Physical, social and institutional vulnerability assessment in small Alpine communities. Results of the SAMCO-ANR project in the Upper Guil Valley (French Southern Alps)
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2- Methods

Physical vulnerability (i.e. total potential consequences of hazards on stakes) was estimated and mapped via GIS model from Potential Damage Index (PDI) (Fig. 3). This index allowed us to quantify and describe both direct - physical injury, structural and functional impacts - and indirect consequences - socio-economic impacts - induced by hazards; this by combining weighted parameters reflecting the exposure of elements at risk; buildings, networks and land cover (Fig. 3). At least 1989 buildings, 367 km² of land cover and 902 km of network were considered. Vulnerability maps were then crossed to hazard map reflecting different scenarios of exposure. To take into account the temporal variability of vulnerability, we produced different maps for summer and winter periods. To assess social and institutional vulnerability we used (and) questionnaires (5% of the total population investigated), interviews and mind-maps (30% collected) dealing with risk perception, mitigation measures and confidence in the actors of risk management.

Fig. 1 Study area map

1- Background

The Guille catchment is particularly prone to torrential and gravitational hazards such as floods, debris flows, landslides or avalanches due to several pre-disposing factors (bedrock, suprainfrastructure, abundant debris, strong hill-slope-channel connectivity) in a context of summer Mediterranean rainstorms as triggers. Since the second half of the 20th century, the progressive decline of agriculture and the development of tourism activities led to a concentration of human stakes on alluvial cones and valley bottom; therefore an increase of vulnerability for mountainous communities. Following the 1957 and 2000 catastrophic floods and the 1948 and 2008 avalanche episodes, some measures were taken to reduce exposure to risks (engineering works, standards of construction, rescue training). Nevertheless, in front of urban expansion (land pressures and political pressures) and obsolescence of the existing protective measures, it is essential to reassess the vulnerability of the stakes exposed to hazards. In the frame of the SAMCO project designed for mountain-risk assessment in a context of global change, we developed a systemic approach to assess three specific components of vulnerability - physical, social and institutional - for the six municipalities of the Upper Guille catchment (Burdolas, Abriès, Argüelles, Château-Ville-Neuve, Moïse-en-Queyras and St-Véran) (Fig. 1).

For the sake of clarity for readers we present here only few instances: summer torrential vulnerability over summer torrential risk for 1957 flood extension and winter avalanche risk. The highest degree of potential physical injury (Fig. 4) for flooding is preferentially located in historical villages (Fig. 6) for flooding is preferentially located in summer torrential risk for 1957 flood extension and winter avalanche risk. The highest degree of potential

Fig. 2 PDI method

Fig. 3 Weighted indicators

3- Results: Physical vulnerability assessment

Physical vulnerability (i.e. total potential consequences of hazards on stakes) was estimated and mapped via GIS model from Potential Damage Index (PDI) (Fig. 3). This index allowed us to quantify and describe both direct - physical injury, structural and functional impacts - and indirect consequences - socio-economic impacts - induced by hazards; this by combining weighted parameters reflecting the exposure of elements at risk; buildings, networks and land cover (Fig. 3). At least 1989 buildings, 367 km² of land cover and 902 km of network were considered. Vulnerability maps were then crossed to hazard map reflecting different scenarios of exposure. To take into account the temporal variability of vulnerability, we produced different maps for summer and winter periods. To assess social and institutional vulnerability we used (and) questionnaires (5% of the total population investigated), interviews and mind-maps (30% collected) dealing with risk perception, mitigation measures and confidence in the actors of risk management.

Fig. 8 Total potential impact for the 1957 flood extension

Fig. 10 Total potential impact of avalanches

4- Results: Social and institutional vulnerability assessment

Did you personally experienced a natural disaster?

Fig. 14

To what extend do you have confidence in these stakeholder?

Fig. 15

5- Conclusion

This work remains part of a large study on risk in mountainous region that should lead to a web demonstrator intended for risk stakeholders. We expect that these first results on vulnerability will contribute to a better assessment of the global vulnerability of the upper Queyras region to hydrogeographical hazards. This work must help the development of better land use and could be used to help local authorities to improve and update their Emergency Action Plan in their Prevention Plan.

The next step of this work will be to try to elaborate a method combining these maps to produce a global risk map for mountain risk.

For your municipality.

The next flood could have negative effect by the next flood. Your house (or property) could be damaged by the next flood.

Fig. 12

These natural hazards seem to you…

Fig. 13

Fig. 11

The next step of this work will be to try to elaborate a method combining these maps to produce a global risk map for mountain risk.