

Agroforestry and carbon sequestration

Reference 10

Sileshi, GW. 2016 The magnitude and spatial extent of influence of *Faidherbia albida* trees on soil properties and primary productivity in drylands. *Journal of Arid Environments* 132: 1-14. doi: 10.1016/j.jaridenv.2016.03.002

Background and objective

Faidherbia albida is a leguminous (nitrogen-fixing) tree which presence in the crop fields has been widely reported to increase soil fertility and crop yields. Used to combat desertification and greening of the Sahel. *Faidherbia* has also gained prominence in climate -smart agriculture. This review provides analyses of the magnitude and spatial extent of *Faidherbia* tree impact on soil properties and cereals primary productivity. The meta-analysis aimed to answer the questions: 1) Is there any consistent increase in soil nutrient pools and crop yields due to *Faidherbia* trees and how large is the effect size?; 2) Does the tree's root system mine a particular nutrient from the soil beyond the reach of its crown?; and 3) Does the tree's root system mine the soil beyond the reach of its crown? Here, only data regarding soil organic carbon pools are reported.

Search strategy and selection criteria

Literature search in both published and unpublished sources on secondary data on SOC.

Study must 1) have been published in a refereed journal, book chapter or peer-reviewed proceeding or any other report; 2) have soil or crop yield measurements 'under canopy' and a corresponding measurement 'outside canopy' to be treated as a well-defined control; 3) have reported the mean as numerical or graphical data; and 4) reported soil properties for each soil depth separately.

Data and analysis

From the studies selected, pairs of observations (under canopy and corresponding values in the open area) on SOC and soil organic matter were extracted.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
21	<i>Faidherbia</i> trees on arable land (arid zones).	Agroforestry: Scattered <i>Faidherbia albida</i> trees in crop systems	Open area or patches taken furthest from the tree trunk, in the same field as the intervention.	Logarithm of ratio (RR) of soil organic carbon (SOC) measurements under the canopy to SOC measurements in the open area (or patches taken furthest from the tree trunk).	44%

Results

- The SOC contents (% w/w on dry soil) under the canopy ranged from 0.8 to 5.3% while the values in the open ranged from 0.5 to 3.3%.
- Significant increases in SOC (46%) under canopy than in the open area.
- The magnitude of increase was significantly higher on sites with below-average SOC content, compared to those with above-average SOC values in the open area
- The tree created predictable patterns in SOC consistent with distance-decay models of spatial interaction. Its growth and canopy development appear to explain the size dependence of the spatial extent of its influence, with a marked influence observed under large trees than small trees.
- NA

Factors influencing effect sizes

Effect on SOC depends soil nutrient content (larger increases in nutrient-poor sites) and on distance from trunks (larger increases close to trunks).

Conclusion

Faidherbia induces significant improvement in soil properties (including soil organic C, with a significant increase of 46%) under its canopy, with spatial patterns that vary with distance from the trunk in a predictable manner.