



Comparison of the contribution of a participatory approach and a mathematical modeling in the design of complex agroforestry systems

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Redesigning our agricultural systems has become a priority today in order to limit the negative impacts on the environment and global health caused by our farming systems. Two main types of approach to the design of innovative cropping systems exist: the top-down type, a linear approach where research produces knowledge that is disseminated by advisory agencies to farmers, and the bottom-up type, a participatory approach that includes a set of relevant actors to produce innovations. We tested these two approaches for the design of cocoa-based agroforestry systems in the Dominican Republic. On the one hand, agronomic monitoring of 34 agroforestry plots allowed us to produce different prototypes for optimizing the functioning of these systems using different algorithms. On the other hand, an original participatory design process was conducted to develop four prototypes of innovative cocoa agroforestry systems. The economic and environmental sustainability, through the biodiversity grown within the prototypes from these two types of approaches, are compared. The mathematical modelling approach resulted in prototypes that are less diverse than those from the participatory approach, with a crop biodiversity from 2 to 4 species and from 4 to 7 species respectively. From an economic point of view, the results are also weaker, with a turnover of between US\$ 2500 and US\$ 3500 ha⁻¹ yr⁻¹ for the modeling approach compared to US\$ 6683 to US\$ 8670 ha⁻¹ yr⁻¹ for the participatory approach. These systems have real potential for improvement because the complexity of interactions between different crop species, and in particular of facilitation processes, is still poorly explored. The strengths and weaknesses of the two methods are discussed and clearly indicate that hybrid approaches, giving a prominent place to both rural and research actors, would provide more disruptive and sustainable solutions.