SINGLE-IMPACT FICHE
LANDSCAPE FEATURES

IMPACT: POLLINATION

Data extracted in October 2021

Note to the reader: This fiche summarises the impact of three landscape features (field margins, flower strips and hedgerows[1]) on POLLINATION. It is based on 6 peer-reviewed synthesis research papers[2], including from 29 to 71 individual studies.

1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  The effect on pollination differs among landscape features (see **Table 1**):
  - <u>Field margins</u> have a positive effect on pollination (i.e. increase of pollination) compared to cropland or grassland without field margins, according to the 3 synthesis papers reviewed.
  - <u>Flower strips</u> have a positive effect on local pollinator abundance compared to cropland or grassland without flower strips and in the abundance and richness of pollinators in the flower strips themselves, according to 3 synthesis papers review. While flower strips have no effect on pollinators abundance and pollination services in the crops, according to 3 synthesis papers.
  - <u>Hedgerows</u> have no effect on crop pollination compared to cropland without hedgerows, according to 1 synthesis paper reviewed.

The 6 reviewed synthesis papers include data collected in Europe (see **Table 2**).

Table 1. Summary of effects. The effect with the higher score is marked in bold and the cell coloured. The numbers between parentheses 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. Two synthesis papers reported more than one effect for flower strips and some synthesis papers reported effects for more than one landscape feature.

Impact	Intervention	Positive	Negative	No effect	Uncertain
Increase pollination	Field margins	**3 (3)**	0	0	0
	Flower strips	**3 (3)**	0	**3 (3)**	0
	Hedgerows	0	0	**1 (1)**	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 this document* →.

---

[1] Described in the General Fiche.

[2] Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results →.

As shown in the "Quality score" in **Table 2,** the quality the 6 synthesis papers retrieved ranged from 62% to 88%. The least frequently satisfied quality criteria were: "Individual effect sizes", "Dataset available" and "Method of data extraction".

2. IMPACTS

The main characteristics and results of the synthesis papers are summarised in **Table 2**. Detailed results of each synthesis study are reported in the summary reports →.

Table 2. Main characteristics of the synthesis papers reporting impacts of landscape features on pollination. The references are ordered chronologically with the most recent publication date first.

Reference	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Lowe, EB; Groves, R; Gratton, C 2021	Flower crops	Global	29	Field-edge flower plantings (flower strips)	Unplanted, unmanaged field edges; unplanted, managed field edges (e.g., herbicide or mowing); grass strips; bare ground; and crop fields with no edge	Pollinator abundance and richness in the field-edge flower plantings; Pollinator abundance and richness in the crops	Results suggest that field-edge flower plantings are highly effective at increasing pollinator richness and abundance in field edges and that plantings become more effective as they mature. However, the influence of field-edge plantings on crop pollination is inconsistent.	88%
Albrecht, M; Kleijn, D; Williams, NM; Tschumi, M; Blaauw, BR; Bommarco, R; Campbell, AJ; Dainese, M; Drummond, FA; Entling, MH; Ganser, D 2020	Cropland	North America, Europe, New Zeland	35	1) Flower strips; 2) Hedgerows	No flower strips; 2) No Hedgerows	Crop pollination service	This synthesis reveals inconsistent and highly variable effects of flower strips and hedgerows on crop pollination services.	62%
Zamorano, J; Bartomeus, I; Grez, AA; Garibaldi, LA 2020	Croplands and grasslands	Northern hemisphere	40	Sites with field margin floral enhancement (flower strips)	Sites without field margin floral enhancement	Abundance and richness of pollinators	Overall, the field margin floral enhancements increased the abundance and richness of pollinators at the field edge but had no consistent effect in the interior of the crop fields.	81%
Marja, R; Kleijn, D; Tscharntke, T; Klein, AM; Frank, T; Batáry, P 2019	Croplands and grasslands	Europe	62	Agri-environmental management schemes (hedges, field margins and set aside lands) (field margins)	No agri-environmental management schemes (usually conventional farming)	Pollinators species richness	This study shows that pollinator species richness benefitted from Agri-environmental management schemes.	81%
Scheper, J; Holzschuh, A; Kuussaari, M; Potts, SG; Rundlf, M;	Croplands and grasslands	Europe	71	Sites with agri-environmental measures including 1) sown flower strip; 2) grass-	Conventionally managed control sites	Abundance and richness of pollinators	This study shows that agri-environmental measures generally enhance local pollinator species richness and	69%

Reference	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Smith, HG; Kleijn, D 2013				sown or naturally regenerated field margin or set-aside)			abundance in agroecosystems.	
Shackelford, G; Steward, PR; Benton, TG; Kunin, WE; Potts, SG; Biesmeijer, JC; Sait, SM 2013	Fields, orchards, and vineyards of food crops	Global	46	High compositional complexity (proximity or diversity of non-crop plants in margins of food crops) (field margins)	Low compositional complexity	Abundance and richness of pollinators	Some pollinators and natural enemies seem to have compatible responses to complexity, and it might be possible to manage agroecosystems for the benefit of both.	81%

3. KNOWLEDGE GAPS

Lowe et al., 2021   Critical gaps in our knowledge of when and how plantings can improve ecosystem service provision and delivery. Longer-duration studies would help to determine if field-edge plantings can influence pollinator population growth and may clarify how plantings improve crop pollination, while further research on landscape context and crop type may define when this happens.

Zamorano et al., 2020   Authors detected a bias in publications studying the impact of field margins on biodiversity at the edge of the crop primarily with positive effect sizes and larger standard errors (i.e. low sample size).

Marja et al., 2019   There was a geographical bias in the dataset, as most studies originated from Western or Northern Europe.

Shackelford et al., 2013   The authors identified the interactions between pollinators and natural enemies and their interacting effects on crop productivity as knowledge gaps.

4. SYSTEMATIC REVIEW SEARCH STRATEGY

Keywords	Different searches were conducted with the following search strings:
	1) TS= ("terrac*" OR "contour bund*" OR "level bench*" OR "level ditch*" OR "fish-scale pit*" OR "dry-stone wall*" OR "dry stone wall*" OR "stone wall*" OR "earth wall*" OR "dry wall*" OR "dry-wall*" OR "rubble wall*") AND TS= ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= (agric* OR cultiv* OR crop* OR farm*)
	or
	TITLE-ABS-KEY: ("terrac*" OR "contour bund*" OR "level bench*" OR "level ditch*" OR "fish-scale pit*" OR "dry-stone wall*" OR "dry stone wall*" OR "stone wall*" OR "earth wall*" OR "dry wall*" OR "dry-wall*" OR "rubble wall*") AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*"

OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: (agric* OR cultiv* OR crop* OR farm*)

2)   TS= ("ditch*" OR "earth bund*" OR "open-channel" OR "intermittent W/4 stream" OR "small W/4 stream") AND TS= ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

or

TITLE-ABS-KEY: ("ditch*" OR "earth bund*" OR "open-channel" OR "intermittent near/4 stream" OR "small near/4 stream") AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

3)   TS= ("pond*" OR "soda pan*" OR "reedbed*" OR "small W/4 lake*" OR "small W/4 wetland*") AND TS= ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

or

TITLE-ABS-KEY: ("pond*" OR "soda pan*" OR "reedbed*" OR "small near/4 lake*" OR "small near/4 wetland*") AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

4)   TS=(("strip*" OR "margin*" OR "hedge*" OR "edge*" OR "border*" OR "band*" OR "line*" OR "verge*" OR "row*") near/3 ("flower*" OR "vegetat*" OR "tree*" OR "shrub*" OR "plant*" OR "grass*" OR "filter*" OR "buffer*" OR "wooded" OR "riparian" OR "field*" OR "wildlife" OR "seminatural" OR "semi-natural" OR "semi natural")) AND TS=("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

merged with

TS= ("margin strip*" OR "windbreak*" OR "shelterbelt*" OR "hedgerow*" OR "road verge*" OR "riparian buffer*" OR "riparian vegetation" OR "riparian woodland*" OR "buffer zone*" OR "riparian zone*" "vegetated filter strip*") AND TS=("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

or

TITLE-ABS-KEY: (("strip*" OR "margin*" OR "hedge*" OR "edge*" OR "border*" OR "band*" OR "line*" OR "verge*" OR "row*") W/3 ("flower*" OR "vegetat*" OR "tree*" OR "shrub*" OR "plant*" OR "grass*" OR "filter*" OR "buffer*" OR "wooded" OR "riparian" OR "field*" OR "wildlife" OR "seminatural" OR "semi-natural" OR "semi natural")) AND TITLE-ABS-KEY: ("meta-analy*" OR

"systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

merged with

TITLE-ABS-KEY: ("margin strip*" OR "windbreak*" OR "shelterbelt*" OR "hedgerow*" OR "road verge*" OR "riparian buffer*" OR "riparian vegetation" OR "riparian woodland*" OR "buffer zone*" OR "riparian zone*" "vegetated filter strip*") AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

5)   TS=(("patch*" OR "islet*" OR "island*" OR "remnant*" OR "group*" OR "copse*" OR "coppice*") near/3 ("flower*" OR "vegetat*" OR "tree*" OR "shrub*" OR "grass*" OR "forest*" OR "wooded" OR "field*" OR "wildlife" OR "seminatural" OR "semi-natural" OR "semi natural")) AND TS=("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

merged with

TS=("woodland creation*" OR "mid-field islet*" OR "environmental island*" OR "refuge*" OR "scattered tree*" OR "shading tree*") AND TS=("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

or

TITLE-ABS-KEY: (("patch*" OR "islet*" OR "island*" OR "remnant*" OR "group*" OR "copse*" OR "coppice*") W/3 ("flower*" OR "vegetat*" OR "tree*" OR "shrub*" OR "grass*" OR "forest*" OR "wooded" OR "field*" OR "wildlife" OR "seminatural" OR "semi-natural" OR "semi natural")) AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

merged with

TITLE-ABS-KEY: ("woodland creation*" OR "mid-field islet*" OR "environmental island*" OR "refuge*" OR "scattered tree*" OR "shading tree*") AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

6)   TS= ("landscape feature*" OR "landscape characteristic*" OR "green infrastructure*" OR "landscape connectivity" OR "landscape diversity" OR "landscape element*" OR "landscape fragment*" OR "landscape mosaic*" OR "landscape structure*" OR "nature-based feature*" OR "linear feature*") AND TS= ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TS= ("agric*" OR "cultiv*" OR "crop*" OR "farm*")

or

	TITLE-ABS-KEY: ("landscape feature*" OR "landscape characteristic*" OR "green infrastructure*" OR "landscape connectivity" OR "landscape diversity" OR "landscape element*" OR "landscape fragment*" OR "landscape mosaic*" OR "landscape structure*" OR "nature-based feature*" OR "linear feature*") AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") AND TITLE-ABS-KEY: ("agric*" OR "cultiv*" OR "crop*" OR "farm*")
Search dates	No time restrictions
Databases	Web of Science and Scopus, run in October 2021
Selection criteria	The main criteria that led to the exclusion of a synthesis paper were when the paper: 1) does not deal with any landscape feature; 2) does not synthesise pairwise comparisons on the effect of landscape features; 3) does not include results for cropland or grassland; 4) deals with agroforestry; 5) is either a non-systematic review, a non-quantitative systematic review, or a meta-regression without mean effect sizes; 6) is not written in English. Synthesis papers that passed the relevance criteria were subject to critical appraisal carried out on a paper-by-paper basis. The search returned 244 synthesis papers potentially relevant for the practice object of our fiche. From the 244 potentially relevant synthesis papers, 136 were excluded after reading the title and abstract, and 74 after reading the full text according to the above-mentioned criteria. Finally, 34 synthesis papers were selected for landscape features, from which 6 were relevant for this impact.