



## **Financing and budgetary impact of landslide losses for highways and urban infrastructures in NW Germany – an economic analysis using landslide database information and cost survey data**

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Recent studies show that landslides cause even in low mountain areas of Central and Western Europe millions of dollars in annual losses (Klose et al., 2012; Vranken et al., 2013). The objective of this study has therefore been to model landslide disaster financing and to assess budgetary impacts of landslide losses for highways and urban infrastructures in the Lower Saxon Uplands, NW Germany. The present contribution includes two case studies on the financial burden of landslides for public budgets using the examples of the Lower Saxony Department of Transportation and the city of Hann. Münden.

The basis of this research is a regional subset of a landslide database for the Federal Republic of Germany. Using a toolset for landslide cost modeling based on landslide databases (Klose et al., 2013), the direct costs of more than 30 landslide damage events to highways in a local case study area were determined. The annual average landslide maintenance, repair, and mitigation costs for highways in this case study area are estimated at \$0.76 million between 1980 and 2010. Alternatively, a cost survey based on expert interviews has been conducted to collect landslide loss data for urban infrastructures. This cost survey for the city of Hann. Münden shows annual landslide losses of up to \$3.4 million during the previous 10 years. Further expert interviews at city and highway agency level were focused on identifying procedure, resources, and limits of financing landslide damage costs. The information on landslide disaster financing and cost survey data on annual maintenance and construction budgets for highways, city sewer lines, and urban roads were used to evaluate the fiscal significance of estimated landslide losses.

The results of this economic impact assessment prove variable financial burdens of analyzed public budgets. Thus, in costly years with landslide losses of more than \$7 million, the Lower Saxony Department of Transportation is required to shift up to 19% of its financial resources for road construction to landslide repair and mitigation. The budgetary impact of estimated annual average damage costs for highways amounts to 3.1% of the annual average road construction budget. At city level, annual landslide losses of up to \$2.4 million for urban roads and \$1 million for sewer lines have been identified. These damage costs correspond to 31% or 22% of the city's construction budgets for urban roads or sewer lines. The present study has proven that landslide losses show the potential of significant economic impact on public budgets. Landslide losses affect short- to mid-term financial planning and are often accompanied by high opportunity costs.

### References:

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