



Landslides in Nicaragua – Mapping, Inventory, Hazard Assessment, Vulnerability Reduction, and Forecasting Attempts

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A successful landslide hazard and risk assessment requires awareness and good understanding of the potential landslide problems within the geographic area involved. However, this requirement is not always met in developing countries where population, scientific community, and the government may not be aware of the landslide threat. The landslide hazard assessment is often neglected or is based on sparse and not well documented technical information.

In Nicaragua (Central America), the basic conditions for landslide hazard and risk assessment were first created after the catastrophic landslides triggered by Hurricane Mitch in October 1998. A single landslide took the life of thousands of people at Casita volcano forcing entire communities to be evacuated or relocated and, furthermore, thousands of smaller landslides caused loss of fertile soils and pasture lands, and made serious damages to the infrastructure. Since those events occurred, the public awareness has increased and the country relies now on new local and national governmental laws and policies, on a number of landslide investigations, and on educational and training programs. Dozens of geologists have been capacitated to investigate landslide prone areas, The Instituto Nicaragüense de Estudios Territoriales (INETER), governmental geo-scientific institution, has assumed the responsibility to help land-use planners and public officials to reduce geological hazard losses. They are committed to work cooperatively with national, international, and local agencies, universities and the private sector to provide scientific information and improve public safety through forecasting and warnings. However, in order to provide successful long-term landslide hazard assessment, the institutions must face challenges related to the scarcity and varied quality of available landslide information; collection and access to dispersed data and documents; organization of landslide information in a form that can be easy to access, manage, update and distribute in a short time to all sectors and users; and finally, the need of a comprehensive understanding of landslide processes.

Many efforts have been made in the last 10 years to gain a more comprehensive and predictive understanding of landslide processes in Nicaragua. Since 1998, landslide inventory GIS based maps have been produced in different areas of the country, as part of international and multidisciplinary development projects. Landslide susceptibility and hazard maps are available now at INETER's Website for all municipalities of the country.

The insights on landslide hazard have been transmitted to governmental agencies, local authorities, NGO's, international agencies to be used in measures for risk reduction. A massive application example was the integration of hazard assessment studies in a large house building program in Nicaragua. Hazards of landslides, and other dangerous phenomena, were evaluated in more than 90 house building projects, each with 50 – 200 houses to be build, sited mainly in rural areas of the country. For more than 7000 families, this program could finally assure that their new houses were build in safe areas.

Attempts have been made to develop a strategy for early warning of landslides in Nicaragua. First approaches relied on precipitation gauges with satellite based telemetry which were installed in some Nicaraguan volcanoes where lahars occur frequently. The occurrence of lahars in certain gullies could be detected by seismic stations. A software system gave acoustic alarm at INETER's Monitoring Centre when certain trigger levels of the accumulated precipitation were reached. The monitoring and early warning for all areas under risk would have required many rain gauges. A new concept is tested which uses near real time precipitation estimates from NOAA meteorological satellite data. A software system sends out alarm messages if strong or long lasting rains are observed over certain landslide "hot spots".

The work in Nicaragua also aims to develop methods which can be followed in Central America and by other developing countries in the data collection, hazard mapping and assessment, Web publishing, and early warning.