



## **Landslide risks and associated management strategies in the Combeima region, Tolima, Colombia**

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Rainfall related landslides are a major hazard in many regions of Colombia, mainly due to the rough topography and tropical rainfall conditions. A particularly affected area is the Combeima valley in the Tolima region on the eastern slopes of the volcanically active Cordillera Central. The Combeima river is the major drainage of the active ice-capped volcano Nevado del Tolima. Population centers along the river have repeatedly and severely been affected by landslides and debris flows from steep tributaries during intense rainfall events. Hundreds of people have been killed by such events in the past. Most recently, multiple slope failures and landslides destroyed major parts of population centers in June 2006. The high landslide risks prevailing in the Combeima area have prompted efforts in the area of hazard and risk prevention, including recently a project where the leading Colombian institutions involved in prevention activities collaborated with the support of the Swiss Agency for Development and Cooperation. The objective of the project is the identification and quantification of landslide risks and the set-up of an early warning system for an improved protection of vulnerable people. To this aim, past rainfall-landslide events are analyzed to derive critical thresholds of landslide initiation. Effects of, and areas affected by, landslides and debris flows are modeled using numerical two-dimensional flow models. A major challenge is the estimation and quantification of the potential damage of settlements and important infrastructure such as transport/traffic and energy lines. Existing socio-economic data are integrated but have to be complemented by field surveys in collaboration with community leaders. The landslide risk estimation studies are part of an integrated risk management including the installation of an early warning sys-

tem based on real-time rainfall data processed in an operational center in the regional capital Ibagué and subsequent multiple-stage alarm releases in dependence of landslide initiation thresholds. The early warning system will be managed by the affected communities with support by the technical institutions. Education and communication programs with the affected communities are an essential part for successful improvement of protection.