

## Session 10. Quantifying the role of agroforestry in modifying watershed functions

The session (attended by 50 participants) aimed at studies that provide quantification of the processes involved in the water balance at plot level with consequences for river flow, in agroforestry systems with variable composition. Most of the detailed studies derived from coffee agroforestry in either Costa Rica or Indonesia.

The session opened with a presentation of plot-level processes on hillslopes gave evidence of the role of surface litter, the soil macrofauna that feeds on that and macroporosity that enhances infiltration. Multistrata coffee are intermediate between coffee monoculture and natural forest in litterfall, standing necromass as well as macroporosity and surface runoff. Differences litter quality (based on lignin, polyphenol and N content) were small and could not account for the much longer litter residence time in forests, suggesting other factors such as species diversity and microclimate are important. Further studies suggest that the species composition of the earthworm fauna and the macroporosity resulting from root turnover are important modifiers on these relations.

Multistrata agroforest intercept more rainfall than monoculture coffee and have higher transpiration losses as revealed in the patterns of sapflow, as measure of water uptake from the soil. Models of water uptake that relate uptake potential to relative root length density in different layers provide a good starting point for water balance models in mixed systems. These effects in combination with reduced drainage and increased infiltration reduced runoff and in multistrata agroforests thus they contributed less to peak watershed outflows (and hence flooding risk) than monoculture coffee. Nevertheless, stream flow patterns were dominated (60%) by non agricultural sources (roads, settlements, etc.) pointing to the need for a balanced assessment when attributing the blame for flooding events to land use patterns.

Deep tree roots contribute to slope stabilization, while shallow tree roots bind the topsoil and reduce the risk that soils break while sliding down the slope. Simple characterizations of root architecture assist in differentiating among trees and appreciate the value of tree diversity in mixed agroforestry in terms of complementarity of functions. Differences in root strength between tree species are linked to the lignin content of roots. When root density and strength are combined, bamboo emerges as one of the best options for slope stabilization.

At watershed level, buffering of flows is the main challenge. Three new 'buffer indicators' were proposed that focus on

- A) flow persistence (as indicator of the prevalence of three pathways: overland flow with zero persistence, interflow with about 50% persistence and groundwater pathways with about 95% persistence),
- B) the seasonal pattern of depletion of landscape stores of water in the dry season, followed by recharge in the early part of the rainy season (with low river flow per unit rainfall) and a saturated phase (with high riverflow per unit rainfall).
- C) the ratio of above-average riverflow and above-average rainfall, that can focus on buffering during extreme events.

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