Agroforestry and soil nutrient

Reference 3

Bayala, J; Kalinganire, A; Sileshi, GW; Tondoh, JE. 2018 Soil Organic Carbon and Nitrogen in Agroforestry Systems in Sub-Saharan Africa. A Review. In: Improving the Profitability, Sustainability and Efficiency of Nutrients Through Site Specific Fertilizer Recommendations in West Africa Agro-Ecosystems pp. 51-61, Springer, Cham. doi: 10.1007/978-3-319-58789-9_4

Background and objective

Trees in farming systems play a range of ecological functions among which soil fertility improvement seems to be the most accepted role, particularly through the increase in soil carbon and nitrogen. This study aims at capitalizing the existing information about soil carbon and nitrogen improvement of four key agroforestry practices (alley cropping, improved fallow, mulching and parkland). Here, only results on soil nitrogen and C:N where reported.

Search strategy and selection criteria

Literature search through ICRAF, FAO, and Google Scholar. The search equation included the terms Agroforestry, soil fertility, and the four types of systems considered. 1)The data are from sub-Saharan Africa; 2) The publication contains reported carbon and nitrogen data of the four agroforestry practices and a corresponding control plot where the practice was not applied, with mean values reported numerically; 3) Data were from well designed and replicated experiments or observational studies either on a research station or on farmers' fields.

Data and analysis

Data were converted to mean difference and were further analyzed usign mixed models fitted using Restricted Maximum Likelihood (REML). 95% confidence intervals of mean differences were computed.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
34	Arable land in (tropial and semi-arid) sub-Saharan Africa	Plots with one agroforestry practice among alley cropping, improved fallow, mulching and parkland.	Plots without alley cropping, improved fallow, mulching and parkland.	Difference of soil nitrogen and C:N ratios between plots with and without one agroforestry practice.	50%

Results

- Agroforestry (alley cropping, mulching, and parlkand) significantly increased soil nitrogen content by 32.1, 32.4, 35.5%, respectively. The effect of fallow on soil nitrogen content was variable and not significant.
- Alley cropping had significantly lower C:N values compared to mulching and parklands.
- The species used in alley cropping are leguminous, explaining the lower increase of C:N ratio estimated for this practice.
- Legume tree-based farming systems are able to increase soil nitrogen (N) availability and therefore improve soil fertility.
- NA

Factors influencing effect sizes

Level of N content increase with N-fixing species presence due to chemical composition of pruning material that is applied to the soil.

Conclusion

All agroforestry practices (except improved fallows) significantly increased nitrogen over the control. C:N ratios showed the highest values in mulching and parklands as opposed to the alley cropping where nitrogen fixing species are incorporated.