

### Reference 27

Tuomisto HL; Hodge ID; Riordana P; Macdonald DW 2012 Does organic farming reduce environmental impacts? – A meta-analysis of European research Journal of Environmental Management 112, 309-320 10.1016/j.jenvman.2012.08.018

### Background and objective

Organic farming is often perceived to have generally beneficial impacts on the environment compared to conventional farming. A meta-analysis was used to evaluate the results of peer-reviewed studies comparing the nutrient losses, biodiversity impacts, greenhouse gas (GHG) emissions, eutrophication potential, acidification potential, energy use and land use in organic and conventional farming systems in Europe. Here, only results on soil organic carbon are reported.

### Search strategy and selection criteria

The following search term combinations were used: (organic AND conventional AND farming) OR (organic AND conventional AND agriculture). The preliminary search was refined to the subject areas "agriculture", "plant sciences", "environmental sciences & ecology" and "biodiversity & conservation" 1)the study was related to European farming systems, 2) the study compared organic and conventional farming and provided quantitative results on at least one of the following aspects: soil organic carbon, land use, energy use, GHG emissions, eutrophication potential, acidification potential, nitrogen leaching, phosphorus losses, ammonia emissions or biodiversity, and 3) the paper was published in a scientific peer-reviewed journal. All types of studies (i.e. original field investigations, modelling studies and Life Cycle Assessment studies) were included in the study.

### Data and analysis

The median values of the response ratios for each impact category were calculated. The normality of the data was tested by using the Kolmogorov–Smirnov test. Not all impact ratios were normally distributed, therefore a Wilcoxon Signed Rank test was used to determine whether the median impact ratios were significantly different from zero. The correlations between some farming practices and environmental impacts were examined using the Spearman Rank test. SPSS 14.0 software was used for the statistical analyses.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
71	Field studies, modelling studies and Life Cycle Assessment studies of organic systems in comparison to conventional systems in Europe.	Organic systems	Conventional systems	Metric: Soil organic matter per unit of area; Effect size: Considered metrics: soil organic matter. Effect sizes: Standardized difference of the considered metrics between organic systems and conventional systems.	68.75

### Results

- The median soil organic matter content across all the cases was 7% higher in organic farms compared to conventional farms. Regardless of a wide variation, the median difference between the systems was statistically significant.
- The organic matter inputs in the form of manure or compost were on average 65% higher on organic farms compared to conventional farms. When the organic system had more or the same amount of manure input than conventional system, the SOM content in organic systems was significantly higher (35%, graphical interpretation).
- When organic systems had lower manure input than conventional systems, the difference in soil organic matter content between the systems was not significant.
- There was no correlation between organic matter inputs and soil organic matter (Spearman's Rho = 0.24, N = 46; P = 0.11). Therefore the organic matter inputs alone cannot explain the differences in Soil organic matter content levels between the systems.
- NULL

### Factors influencing effect sizes

- Input of organic matter : NA
- Presence of leys in the rotation : Organic farms in the data had on average 14% more leys in the rotation, although there was no correlation between ley area and soil organic matter content (Spearman's Rho = 0.08, N = 47, P = 0.58).

### Conclusion

The results indicate that organic farming generally leads to significantly higher soil organic matter content, but some conventional farming systems do have the potential to achieve similar or even higher soil organic matter levels when they include the application of manures.