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

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Flood risk is a common concern in many parts of the world, including Italy. As Legambiente's "*Città Clima 2023"* report shows, from 2010 to 31 October 2023, 684 floods from intense rain, 166 river floods and 86 landslides from intense rain were recorded on Italian territory.

Member States of the European Union have the obligation to prepare hazard and risk maps for areas at significant potential risk of flooding. These maps contain the perimeter of the geographical areas that could be affected by floods according to three probability scenarios: low impact (P1 events with a return time between 20 and 50 years– low danger); average impact (P2, events with a return time greater than or equal to 100 years - medium hazard); high impact (P3/P4 events with a return time greater than 500 years– high danger). The risk maps indicate the potential negative consequences deriving from floods within the three aforementioned danger scenarios expressed in terms of: approximate number of inhabitants potentially affected; type of economic activities in the potentially affected area; number of industrial plants referred to in Directive 2010/75/EU (Industrial Emissions Directive) that could cause accidental pollution in the event of floods; and protected areas as defined by Directive 2000/60/EC (Water Framework Directive) potentially affected by such pollution.

The research will present some case studies to highlight how the territory's features and the built environment can amplify the economic impact, reduce the communities' resilience, and cancel the ability to absorb even low intensity flood events. The examples concern small towns in the Province of Como (northern Italy), located along the banks of the Como Lake. These urban settlements are surrounded behind by mountain systems (with a height varying between 1,000 and 2,000 meters above sea level) which descend steeply onto the lake. The territory is also characterized by the presence of an intricate system of streams that flow sharply downwards: the historic centers of the towns are located right near their mouth which become very dangerous if floods occur.

As is well known, the coexistence with water (such as streams, rivers, lakes, and seas) has always been a cornerstone for the development of human settlements. In fact, it guarantees: direct access to potable water for drinking, cooking and irrigating crops; fishing and hunting activities; the development of agriculture (as source for irrigation and fertile alluvial land); means of transport for goods and people, increasing and facilitating trade and cultural exchanges; essential source of energy for production activities; defense and

natural barrier against enemy incursions, helping to protect settlements and communities; presence of milder climate due to the thermoregulatory effect of water.

Floods, and the so often associated landslides, are natural hazards, but unnatural disasters are deaths and damages resulting from the interaction with human being, goods, and human activities. The agglomeration of people, assets and economic activity make urban settlements particularly vulnerable to natural hazards and, therefore, disasters. Some of the main drivers of risk in the city environment are: population growth and urban density; physical localization of urban settlements in areas at risk (93.9% of its municipalities are classified in areas with danger from landslide P3 and P4 and/or areas with hydraulic hazard P2); rapid unplanned urbanization and the lack of disaster risk considerations in land management; weakness in local governance and insufficient participation of local stakeholders in urban planning and management; unwise environmental and natural resource management and so on.

The geo-morphological features of Como Lake territory contribute to amplifying the phenomena. In the Como Lake district, the peculiar shape of the hydrographic basins (the so called Lario basin) that characterize the fluvial branches of streams drastically reduces the times of entry into the network (where by network we mean the watercourse): in the Lario basins, with the same amount of rainfall, the flow rate in the closing section (where, as we have seen, the inhabited centers are located) can be double that in other areas.

The dynamics of flood phenomena is always the same. Violent period of bad weather, with thunderstorms and intense cloudbursts, hit the Como area. The tales of citizens, collected by newspapers and referring to events even distant in time or space, are quite similar: it starts to rain in the night, first slowly, then increasingly harder, and suddenly the street under their house turns into a raging river and the water and the mud break through everything. The frequent related landslides bring mud and debris onto road surfaces, as well as causing trees and branches to fall. Furthermore, nocturnal events make rescue and evacuation operations difficult. The resilience (define as the ability to absorb a catastrophic event without suffering irreparable damage) of these urban settlements is very low. This is due also to their localization and the morphology of the surrounding area with often a single road running along the shore of the lake connecting the towns. The rescue arrives slowly, working in narrow and steep spaces. The population appears increasingly impatient and not keen to understand that solving this kind of problems requires specific measures, long times, careful planning, and many resources (not only economic): usually, they complain about the fact that although events are often (partially) predictable, the public administration (from local to national level) are unable to adequately defend the territory and the inhabitants.

To understand the actual damage that a flood can cause, here just few significant examples: in July 2021, in the small city of Laglio (about 900 inhabitants on the west side of Como Lake), ten days of bad weather caused damages amounting to 67 million euros. In Blevio, a town with just over 1,000 inhabitants on the east side of the Como Lake, in July 2021 the amount of damage was quantified at 16 million euros.

The research question that authors would answer with the presented paper is: Which are the real costs that a community bears for flood events?

As defined with the Disaster Risk Management Cycle, there are different phases associated with the triggering of a possible disastrous event. We can summarize in 1) preparedness, prevention, and mitigation phase; 2) emergency management and response phase; 3) rehabilitation and recovery phase.
The research focuses not only on the costs associated with hazardous event management, but the analysis of the money saved in relation to the money spent (investment analysis).
In phase 3, the money spent is a “bad” investment because it does not lead to any savings. Moreover, these costs are divided into direct and indirect costs. The direct costs are the most evident to society and to inhabitants: they are used to repair the damages caused by the flood (e.g. works to be reconstructed, roads to be cleaned). But there are also costs not visible but equally enormous: a road to clean or a bridge to rebuild have a cost: their completion takes time. A blocked road means (especially on the shores of the lake) people who, for example, cannot move and reach their workplace and people forced to use long and tortuous alternative routes. Since that the urban settlements system works as a series circuit, an interrupted road on the eastern or western bank of the Como Lake will have negative effects on the other coastal towns and on the city of Como itself, all cities that also live on tourism for many months of the year.
The costs relating to emergency management and response phase (2) will probably never be zero. In risk management it is well known that it is possible work to reduce risk, but hardly it will be completely removed. Emergency costs are typically linked to the administrative and technical national bodies that oversee the territory (Civil Protection and National Technical Structure) and to the interventions carried out by the Fire Brigade Command: during the event and in the hours immediately following, they carried out many interventions to free people in danger, to clear the streets and to protect the places.
Considering the costs linked to preparedness, prevention, and mitigation phase, it is important to underline that not being able to act on the cause of the hazard (the meteorological event), the only way to protect people and goods from floods is to work on Exposure and Vulnerability (that with Hazard, define the classical equation of Risk) and create works that allow to reduce the impacts of these events. The idea of acting on prevention usually arises just after the disaster: it is strong in the following days, decreases in the following months, and quickly reduces in intensity.
From a technical point of view, prevention interventions (in the long term) are the most effective: they have the best euro spent / euro saved ratio. Every euro spent on prevention works reduces the costs of the other phases. Prevention works (whether structural/non-structural, temporary/permanent, such as river crossings and lamination basins) need to be planned in the long term, with an overall vision (they can protect more vast territories) and require huge economic and human resources.

A further aspect, which indirectly represents a hidden cost linked to natural disasters, is the social cost (i.e., the destruction of communities, social and family ties, the loss of attachment to place, and of collective memory). Moreover, the prospect that a flood is a recurring event generates fear and apprehension in the population: this pushes people to spend time and money to carry out ineffective “do it yourself” defense works (of their homes).

In conclusion, the paper will highlight, through the in-depth analysis of the examples cited above, the need for public administrations and communities to invest in territorial resilience and prevention strategies and actions. The process of growing resilience is long and, evidently, during this time the interventions referred to emergency management phase and to rehabilitation phase cannot be neglected. The main aim for public administration should be a precise and careful plan towards a progressive shift of investments from post-event to pre-event. It is easy to demonstrate that good territorial planning can generate positive effects in terms of territorial resilience, reducing the per capita costs that each citizen must bear due to catastrophic flood events.