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Mechanisms of Stability and Erodibility of Humid Tropical Soils under Intense Rainfall

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The structural degradation of the soil surface due to rainfall makes the surface more susceptible to erosion. In the humid tropical Caribbean with steep sloping and mountainous topography, the soils that are mostly of medium (20 – 45 % clay content) to fine (>45 % clay content) texture are particularly vulnerable to structural breakdown and prone to run-off and erosion due to high rainfall episodes that characterize the region. Consequently, understanding the mechanisms leading to structural stability and breakdown under intense rainfall is of particular importance in achieving and maintaining an open aggregated structure that is necessary to ensure adequate water movement through the soil and reduction in runoff and erosion risks under continued wetting and raindrop impact. We studied the structural stability in the presence and in the absence of rainfall, runoff following surface sealing and the effects of intrinsic soil properties and extrinsic dynamic wetting factors of the surface 0 – 10 cm of 23 agriculturally important humid tropical soils in Trinidad with varying clay content, mineralogy and organic mater (OM) content. We found that the contributors to cation exchange capacity (CEC) in a soil have a strong influence in the stability and erodibility of the soil under intense rainfall. Hence, in soils where clay content is medium (20 - 45 %) to high (>45 %) and smectitic mineralogy was the principal contributor to high CEC, aggregates succumbed easily to slaking forces and raindrop impact. But if in the same clay texture range, high CEC is jointly contributed by smectitic mineralogy and high OM (>3 %), the resistance to slaking forces of fast wetting is increased. Therefore, for these and other similar soils exposed to intense rainfall, OM content must be maintained at high levels to strengthen the fragile fabric of the soils against the disruptive forces of intense rainfall.