

Soil erosion in mountainous areas: how far can we go?

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Erosion is the counter part of soil formation, is a natural process and cannot be completely impeded. With respect to soil protection, the term of tolerable soil erosion, having several definitions, has been created. Tolerable erosion is often equalled to soil formation or production. It is therefore crucial that we know the rates of soil formation when discussing sustainability of soil use and management. Natural rates of soil formation or production are determined by mineral weathering or transformation of parent material into soil, dust deposition and organic matter incorporation. In mountain areas where soil depth is a main limiting factor for soil productivity, the use and management of soils must consider how to preserve them from excessive depth loss and consequent degradation of their physical, chemical and biological properties. Even under natural conditions, landscape surfaces and soils are known to evolve in complex, non-linear ways over time. As a result, soil production and erosion change substantially with time. The fact that soil erosion and soil production processes are discontinuous over time is an aspect that is in most cases completely neglected. To conserve a given situation, tolerable values should take these dynamics into account. Measurements of long and short-term physical erosion rates, total denudation, weathering rates and soil production have recently become much more widely available through cosmogenic and fallout nuclide techniques. In addition to this, soil chronosequences deliver a precious insight into the temporal aspect of soil formation and production. Examples from mountainous and alpine areas demonstrate that soil production rates strongly vary as a function of time (with young soils and eroded surfaces having distinctly higher rates than old soils). Extensive erosion promotes rejuvenation of the surface and, therefore, accelerates chemical weathering and soil production – the resulting soil thickness will however be shallow. The comparison of soil production and erosion rates indicates that the present-day management of grassland soils in several alpine and mountain regions will lead in the long-term to very shallow soils (showing the characteristics of young soils). Shallow soils go along with high ‘tolerable’ erosion rates. It is, however, strongly doubtful whether this matches the deeper sense of sustainability.