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Advice Document

To the

European Commission

On

Reducing the risk from natural hazards

- The role of Geosciences –

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Reducing the risk from natural hazards – the role of Geosciences

1. Introduction

Natural hazards such as landslides, earthquakes, volcanoes and floods are geological and environmental phenomena occurring at irregular intervals and at varying intensity. Some regions and/or locations are more at risk than others, depending on factors such as geology, topography and proximity to hazard sources. Volcanism, earthquakes, landslides, tsunamis, et cetera, may be linked to each other and may have global effects. The risk posed by a natural hazard is in direct proportion to the population density in the area vulnerable to the risk. However, the effects of natural hazards can be mitigated, and in some cases even prevented, to alleviate human suffering and reduce economic loss.

Geosciences and professional geologists can be used to determine what hazards particular locations face, and can assess how to mitigate these hazards. Efforts to mitigate the risk do not need to be costly; for example the costs of producing hazard maps or increasing geoscientific knowledge in general are generally less than 1-2% of the reconstruction costs incurred after a major natural disaster. All activities should be tailored to specific hazards and locations, allowing for cultural and economic diversity.

This advice document is written in response to the European Commission consultation meeting, 8 February 2005, on 'Civil protection and accidents at sea'; on request by Mrs. Bucella to provide a concrete geoscientific advice document; and following the geoscientific manifesto on civil protection against natural hazards, presented by the European Federation of Geologists at this consultation meeting. This advice document is written by the Group of Experts on Natural Hazards of the European Federation of Geologists (EFG).

2. Measures to mitigate effects of natural hazards

Measures to be taken for mitigating the effects of natural hazards can be grouped together in three major areas, of which the first two can be implemented by political and social will alone:

- **Public awareness, education and communication systems**
- **Land-use planning**
- **Early warning systems**

The third mitigation measure, implementation of early warning systems, requires additional technical development as well as political action.

2.1 Public awareness and education

Effort must be made to increase the level of public awareness regarding the causes and effects of natural hazards. People living in vulnerable areas, e.g. in valleys affected by repeated flooding, should be aware of the potential risk and possible measures they can take to protect their lives and possessions. Local authorities must know when to alert the population and how to engage disaster management teams.

The more that can be achieved at a local plan, the better immediate measures. Education and practical instruction ought to be implemented at different levels in society: at public schools, via seminars, educational brochures as well as specific information for local politicians and decision makers. Measures may also be directed towards the tourist industry, including brochures and videos describing natural hazards in vulnerable parts of the world where tourism is important.

The European Federation of Geologists (EFG) can assist in editing schoolbooks, producing pamphlets and to arrange seminars in all member countries (to the general public, as well as specific education to policy-makers and land-use planners). Efforts can be focused on the specific priority schemes in each country.

2.2 Land-use planning

Hazard maps should be developed where appropriate. A standard European system is recommended with the same hazard and risk levels, scales and information. Geological maps are important input to the generation of hazard maps. In most European countries geological maps are already digitally available at their national Geological Surveys, containing boundary indications of river flood plain deposits, locations of soft clays, et cetera.

Hazard maps available for decision makers should be implemented in land-use planning. The risk to natural hazards can be mitigated by avoiding vulnerable areas for construction or by implementing specific measures; however the need for such action must be identified. A special European Directive and appropriate regulations to address natural hazards should be considered as part of development planning. Note that these issues should not automatically be merged with terrorism hazards under the same Civil Protection umbrella, as they require a completely different approach.

Co-ordinated and informed land-use planning should be the foundation for mitigating risk, for example by preventing home construction in river flood plains, or the construction of hazardous industry in areas prone to natural hazards. In Italy, for example, since 1989 the *National and Land*

Protection Law requires compulsory geological studies on natural risk for river basins and land management. All urban planning instruments have to be redacted with geological support.

2.3 Early warning systems

Many natural hazards are forewarned by precursors, which are small but significant signs heralding the event. Monitoring of appropriate precursors may provide a means to identify an impending natural hazard sufficiently early to initiate mitigation measures. Early warning systems may be implemented at local scale (e.g. an instable slope), or at regional scale (e.g. tsunami warning). Data from sensors or monitoring systems at the earth surface may be combined with observations from space for both local and regional early warning systems.

The EFG strongly recommends that emphasis should be placed on the development of co-ordinated European organisations for emergency and rescue response as well as relief and aid organisations. The continuation of the current status - an agglomeration of uncoordinated groups at disaster sites - should be avoided in the future. A European hazard monitoring system must be realized with special funds of the Union.

Early warning systems are only as good as the ability to communicate the message and for the people to act on it. A warning system may identify the hazard and the people may have been trained how to react but if the warning is not passed quickly to the right people in the hazardous area, then nothing will happen.

A system of geo-indicators, covering a wide range of geological hazards, has already been developed by the International Union of Geological Sciences (IUGS) and could provide a framework for the development of monitoring systems applicable to European environments. However, continued research is required to further improve these monitoring and early-warning systems.

3. A discussion of natural hazards relevant for the European community

A consideration of the potential risk from natural hazards should be compulsory in advance of infrastructure projects and construction of buildings for storing of hazardous material affecting man and environment. Infrastructure utilised by large groups, for example hospitals, schools, bridges and tunnels should not be located in areas at high risk for natural hazards. Several examples are considered below.

Flooding

Flooding is any abnormally high water flow that overruns the natural or artificial confining boundaries of the waterways. Single events can result in heavy tolls of death and property damage, as in the Sichuan, China, flood of 1983, when more than 1 300 died and 1,5 million were left homeless. Floods are caused not only by rain but also by man-made changes to the earth's surface, e.g. farming, deforestation and urbanization. These actions increase runoff from rains, and storms that previously would have caused no flooding, inundate vast areas today.
Disaster conditions are also created by reckless building in vulnerable areas, poor watershed management and failure to control flooding. Floods damage human settlements, force evacuation, damage crops and food stocks, strip farmland, wash away irrigation systems erode large areas of land or make them otherwise unusable.

Construction in areas that have a historical record of flooding should be avoided. Citizens already living in such areas should be made aware of the precursors to flooding, and plans for responding to flooding events should be made by local authorities. The influence of power stations, dams, channels, and agricultural reshaping of the landscape in combination with heavy precipitation must be well understood and – if possible – mitigated. Alleviating the harmful effects of floods requires reducing the vulnerability of human settlements and residences, and strengthening the social structure of communities so that they can absorb the impacts of a disaster and recover rapidly. The first and most important step is to identify the high-risk areas through risk maps showing flood probabilities.

Earthquakes

Although earthquakes cannot be eliminated, measures may be made to mitigate the effects through proper zoning and building codes. Severe earthquakes are most common in southern Europe, in the countries surrounding the Mediterranean. Earthquakes occur all the time; the last event in Europe was a non-destructive earth movement at the scale of 4.6 on the Richter scale that affected Crete the 8th of February, 2005, and in the last months hundreds of small earthquakes have occurred in the Mediterranean, and area where volcanism also has to be considered.

Tsunamis

Tsunamis can occur along the coast regions of Europe, as was the case in Lisbon and westernmost Spain the 1st of November, 1755. The wave from the earthquake outside Portugal reached about 15 meters height when it hit Lisbon. Another example is the tsunami which occurred in the North Sea 8200 years BP, caused by a gigantic underwater landslide at the Norwegian continental slope. Another famous tsunami hit Crete with a wave of 50 meters height, when Santorini (Thera) exploded in 1470 B.C. In December 1908 an earthquake caused a tsunami along the Italian coasts, creating an 8 m high wave. Current technology, if applied, can mitigate the destructive impacts of tsunamis on lives and property. Land use zoning coastal areas may be a less costly way to reduce economic losses from tsunamis. Tsunamis have also been forecasted at the Canary Islands as a result of volcanism and rock falls/landslides.

Landslides (including rock-falls)

Landslides are common along watercourses and in regions with accentuated topography, and can be compared to snow avalanches. Large masses of soil and rock can suddenly be detached, causing significant damages to roads, dams, buildings or other infrastructure. Rock-falls occur on precipices or slopes, and falls of material in autumn and spring occur as a result of frost weathering and after heavy rains. In mountainous areas, valley slopes are subject to both rapid and episodic devastating processes. Buildings should not be placed in such positions where landslides might move large terrains without forewarning. Landslide hazard maps are available in some regions; a unified map covering the whole of Europe is regarded as a high priority target. In Italy inventories of landslides exist including potential landslide regions. In May 1998 over 100 landslides occurred in the Sarno-Quindici area, 30 km east of Naples. These landslides travelled up to 4 kilometres and impacted a number of towns resulting in severe destruction and the loss of 161 lives.

There are methods for mitigating landslide losses. Land use management, building and grading codes, the use of will-designed engineering techniques for landslide control and stabilization, and the timely issuance of emergency warnings can significantly reduce the catastrophic effects of landslides.

4. Conclusions and recommendations

Earthquakes, tsunamis and volcanic outbursts can threaten the whole mankind. A single hazardous event can destroy crops, buildings, highways, ports and dams, affecting food distribution, water supply and communication systems. Nearly all countries risk devastating economic losses and long lasting suffering for the survivors.

During the past 20 years natural hazards have claimed more than 3 million lives worldwide and affected almost 1 billion people. Accompanying the loss of life are devastating economic loss and suffering for survivors.

However, hazard reduction successes have clearly shown that losses of lives and material are not inevitable. While it may not be possible to prevent the occurrence of natural hazards, the disasters that follow can often be avoided. An understanding of geological processes is a good step forward avoiding being surprised every time a new catastrophic event takes place.

Unfortunately there are still no methods to absolutely predict or prevent hazardous natural phenomena. However, building codes based and reliable hazard maps can be used in land-use planning to help eliminate the worst disaster scenarios and to help mitigate the effects of smaller scale hazards.

The EFG has both expertise and established communication network to experienced and renowned organisations in other parts of the world, like the Natural Hazard Center in Colorado. The general scope of EFG demands that the organization should be launched and administrated on a European basis.

As mentioned above, the objective of this document is to contribute to reduce catastrophic life loss, property damage and social-economic disruption from natural hazards. The EFG approach intends to:

- Introduce and accelerate known mitigation and preparedness approaches, including the establishment of monitoring systems.
- Collect data of existing hazard mitigation experience and practices.
- Develop specific scientific and technological knowledge to improve hazard mitigation.

Other measures are: increasing earthquake and wind-resistance of building structures and dams, and barriers in order to reduce the effects of floods and tsunamis, and enforcing grading codes to prevent landslides. Hazard prediction and warnings are crucial to hazard reduction with great potential to reduce losses of lives. The scientific and technical applications to mitigate the effects of natural hazards include better building structures, predicting and warning of hazards and avoiding sites where natural hazards are likely to strike most severe. Social strategies can mitigate the effects of hazards restricting land use, developing emergency preparedness measures, and restructure the community as to be less vulnerable to hazards.

Hazard reduction can be said to be: “the process of lessening the impacts of a potential event on the social, cultural, political, infrastructural and economic environments”. Experience demonstrates that we today have enough knowledge to reduce both human and property losses substantially. Let us not hesitate to implement the necessary measures.

5. Plan of action

In the first phase the following actions should be realized:

- Consider what natural hazards exist within each member country that could result in a “natural disaster”.
- Provide information on what legislation is in place to mitigate such problems.
- Cross-correlate between the member states to ensure hazards are not overlooked.
- Review the legislation for its applicability in all the countries of the European Union.
- Produce a summary of what the known hazards are to Europe and what litigation is used.
- The above should be used to determine the following actions, as described in this advice document (incl. generating hazard maps, firstly for the most vulnerable areas; educate general public, policy-makers and land-use planners; install early-warning systems where appropriate, etc).