.	10.5194/se-8-217-2017
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
Ref22	Wei, W; Chen, D; Wang, LX; Daryanto, S; Chen, LD; Yu, Y; Lu, YL; Sun, G; Feng, TJ	2016	Global synthesis of the classifications, distributions, benefits and issues of terracing	EARTH-SCIENCE REVIEWS, 159, 388-403.	10.1016/j.earscirev.2016.06.010
Ref25	Rivest, D; Paquette, A; Moreno, G; Messier, C	2013	A meta-analysis reveals mostly neutral influence of scattered trees on pasture yield along with some contrasted effects depending on functional groups and rainfall conditions	AGRICULTURE ECOSYSTEMS AND ENVIRONMENT, 165, 74-79.	10.1016/j.agee.2012.12.010
Ref28	Bayala, J; Sileshi, GW; Coe, R; Kalinganire, A; Tchoundjeu, Z; Sinclair, F; Garrity, D	2012	Cereal yield response to conservation agriculture practices in drylands of West Africa: A quantitative synthesis	JOURNAL OF ARID ENVIRONMENTS, 78, 13-25.	10.1016/j.jaridenv.2011.10.011

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