29 August 2024

Flood risk in the Como Lake district (Italy): economic and social impacts for the communities

Elisabetta M. Venco – *Department of Civil Engineering and Architecture – DICAr, University of Pavia*

Massimiliano De Rose – *Engineer, Lombardy Regional Council of Engineering Professional Associations – CROIL*

Index

S–15 **Flood Risk and Natural Hazard in the Built Environment – From Economic Impact to Regional Resilience**

Elisabetta Venco (P)
Massimiliano De Rose

NATURAL RISKS

Natural hazards are predominantly associated with natural processes and phenomena.
Potential loss of human life, damage or destruction of elements that make up a system/society/community in a specific time frame due to a natural hazardous event.
It is determined probabilistically as a function of multiple factors.

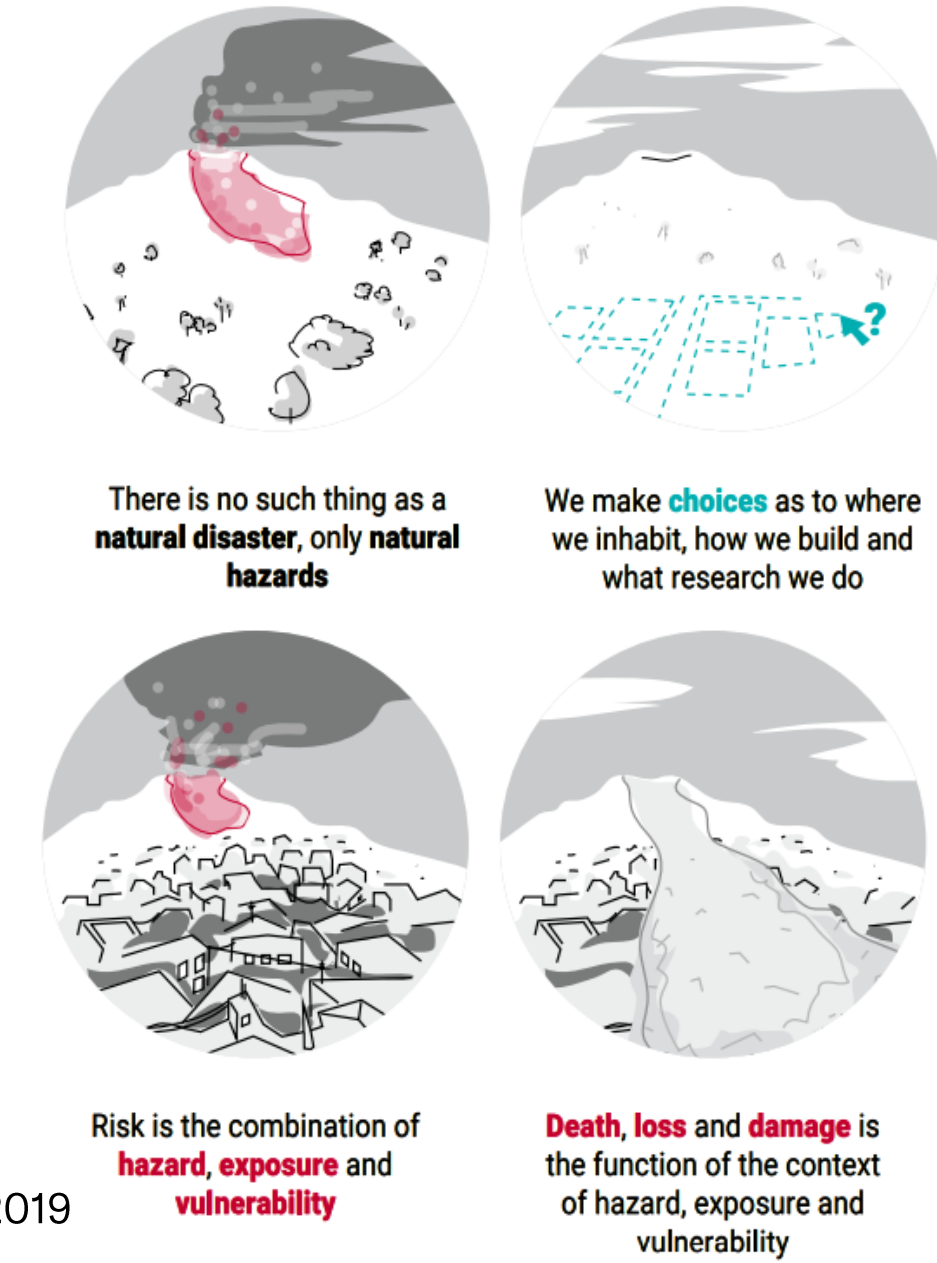
Hazard: Potentially harmful event/process of a given intensity in a given space and time.

Vulnerability: Propensity of an element to suffer damage

Exposure: Quantity/value/type of elements affected

Adaptation: ability of the affected elements to response and to cope

$$R \approx H*V*E/A$$



UNDRR 2019

HAZARDOUS NATURAL EVENTS: FLOODS

Floods are among the most typical manifestations of hydrogeological instability and occur when the waters of a river/lake are not contained by the banks and pour into the surrounding area causing damage to buildings, industrial settlements, communication routes, agricultural areas.

TRIGGERING FACTORS

EXOGENOUS: heavy rainfall
ENDOGENS: earthquakes, landslides

SPATIAL DIMENSION Sudden floods: valley bottom of mountainous areas; River floods: alluvial plains; Floods due to dam/shore rupture: Random, based on dam/shore location

DURATION Flash floods: rapid, a few hours. River floods: from days to weeks

TIME OF OCCURANCE Flash floods: seconds. River floods: days

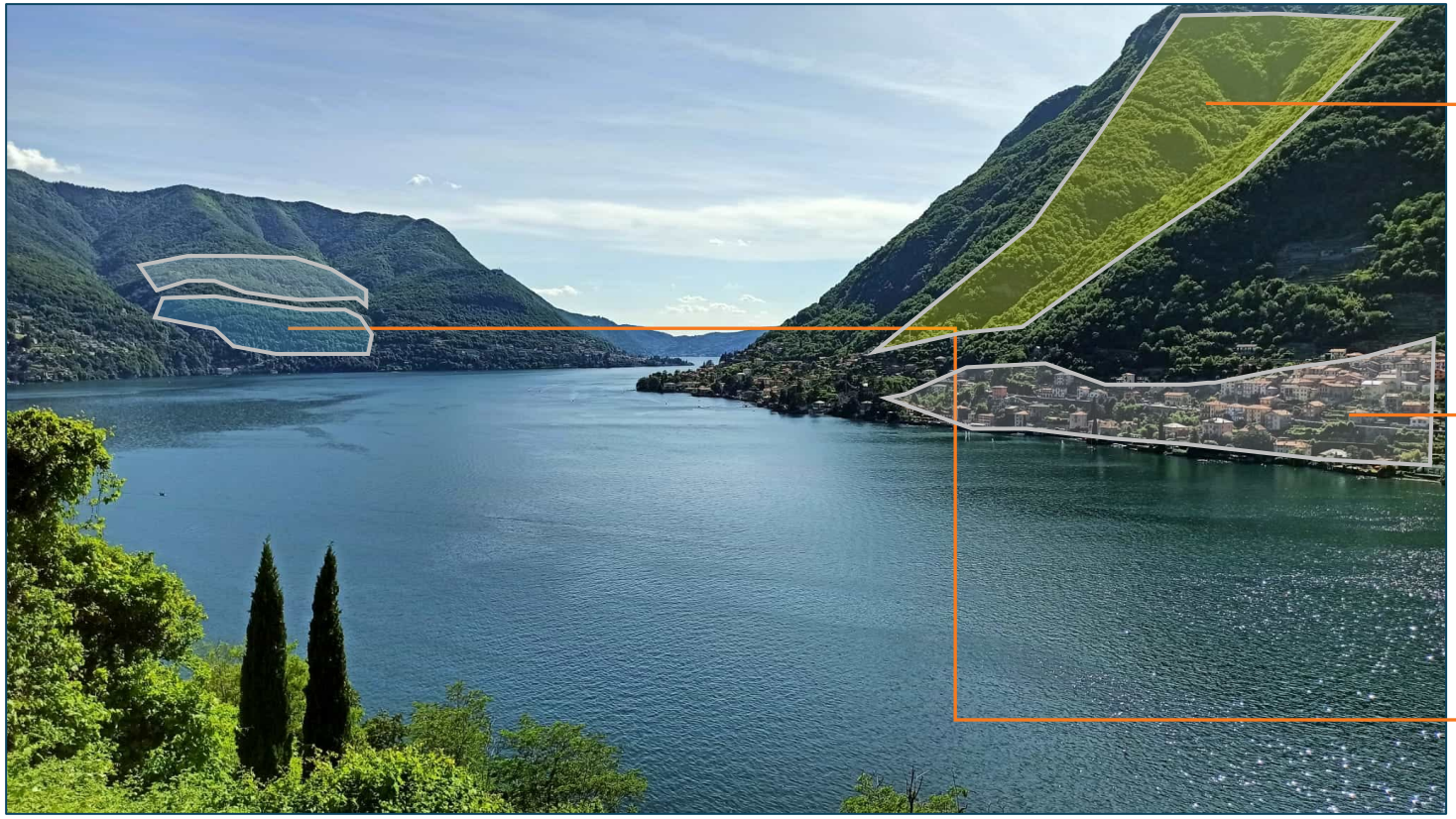
MAGNITUDE/FREQUENCY They follow an inverse relationship: higher magnitude, lower frequency (sudden floods, river floods). Totally random if due to floods due to dam/shore break

SECONDARY EVENTS Downward erosion, landslides

HAZARDOUS NATURAL EVENTS: FLOODS

The river basin and its influence on the flood wave

Which are the territorial characteristics that influence the size of the flood wave?
Is there a link between the geo-morphological peculiarities of the territory and the violence with which flood phenomena occur?



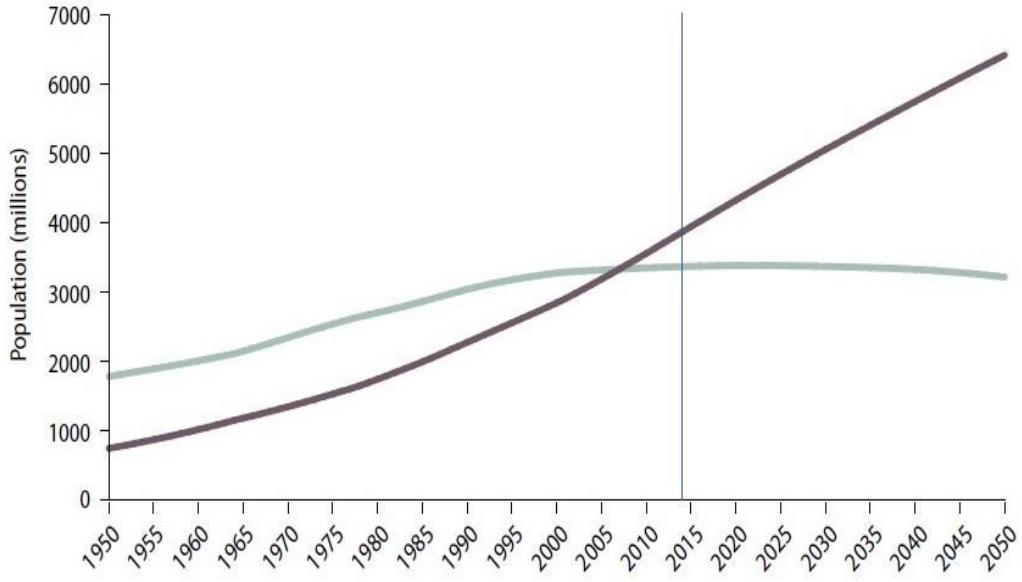
The **SHAPE** of the basin, more than its surface, can amplify the effect of the flood wave.

The extension of the **IMPERMEABLE SURFACE**, whether caused by human activity or not, increases the speed of water flow towards the closure section.

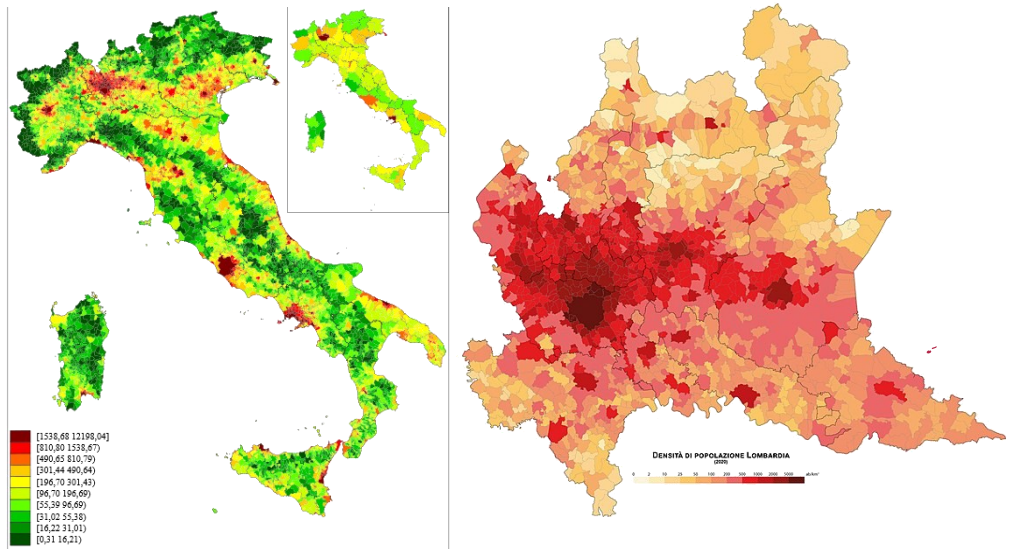
The infiltration capacity of the **SUBSOIL** influences the quantity of water that reaches the valley.

WHY ARE CITIES AT RISK?

- Growth of population and urban density
- Physical location of urban settlements in areas at risk
- Decline of ecosystems
- Deterioration of existing infrastructures and building environment
- Negative effects of climate change
- Concentration of resources and means for risk management at national level
- Weakness in local governance and insufficient participation of local stakeholders in urban planning and management
- Inadequate management of water resources, drainage systems and solid waste
- Lack of coordination in emergency services



Urban and Rural population, 1950-2050 (UNDESA, 2015)



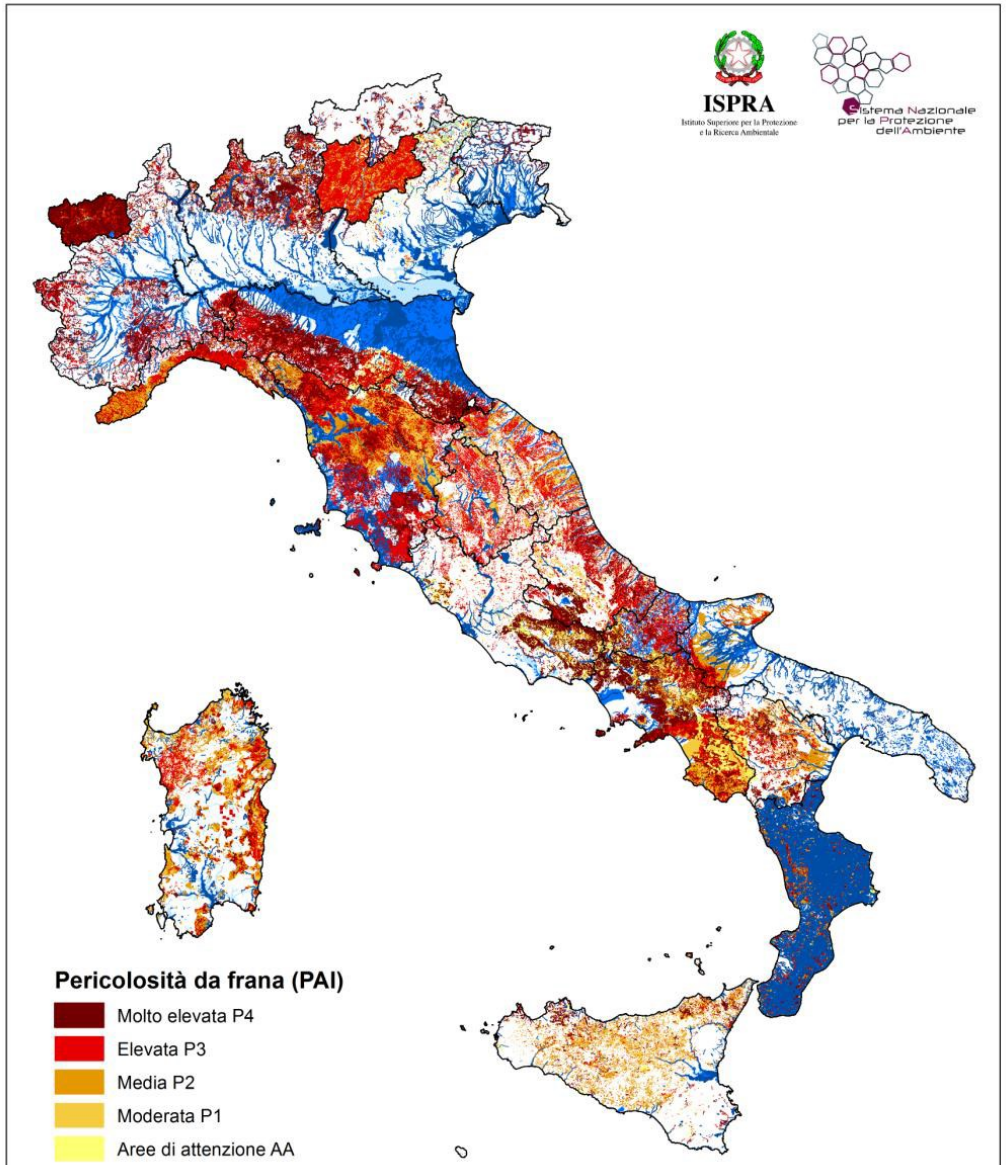
Italian population density – Census 2011 and
Lombardy Region population density – Census 2021

WHY ARE CITIES AT RISK?

Report on hydrogeological instability in Italy

	Flood risk	Landslide risk
POPULATION	1.303.666	6.818.375
	2,20%	11,50%
COMPANIES AND FACILITIES	84.441	642.979
	1,80%	13,40%
CULTURAL HERITAGE	12.533	33.887
	5,90%	16,50%
BUILDINGS	565.548	1.549.759
	3,90%	10,70%
FAMILIES	547.894	2.901.616
	2,20%	11,80%
MUNICIPALITIES	7.423	
	93,90%	

IdroGEO - isprambiente



18,4% of the Italian territory and **94% of its Municipalities** are classified in areas with **high danger from landslide** and/or areas with **medium hydraulic hazard**

WHY ARE CITIES AT RISK?

What causes damage to our cities?

Weather events cannot be manipulated (at least not yet).

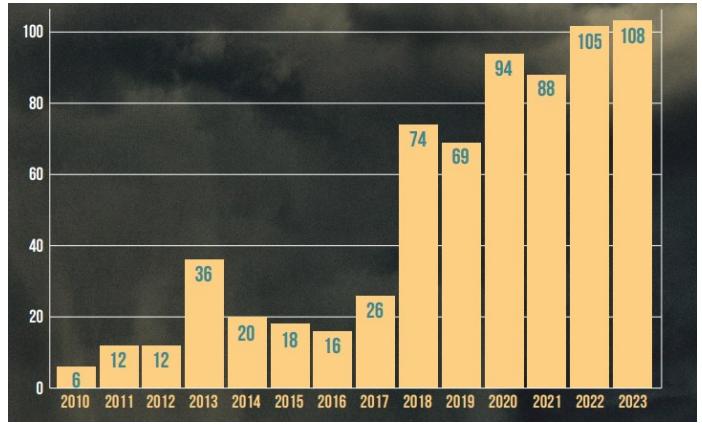
Land defense works can be carried out, but I can't remove landslides completely: landslides are natural phenomena! **I can monitor the territory to prevent them.**

RAIN → WATER → SOLID TRANSPORT → TERRITORIAL DAMAGES

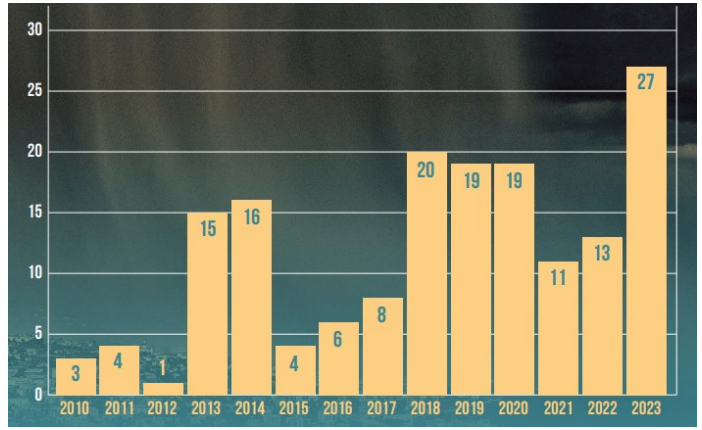
LANDSLIDE → SOLID TRANSPORT

It is possible to reduce the water flowing downstream - **LAMINATION**

It is possible to block the flow of debris towards the valley - **DEBRIS FLOW BARRIERS**



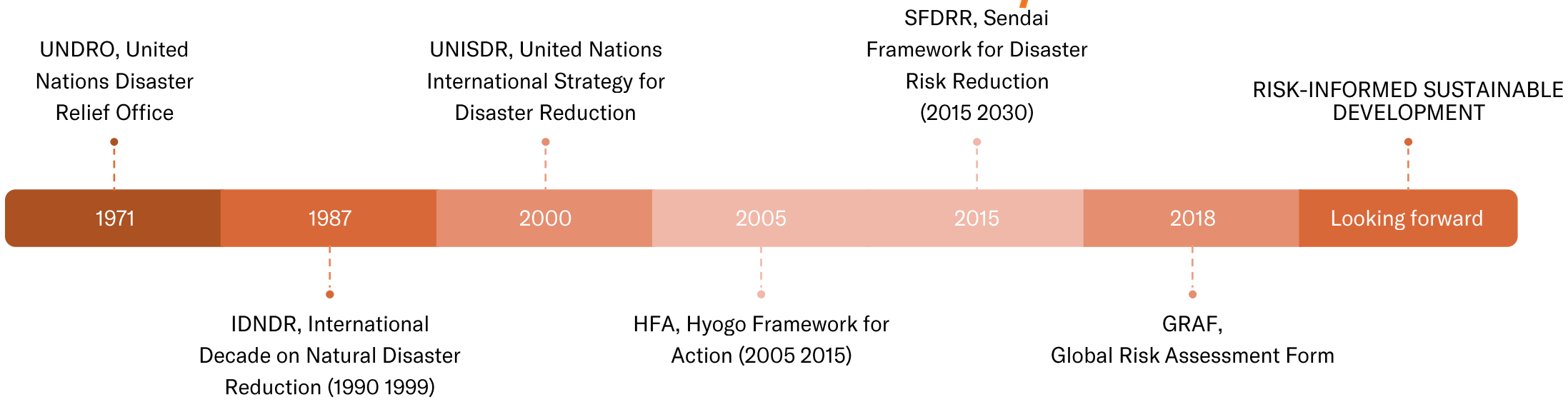
Flooding due to heavy rains in Italy 2010-2023
Report-Citta-Clima-2023



Intense rains and consequent flooding of the water courses in Italy 2010-2023
Report-Citta-Clima-2023

DISASTER RISK REDUCTION: FROM PREVISION TO PREVENTION

- 2030 Agenda for Sustainable Development
- Paris Agreement on Climate Change – COP21
- Addis Ababa Action Agenda
- New Urban Agenda



- Prevision: Recovery and disaster response (up to the 1960s)

Coordinated use of sophisticated tools and techniques for the study of the dynamics and intensity of expected phenomena.

We must shift from a culture of reaction to a culture of prevention

- Prevention: Risk management and mitigation (since the 1970s)

Set of activities and / or interventions aimed at avoiding or minimizing the possibility of damage resulting from calamitous events also on the basis of knowledge acquired as a result of forecasting activities.

DISASTER RISK MANAGEMENT

PHASE (1) Preparedness, Prevention and Mitigation

Activities and measures to avoid existing and new disaster risks, to lessen and minimize the adverse impacts of a hazardous event. While certain disaster risks cannot be eliminated, prevention aims at reducing vulnerability and exposure in such contexts. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness.
With preparedness, we define knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters. It includes activities as contingency planning, the stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises.

PHASE (2) Emergency Management and Response

Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. Disaster response is predominantly focused on immediate and short-term needs

PHASE (3) Rehabilitation and Recovery

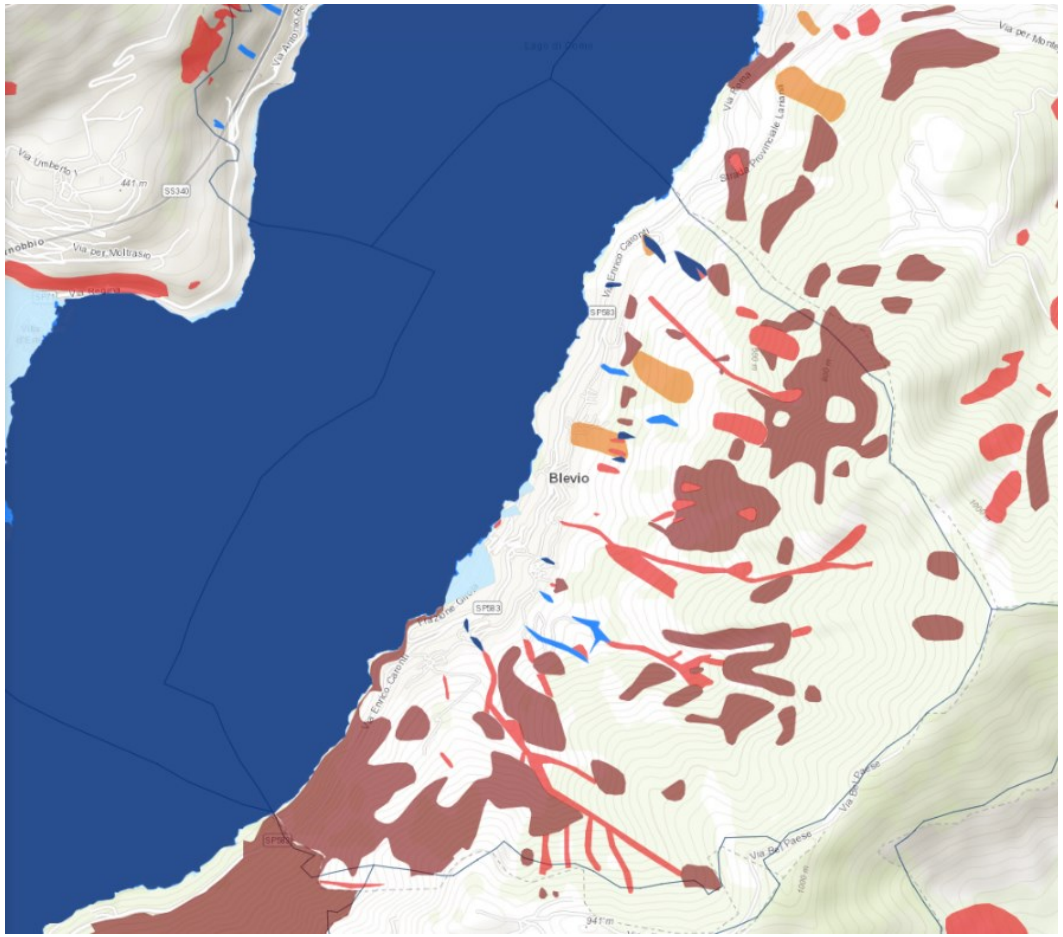
The restoration or improvement of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and “build back better”, to avoid or reduce future disaster risk

General context: Como Lake

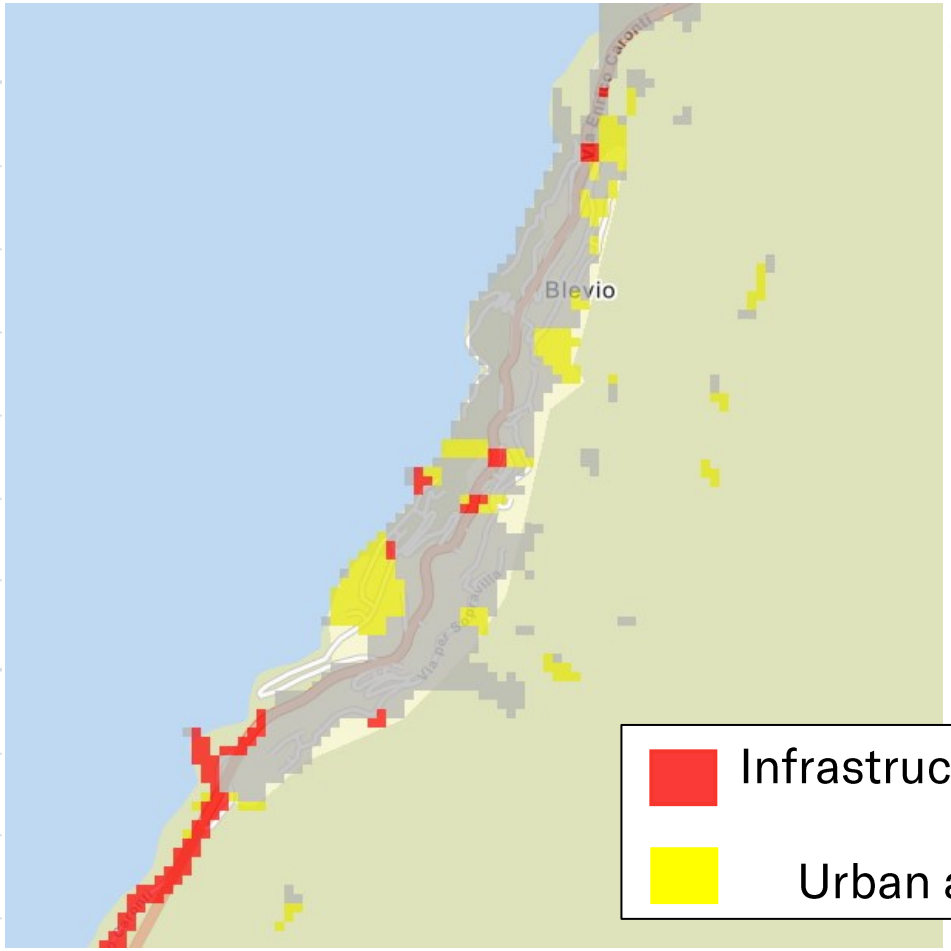
BLEVIO								
Territory (sqkm)	n° companies	n° buildings	n° cultural heritage	Pop	n° family	young 0-14y	adults 15-64y	elderly +65y
5,47	67	567	13	1.185	545	14,1 %	63,4 %	22,5 %
Population at risk – flood hazard				Population at risk – landslide hazard				
52				36				

LAGLIO								
Territory (sqkm)	n° companies	n° buildings	n° cultural heritage	Pop	n° family	young 0-14y	adults 15-64y	elderly +65y
6,2	65	365	5	917	425	12,7 %	64,2 %	23,1 %
Population at risk – flood hazard				Population at risk – landslide hazard				
104				-				

BLEVIO



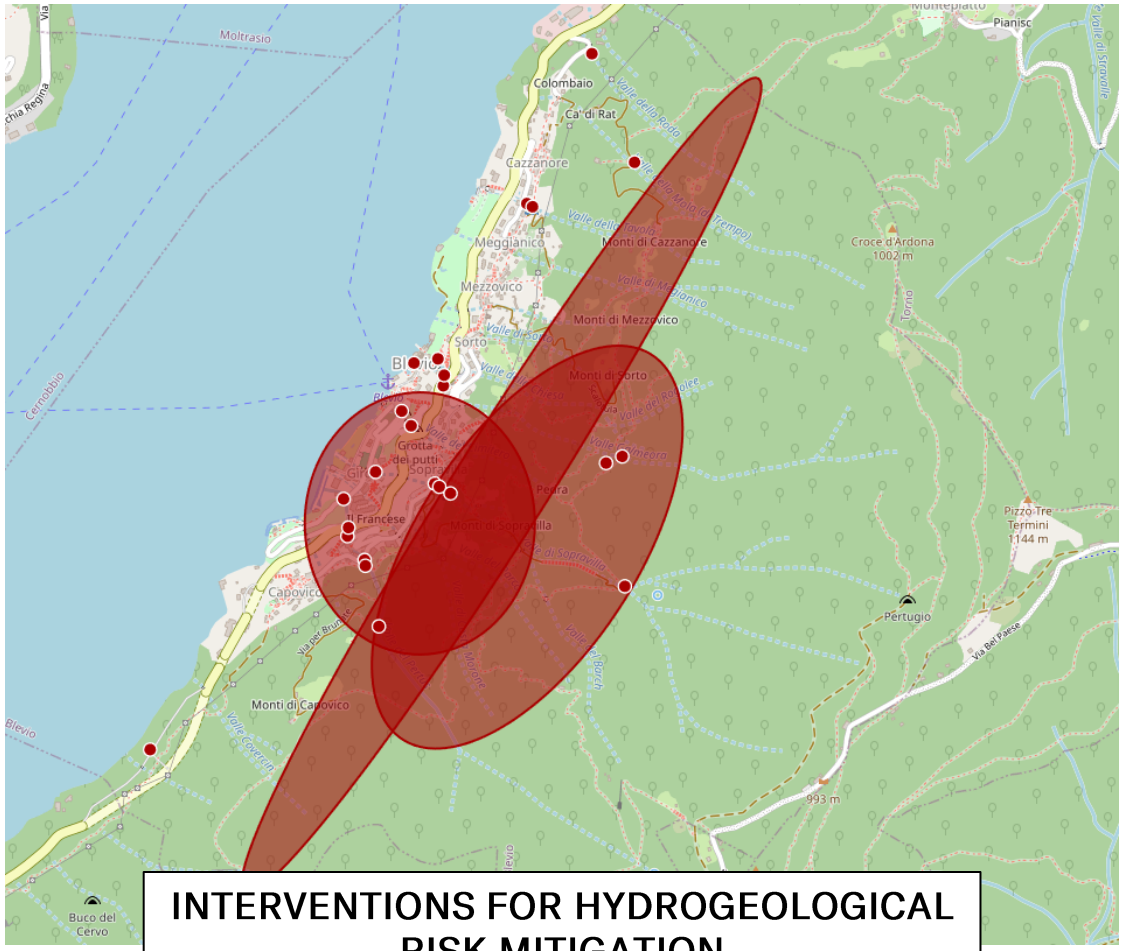
Floods and landslide risk - IdroGEO - isprambiente



Urban areas and infrastructures at risk for landslide hazard
Viewer Geografico 2D - Geoportale (servizirl.it)

BLEVIO

Interventions for hydrogeological risk mitigation – source:
Geoportale - Regione Lombardia

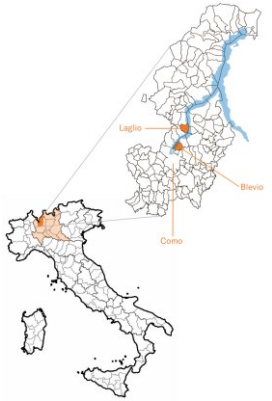


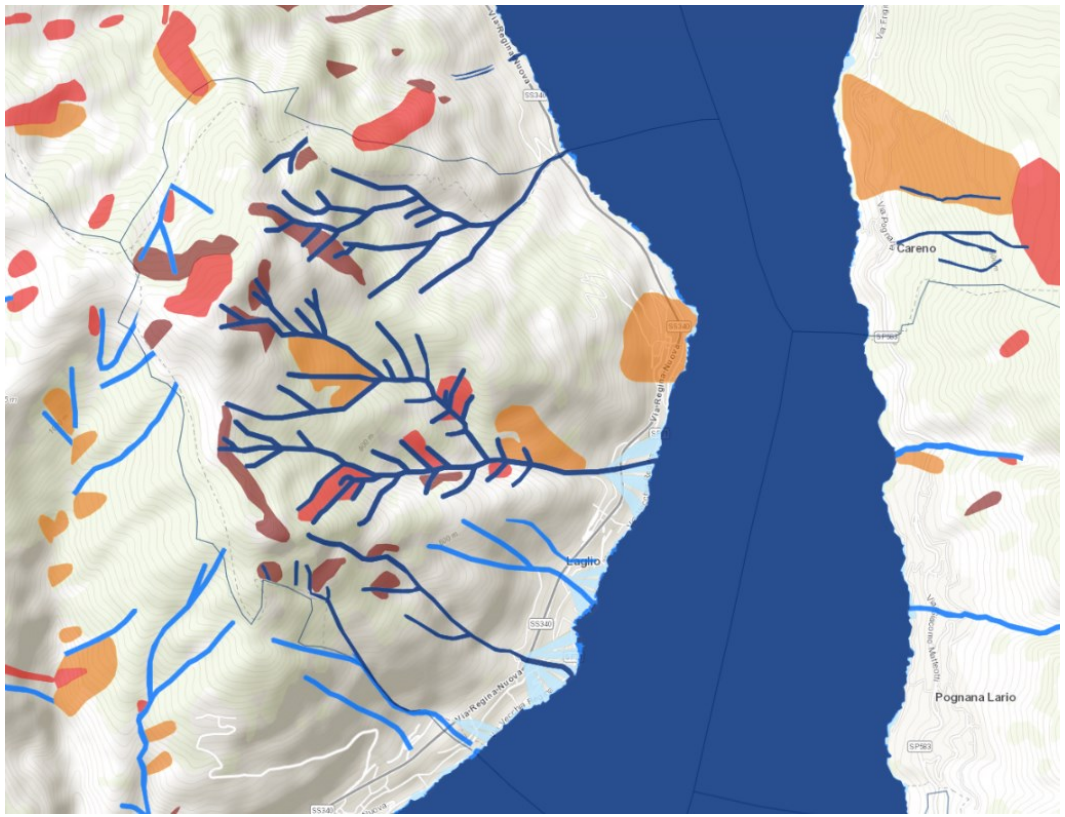
INTERVENTIONS FOR HYDROGEOLOGICAL RISK MITIGATION

- Civil Protection interventions and PNRR founds
- Soil defense interventions on the territory

Type	Description	€	Foundings source	DRM phase
Soil defense interventions on the territory	Extraordinary maintenance interventions on valleys and watersheds following the flood events of July and August 2021	2.250.000	Piano Lombardia	2
	Arrangement of slopes above inhabited areas	200.000	Regione Lombardia	3
	Construction of weir and material containment works, access track and arrangement of the Girola stream area	1.500.000	Piano Lombardia	1
Civil Protection interventions and PNRR founds	Restoration of flow inside the riverbed; restoration of interrupted road connection, with removal and temporary storage of the material	624.670	Civil Protection Department and other National source	3
	Cleaning of provincial road from debris and dangerous plants and reconstruction of sections of road support walls. Cleaning of drains and gutters.	158.680		3
	Rental fees support until 10/31/2021. Accommodation in reception facilities until 09/17/2021.	5.200		2
	Independent accommodation for eight families, from 1/11/2021 to 30/06/2022.	58.220		2
	Construction of a concrete weir with a sedimentation and accumulation area upstream of the manhole section	200.000		1
	Construction of a comb weir in concrete, casted with a helicopter, and extraordinary maintenance of the riverbed	150.000		1
	Check of the stability of buildings, riverbed, areas nearby the rivers and consequent assignment of works to restore the flow inside the riverbed, the carriage and pedestrian roads with the removal of material that compromised their usability.	226.530		3
	Management of waste and flooded material with transfer of the same from the temporary collection point to public landfills to ensure the safe usability of the areas currently used as post-flood waste storage (usually used for the storage of materials and means of use for provincial road maintenance).	400.000		3
	Various – not specified	14.020.000		-
		19.713.300		

LAGLIO





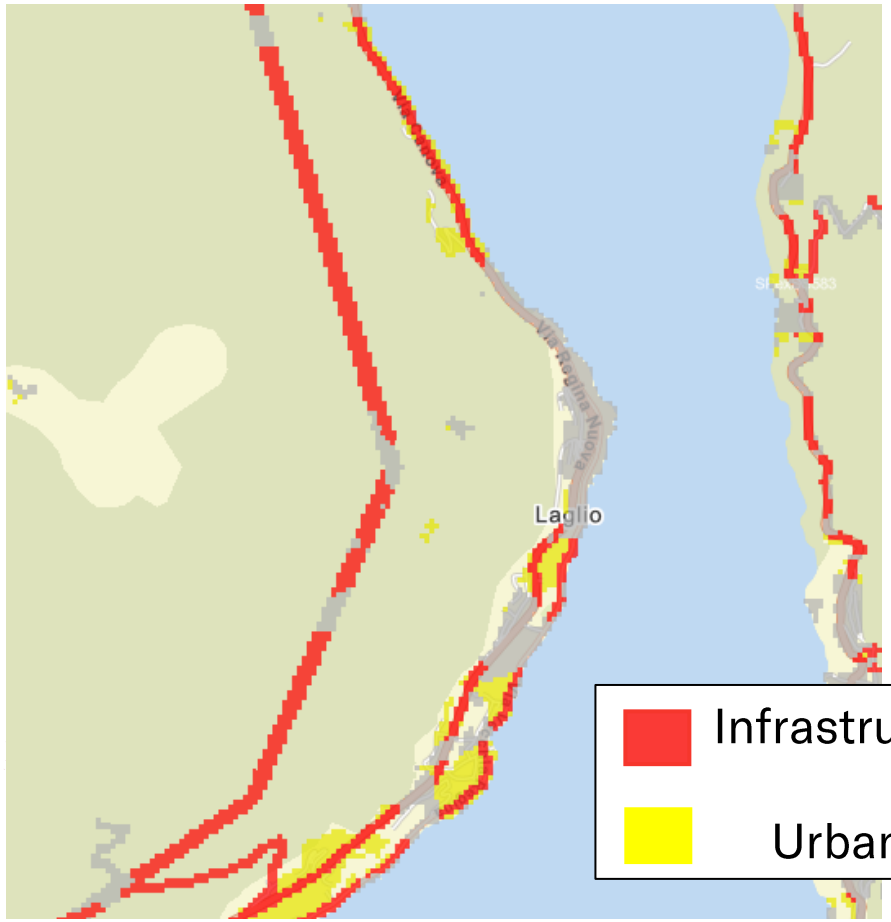
Frane

- Molto Elevata P4
- Elevata P3
- Media P2
- Moderata P1
- Aree Attenzione AA
- P4 + P3

Alluvioni

- Elevata
- Media
- Bassa

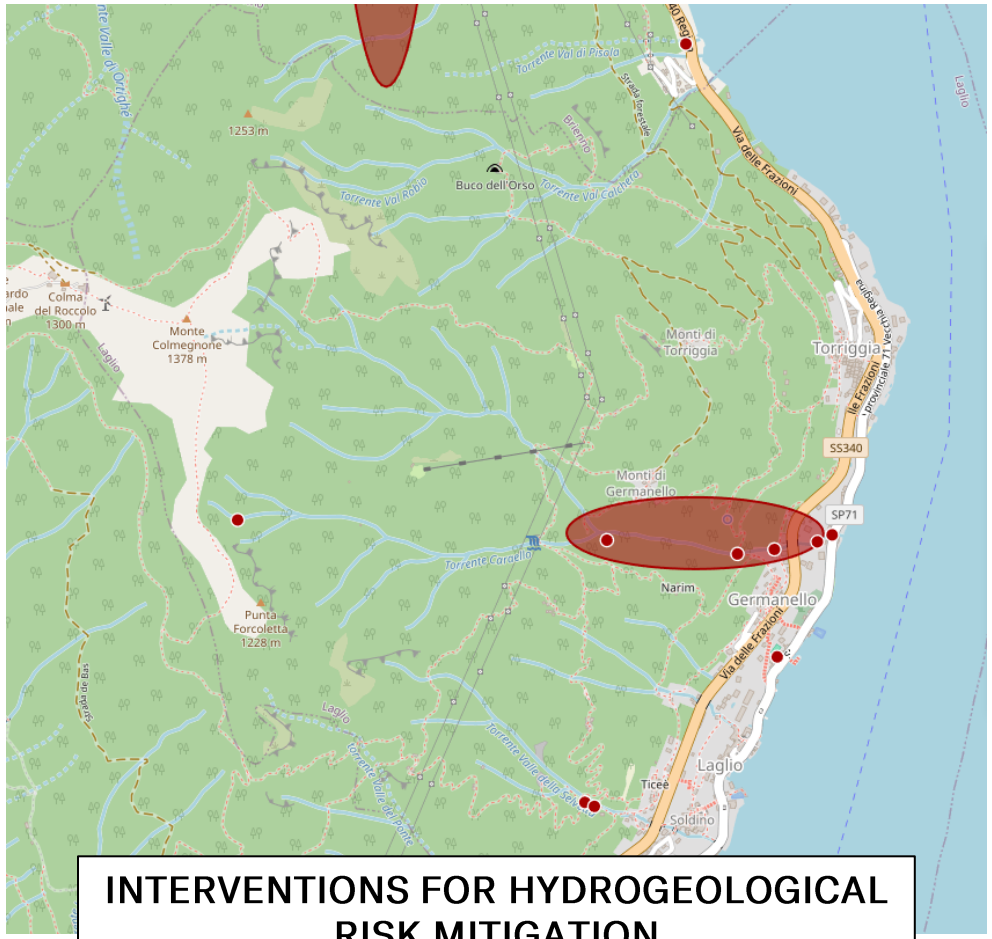
Floods and landslide risk - [IdroGEO - isprambiente]



Urban areas and infrastructures at risk for landslide hazard [Geoportale - Regione Lombardia]

LAGLIO

Interventions for hydrogeological risk mitigation – source:
Geoportale - Regione Lombardia

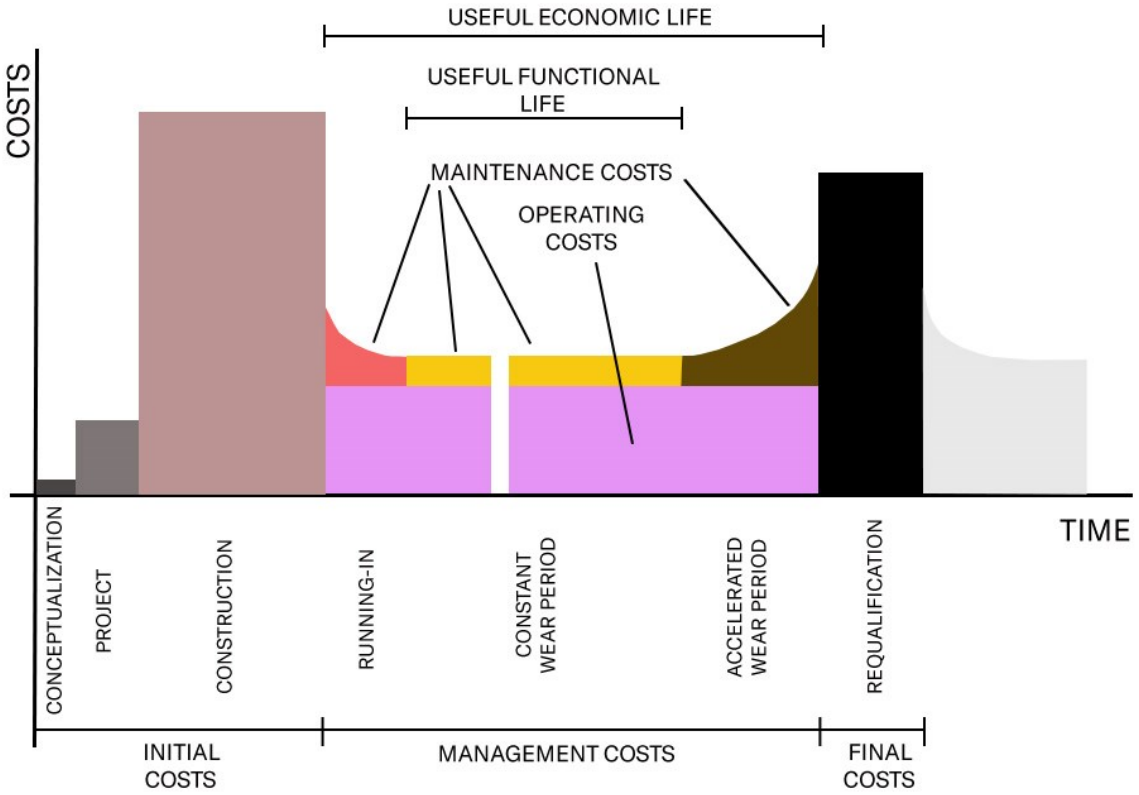


INTERVENTIONS FOR HYDROGEOLOGICAL RISK MITIGATION

- Civil Protection interventions and PNRR founds
- Soil defense interventions on the territory

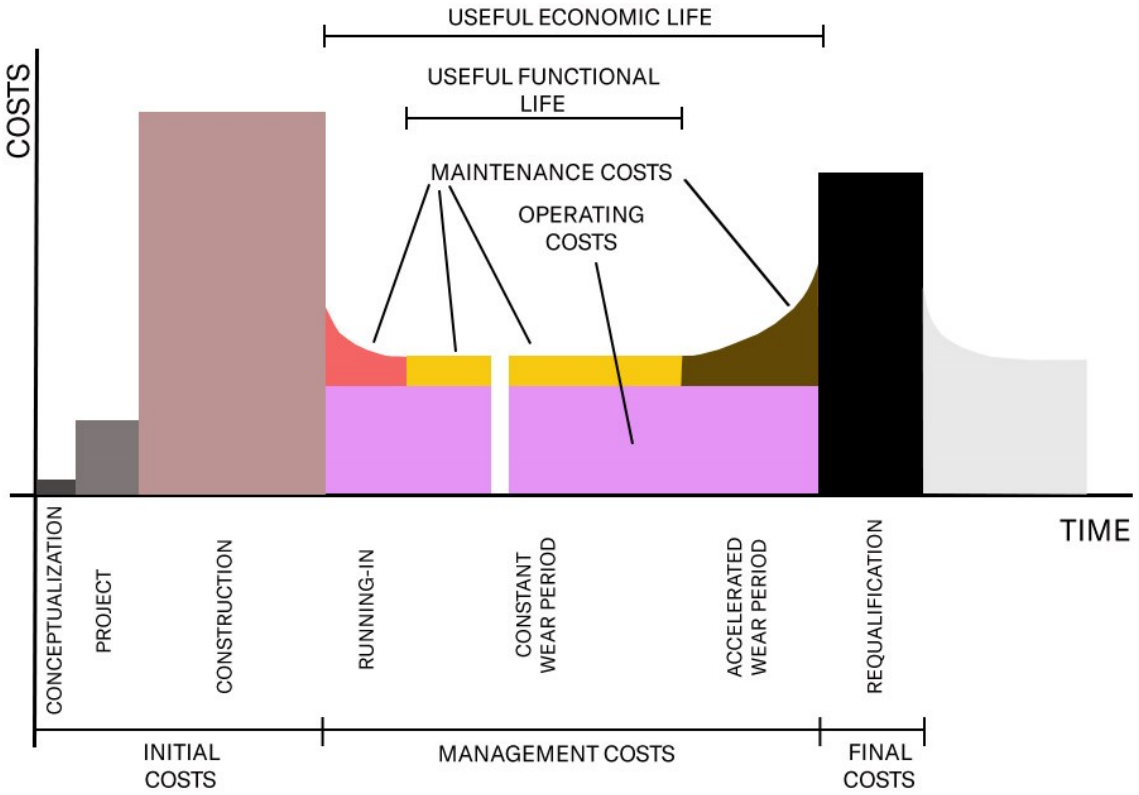
Type	Description	€	Foundings source	DRM phase
Soil defense interventions on the territory	Urgent extraordinary maintenance interventions to be carried out in the Caraello valley following the flood events of July and August 2021	1.000.000	Piano Lombardia	2
Civil Protection interventions and PNRR founds	Cutting of forests fell down by storm Vaia, preparation and logging; where necessary, ground layout and possible localized replanting	13.750	Civil Protection Department and other National source	3
	Protection works with containment measures for debris material in the riverbed, upstream of the village of Germanello, Ticee and Soldino	600.000		3
	Bridge reconstruction	400.000		3
	Reconstruction of the bridge in "via delle frazioni" over the Caraello stream	225.000		3
	Clearance of debris material from the Caraello stream following a technical geological study	250.000		3
	Clearance of debris material deriving from Caraello stream safety of Piazza Roma	25.390		3
	Debris flow Caraello stream, clearance of the channel and restoration of hydraulic functionality	107.700		3
	Clearance of debris in the terminal stretch of the stream and execution of urgent interventions	1.000.000		3
	Cleaning of debris and damaged tall plants on roadways, cleaning of blocked drains and gutters	205.300		3
	Independent accommodation for three families, until the end of the state of emergency (30 June 2022).	29.900		3
	First intervention liberation of Selvetta stream	40.000		3
	Implementation of intervention aimed at resolving the clogging due to the accumulation of debris material impending on the town, of the safety weirs placed above the town of Ticee in the Selvetta stream. Geological support with study for the carrying out of the intervention to make the town of Ticee and Soldino safe.	151.870		3
		4.048.910		

Cost Analysis

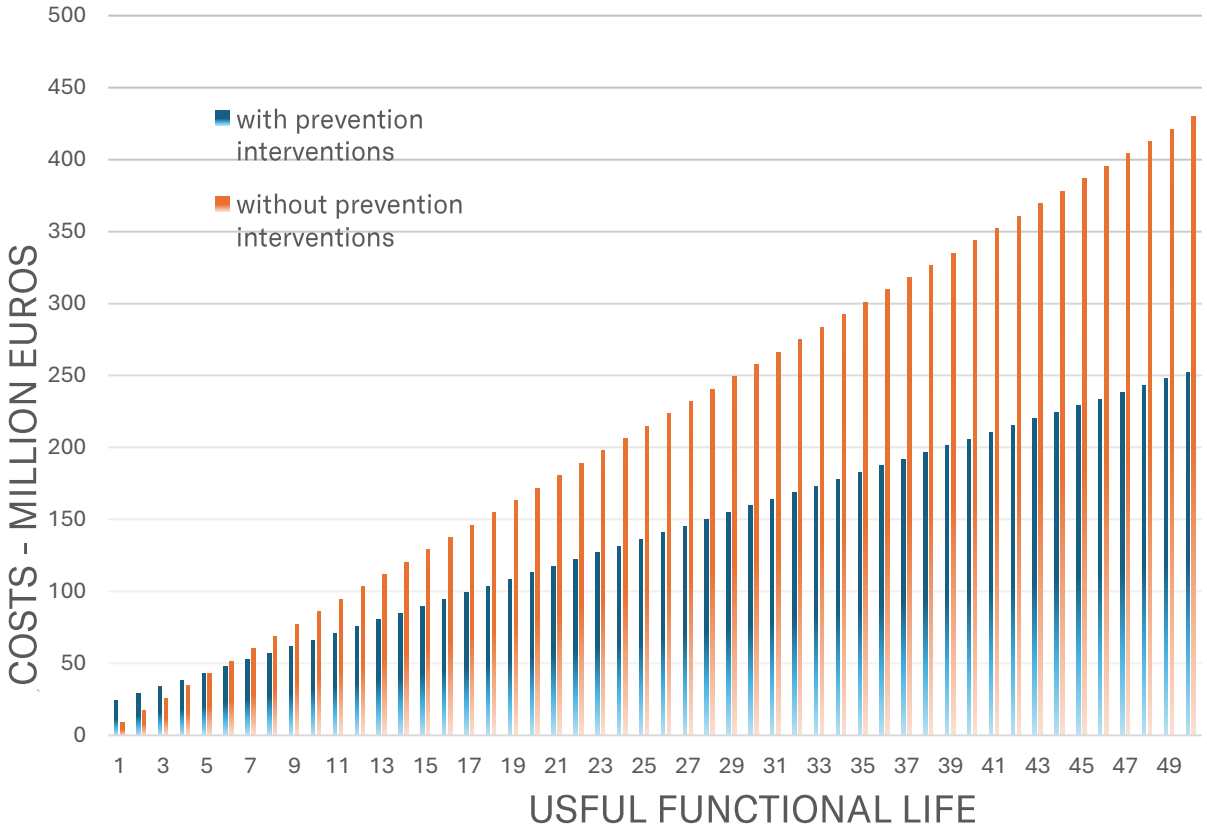


Source: DISTRIBUZIONE NEL TEMPO DELLE DIVERSE COMPONENTI DI COSTO GLOBALE – Molinari C. (2002) Procedimenti e metodi della manutenzione edilizia. Sistemi Editoriali, Napoli – Adapted by authors

Cost Analysis

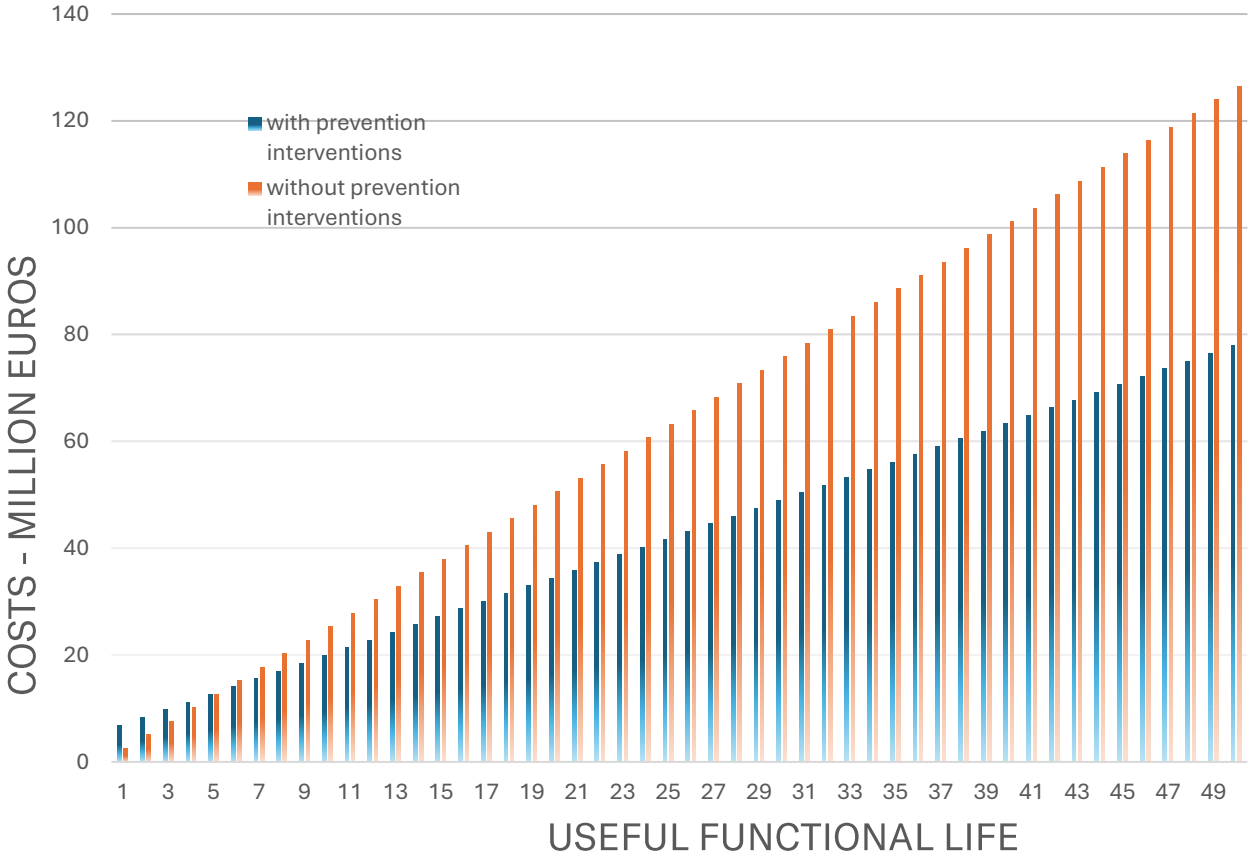


Source: DISTRIBUZIONE NEL TEMPO DELLE DIVERSE COMPONENTI DI COSTO GLOBALE – Molinari C. (2002) Procedimenti e metodi della manutenzione edilizia. Sistemi Editoriali, Napoli – Adapted by authors

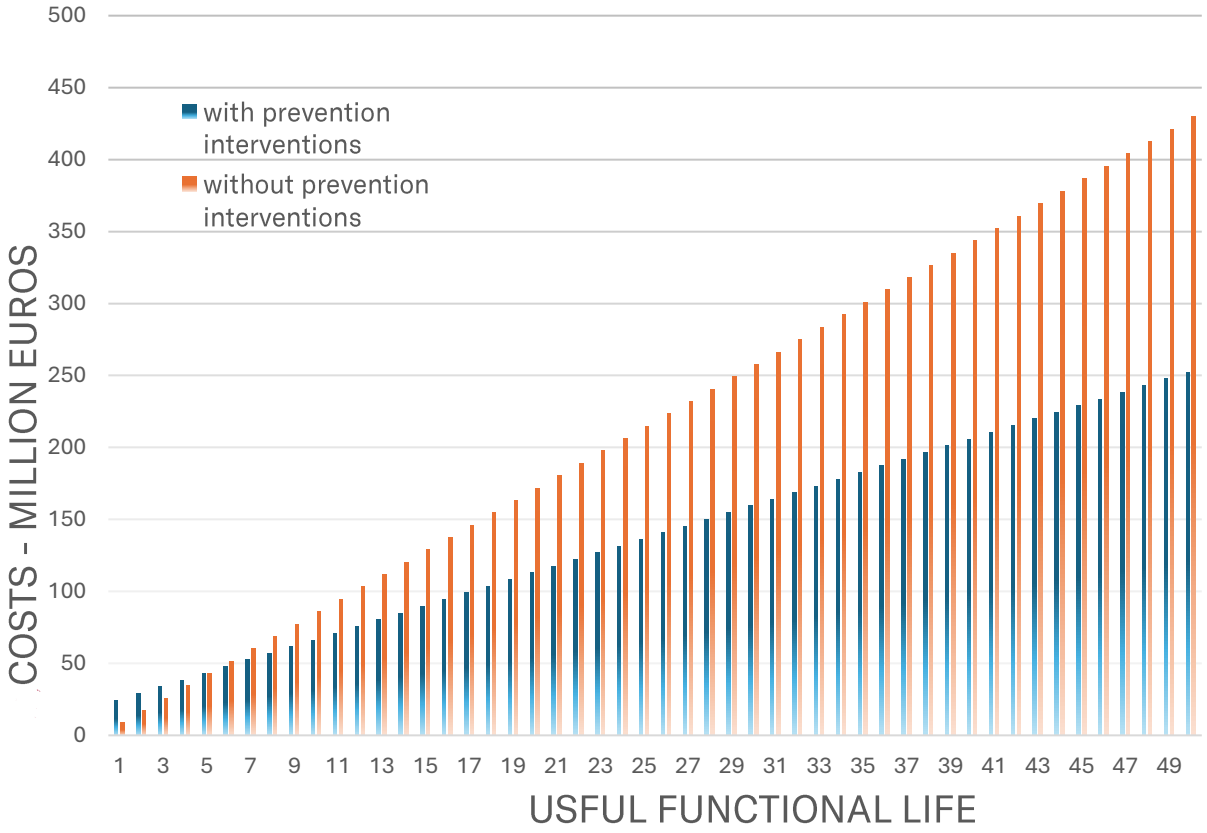


BLEVIO

Cost Analysis



LAGLIO



BLEVIO

29 August 2024

Thank you!

Elisabetta M. Venco – *elisabettamaria.venco@unipv.it*

Massimiliano De Rose – *presidenza@croil.it*