Soil physical and hydrological parameters as indicator for the sustainability of land use systems in degraded areas on terra firme in the Amazon Basin

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Large areas in Central Amazon were deforested and abandoned after a short period of cultivation. There is a need to develop alternative land use systems, which allow the utilization of degraded areas in an economically viable and socially and ecologically sustainable way. If this can be achieved, there is a chance to reduce the rate of deforestation and to reintroduce those areas in the production process. This study is part of an ongoing long-term program for the recultivation of degraded sites in the Central Amazon Basin, and our specific objective was to investigate the soil physical and hydrological characteristics under monocultures and an agroforestry system. The experiment was conducted on a Xanthic Ferralsol near Manaus. The investigated systems were monocultures of Cupuaçu (*Theobroma grandiflorum*) and Pupunha (*Bactris gasipaes*) and an agroforestry system composed of Cupuaçu, Pupunha, Annatto (*Bixa Orellana*), Brazil nut (*Bertholletia excelsa*) with a cover crop of Pueraria (*Pueraria phaseoloides*). Adjacent sites with fallow and primary forest were included for comparison. Soil physical (particle size, bulk density, pore size distribution) and hydrological (saturated and unsaturated hydraulic conductivity and soil retention curves) parameters were evaluated. The soil parameters showed a high spatial heterogeneity. The investigated soil showed an unusual behavior: the hydraulic conductivity was high close to and at saturation as it is commonly found in sandy soils; however, at high soil water suction, it can retain large amounts of water which is a typical characteristic for clayey soils. This phenomenon may be explained to the particle size distribution (predominantly clay) and its strong aggregation. The sustainability of this soil is related with the stability of its aggregation, therefore the flocculation index may be a good parameter to evaluate its physical stability. Within the agroforestry system, significant lower bulk densities were found near the trunks of *Bactris gasipaes*. If this small-scale heterogeneity within a land use system is not taken into account, it may cause considerable errors on soil water estimates. An abrupt increase of the hydraulic conductivity near saturation was found that indicates the high risk of nutrient leaching and pesticide contamination during the periods of heavy rainfall. Practical and ecological interpretation of these data will be discussed.