

Historical records of natural hazards events as guidance for preventive spatial planning

Local knowledge about historical natural hazards events could be used to prevent building in hazard prone areas, and therefore save lives and economic values. Still, such knowledge is not being used in a systematic manner for spatial planning purposes in Norway. This is one reason why the vulnerability reducing potential of spatial planning is not fully utilised.

In this poster we report findings and recommendations from the first of three main stages of the AREALKLIM research project, which assesses the relationship between damages to buildings & other infrastructure and weather-related natural hazard events. Our aim is to increase the ability of spatial planning to prevent damages that could be caused as a consequence of climate change.

The 1897 Tenål debris flow

Eyewitness Nils Jørgen Gregersen (1840-1924):

"The gorge was filled with rocks, clay and mud, with shrubs and trees – everything that this immense power encountered on its way. Repeated booms sounded as the mass was forced through the narrow gully. Thereafter it spread over the fields of Tenål and passed its "avant-gard" towards the Vikja river. The inhabitants of Tenål avoided damage to their buildings this time. The slide deflected and hit the fields."



1970's-2008: Building in the hazard zone at Tenål



Photo: Kyrre Groven

After some 18 houses close to the small river were destroyed by blocks and mud during a flood incident in the Middle Ages, the Tenål farms were moved to a safe location. Noone were harmed by the 1897 debris flow, thanks to sparse settlement along the river. Since the 1970's the Municipality of Vik has approved building of 12 houses within or close to the area that was affected by the debris flow in 1897. The last building application was given in 2008. Stories about the historical events were alive in the local community, but were ignored by developers and authorities (Groven 2013a).

The 2011 Tuftadalen slush avalanche



Photo: Ulrik Domaas, NGI

Two people were killed on 21 March 2011, as a slush avalanche at the speed of approx. 80 kmph swept away a private house situated at the bank of a small river in Tuftadalen, Balestrand (NGI 2011). The house was built in 1980 against the advice of an old neighbour, virtually at the site of an old mill that was taken by the river in historical time. The danger of slush avalanche could not easily be predicted, but local authorities failed to prevent building at a flood prone site, partly due to missing routines for gathering local knowledge on natural hazards as part of the building application process (Groven 2013 b).

USE OF HISTORICAL RECORDS IN SPATIAL PLANNING

Spatial planning is a key instrument for reducing the vulnerability of society against natural hazards, but its potential is yet to be fully utilised (Schmidt-Thomé 2006). Systematic use of historical data and local knowledge on natural hazards, seems to be one prerequisite for improvement. Planning tools generated from historical data on floods, landslides and other hazards are becoming increasingly available. These have been put forward by governmental bodies, mainly for use in local land-use planning. Hydrologic time series are used for developing flood inundation maps (www.nve.no). As for landslides and snow avalanches, historical sources such as parish registers, have been used for data gathering (Furseth 2006). Records of more than 3,000 historical landslides, rockfalls and avalanches are available on the web portal www.skrednett.no, and contribute to the preparation of danger zone maps for a variety of natural hazards. Even though such tools are helpful, in most cases they provide rather coarse information that needs to be supplemented by local knowledge and experts' judgement. There is also evidence that available tools are not being used in many municipalities.

In Europe, historical flood records have been used on a superior level for flood frequency analyses and flood warning systems (e.g. Payrastre et al. 2011; Stefanescu 2013). One prominent example of systematic use of local knowledge about natural hazards, are found in the Alps, where avalanche cadastral maps in some regions have been drawn for centuries. As of 2003, half of the avalanche prone communities in Switzerland had statutory avalanche hazard zones and a related land-use planning process (Ammann 2003). In Norway, similar risk zone maps for snow avalanche have been prepared for only two municipalities (Odda and Årdal).

WHAT WE HAVE DONE

The project draws its empirical material from ten historical cases where weather-related natural hazards events have caused damage to buildings or other infrastructure. A common characteristic for the cases is that spatial planning played a role in the outcome of the events, or led to increased vulnerability in the area. Our approach is inspired by performance auditing: In each case studied we determine whether the damage could have been avoided or turned out less severe if the spatial planning process or implementation of the plans had been carried out according to the regulations valid at the time the plans were made, and by current regulations. We have also focused on to which extent local knowledge on natural hazards has been a premise in the planning and building application processes.

WHAT WE HAVE FOUND

Main findings from the first AREALKLIM work package:

- Spatial planning and building application processes do indeed play an important role in natural hazards prevention: Damages could have been avoided in six out of eight more recent cases with a stricter application of the spatial planning laws, or better enforcement of existing plans.
- Local knowledge of earlier natural hazards events could have prevented harm to people and property if taken into account in spatial planning (e.g. the Tuftadalen case) or prevented building of infrastructure in hazard prone areas (e.g. the Tenål case).
- Despite of stricter legislation, improved access to hazard mapping resources, and greater awareness of existing natural hazards among municipalities, doubts remain about the capacity of municipalities to plan according to changes in future climate change. Uncertainty issues leading to delay of action, and anticipated new patterns of natural hazards due to climate change (e.g. slush avalanches in new localities) contribute to this.

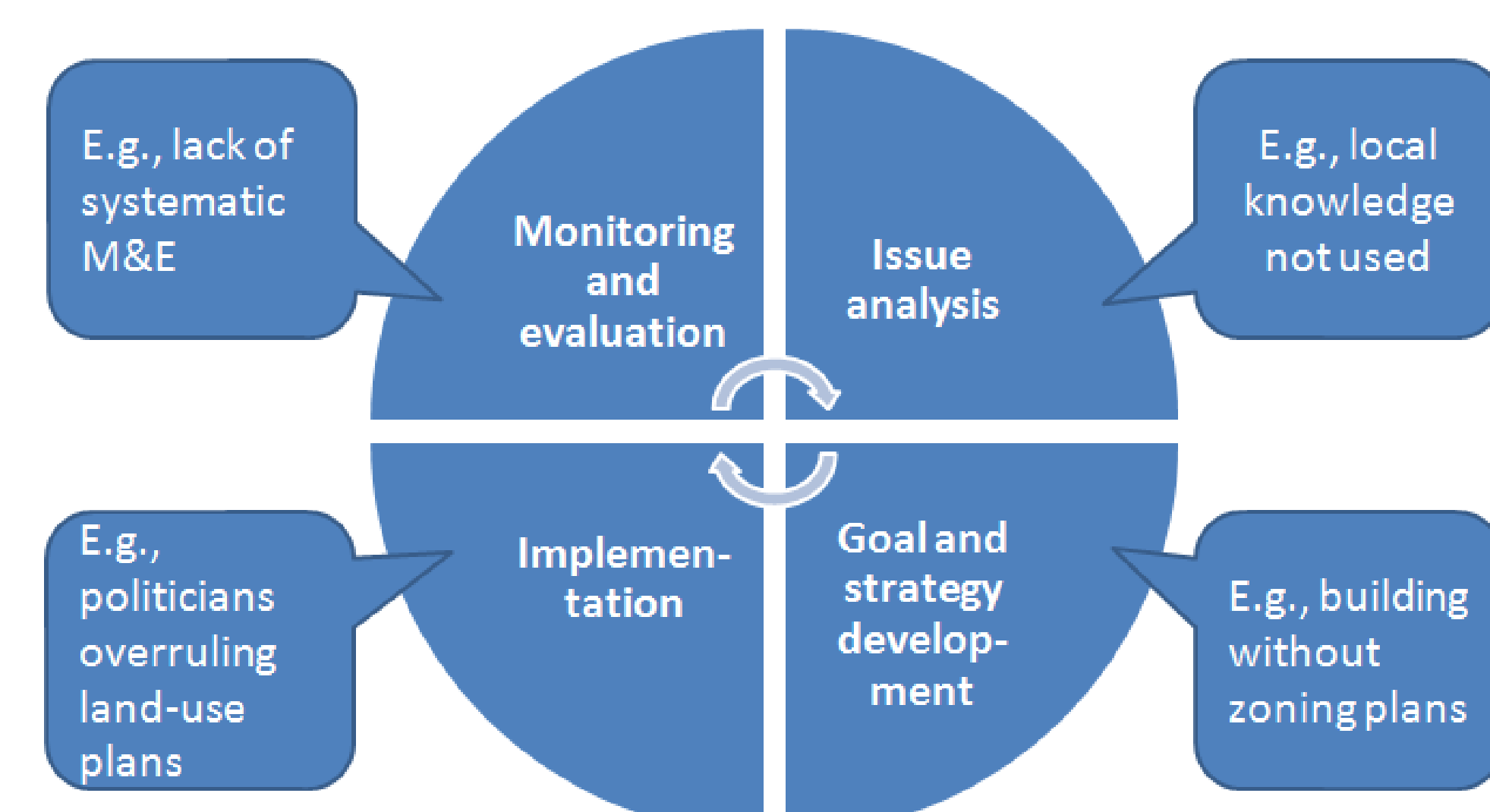
RECOMMENDATIONS

We recommend that municipalities activate local knowledge on historical natural hazards events, and implement these insights in land-use planning. This could be done by appointing a group with mandate to establish a database of natural hazards events, potentially stimulating community commitment to hazard prevention. Systematizing of professional reports, archive inquiries and interviews with elderly people would be appropriate methods. Interpretation of historical information needs to be assisted by geophysical expertise (Coeur and Lang 2000), and should be a supplement to experts' investigations.

THE AREALKLIM PROJECT (2012-2014)

The project is funded by the Regional Research Funds in Norway (RFF Vestlandet), Norwegian Water Resources and Energy Directorate (NVE), and others. Its main goal is to increase the ability of spatial planning to prevent damages from weather related natural hazards. The project consists of three main parts:

1. Analysis of earlier natural hazards events and related planning processes; Structure findings in accordance with the model below.
2. Use insights from (1) to inform ongoing planning processes in natural hazards prone areas; Develop new management tools.
3. Develop course modules on natural hazards, climate change and spatial planning for educational purposes, based on (1) & (2).



Model for structuring findings from historical cases in AREALKLIM

REFERENCES

- Ammann, W. J. (2003). Integral risk management in avalanche protection and mitigation: The Swiss approach. In: *Recommendations to deal with snow avalanches in Europe*. J. Hervás (ed.). Ispra, Italy, European Commission Joint Research Centre.
- Coeur, D. and M. Lang (2000). Historical information about floods: does History only give lessons? *Houille Blanche - Revue Internationale De L'Eau* (2): 79-84.
- Furseth, A. (2006). *Skredulykker i Norge*. Oslo, Tun Forlag.
- Groven, K. (2013a). *Skredfare på Tenål i Vik. Historisk naturskadebase, AREALKLIM arbeidspakke 2.1. Vestlandsforskningsnotat 3/2013*. Sogndal, Vestlandsforskning.
- Groven, K. (2013b). *Tuftadalen i Balestrand. Historisk naturskadebase, AREALKLIM arbeidspakke 2.1. Vestlandsforskningsnotat 2/2013*. Sogndal, Vestlandsforskning.
- NGI (2011). *Oppsummering av befarings i forbindelse med skredulykke 21.03.2011. Teknisk Notat*. Oslo, Norges Geotekniske Institutt.
- Payrastre, O., E. Gaume and H. Andrieu (2011). Usefulness of historical information for flood frequency analyses: Developments based on a case study. *Water Resources Research* 47.
- Schmidt-Thomé (2006). *Integration of natural hazards, risk and climate change into spatial planning practices*, PhD thesis no. 193 of the department of Geology, University of Helsinki.
- Stefanescu, V. (2013). Decision support system based on the history of flood and flash flood events in Romania. *Natural Hazards* 65(3): 2331-2352.

