



Landscape and soil governance: A rapid vulnerability assessment method applied in a Paramo landscape in Northern Peru

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The Andean paramo ecosystems constitute geodiversity hotspots of global importance, but also have important ecosystem functions. These include agricultural production (mostly livestock and high altitude crops such as potatoes, but also forestry) and deliverance of water to be used for various purposes (drink water, irrigation water, hydroelectric power) in downstream catchments, often hosting major population concentrations and industries.

Because of their alpine relief, extreme climate and overall fragile soils, Paramo ecosystems are susceptible to degradation upon land use, particularly under increased human pressure such as by encroaching agriculture, accelerated by climate change posing a further threat to the functioning of remaining more or less conserved or pristine Paramo areas. Throughout the more populated parts of the Andes, where land use has seriously intensified over the past decades, degradation has become rampant with associated losses of the functions mentioned. To this comes an increased worldwide demand for minerals, leading to their exploration and large-scale exploitation in hitherto inaccessible and remote areas, such as the higher parts of the Andes. Not surprising, the mining issue and related environmental hazards are high on the political agenda of most Andean countries, though not always based on scientific knowledge of its potential impacts in specific areas.

A rapid assessment methodology is presented for the Las Lagunas region near Cajamarca in Northern Peru. The method includes prefield segmentation and classification of Landsat ETM+ and ASTER imagery, complemented with detailed aerial photo interpretation. The results are stored in a GIS geodatabase and supplemented with data from field surveys. This leads to rapid and sound postfield analyses and vulnerability classifications using simple GIS tools. The results are pointing at four important issues in relation to soil and landscape governance and identification of vulnerability zones: 1) The widespread glacial deposits of the former local icecap and overlying peat areas form an important but unexplored proxy for climate change, 2) The fragile soils contain large amounts of organic matter and are important as carbon stocks, 3) Increased water use will lower groundwater levels and lead to oxidation of peat and hence reduction in carbon storage, 4) Climate change will lead to increased human pressure (e.g. increased grazing) on the fragile ecosystem making it more vulnerable for degradation and loss of soil water retention.

Apart from the scientific value of the assessment and its potential for application in other mountain areas, it is of utmost importance for projecting future managing strategies that should be implemented in regional planning to prevent unnecessary loss of irreplaceable soils and landscapes as well as to optimize sustainable use of resources and sustainable development of these areas.