

MEETING MULTIPLE DEMANDS ON NATURAL HAZARD PREVENTION AND PROTECTION IN ALPINE REGIONS UNDER A CHANGING CLIMATE – EXPERIENCES FROM AUSTRIA

Maria Patek^{1*}

ABSTRACT

The political, socio-economical, scientific, legal and technical issues underpinning natural hazard management strategies have undergone considerable change during the past few years. With the increase in environmental consciousness, and the potential impacts of Climate Change ahead, the demands on integral aspects of natural hazard management have also become more stringent. Public awareness of natural hazards is increasing and the expectations of the public are changing towards increased levels of protection as Austria becomes wealthier and therefore more vulnerable. At the same time, public investments in natural hazard protection and prevention measures are more and more limited, and the shortage of financial resources cause a challenge in meeting the demands of maintaining or restructuring structural measures in use. Conventional protection concepts are not more adequate in covering all the aspects a modern natural hazard management strategy require, especially in which terms like social responsibility, capacity building, and resilience are leading policy development and implementation. Thinking – and speaking – about these challenges that forces each of our natural hazard management policies around the world is a present and common need, and the International Research Society INTERPRAEVENT is one of the most suitable places for such a task – especially in providing evidence that can help to underpin our efforts to live with natural hazards in the 21st century.

Key Words: Natural hazard management, Climate Change, Strategy, Demand-driven approach

INTRODUCTION

In 2002 Göttle & Loipersberger predicted in their speech at the INTERPRAEVENT session in the Pacific Rim that natural hazard management will further challenge our policy development and implementation efforts related to mitigating the impacts of natural hazards on our society, environment, economic development and welfare (Göttle & Loipersberger, 2002). They closed their speech with a positive outlook that there is a way to master the upcoming challenges successfully. Now 8 years later and considering the increasing number of natural disasters with adverse effects on our societies, economics and environments, together with all the changes and challenges that influencing our strategies and principal concepts in natural hazard management, I'm sorry to say that we're still far away from a business as usual situation in natural hazard management. This unemotional perspective of an

1 Federal Ministry of Agriculture, Forestry, Environment and Water Management, Unit IV/5 "Torrent and Avalanche Control", Marxergasse 2, A-1030 Vienna, Austria (*Corresponding Author; E-mail: maria.patek@lebensministerium.at)

(policy) issue that is on top of many political agendas around the world resulted from the experiences we have with regard to natural hazard management in Austria, and I guess there are similar situations in the countries represented in the framework of INTERPRAEVENT. Since 2002, we experienced a number of natural disasters in Austria with to some extent disastrous consequences (flood 2002, 2005, 2007, 2009; extreme snowfall triggering huge snow avalanches in 2006, 2008, 2009; landslide disasters 2005 and 2009; storm events 2007 and 2008), and the point is: they still occur even though we invest million of Euro into natural hazard mitigation concepts and strategies. Although floods, snow avalanches, debris flows or landslides are natural events, the disasters they trigger are not, because of increasing vulnerability and damage potential in areas at risk. Additionally, special attention must be given to the possible consequences of Climate Change which will have certainly impacts on the frequency and magnitude of future hazardous events. The question that inevitable arises is: Are our present natural hazard management concepts and strategies adequate enough to respond effectively to those challenges?

ALPINE NATURAL HAZARDS IN AUSTRIA – BASICS AND FACTS

With around 83,000 km² Austria is a relatively small, land-locked country in the heart of Europe. Its landscape is dominated by the Alpine massif (approx. 60% of the total area), what strongly influences the climatic, socio-cultural and economic conditions within the country. Because of its topography and in combination with the climatic variability as a consequence of this, Austria is among the most water-wealthy regions in the world. Water and forests are a characteristic element of the Austrian landscape. Approximately 100,000 km running water courses and about 9,000 standing waters form the scenery for the major part of Austria's living and economic areas. All conurbations and large economic areas are located at big rivers (like the Rhine, Lech, Inn, Salzach, Drau, Mur etc.). About half of the Austrian territory is covered by forests, of which one-third have direct protection function (e.g. to protect infrastructure or settlements against snow avalanches or rock-falls).

However, land for human settlement and economic activity is relatively scarce in Austria. Only 37% of the national territory is suitable for permanent settlements; in some side valleys, e.g. in Tyrol, this share is about 9%. This is not only due to the steepness and inaccessibility of the Alpine valleys, but is also a result of the permanent risk of natural hazards like floods, debris flows, landslides, rock-falls, and avalanches to which the land is exposed. Torrents are a typical feature mainly of the many Alpine valleys. More than 12,000 torrents are registered in Austria, and about 2,000 of them are considered particularly dangerous. In the winter season, about 5,000 snow avalanche paths form a notable risk to inhabitants and tourists too.

As a consequence of the limited settlement area available, urban sprawl and land consumption occurs in restricted areas, with resulting high pressures on the environment. Global warming and its consequences enforce this pressure. These developments – among much more others - are one of the reasons why natural hazard and risk management is considered as a key task in terms of policy development and implementation. The most important policy drivers in Austria concerning natural hazard management at the moment are:

- Development of a national Climate Change Adaptation Strategy
- Implementation of the EU Floods Directive (2007/60/EC) and EU Water Framework Directive (2000/60/EC)
- Strategic Environmental Assessment Directive (SEA, 2001/42/EC)

- AGENDA 21 (Rio de Janeiro, 1992 and Johannesburg, 2002) with the EU strategy identified in Gothenburg (2001)
- Implementation of the Alpine Convention Protocol
- Shortage / limitations of financial resources

Natural hazard management is part of the state responsibilities “public safety” and “public precautions for existence”, but it has to be noted that there is no legal “right (title) for protection” in Austria. As protection measures against natural hazards in general require the public investment of considerable financial, material, and personal resources, each year a tremendous amount of national financial allocation is needed to cover the costs both for new protection measures as well as the maintenance of existing structures. In total, Austria is investing around EUR 200 million each year into natural hazard prevention and protection, with an increasing part on maintenance and reconstruction of structural measures in use. Considering the large number of existing protection measures in Austria and the state of repair of these structures, it is inevitable that the public sector, given budgetary constraints, will face challenges in meeting the financial commitments required to maintain the functionality of these structures over time.

PROGNOSTED IMPACTS OF CLIMATE CHANGE ON NATURAL HAZARDS IN AUSTRIA

The impacts of global warming are already apparent in the Alps, since mountain areas are exceptionally vulnerable to climate change. In the last years, frequent extreme events like storms and heavy rainfall have increasingly caused debris flows and floods, associated with considerable ecological, economical and social damage. Scientific studies predict further significant climatic changes for the future. These prognoses base on several different assumptions of emissions levels. On this basis a maximum global increase of temperatures by 6.4°C has been computed for the end of the century. The most likely figures, however, are between 1.8°C and 4.0°C (IPCC 2007). In addition, a decrease of 20% of the mean summer precipitation is expected in the Alps. By contrast regional changes between -10% and +20% have been computed for winter precipitation. As a result the seasonal distribution of precipitation will shift and the frequency and intensity of extreme events will increase.

Recent research results indicate that Climate Change will have a paramount impact on natural hazards in the Alpine environment. The following changes are expected:

- probable increase of floods in frequency and amplitude (above 100-year-flood) induced by
 - increase of precipitation in the winter, which falls as rain at lower altitudes and causes floods in combination with snowmelt (“rain on snow”)
 - increase of intense rainfall up to high altitudes and extreme weather phenomena in the summer with high regional impact on floods and debris flows
 - shifting of snow line
 - soil desiccation
 - lower attenuation of floods due to the damage of protection forests and the change of the vegetation cover (by pests, erosion damage, over cutting)
 - increase of sediment transport due to melting permafrost (moraines) and the damage to natural vegetation caused by erosion and avalanches

- increase of avalanches in frequency and run out distances caused by:
 - heavier snowfall at middle and high altitudes in the late winter
 - sudden increase of temperatures up to high altitudes (Feb. 2008)
 - increase of snow drift
- extreme low water periods and droughts mainly in the summer due to an intensified evaporation and lower rainfall; thus increase of utilisation of water resources
- lowering of the water table; reduction of reservoirs of storage dams
- risk of rock falls and slides caused by:
 - melting permafrost
 - melting glaciers
 - intensive rainfall
 - increase of precipitation in the winter
 - threat to protection forests
 - changes of natural vegetation
 - drought cracks
- soil erosion intensified by:
 - dehydration of soils
 - melting permafrost
 - full-depth avalanches in spring
 - damage to protection forests
 - changes of natural vegetation
- Risk of forest fires intensified by:
 - reduced rainfall and higher temperatures
 - increased dehydration of soils

MULTIPLE DEMANDS ON NATURAL HAZARD MANAGEMENT – CHALLENGES FOR POLICY AND PRACTICE

Austrian – as well as - European policies are underpinned by the principles of sustainable development, where economic approaches are considered alongside measures to benefit the local environment and improve the quality of life. Sustainability is driven by finite characteristics of natural and human resources. Population growth, demand for land use, urbanisation, social awareness, health and safety imperatives and the development of new technologies have all been affecting sustainable development in Europe in the last decade. As a consequence, sustainability is now an established fact, with discernible benefits for businesses, communities, and the natural environment across Europe. These developments have also consequences for the management of natural hazards.

Mitigating natural hazards in Austria and more over in the Alps has a long tradition (e.g. the Austrian Forest-Engineering Service for Torrent and Avalanche Control celebrates its 125th anniversary in 2009), which build the basis of services of public interest in these regions. Emanating from conventional mitigation concepts (like the system of forest-technical torrent and avalanche control) – which aimed at decreasing both, the intensity and the frequency of events by implementing permanent measures in the upper parts of the catchments to retain solids from erosion and in the release areas of avalanches (and supplemented by silvicultural efforts to afforest high altitudes) – a more sophisticated approach has been implemented since the 1970s aiming at the deflection of natural hazard processes into areas not used for settlements. A fundamental change in the mitigation strategy applied in Austria has been recognised in the last few years, depending on the evidence that conventional technical

measures against natural hazards are not only very cost-intensive in construction and maintenance, and that the feasibility of technical structures is restricted due to a scarceness of financial resources provided by responsible authorities. Moreover, and considering a increasing number of catastrophic events that were not prevented by any incentives and efforts to improve the protection strategy system, it has to become clear that conventional technical measures do neither guarantee reliability nor complete safety and a residual risk of damage to buildings, infrastructure and harm to people still remains.

But restrictions and limitations on the level of safety or the residual risk are not the only challenges that face the Austrian policy on natural hazard management. Among others we have to consider developments and changes related to:

- Modified public demands (incl. tourism and economic growth) push the living space forward into endangered areas
- Enormous increase of damage potential (human losses, economic damages) and vulnerability of infrastructure and buildings in hazard-prone areas
- Around 242,000 buildings in Austria are at risk to flooding, 35,000 endangered by torrents
- Collision of interests between unrestricted use of private real estate and risk-aware land use
- Demographic changes and regional mismatch (preparedness, coping and long-term recovery)
- Increase in environmental consciousness
- Increasing demand for the maintenance and reconstruction of protective structures in use

To cover these restrictions and challenges, recent policy developments are aiming to build natural hazard-related resilient communities. This approach which implies active involvement of individuals and communities at risk is one result of a long-lasting debate on how and to which degree a privatization of risk can be accepted and accounted from both an individual and public point of view. The ultimate goal of sustainable development requires a holistic view of management of natural hazards, taking account of social and economic development and long-term change in the natural environment. This goal includes to find the balance between natural hazard control by physical structures and damage prevention by alternative means and options (e.g. planning, adaptation resilience, insurance, preparedness etc.) to alleviate natural hazards of different magnitudes and sources.

In order to develop sustainable natural hazard management concepts, it is inevitable to further understand and assess multiple benefits of mitigation and protection strategies (e.g. in flood management the extent of flood damage reduction, erosion control and sediment management, improved water quality and water supply, fish and wildlife habitat, habitat for endangered species, outdoor recreation etc.), or measures that support multiple user-functions. This is especially critical in densely populated areas where multiple requirements have to be satisfied in one go.

DEMAND-DRIVEN APPROACH IN NATURAL HAZARD MANAGEMENT

As a consequence of the challenges and demands ahead a modern natural hazard management strategy has to balance at least

- technical
- economical
- ecological
- social
- legal
- political
- natural
- organisational/institutional

standards, interests, and uncertainties on a not only local but even more regional / trans-national / global level. In Austria, there are several examples where this paradigmatic shift can be manifested, e.g. no more protection at all costs (prioritisation of areas at risk by cost-benefit analyses), support of capacity building processes on an individual, community and regional level, fostering community-based public education initiatives, promotion of the voluntariness principle in mitigation concepts, or the integration of environmental management, land use planning and emergency management into natural hazard and risk management approaches. This shift towards “living with natural hazards and risks” is already applied in underlying protection concepts like risk-cycle and life-cycle based strategies, adoption of precautionary principles in natural hazard management, consideration of social responsibility, investment in education approaches or in further harmonising technical standards and codes.

The principal idea that natural hazard management should be more demand driven, i.e., that individuals / communities should be provided with services they want and for which they are willing to pay /contribute is not a new one, but becomes in the last few years more and more important. Although demand-driven interventions represent progress over top-down approaches, consideration must be given to the risks involved. It must be clear that demand-driven planning processes requires flexibility on the part of technical consultants, planners, and government authorities to respond to the kind of unexpected findings that are likely to emerge from serious dialogue with project beneficiaries (which are not only represented by individuals / communities at risk, but also by other stakeholders interested in mitigation activities). From an individual / community point of view this approach requires a better understanding and knowledge of the consequences of natural hazards particular on areas at risk in their vicinity, and the willingness to a greater ownership of risks (e.g. by applying flood proofing requirements or additional insurance opportunities etc.).

FINAL REMARKS AND RECOMMENDATIONS

From a historical perspective Austria – as well as many other European or worldwide states - have developed independent and successful strategies to improve the understanding of natural hazard-related risks. Over centuries, a suite of natural hazard management approaches (technical and bio-engineering measures (so-called structural measures), as well as regulatory, economic, and informatory instruments (so-called non-structural measures) has been developed and adopted in areas at risk. Several natural disasters in the course of the past few years have shown repeatedly, that even complex and expensive protective measures cannot prevent extreme events. We need to accept that some hazards will occur, but we can reduce their impacts by preparing and mitigating the consequences. In this context we always have to consider that absolute safety from natural hazards cannot be reached.

In order to tackle the challenge of rising natural hazards and related risk and to develop effective policies and risk management practices, new strategies consider a more demand-driven approach. Investing in concepts that support people at risk in more ownership of risk is a step towards balancing public and individual demands and interests in natural hazard management, but it is important to never neglect the several risks which such a concept implies. Further capacity building, awareness raising, interdisciplinary communication and (international) co-operation were identified as key factors in implementing a more demand-driven approach successfully.

All the considerations above need further and appropriate evidence. I'm confident that R&D is key to help us live with natural hazards and risk in a changing climate and environment. Only evidence-based policy making can help us to bridge the gap between current demands and limitations to natural hazard management and further uncertainties that comes along with Climate Change and other future developments or changes. It is at the core of the International Research Society INTERPRAEVENT to further strengthen the link between academics, practitioners and policy-makers in natural hazard-related research in order to help optimising the output and outcome of research efforts and also to contribute to this (new) paradigm of risk prevention and mitigation.

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