



Agroforestry based on legume trees to improve banana cropping ecosystem services provision

A. Transitioning to Healthy Soils

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Agroforestry is a promising lead to face environmental and societal emerging challenges faced by tropical agroecosystems. This stake is especially high in West Indies, where global changes consequences are already impacting banana cropping systems. Yet, agroforestry is not well known in these territories, and needs more research before being advised to the farmers. In this context, CIRAD set up an experimental site in 2018 comparing three banana cropping systems: (i) a conventional system, mirroring the average practices in Martinican banana systems, (ii) a bio-intensive system, where synthetic inputs are replaced by organic ones, and (iii) a bio-diversified system, associating organic inputs with a complementary crop (cocoa) and legume service-trees (*Inga Ingoides* and *Indigofera zollingeriana*). The following ecosystem services and disservices were assessed after four years: C storage, N provision and competition, soil structure maintenance, and weevil and plant-feeding nematodes regulation, in parallel to crop yield. The three systems exhibited contrasting services provision. In 2021, banana yield was the highest in the conventional system thanks to shorter production cycles, and the lowest in the bio-diversified system due to lower banana plantation density. Nonetheless, the conventional system faced higher weevil pressure compared to the organic systems, likely due to the lower diversity found in this system. On the other hand, the organic systems faced higher competition for N yet higher levels of C restitution due to their mechanical management of the inter-row weeds. This effect was in part counterbalanced in the bio-diversified system by the presence of legume trees, which led to a significant enrichment of soil C and above all soil organic N (+15% and +11% increase compared to the conventional system, respectively). Overall, the services trade-offs suggest a better sustainability of the agroforestry system due to a fast increase of soil quality, that needs to be confirmed by longer-term analyses.