Agroforestry and yield

Reference 8

Bayala, J; Sileshi, GW; Coe, R; Kalinganire, A; Tchoundjeu, Z; Sinclair, F; Garrity, D. 2012 Cereal yield response to conservation agriculture practices in drylands of West Africa: A quantitative synthesis. Journal of Arid Environments 78: 13-25. doi: 10.1016/j.jaridenv.2011.10.011

Background and objective

The lack of quantitative synthesis in terms of the nature and magnitude of response and the contrasting results reported regarding the potential of conservation agriculture (including some forms of agroforestry) call for a comprehensive and quantitative analysis. The present study attempts to provide a comprehensive, quantitative synthesis of existing reports on the effect of conservation agriculture (including some forms of agroforestry, i.e. parkland and coppicing trees) practices on crop yield response in Burkina Faso, Mali, Niger and Senegal. Here, we focus on agroforestry systems (parkland and coppicing).

Search strategy and selection criteria

Data for the meta-analysis were compiled from publications and reports. The studies included were located by searching through computer library databases (ICRAF, FAO, and Google Scholar). However, this alone does not provide a comprehensive search and therefore itwas followed up with supplementary searches for grey literature such as student theses and unpublished research reports. (1)The data are from one of the four countries Burkina Faso, Mali, Niger and Senegal; (2) The publication contains reported crop yield of one or more of the 6 CA practices and a corresponding control plot where the practice was not applied, with mean yields either reported numerically or graphically. The yield data from rotations were not time-averaged by including years when other crops were grown while data from tree-based systems were based on total area; (3) Data were from well designed and replicated experiments or observational studies either on a research station or on farmers fields.

Data and analysis

Mean difference (D) in yield data were analyzed by simple summary statistics and calculation of empirical cumulative distributions. Data on D were further analyzed using mixed models fitted using Restricted Maximum Likelihood (REML). Besides null hypothesis testing, statistical inference was based on the predicted means and their 95% confidence intervals (CI). The relative frequency of positive or negative effects was estimated for each practice using the cumulative probability distribution of D.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
63	Conservation agriculture with and without trees	Six different forms of conservation agriculture, including parkland trees and coppicing trees	System without conservation agriculture (in particular, no tree)	Difference of yield of both grain and straw biomass between convervation agriculture with trees and control without trees.	50%

Results

- No significant effect of parkland on yields of maize, sorghum and millet. However, when separating F. albida from the rest of the species because of its reverse phenology, shedding leaves during the rainy season, mean difference in grain yield was 0.24 t ha1 for F. albida compared to 0.14 t ha1 for the rest of the parkland species.
- Significantly higher yields in coppicing systems for maize and for millet. No significant effect of coppicing for sorghum.
- A large proportion of the cases recorded a reduction in grain yield (D < 0) in parklands (66%) and coppicing trees (44%) relative to the control. Similarly, straw yields were lower than or equal to the control in over 50% of the cases in parklands and 37% of the cases in coppicing trees
- For coppicing trees, yield increases were generally more positive where annual average rainfall is >800mm or <600mm.
- Yield increases were lower relative to the control under parkland trees where annual average rainfall is >800 mm.

Factors influencing effect sizes

Rainfall, site productivity, type of systems, crop species, tree species: variable effects.

Conclusion

Coppicing increases yields of cereals in average, but not parkland systems. Yield response variability is high and could be partly explained by rainfall and site quality.