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Land cover effects on infiltration and preferential flow pathways in the high rainfall zone of Madagascar

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Shortened slash-and-burn cycles exhaust agricultural land and have resulted in extensive tracts of highly degraded land across the tropics. Land degradation typically results in decreased rainfall infiltration due to a reduced field-saturated hydraulic conductivity of the topsoil because of a progressive decline in soil organic matter, exposure to raindrop impact, surface sealing and compaction. This results, in turn, in enhanced surface runoff and erosion, and consequently less subsurface flow and groundwater recharge. On the other hand, natural vegetation regrowth or active reforestation can lead to a renewed accumulation of soil organic matter, macropore development and increased infiltration rates.

As part of the P4GES project (Can Paying 4 Global Ecosystem Services values reduce poverty?; www.p4ges.org), we study the effects of land use change and reforestation on water resources in the Corridor Ankeniheny-Zahamena (CAZ) in eastern Madagascar. In this poster, we present the results of infiltration and preferential flow measurements in four different land uses in the southern part of the CAZ: (i) closed canopy forest, (ii) 3-14 year-old regrowth on fallow land (savokas), (iii) exhausted and severely degraded land (tany maty), and (iv) recently reforested sites (6-8 years old). The results show that infiltrability increases significantly after several years of forest regrowth after land abandonment, but it remains unclear whether active replanting decreases the time required for restoration of soil hydrological functioning. Preferential flow pathways differed strikingly between the respective land cover types: infiltration in mature forests was predominantly characterized by macropore flow (preferential flow pathways), whereas infiltration in exhausted agricultural land was dominated by matrix flow (few preferential flow pathways). Occurrence of preferential flow pathways in reforestation and fallow sites varied considerably. These results suggest that land cover significantly affects hydrological flow pathways and that natural regeneration and active reforestation of degraded land can result in increased infiltration and a reduced likelihood for surface runoff.