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Plant diversity level does not affect cocoa productivity: The case of Colombian agroforestry systems

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Cacao is a major commodity crop that is mostly planted in small plots managed by family workforce in agroforestry systems (AFS). AFS are productive systems that combine a diverse canopy and provide opportunities for preserving biodiversity while sustaining rural livelihood. However, the role of the diversity and structure of the associated plant community on cocoa's productivity is still poorly assessed, especially in Colombian AFS. We selected fifteen cacao-based AFS in the upper Magdalena region of Colombia. In each one, we used a 1,000 m² plot to characterize the diversity, structure and uses of the associated plant community. Additionally, we described the cocoa tree populations by measuring plantation density, age, and size of the cocoa trees. Finally, we characterized management practices by conducting farmers interviews to assess the frequency of pruning, application of fertilizer and manual pest control. AFS were ranked by multivariate analysis according to (i) management intensity, and (ii) plant functional groups based on the uses by humans. Four types of AFS differed on their management intensity and ranged from old plots planted at low density and based on traditional varieties to young plots planted at high densities of improved cacao varieties. Three types of AFS differed for their plant functional groups and included plantations where either fruit, timber or service trees predominated. Cocoa yield was in average low and although it widely varied among farms, differences were not significant among management or plant functional group types. As expected, cacao yield was positively affected by the proportion of improved cacao varieties and negatively affected by the proportion of unproductive cocoa trees. However, cacao yield was not affected by associated plant diversity. When most approaches to increase productivity are focused on replacing unproductive cacao trees with improved cacao varieties, we suggest that associated plant diversity should also be taken into account to diversify products and increase overall productivity, especially when the selected species do not affect cocoa yield. Better planning and management of associated plant species within cocoa-based AFS could provide further benefits to farmers such as provision or regulation ecosystem services. Research funded by UMNG Grant CIAS 2304.

References:

1. plant functional groups
2. *Theobroma cacao*
3. Colombia Peace Agreement
4. management intensity
5. plant species richness