



Landscape processes, effects and the consequences of migration in their management at the Jatún Mayu watershed (Bolivia)

Ivanna Penna (1), Stephanie Jaquet (2), Karen Sudmeier-Rieux (1), Raoul Kaenzig (3), Gudrun Schwilch (2), Michel Jaboyedoff (1), Hanspeter Liniger (2), Angelica Machaca (4), Edgar Cuba (4), and Sebastien Boillat (5)

(1) Risk Analysis Group-Institute of Earth Sciences. University of Lausanne, Switzerland. (ivanna.penna@unil.ch), (2) Centre for Development and Environment. University of Bern, Switzerland., (3) Institute of Geography. University of Neuchatel, Switzerland., (4) Agroecología Universidad de Cochabamba, Bolivia., (5) Department of Geography and Environment. University of Geneva, Switzerland.

Bolivia has a large rural population, mostly composed of subsistence farmers that face natural and anthropogenic driven processes affecting their livelihoods. In order to establish sustainable management strategies, it is important to understand the factors governing landscape changes. This work explores the geomorphic imprint and effects of natural and anthropogenic driven processes on three mountain communities undergoing de-population in the Jatún Mayu watershed (Cochabamba, Bolivia). Based on satellite image interpretation, field work and household surveys, we have identified gullies and landslides as main active processes, causing land losses, affecting inter-communal roads, etc.

While landslides are mostly occurring in the middle and lower section of the basin, gullies are especially affecting the upper part (especially the southern slope). Our analysis indicated that in the middle and lower part of the basin, landslides are developing in response to the Jatún Mayu incision (slopes reach a critical angle and slope failures increase). However in the upper part, where no river down-cutting is taking place, preliminary analysis indicates that past and present human interventions (over-grazing, agriculture, road construction, etc.) play a key role on driving land degradation toward the formation of gullies. Based on the comparison of high resolution images from 2004 and 2009, we determined an agricultural land loss rate of 8452 m²/year, mostly in the form of landslides. One single event swept away 0.03 km² of agricultural lands (~13 parcels), approximately 87% of an average household property.

People's main concerns are hail, frost and droughts because they cause an "immediate" loss on family incomes, but the impacts caused by landslides and gullies are not disregarded by the communities and the government. Communities are organized to set up and maintain key infrastructure such as irrigation canals and roads. They also intend to develop protective measures against erosion like check dams based on tyres filled with rocks. In addition, organizations supported by government and institutions from abroad have built dams, reforested some slopes, and raised local capacities to improve soil conservation measures e.g. through slow-forming terraces. However, rural-to-urban migration could be affecting the management of processes leading to land degradation. Around 77% of the 22 households surveyed have at least one migrant family member (permanent, seasonal or double residence migrant). Labour force is reduced and because of de-population, two of the three schools in the area have closed. In spite of the support that communities receive, our findings indicate that high population mobility is affecting land management practices and the capacity of communities to cope with land degradation processes.