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Introduction

To reduce human losses and economic damages caused by disasters around the globe, risk prevention still needs to be promoted. In the European context, the KULTURisk project aims to assess and demonstrate the potential benefits of different risk prevention measures in the reduction of damages produced by water-related hazards, such as floods and landslides. This demonstration will initiate a culture of risk prevention, which can then be extended to other types of natural hazards, such as earthquakes and forest fires.

Initial steps: reviewing the literature and EU guidelines

A literature review has been carried out to identify knowledge gaps and propose further cutting-edge research in the field of risk prevention. This literature review has been divided into three main

parts: assessment methodologies, prevention measures, and risk communication.

The review of assessment methodologies focused on four main topics: 1) existing EU, national and international policies in the field of prevention; 2) currently available risk assessment and management methodologies for natural hazards and in particular for those related to water-related disasters; 3) currently available methodologies to evaluate risk perception and possibilities of integration in the framework of risk assessment and management of water-related hazards; and 4) existing methodologies to assess the total cost of hydrological disasters, economic valuation methodologies and project appraisals.

The prevention review focused on three themes: 1) existing national and international operational

warning systems for water-related hazards induced by severe weather conditions; 2) recent developments in hazard mapping and risk transfer practices (insurance policy) in water-threatened areas; 3) use of structural measures for water related risks, including lessons learned from past flood defense strategies, existing structural measures in landslides and critical discussion on the use of the return period concept in the design of structural measures.

Lastly, the third part of the literature review focused on recent research on risk communication, in particular on flooding and other water-related hazards.

Key preliminary findings

The notion of risk prevention

There is a need for more consistent terminology related to disaster risk management. Strictly speaking, even the term risk prevention can be questioned as risks can only be reduced or mitigated, and not entirely avoided. Moreover, in many European and national documents, risk prevention is used to mean both risk reduction (i.e. policy objectives) and risk management (i.e. tools to achieve policy objectives), and this can also lead to confusion.

In KULTURisk, risk prevention expresses the objective to reduce the risk to an acceptable level by lessening the potential adverse impacts of natural hazards through actions taken in advance. In this context, risk prevention measures are all the initiatives taken before the occurrence of disasters that aim to avoid the unacceptable risk.

Risk assessment methods needs further development

Regarding the existing methodologies for risk assessment, the existing lines of thought concentrate on the three issues: hazard, vulnerability and risk assessment. However, important social, economic and environmental aspects are not always considered. Also, in many cases there is little or no stakeholder involvement, and as a result the risk assessment does not comprehend all relevant dimensions. It can be

concluded that the analyzed methodologies represent a good starting point for future developments in risk assessment for natural hazards, offering room for improving both the natural science aspects (e.g. models) and the socio-economic ones (e.g. public participation) and their integration through innovative spatial and mathematical modelling.

Community is involved only towards the end of the risk management process

The existing risk management methodologies have similar procedures for the selection of management measures. From the hazard viewpoint, it is encouraging that both structural and non-structural solutions take into account concepts such as sustainability and global change. All too often, however, the participation of the community is relegated to the final selection of risk management measures, instead of being considered as an integral part of the process from the very start.

Intangible costs of disasters: controversial to monetise but crucial to identify

The concept of total cost is much more ambitious than what has been traditionally provided in assessment exercises, because it aims at describing the total burden imposed by a disaster to the coupled socio-environmental system. The full impact of a disasters includes costs (and benefits) that are difficult to identify and quantify. They comprise all direct, indirect,

tangible and intangible costs and benefits. Given the significant limitations concerning the monetisation of intangibles, a cost-effectiveness approach is more appropriate for a comprehensive assessment of risk prevention measures.

Collaboration can improve the performance of Early Warning Systems (EWS)

Despite significant technical progress in the development of operational EWS for water related hazards, further work is required to exploit the benefits for risk reduction brought by using such systems. Increased global interdependence underlines the necessity of cooperation, coordination and information exchange on EWS. Stronger involvement by private and public stakeholders and greater transparency about EWS methods and performance are key factors in encouraging public confidence in, use of, and consequently benefit from EWS. This process requires more communication both to the public and within the scientific community as well. Indeed, there is a need for more accessible and open information from the developers of warning systems, which should act themselves as promoter of their product. In this way, warning systems will become part of the cultural background, and people will be better prepared to cope with emergencies.

Freeboards: height standards arbitrarily defined, misleading for risk perception

Structural flood defences, such as river dikes or levees, arbitrary freeboards are often designed to include the use of additional freeboards to provide an additional, often arbitrary, safety margin to deal with the uncertainty associated with the estimation of extreme water levels. However, there is a number of issues associated with the use of these safety freeboards. In fact, their definition is often arbitrary and is hardly justified. Also, the adoption of freeboards often leads to the false perception of additional safety level.

Probabilistic flood maps: technically correct but still difficult to implement and communicate

Visualizing flood hazard as a probability is theoretically more correct than using deterministic maps as it accounts for uncertainty in the modelling process. However, environmental agencies, river basin authorities and engineering consultancies hardly ever apply probabilistic approaches for floodplain mapping, mainly because it is believed that people would find the deterministic ones easier to understand. Yet, most people do recognize that not all the floodplain areas are exposed to the same level of flood hazard. Also, there is a common perception that decision makers prefer deterministic binary maps over probabilistic maps, mainly because uncertainty estimation in modelling water-related hazards is still under development. Research is thus needed to improve the

understanding, communication and use of probabilistic maps in risk management.

Risks perceived by ordinary people are more complicated than those calculated by experts

In risk assessment and management, the importance of considering how local stakeholders perceive both risk itself and management options is now widely recognized. The review shows that while experts refer to more 'quantitative' criteria (probabilities, expected damage), laypersons are often said to rely on more qualitative dimensions, which are more complicated to assess. Research opportunities include assessing the factors that influence risk perception, such as the immediacy of an adverse effect, the irreversibility and intensity of its impacts, the perceived economic loss and life threat, the choices available, the voluntariness of risk taking, the knowledge and the familiarity with the hazard, as well as the possibilities of controlling or reducing the risk. Given this complexity, another needed line of more research is needed to develop methodologies for incorporating these components of risk perception into the framework of risk assessment. This integration would provide decision makers with a more comprehensive evaluation of risk including its essential social dimensions for a more effective risk management.

Different assumptions of existing risk communication approaches must be better understood

The field of risk communication has expanded rapidly. While past research offers some important insights, for instance about the importance of message design to understanding the roles of emotion and trust in response to risk, this review has highlighted important debates about the meaning and purpose of risk communication. In particular, several different approaches to risk communication have been identified, which involve rather different normative beliefs and theoretical assumptions, which in turn provide quite different bases for assessing the character, quality, and purpose of risk communication. Those differences must be understood and appreciated to assess the potential roles of risk communication in risk reduction and management.

Flood insurance mechanisms need further development and possibly a standard structure

Appropriate land-use planning coupled with building codes and individual flood proofing provide methods for reducing exposure to flood risk, whereas flood protection measures and early warning systems can protect properties in flood prone areas. Insurance provides a method for transferring the residual risk after consideration of the planning and engineering approaches. Furthermore, insurance and other similar mechanisms of risk transfer are

often considered as important tools for creating incentives for risk reduction in flood prone areas and adaptation to global changes. Nevertheless, there are significant obstacles to developing appropriate flood insurance and risk transfer mechanisms. Although flood insurance is provided in many European countries, there is significant variability in the availability, structure and

coverage of insurance and risk transfer policies, as well as variation in the levels of government involvement and market penetration.

Further directions

The KULTURisk research project team is currently working on the risk prevention framework in the selected case studies, and developing the baseline for the

application of the risk-based methodology for the different risk prevention measures.

Moreover, communication of standard methods of risk prevention to decision-makers, stakeholders and end users is being prepared, which will be compared later with improved risk prevention methods.

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