# SINGLE-IMPACT FICHE
## LANDSCAPE FEATURES

## IMPACT: SOIL EROSION

Data extracted in October 2021

**Note to the reader**: This fiche summarises the impact of five landscape features (buffer strips, field margins, hedgerows, terraces, and trees in group[1]) on SOIL EROSION. It is based on 12 peer-reviewed synthesis research papers[2], each of them including from 11 to 300 individual studies.

## 1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  Landscape features have a consistent positive effect on soil erosion (i.e. decrease of soil erosion) compared to croplands or grasslands without landscape features (see **Table 1**):

- Buffer strips have a positive effect on soil erosion (soil loss and run-off) compared to cropland or grassland without buffer strips, according to 3 synthesis papers reviewed, while 1 of those synthesis papers also reported no effect on run-off. Another 2 synthesis papers reported relevant results, but without statistical test of the effects and they are labelled as uncertain. Details are provided below in Table 2 and in the summary reports.
- Field margins have a positive effect on soil erosion compared to cropland or grassland without field margins, according to the 2 synthesis papers reviewed.
- Hedgerows have a positive effect on soil erosion (soil loss and run-off) compared to cropland or grassland without hedgerows, according to 3 synthesis papers reviewed, while 1 of those synthesis papers also reported no effect on run-off.
- Terraces have a positive effect on soil erosion compared to cropland or grassland without terraces, according to 4 synthesis papers, while 1 of those synthesis papers also reported no effect (depending on the type of terraces). Another synthesis paper reported relevant results, but without statistical test of the effects and it is labelled as uncertain. Details are provided below in Table 2 and in the summary reports.
- Trees in group have an uncertain effect compared to cropland or grassland without trees in group. The only 1 synthesis paper reviewed reported relevant results, but without statistical test of the effects and it is labelled as uncertain. Details are provided below in Table 2 and in the summary reports.

All the 12 reviewed synthesis papers include data collected in Europe (see **Table 2**).

**Table 1.** Summary of effects. 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. Some synthesis papers reported more than one landscape feature or more than one result for the same landscape feature.

| Impact | Intervention | Positive | Negative | No effect | Uncertain* |
|---|---|---|---|---|---|

[1] Described in the General Fiche.

[2] Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results. Details can be found in the methodology section of the WIKI.

| | | | | | |
|---|---|---|---|---|---|
| Decrease of soil erosion | Buffer strips | 3 (3) | 0 | 1 (1) | 2 (0) |
| | Field margins | 2 (2) | 0 | 0 | 0 |
| | Hedgerows | 3 (3) | 0 | 1 (1) | 0 |
| | Terraces | 4 (3) | 0 | 1 (1) | 1 (0) |
| | Trees in group | 0 | 0 | 0 | 1 (0) |

* Number of synthesis papers that report relevant results but without statistical test comparison of the intervention and the control.

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 the methodology section of this WIKI.*

## 2. IMPACTS

The main characteristics and results of the synthesis papers are summarised in **Table 2**. Summaries of the meta-analyses provide fuller 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.

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

| Reference | Population | Scale | Num. papers | Intervention | Comparator | Metric | Conclusion | Quality score |
|---|---|---|---|---|---|---|---|---|
| Abera, W; Tamene, L; Tibebe, D; Adimassu, Z; Kassa, H; Hailu, H; Mekonnen, K; Desta, G; Sommer, R; Verchot, L 2020 | Degradated landscape across several agroecology zones | Ethiopia | 103 | 1) Contour bunds; 2) Terraces; 3) Vegetated contour bunds (all classified as terraces) | No treatment; before treatment | Soil erosion, run-off | The vegetated contour bud Fanya juu has the highest effect (-98%), followed by biological (-75%) and bunds (-74%) on soil erosion. | 62% |
| England, JR; OGrady, AP; Fleming, A; Marais, Z; Mendham, D 2020 | Grazed dairy systems | Global | 83 | Vegetation remants (trees in group) | Grazed dairy pasture without trees | Soil slope erosion | Authors report a positive effect of trees in group and field copses reducing erosion. *Reviewers' note: We labelled the results as uncertain due to the lack of statistical testing.* | 38% |
| Jia, L; Zhao, W; Fu, B; Daryanto, S; Wang, S; Liu, Y; Zhai, R 2019 | Slope farmlands | China | 81 | Treatment under minimum soil disturbance practices (contour tillage with hedgerow or micro-basins tillage) (hedgerows) | Control under conventional tillage | Sediment production; run-off | Overall, minimum soil disturbance practices (contour tillage with hedgerow) reduced sediment yield and run-off significantly compared with conventional tillage. | 81% |
| Xiong, M; Sun, R; Chen, L 2018 | Cropland and Orchard | Global | 121 | 1) Buffer strips; 2) Contour bunds, terraces (terraces); 3) Hedgerows | No soil conservation techniques | Soil loss, run-off | Buffer strips, terraces and contour bunds were effective in reducing soil erosion and run-off. | 69% |

| Reference | Population | Scale | Num. papers | Intervention | Comparator | Metric | Conclusion | Quality score |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | However, hedgerows were effective in reducing soil erosion but were not effective in reducing run-off. | |
| Chen, D; Wei, W; Chen, L 2017 | Croplands in China | China | 46 | Terraces | Non-terraced land | Run-off; sediments | The results confirmed that terracing significantly and positively affected water erosion control. | 75% |
| Mandal, D; Srivastava, P; Giri, N; Kaushal, R; Cerda, A; Alam, NM 2017 | Croplands and cropland in sloppy areas | Indian tropics | 83 | Contour grass barrier (terraces) | 1 )Bare land/fallow land; 2) Without grass barrier | Run-off, soil loss | The overall result of the meta-analysis showed that infiltration capacity increased approximately 2-fold after planting grasses across the slopes in agricultural fields, which reduced the runoff by 45% and the transported soil by 59% compared to control (no grass). The use of grass barriers was effective and efficient for decreasing soil and water loss on sloppy croplands in tropical and subtropical regions of India. | 44% |
| Van Vooren, L; Reubens, B; Broekx, S; De Frenne, P; Nelissen, V; Pardon, P; Verheyen, K 2017 | Arable crops | Global (temperate climate) | 60 | 1) Grass strips (field margins); 2) Hedgerows | 1) No grass strips; 2) No hedgerows | Soil sediment interception | Grass strips and hedgerows are very effective in increasing soil sediment interception. | 75% |
| Wei, W; Chen, D; Wang, LX; Daryanto, S; Chen, LD; Yu, Y; Lu, YL; Sun, G; Feng, TJ 2016 | Human-made terraces world wide (including crops of rice, grain, coffee, potato, viticulture or ancient cultivation) | Global | 300 | Terraces | No terraces | Run-off; soil erosion | This global synthesis suggested that diverse terracing practices played a positive role in ecosystem services provisions, particularly erosion control, followed by runoff reduction. | 44% |
| Maetens, W; Poesen, J; Vanmaerck, M 2012 | Cropland | Europe and Mediterranean | 111 | 1) Buffer strips; 2)Terraces and contour bunds (all classified as terraces) | Conventional practices | Run-off; soil erosion | Buffer strips are effective in reducing soil loss. Terraces were not effective in reducing runoff and soil loss, while contour bunds were effective in reducing both of them. | 31% |
| Zhang, XY; Liu, XM; Zhang, MH; Dahlgren, RA; Eitzel, M 2010 | Agricultural fields | Global | 73 | Outflow from vegetated buffers (buffer strips) | Inflow into vegetated buffers | Efficacy sediment mass retention | Vegetated buffers are generally effective in removing sediment from runoff. Buffer width, slope, and vegetation type are important | 56% |

| Reference | Population | Scale | Num. papers | Intervention | Comparator | Metric | Conclusion | Quality score |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | factors for designing an effective buffer. | |
| Liu, XM; Mang, XY; Zhang, MH 2008 | Croplands | Global | 31 | Outflow from grassed buffer strips (including vegetative filter strips, riparian buffer zones, and grass waterways) (buffer strips) | Inflow into grassed buffer strips (including vegetative filter strips, riparian buffer zones, and grass waterways). | % of sediment removal | Vegetated buffers in the studies exhibited an excellent potential for sediment removal. *Reviewers' note: We labelled the results as uncertain due to the lack of statistical testing.* | 38% |
| Dorioz, JM; Wang, D; Poulenard, J; Trévisan, D 2006 | Cultivated land | France | 11 | Grass buffer strips | No buffer strips and before buffers strips | Run-off; sediment retention | *Reviewers' note: We labelled the results for buffer strips as uncertain due to the lack of statistical testing.* | 31% |

## 3. KNOWLEDGE GAPS

**England et al., 2020**

The number of publications supporting a given relationship between on-farm woody systems and ecosystem services was often relatively low.

**Xiong et al., 2018**

Due to a lack of detailed information about some of the influential factors and the types of soil conservation techniques (SCT) in this study, as well as the substantial variation in study conditions, the environmental and experimental factors controlling the variability in the efficiency of each SCT could not be clearly identified in this study.

**Chen et al., 2017**

Other variables such as terrace age, size and management, which could possibly influence the effectiveness of terraces, were not considered due to insufficient data.

**Wei et al., 2016**

There is insufficient knowledge regarding design, construction and maintenance alternatives of terraces.

**Zhang et al., 2010**

Although models captured a reasonable amount of variance in buffer removal efficacy, the model predictions contain uncertainty. First, the model is an oversimplification of a complex set of processes. Second, the environmental settings and management scenarios of the studies vary considerably. Finally, the models would be greatly improved had there been enough information on buffer slope available in the literature.

**Dorioz et al., 2006**

Long-term benefits remain questionable given the relatively short-term use of this approach in phosphorus reduction and the lack of long-term experimental results.