Agroforestry and carbon sequestration

Reference 7

Felix, GF; Scholberg, JMS; Clermont-Dauphin, C; Cournac, L; Tittonell, P. 2018 Enhancing agroecosystem productivity with woody perennials in semi-arid West Africa. Agronomy for Sustainable Development 38, 57. doi: 10.1007/s13593-018-0533-3

Background and objective

In semi-arid West Africa, the question remains as to whether biomass derived from trees and shrubs can provide an adequate soil amendment to improve soil quality and crop productivity, in a way that is sustainable and accessible to farmers. The objective is to quantify the effects of the presence of woody perennials and the use of ramial wood amendments on crop productivity and soil characteristics. Here, only results on soil total carbon are reported.

Search strategy and selection criteria

The first series of search terms related to the source of the woody perennial (tree or shrub), the second to the management practice (mulch or (inter)cropping), the third to the response variables (e.g. soil properties and crop productivity), and the last one related to the specific environmental context (specific countries within semi-arid west Africa). a)Studies that were conducted in the defined environmental context (rainfall < 1000 mm year−1 in semi-arid agroecosystems of Sudano-Sahelian Africa. b) Studies that included woody amendments as a management practice (surface-mulched or buried branches and/or leaves, but not biochar), and describing local uses of woody residues, or the presence of woody shrub or tree vegetation in farmers' fields, and reported effects on soil quality and/or crop productivity. c) Studies conducted on either farmers' fields or experimental stations were typically included with corresponding field data; pure modelling results were excluded. d) Literature reviews were excluded from the meta-analysis but were used to cross-check data, methods, and references.

Data and analysis

Graphical analysis based on boxplots.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
47	Cropping systems with trees in Semi-arid west Africa.	Plots under or at the vicinity of tree canopy. Plots receiving ramial wood as soil amendment.	Plot outside the area of canopy influence. Plot not receiving ramial wood as soil amendment.	Logarithm of ratio of soil carbon content in plots under tree canopy (or at the vicinity, or amended with ramial wood) to soil carbon content in plots outside the area of canopy influence (or not receiving ramial wood as soil amendment).	50%

Results

- The presence of shrubs and trees on agricultural fields had an overall positive but variable effect on soil total C (i.e.+ 20 to 75%)
- Ramial wood amendments had overall beneficial effects on soil C, independent of source material.
- Higher total soil C content (+ 20 to 75%) under canopies of woody perennials is normally ascribed to litter deposition and sediment trapping.
- Soils amended with coppiced material as mulch tended to result in higher C contents than control soils that did not receive organic amendment, and higher than buried ramial wood
- Shrubs in cereal-based cropping systems render similar benefits as trees (i.e. enhanced soil properties) with fewer trade-offs in terms of yield.

Factors influencing effect sizes

Factors impacting soil carbon have not been investigated in detail.

Conclusion

Presence of trees, shrubs and ramial wood amendments had overall positive effects on soil carbon in the large majority of case studies.