



Assessing the Economic Cost of Landslide Damage in Low-Relief Regions: Case Study Evidence from the Flemish Ardennes (Belgium)

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Several regions around the globe are at risk to incur damage from landslides. These landslides cause significant structural and functional damage to public and private buildings and infrastructure. Numerous studies investigated how natural factors and human activities control the (re-)activation of landslides. However, few studies have concentrated on a quantitative estimate of the overall damage caused by landslides at a regional scale.

This study therefore starts with a quantitative economic assessment of the direct and indirect damage caused by landslides in the Flemish Ardennes (Belgium), a low-relief region (area=ca. 700 km²) susceptible to landslides. Based on focus interviews as well as on semi-structured interviews with homeowners, civil servants (e.g. from the technical services from the various towns), or with the owners and providers of lifelines such as electricity and sewage, we have quantitatively estimated the direct and indirect damage induced by landsliding and this for a 10 to 30 year period (depending on the type of infrastructure or buildings). Economic damage to public infrastructure and buildings was estimated for the entire region, while for private damage 10 cases with severe to small damage were quantified. For example, in the last 10 year, costs of road repair augmented to 814 560 € Costs to repair damaged roads that have not yet been repaired, were estimated at 669 318 € In the past 30 years, costs of measures to prevent road damage augmented to at least 14 872 380 € More than 90% of this budget for preventive measures was spent 30 years ago, when an important freeway was damaged and had to be repaired. These preventive measures (building a grout wall and improving the drainage system) were effective as no further damage has been reported until present. To repair and prevent damage to waterworks and sewage systems, expenditures amounted to 551 044 € and this for the last 30 years. In the past 10 years, a new railway line connecting two important Belgian cities has been built and within that one project, the cost to prevent damage to railroads augmented already to at least 4 567 822 € The value of real estate located in regions affected by landslides decreased with 15% to 35%. All these damage costs were then used to made potential damage maps. Based on the inventory of landslides, frequency of landslides' re-activation and land use, we categorized regions that are affected by landslides according to their temporal probability of landslide re-activation. This allowed us to produce a (semi-) qualitative risk map for regions that were affected by landslides in the past.

This paper shows that, though generally not spectacular, landsliding in low-relief regions susceptible to landslides is a slow but continuously operating process with considerable damage allowing one to identify several medium to high landslide risk zones. As such this study provides important information for government officials, especially those in charge of spatial planning and of town and environmental planning, as it clearly informs about the costs associated with certain land use types in landslide prone areas. This information can be particularly useful for regions in which increasing demand for building land pressures government officials and (local) political leaders to expand the built environment.