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# An approach to vulnerability assessment based on historical data of landslide damage

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The historical data concerning landslides can represent a good way -or sometimes the only way- to assess the damage induced by these phenomena, and to outline the vulnerability for future landslide events.

The requests for refunding of damage, sent from damaged people to local and national Authorities after landslide events, provide a rough estimate of induced damage. For most recent events, these data are quite homogeneous because they are gathered in pre-printed forms. Data gathered in this way, despite not characterised by an absolute precision, supply an estimate of economic damage.

A specific research project, started many years ago at the CNR-IRPI of Cosenza, has been coping with the implementation of a complete database of landslides occurred in Calabria during the past centuries. Recently, a great amount of data has been acquired by regional archives of both Minister of Public Works and Corp of Engineers. These documents concern detailed descriptions of hundred of landslides which induced damage in Calabria region.

For some types of phenomena, considered representative of most critical climatic and geological sectors of the region, the analysis of a great amount of historical data allowed us to sketch some types of landslide “scenarios”. Basing on these elaborations, a simplified procedure for landslide damage assessment has been carried out. This procedure can be applied to future landslide events in order to roughly predict what kind of elements can be damaged and in what way.

Damage has been subdivided in three parts: direct, indirect and intangible.

To define the direct damage, damaged elements have been divided in nine main categories. In each category sub-types and component of the element have been introduced. For each sub-type and component, an arbitrary value, from 1 to 10, has been established.

Three level of vulnerability have been set: Level 1, Level 2 and Level 3, ordered in terms of decreasing severity.

The direct damage can be obtained by multiplying the level of vulnerability for the value of the damaged elements (or of its sub-type and component).

The indirect damage has been assessed taking into account the interruption or the delay of human activities caused by the landslide event, both in the areas directly involved in the phenomena evolution and in nearby zones. The activities have been divided in four main groups. For each group an arbitrary value has been set. Also in this case, the damage can be obtained by multiplying the level of vulnerability for the value of the damaged activities.

For the first two type of damage, historical data can be used to gathered useful information. For the assessment of intangible damage no data are available. This type of damage has been assessed basing on the number of people resident in the hit areas (at the time of the landslide event) which could be psychologically damaged by the landslide. To quantify this kind of damage, simplified procedures available on literature (mainly considering the age, the income and the resilience of people) has been used.

Despite the procedure has been obtained considering past landslide events, it can be used in a predictive way. It can also be used in other areas different from Calabria, by reviewing the arbitrary values of vulnerable elements according to the local economy of the area in which the approach will be used.