FARMING PRACTICE
LANDSCAPE FEATURES

IMPACT: CARBON SEQUESTRATION

Reference 1

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

Background and objective

The establishment of hedgerows may be a promising strategy to promote carbon (C) sinks for climate change mitigation. However, comprehensive and quantitative overviews comprising both soil and biomass C in traditional hedgerow ecosystems in the temperate climate region are scarce. The aim of this meta-analysis and review was to derive comprehensive estimates of C stocks in both soils and biomass of hedgerows. Here, results on soil organic carbon (SOC) stocks are reported.

Search strategy and selection criteria

A literature survey based on the ISI Web of Science database was carried out, applying the following search string: (hedge* OR bocage OR "field margin"$OR shelter$belt OR wind$break) AND (carbon OR "*organic matter*" OR humus) AND soil. The reference lists of the obtained articles were also searched for eligible studies. The literature search was updated until May 2020 without date restrictions. 1) Report SOC contents or stocks in hedgerow soils 2) Studies with a paired-plot design, in which adjacent agricultural fields were sampled as a control 3) Original studies with measured data; model studies were not considered 4) The control plot had to have a comparable soil type, especially a comparable texture, with that of the hedgerow plot 5) Studies analysing other types of field margins, e.g. windbreaks. consisting of one tree line and no shrubs or field margins with mainly herbaceous vegetation, were excluded 6) The analysis was restricted to the temperate climate zone with a mean annual temperature of between 0 and 18 °C, according to the IPCC definition of temperate climate.

Data and analysis

The difference in SOC between the hedgerow soils and the soils of adjacent agricultural fields was studied through meta-analysis. Unique effect sizes with corresponding 95 % Wald-type confidence intervals were calculated for all studies. Heterogeneity between the studies was tested with Cochran's Q-test and I2 statistics. Correspondingly, a random effects model was applied to calculate the overall effect sizes. The individual effect sizes were therefore weighted by the inverse of their variance. Lastly, all response ratios were back-transformed into percentages to aid interpretation. Analyses were performed with the metafor package in R version 3.5.3.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
9	Croplands and grasslands	Hedgerows	No hedgerows	Metric: Soil organic carbon stock; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	100

Results

- The establishment of hedgerows on cropland leads to a significant increase in SOC stocks. The SOC stock under hedgerows was on average 32 % higher than in the adjacent cropland, with a 95 % confidence interval ranging from 15 to 51 %. Using the case of average temperate cropland, this translates into an SOC stock increase of 17 ± 12 Mg C ha−1 with the establishment of hedgerows on cropland.
- In contrast, the difference between SOC under hedgerows and adjacent grasslands was close to zero (average of 9 %). The 95 % confidence intervals for the grassland overall estimate ranged from −30 to 19 % and thus overlapped zero, indicating that the establishment of hedgerows compared with grassland has no statistically significant effect on SOC.
- Test for heterogeneity was significant for both subgroups (cropland control: Q = 34.15, df= 9, p value <0.001; I2 = 78.82 %; grassland control: Q = 21.45, df = 5, p value <0.001; I2 = 83.23 %). However, except for one site in the "grassland control" subgroup, the confidence intervals of all studies overlapped with the overall estimate. Therefore, the direction and average magnitude of the treatment effect were robust for both subgroups.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The establishment of hedgerows, especially on cropland, can be an effective option for C sequestration in agricultural landscapes.