



Is agroforestry an effective way to diversify cropping systems to improve biodiversity and ecosystem services?

* Damien Beillouin, CIRAD, France

Tamara Ben-Ari, INRAE, France

Eric Malezieux, CIRAD, France

Verena Seufert, CIRAD, Germany

David Makowski, CIRAD, France

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Increasing the diversity of species in agricultural systems is expected to benefit biodiversity and enhance ecosystem services. A fast-growing literature on this subject has produced numerous qualitative and quantitative syntheses largely varying in their scope, quality, type of crop diversification considered, and indicators of ecosystem services investigated. It resulted in a fragmented evidence difficult to synthesize and analyze for most decision makers. Here, we quantified simultaneously the biodiversity, supporting, regulating and provisioning ecosystem services of five main type of crop diversification, i.e., agroforestry, associated plants, intercropping, crop rotation and cultivar mixture. In this aim, we collected and integrated the results of 5156 experiments from 95 meta-analyses, covering more than 120 crops and 85 countries. Our results show that, all crop diversification strategies considered together, significant improvement of crop yields, associated biodiversity, and several ecosystem services including water quality, pest and disease control, and soil quality are obtained compare to less diversified systems. Yet, there was substantial variability in the results for each individual ecosystem service between the different diversification strategies. Agroforestry strikes out as a particularly promising strategy compared to the 4 others; that is able to substantially increase all the ecosystem services considered in our analysis, that is, associated biodiversity (+61%, [26%, 105%]), production (+35%, [12%, 62%]), water regulation (+45%, [13%, 87%]), water quality, pest and diseases control (+59%, [38%, 82%]), and soil quality (+19%, [16%, 23%]). We detailed these performances according to the type of agroforestry systems (e.g. parkland, alley cropping, hedgerows); and identified knowledges gaps. Further investigation is of interest to study the performance of systems where several diversification strategies are combined, and the economic performance of these systems, which have so far been poorly documented in the papers identified.