IMPACT: SOIL EROSION

Reference 20

Lee, H; Lautenbach, S; Nieto, APG; Bondeau, A; Cramer, W; Geijzendorffer, IR 2019 The impact of conservation farming practices on Mediterranean agro-ecosystem services provisioning-a meta-analysis REG ENVIRON CHANGE 10.1007/s10113-018-1447-y

Background and objective

In the Mediterranean region, the long-term provision of agro-ecosystem services is threatened by accelerating climate change, unsustainable farming practices, and other pressures. Alternative management practices such as conservation agriculture could be expected to ensure sustainability of ecosystem services from Mediterranean agro-ecosystems. Conservation agriculture is characterized by minimal soil disturbance, permanent soil cover, and diversification of crop species. The objective of this study is to fill this knowledge gap by conducting a meta-analysis on the impact of conservative management practices on ecosystem services in the Mediterranean basin based on published literature. Our goal is to identify the positive and negative impacts of conservation farming practices on ecosystem services in the Mediterranean basin, providing evidence-based recommendations for sustainable land management in the Mediterranean basin in the future.

Search strategy and selection criteria

Target literature was selected following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework: Identification, Screening, Eligibility, Inclusion (Moher et al. 2009) (Supplementary Fig. SF1). Literature searches were conducted in the ISI web of knowledge core database targeting peer-reviewed articles published online until April 30, 2015 in two steps. In a first query, we tested it by including a specific management option such as "irrigation" because water shortage is conceived as a potential threat to the Mediterranean agricultural system (Fader et al. 2016; Malek and Verburg 2017). The search terms for the first query was thus ("agro" OR "agri" Or "farm") AND (mediterranean) AND (ecosystem) AND (management) AND (irrigat) in the topic field. This query yielded 45 papers. Then, we strove to capture the diversity of farming practices studied in case studies by not including any à priori restrictive search terms. This additional query was made with combinations of keywords including ("agro" OR "agri" Or "farm") AND (mediterranean) AND (management) in the topic field. Similarly, we strove to include all papers that contained relevant information on ecosystem services, and a large number of indicators that were used in the literature to quantify the supply of those services. We therefore refrained from using "ecosystem services" as a search term. Doing so helped to include relevant papers such as traditional agronomy research out of the domain of ecosystem services. The additional query returned data records for 1,881 peer-reviewed articles. We selected empirical case studies which measured ecosystem services-related properties both for conservation (treatment) and conventional (control) management options. This step excluded pure simulation modeling studies and reviews. We focused on papers reporting results from the Mediterranean Basin but included six well-designed papers (see the caption of Supplementary Fig. SF1) reporting from Mediterranean climate regions outside the basin (i.e., South and South West Australia, the Cape of South Africa, Central Chile, and California.

Data and analysis

For the uncertainty analysis, we report the means and 95% confidence intervals (CIs) of the WIRR. The CIs were constructed by non-parametric bootstrapping (nboot = 10,000) (Adams et al. 1997) using the percentile method (Davison and Hinkley 1997). The bootstrapping was only conducted for management options with more than seven case studies (n≥ 8) as the bootstrap is unreliable when the sample size is too small (Efron and Tibshirani 1994). For those with the sample size less than 8 (n < 8), we reported the mean weighted response ratio (WIRR) without estimated CIs. We considered the effect of treatment as significant if the 95% bootstrap CI did not overlap with zero. To aid interpretation, mean response ratios and lower and upper limits of CIs were graphically examined using violin plots (n≥ 8) (Adler 2005). When the sample size was less than 8 (n < 8), the strip chart was constructed to visualize data points. All calculations were done in R version 3.3.1 (R Core Team 2016) using the packages boot (Canty and Ripley 2017) and vioplot (Adler 2005).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
10	Mediterranean agro-ecosystems	Cover crops	No cover crops	Metric: Sediment formation; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- The sample size for mulching, cover cropping, and organic weed management was less than eight. The variance was constructed by nonparametric bootstrapping (nboot = 10000) when the sample size was lager than seven (n ≥ 8). When the sample size is less than eight (n < 8), only strip chart of the effect size was plotted.
- The sample size for mulching, cover cropping, and organic weed management was less than eight and no statistical analysis was carried out. Therefore, the result was set as 'uncertain'.
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The sample size for mulching, cover cropping, and organic weed management was less than eight and no statistical analysis was carried out. Therefore, the result was set as 'uncertain'.