Geophysical Research Abstracts
Vol. 12, EGU2010-14800, 2010
EGU General Assembly 2010

Analytical tools for assessing land degradation and its impact on soil quality

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Maintaining and enhancing the quality of land is of major importance to sustain future production capacity for food and other agriculture based products like fibers and wood, and for maintaining ecosystems services, including below and above ground biodiversity, provision of soil water and sequestration of carbon. Deterioration of this production base will be detrimental to the provision of the foreseen dramatic increase in human needs for goods and services. For this reason, land degradation, defined as a long-term loss in ecosystem function and productivity, has to be understood properly.
Climate, soils, topography and socioeconomic activities are primary factors that can cause, by themselves or in combination, a number of temporary or permanent changes in the landscape, leading to degradation of vegetation and soils. For identifying intervention measures to prevent and revert trends of land deterioration, it is fundamental to know the extent of land degradation and to understand its impact on functional properties of land. To assess the global extent, (Bai et al. 2008) apply a remotely sensed vegetation index that describes the greenness of the vegetation cover as a proxy for biomass. Biomass production has been identified as a strong indicator for soil quality as it is an integral measure for soil, crop and environmental characteristics (Bindraban et al., 2000). Bai and colleagues observed that 24% of the global land has been degrading over the past 26 years - often in very productive areas. The relation with functional properties of land can be made through ecosystem models. Mantel et al. (1999; 2000) applied dynamic crop-soil models to calculate crop productivity at the national level. A baseline scenario that represents the current conditions and a scenario for 20 years of prolonged sheet erosion were modeled to calculate the productivity impact of topsoil erosion for wheat in Uruguay and for maize in Kenya. They concluded that topsoil erosion primarily affects nutrient availability; in 20% of the potential maize growing areas productivity declined more then 50%. Overall, hydraulic soil functions were less affected by erosion in Kenya, still rain-fed yield decline exceeded 50 % on very steep lands. The simulated loss of topsoil in the Uruguay case mostly affected soil physical properties causing a reduction in rainfed wheat yields. Soil fertility status was little affected.
In this paper we reflect on the use and effectiveness of these two approaches and discuss options for their (partial) integration as a means to better quantify extent, degree of degradation and the effects on soil quality.

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