



Economic assessment of landslide risk for the Waidhofen a.d. Ybbs region, Alpine Foreland, Lower Austria

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Economic assessment of landslide risk for the Waidhofen a.d. Ybbs region, Alpine Foreland, Lower Austria

Assignment No. 5 – National Civil Protection Manager

Course 24S796912: Disaster Risk Management with Geoanalytics

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Faculty of Digital and Analytical Sciences,
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June 14, 2024

National Civil Protection Management in Low Austria: ArcGIS-based approach for landslide assessment



- i **Research goals:** Improving the national landslide disaster control by evaluating the expected number of people affected by landslides.
- ii **Aim:** to assess potential risk and estimate economic damage caused by landslides.
- iii **Study area:** Ybbs valley, Lower Austria
- iv **Software:** Arc GIS-based spatial analysis and estimation of the potential monetary losses caused by landslides.
- v **Technical approach:** Geospatial and economic data processing by Arc GIS using spatial and economic analysis
- vi **Methods:** Defining elements at risk located in the risk zone of 100 m near landslides, and assessment of potential consequences.
- vii **Results:** calculated possible losses caused by the destruction of immobility and transport: costs for buildings demolition, restoration, roads rebuilding, debris transport, excavation and removal.

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Study area: Ybbs
valley

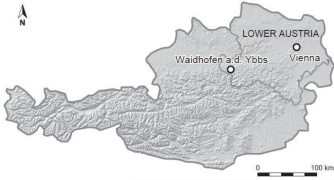
Data

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Study area: Ybbs valley, Alpine Foreland, Austria



- The region of Ybbs valley is located in mountainous Alpine Foreland, Austria.
- It covers a total area of 131.3 km².
- The environmental conditions of the the Ybbs valley are especially prone to landslides.
- Geology: deposits of gravel, sand, marl, conglomerate, calcareous sandstone, clay.
- Most of the region is used as pasture, agricultural land, and large forests.
- Climatic humid to continental. Intensive rainfalls in spring and autumn months.
- The region is attractive for tourists due to its environmental and historical value.



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Data structure

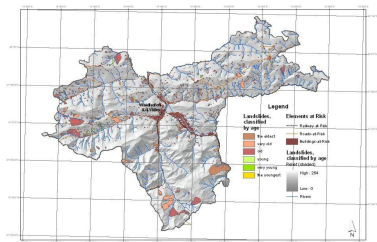
Type of factors	Thematic layers
Anthropogenic	Roads (railway, highways)
	Areas of demolishing & dismantling
	Areas of construction work
	Settlements
Topographic	Orthophotos
	DEM (1m and 3m resolution), DTM
	Vector relief map
Environmental	Watershed areas
	Water catchment areas
	Landscape protected zones
	Areas of NATURA-2000
	Geological vector map
	Natural protected zones; forests; parks.

Data characteristics

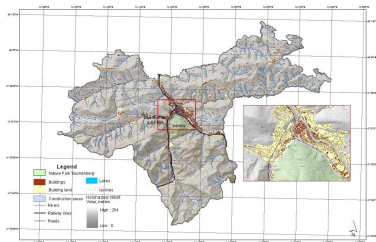
- i **Sources:** Data used in this research were obtained from the repositories of Provincial Government of Lower Austria.
- ii **Content:** Data include vector thematic layers covering the area, aerial imagery, topographic vector layers and maps.
- iii **Organization:** Data have been organized in a ArcCatalog database and sorted according to their types (Tab.1).
- iv **Compatibility:** Data have been stored in the ArcGIS project in Austrian National grid Austria Bundesmeldenetz (BMN) M34.
- v **Probability:** Data on landslide probability are gained from economic monitoring programmes.
- vi **Software:** Arc GIS-based spatial analysis and calculations for estimation of the potential monetary losses caused by landslides.

Methods

Landslides classified by age in Ybbs valley, Lower Austria



Elements at risk: buildings, roads, railway lines. Enlarged: city centre



- i **Location:** The geographic location of landslides within the Ybbs valley was used for defining risk zones.
- ii **Risk zone:** 100-meter buffer area surrounding all landslides downwards, as a landslide with volume of 1 km³ may reach 100 meters while moving.
- iii **Definition of the elements at risk:** objects located in the 100 meter distance downwards the landslides

- i **Estimation of the economic losses:** for Ybbs valley, real estate prices for common goods (immobility, roads) were used for estimation of possible losses in the zone of risk.
- ii **Calculations:** Economic losses were computed approximately (€) based on the average real estate prices for various aspects of renovation, reconstruction and rebuilding of the destroyed objects.

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Estimation of possible monetary losses for transport.

Type of investment	Construction cost	Length (m)	Total losses (€)
Railway tracks, (€/m) restoration (*)	4,200	20,953	A = 88,005,204
Road rebuilding, €/m (**)	4,131	13,541 (length in Ybbs valley)	B = 55,948,749
Debris excavation (a)	17		
Debris removal (b)	25		
Transportation & storage (c)	26		
Roads restoration, (a)+(b)+(c), €/m ² (***)	68.0		C = 927,590
Total possible direct damages (A+B+C) = 144,881,544			

(*) Source: Zischg et al., 2005 (**) Source: Giacometti, 2005. (***) Source: Sterlacchini et al., 2007

Real estate destruction losses, Ybbs valley, as for average market value.

Types of investment	Construction cost, €/year, one house	Total costs, all houses (*)
Demolition cost (concrete masonry), €/m³ (a)	87	-
Average volume to demolish, m ³ (b)	189,32	-
Mechanical excavation costs, €/m ³ (c)	25.5	-
Total (€) to demolish walls, concrete masonry = (a*b)+(c*b)	21,298	13,652,338
Transport and disposal debris, €/m² (**)	26	3,608,462
Inner walls restoration costs (€/m²)	7	-
Average surface of inner walls (m ²)	607	-
Average charge to restore inner walls (€)	4,252	2,725,852
Average price to restore furniture, €/m² (x)	600	-
Average house base area, m ² , (y)	317	-
Total average charge (€) to restore furniture (x*y)	190,500	122,110,500
Average house base area, m ² , (y)	317	-
Average cost to build a house (€/m³)	1,100	-
Total average charge to build a house, €	349,250	223,869,250
Total complete average charge (demolition + restoration), €	216,051	138,488,691

(*) Number of houses at risk in Ybbs valley = 641

(**) Total area of buildings at risk, m² = 138

- i Spatial analysis:** The length and number of the elements at risk within the distance of 100 m near landslides totals to 20.9 km of railway lines, 13.5 km of roads and 641 buildings.
- ii Calculation the economic losses (real estate):** computed from 5 different types of costs: 1) demolition, 2) transport and disposal debris, 3) restoration of inner walls, 4) furniture restoration and 5) house construction.

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Conclusions and key deliverables

- ▶ **Focus** The research focuses on the monetary estimation of the possible losses caused by landslide risks.
- ▶ **Approach** Estimation of the economic damages is performed using existing simplified methodologies.
- ▶ **Estimation of the economic losses:** for Ybbs valley, real estate and market prices for common goods (immobility, roads) were used for estimation of possible losses of the elements at risk in the risk zone.
 - ▶ The average volume of demolish damaged buildings indicated the dimensions of the losses of ca. 13.65 M €.
 - ▶ The estimated price for the debris removal is approx. 3.6 M €, in case buildings are totally affected and covered.
 - ▶ The restoration of the inner walls is based on average prices for building restoration and approximate surface of the walls: 2.73 M €.
 - ▶ Using approximate prices of the furniture costs in a typical house the costs for furniture renovation is € 190,500.
 - ▶ Cost for house construction is computed using real estate prices and average house area in m² which sums up to € 349,250.
 - ▶ The losses for transport include costs to rebuild a road, a railway, and a restoration of the roads.
 - ▶ A total of almost 140 M € would have to be invested for the renovation of the Ybbs valley in case of a landslides disaster
- ▶ **Economic losses:** were calculated *approximately* (€) based on the average real estate prices for various aspects of renovation, reconstruction and rebuilding of the destroyed objects.
- ▶ **Vulnerability:** estimation included basic census and approximate social data.
- ▶ **Software:** Arc GIS presents excellent geospatial tool for risk assessment

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