



Tropentag, October 5-7, 2011, Bonn

“Development on the margin”

Effect of Mass Movements and Climate on Natural Soil Fertility in Mountainous Ecosystems of Monsoonal Vietnam and Humid Tropical Indonesia

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Abstract

Knowledge about the natural state of soil fertility is crucial for quantifying climatic effects or naturally occurring mass movements. There is a lack of data about soil fertility parameters in natural state in steep slopes of mountainous ecosystems of Southeast Asia. Deforestation and subsequent cultivation reduce the remaining primary forest areas with pristine soils. We selected 5 sites in monsoonal northwestern Vietnam and 10 sites in humid tropical Indonesia. Our aims were to find out (1) how soil fertility parameters differ between the two climatic regions and (2) if naturally occurring mass movements in Indonesia have an effect on soil fertility. Soil profiles have been described and analysed horizon wise until 1 m depth. Soils in Vietnam are Luvisols, Alisols and Vertisols. Undisturbed Indonesian soils are Ferralsols, Acrisols and Lixisols. Mass movement affected Indonesian soils are mostly Cambisols. Most soil fertility parameters were significantly higher in Vietnam compared to Indonesia: Clay content 61 %, stocks of organic C 37 %, stocks of total N 30 %, stocks of exchangeable Ca^{2+} 87 % and Mg^{2+} 70 %, cation exchange capacity 78 %, base saturation 30 % and pH value 1,5 units. Only stocks of exchangeable K^{+} were higher in Indonesia (33 %) than in Vietnam. Mass movements under primary forest significantly favoured some of the investigated soil fertility parameters: In mass movement affected soils significantly higher base saturation (60 %), higher pH value (1,3 units), higher stocks of Ca^{2+} (72 %), higher sand contents (21 %) as well as lower clay contents (21 %) were found compared to undisturbed Indonesian soils. Stocks of Mg^{2+} and K^{+} were higher in mass movement affected soils than in undisturbed soils, however, not significantly. No effect of mass movements was detected for stocks of C and N. This study highlights the climatic benefits and constraints of the two studied regions as well as the beneficial effects of mass movements for soil fertility. Mass movements keep the soils young due to mixing old soil with weatherable minerals. Their wide spread occurrence throughout the tropics should be considered more when discussing about soil fertility in natural state.

Keywords: Climate, land slide, mass movement, mountain, primary forest, soil