Risk-based spatial planning - findings from two case studies

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ABSTRACT

Event analysis shows that damages can be reduced by considering the risks involved with natural hazard zones, in particularly those exposed to lower levels of hazard. The purpose of risk-based spatial planning is to guide settlement development such that any risks are contained at an acceptable level to society in the long term. Current risks should be known and new, unacceptable risks should be avoided. It is possible to avoid hazardous areas when authorising new building zones or infrastructures, but there are great challenges in dealing with existing settlements. In such cases, greater care and attention must be paid to present and future risks. The earlier the stage at which risk-based spatial planning is incorporated into the planning process, the greater the potential for effective negotiations within the project, and the sooner effective counter-measures can be taken. However, the rationale behind risk-based spatial planning can only be applied successfully in practice through close collaboration between all of the parties involved, such as spatial planners, land-owners, natural hazard specialists and insurers.

KEYWORDS

risk governance; spatial planning; risk based spatial planning; natural hazards; natural hazards zones

INTRODUCTION

The risks associated with natural hazards are on the increase

In Switzerland, a series of devastating floods has resulted in extensive damage in recent years. Other factors have also contributed to the increase in recorded damage. These include substantial population growth, the more intensive use of space as well as the increase in the value of buildings and infrastructures. Often, the greater risk and thus greater damage is to be found not in regions exposed to substantial and medium hazard levels, but in regions of intensive land use which face only low or residual hazard levels (marked in yellow and yellow-white hatched on hazard maps). In Switzerland, around one fifth of building zones are in at-risk areas. Approaches to handling these risks therefore play a key role in sustainable spatial development.

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Implementing hazard maps demands risk awareness

Hazard maps are available for 95% of the settled areas of Switzerland. They have been produced according to unified standards issued by the Federal Office for the Environment FOEN. Hazard maps display four hazard levels: red and blue areas denote a substantial or medium hazard respectively, while yellow illustrates a low hazard and yellow-white hatched areas a residual hazard. The hazard maps and the associated regulations must be implemented by the responsible authorities. In spatial planning, hazard maps offer a key instrument enabling communes to manage natural hazards and land use. In zones which are subject to a substantial hazard, it is standard practice to forbid the construction of new and the extension of existing buildings. Specific construction regulations are in place for zones facing a medium hazard. In zones with either a low or residual hazard, there is still no obligation to provide protection measures, although they could remain at considerable risk should a large-scale hazard event occur in densely populated areas, causing extensive and costly damage.

Risk-based spatial planning therefore goes a step further. Alongside an assessment of hazard levels, this approach is designed to take current and future land use, and the associated risks, into consideration in spatial planning decision-making. The goal is to avoid any new, intolerable risks. This in turn means that protection measures in yellow and yellow-white zones should also be considered and implemented. The risk-based approach discussed herein is based on the 'Security Level for Natural Hazards' report (PLANAT, 2013). The report calls for the recommended security level to be achieved primarily by land use management, and demands in particular that new, unacceptable risks are avoided (Fig. 1).

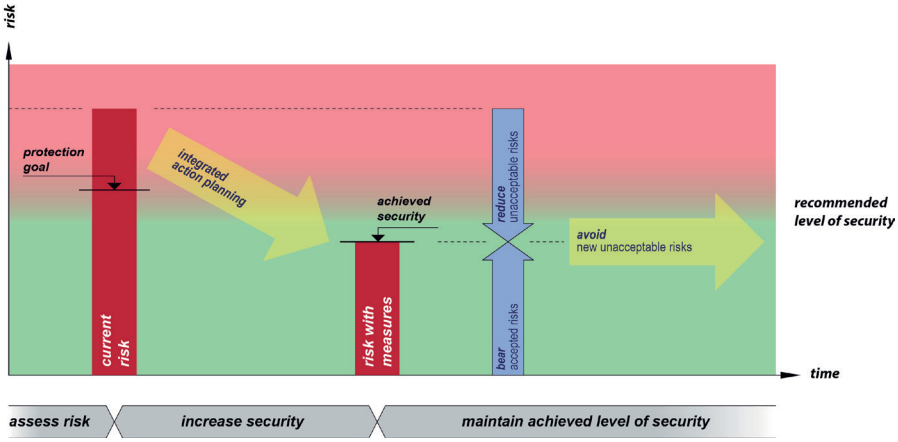

Figure 1: Method by which to achieve and maintain the recommended security level (PLANAT, 2013).

Identifying conflict early and managing the development of risk

Risk-based spatial planning does not stringently impose risk avoidance, but focuses on developing risk-awareness. The aim is not to block land use entirely, but to manage risk in a way that is transparent to those affected. In doing so it is possible to find meaningful and reasonable solutions to mitigate risk (Fig. 2). These solutions are specific to each case and may differ. In this respect, spatial planning plays a crucial role in providing solutions. Where new land use is concerned, alternative locations can be planned at a sufficiently early stage. In the case of established settlements, the existing risks can be identified and the relevant land use restrictions can be defined in partnership with those affected.

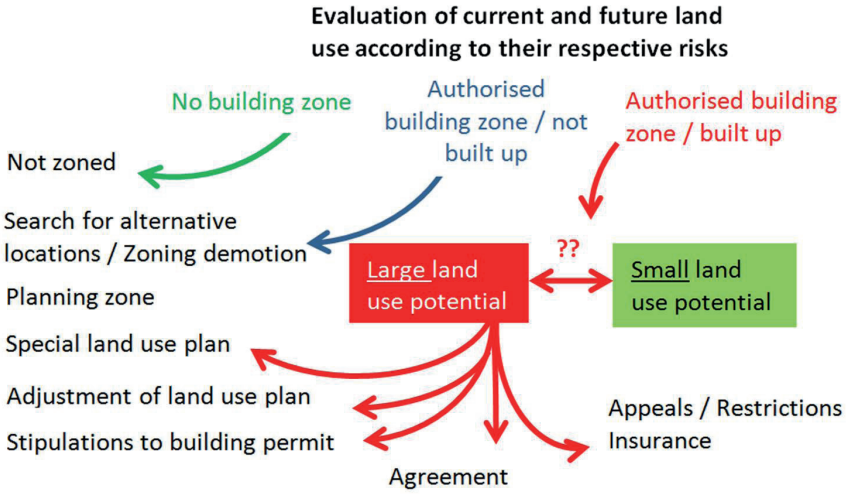

Figure 2: Land use analysis: appropriate action to control the development of risk is determined by the initial conditions presented for spatial planning, land use potential and the specific natural hazard situation.

Risk-based spatial planning relies not only on identifying the existing hazards in a given area, but also on pinpointing the risks that may arise from new or more intensive land use. When balancing interests, spatial planning should ensure that the frequency and impact of natural disasters affecting the people and property of the future are minimised. In this instance the role of spatial planning is to ensure that the demand for land use is balanced with the appropriate protection requirements. This requires all stakeholders to play an active part in the process.

LAND USE PLANNING CASE STUDIES

Evaluation of a broad spectrum of solutions

In order to consolidate the concept of risk-based planning, the Federal Office for the Environment FOEN and the Federal Office for Spatial Development ARE commissioned two land use planning case studies to be carried out collaboratively by spatial planning and natural hazard experts, Casanova and tur gmbh (Casanova Raumplanung/tur gmbh, 2013), and Strittmatter and Partner AG (Strittmatter und Partner AG, 2012). Two communes which are affected by different hazard processes and hazard levels, and have a broad range of land uses, were selected for the case studies. To ensure that a wide range of solutions could be explored, fictitious but realistic examples of land use demands were adopted (Tables 1 and 2).
The following questions were formulated by the FOEN and the ARE to be investigated in the case studies:

– How can spatial planning tools be applied to achieve risk-appropriate land use in accordance with the hazard process and level in a given case?
– What spatial planning tools are available to the selected communes, and how can they be deployed to ensure that known risks are respected in the planning process?

What synergies exist between protection strategies and other tools of risk prevention?

Table 1: The comparative case studies for each canton, investigating both natural hazards and given types of land use.

Case studies	Commune in Canton St. Gallen	Commune in Canton Graubünden
Hazard process	Static flooding (gradual process)	Dynamic flooding, rock fall (sudden process)
Process intensity	Weak to intense	Weak to intense
Advance warning time	Long	Short
Current land use	Urban and industrial land use	Rural and tourism-related land use

Decision-making tree facilitates a systematic approach

To ensure a systematic approach during the process of spatial planning, the experts executing the case studies developed a decision-making tree featuring the relevant decision-making criteria and options for action (Fig. 3). The complete decision tree can be found in the summary publication issued by the bodies involved in the case studies (PLANAT/BAFU/ARE (2014). This report also sets out key information on the principal concepts of risk-based spatial planning, decision-making criteria, and the appropriate courses of action.
Certain aspects of a planning project must be assessed before the decision-making tree is applied. These are whether a planned land use encroaches on a hazard zone, whether necessary information about hazard processes (hazard maps, intensity maps) is available and up to date, and finally whether this information contains sufficient detail, or must be supplemented. Current and planned land use must be examined in the context of land use demand although, depending on the project, this information may not be available until the (special) land use planning process or the building permit procedure. The only effective means of assessing potential damage and risks is to overlay project plans with hazard maps and detailed hazard assessments.

Table 2: The comparative case studies with their respective spatial planning procedures applied, points of conflict and suggested solutions.

	Case study	Spatial planning	Points of conflict	Suggested solution
Static flooding (gradual process)	Enlargement of a nursing home in a built-up area	Extension complies with zoning requirements; building permit process therefore follows directly	Flooding of basement and ground floors, essential facilities at risk, evacuation of residents difficult	Ensure critical land uses are away from flood-affected floors of the building
	Increase of land use and settlement development in a business and industrial zone	Enlargement of the existing establishment conforms to zoning requirements: building permit procedure therefore follows directly	Environmentally hazardous substances (storage areas outdoors, lower and ground floors are at risk of flooding)	Storage on upper floors; alternatively use is forbidden
	Single-family home zone with subsequent densification and rezoning	Zoning (change of local land use plan); subsequent building permit procedure	Flooding of basement and ground floors	Regulations in special usage plan: multi-storey construction, no ground-floor residential use (extensive usage, easy to evacuate)
Dynamic flooding, rock fall (sudden process)	New residential area on the outskirts of a village in an authorised building zone	Compliance with zoning requirements: building permit procedure therefore follows directly	Flooding and overbank sedimentation to the lower and ground floors and exterior spaces, no advance warning time, construction in stages, various owners	Draw up special land use plan to meet the requirements: overall protection for the area by correct arrangement of openings, driveways, entrances (building protection)
	New resort construction with outdoor area use, rezoning	Zoning (change of local land use plan); Subsequent building permit procedure	Substantial process-related effects, rock fall hazard to outdoor area, no advance warning time, high risk to persons	Because no adequate protection is possible for the use of outside space: alternative location sought
	Enlargement of existing school building in an authorised building zone	Compliance with zoning requirements: building permit procedure follows directly	Flooding and overbank sedimentation of the lower and ground floors, no advance warning time, risk to persons in outdoor spaces	Order multiple-property protection that also covers the outdoor space

Following this situation analysis, the decision-making tree guides the user through all of the necessary decisions. In addition to questions concerning risk analysis, it is essential to balance different spatial planning interests. It may be that a protection measure is technically feasible and cost-effective, but it must still meet design and acceptance criteria. Aspects of land use such as water protection, as well as landscape and nature conservation, must also be considered. The spectrum of possible implications for spatial planning is very broad, ranging from

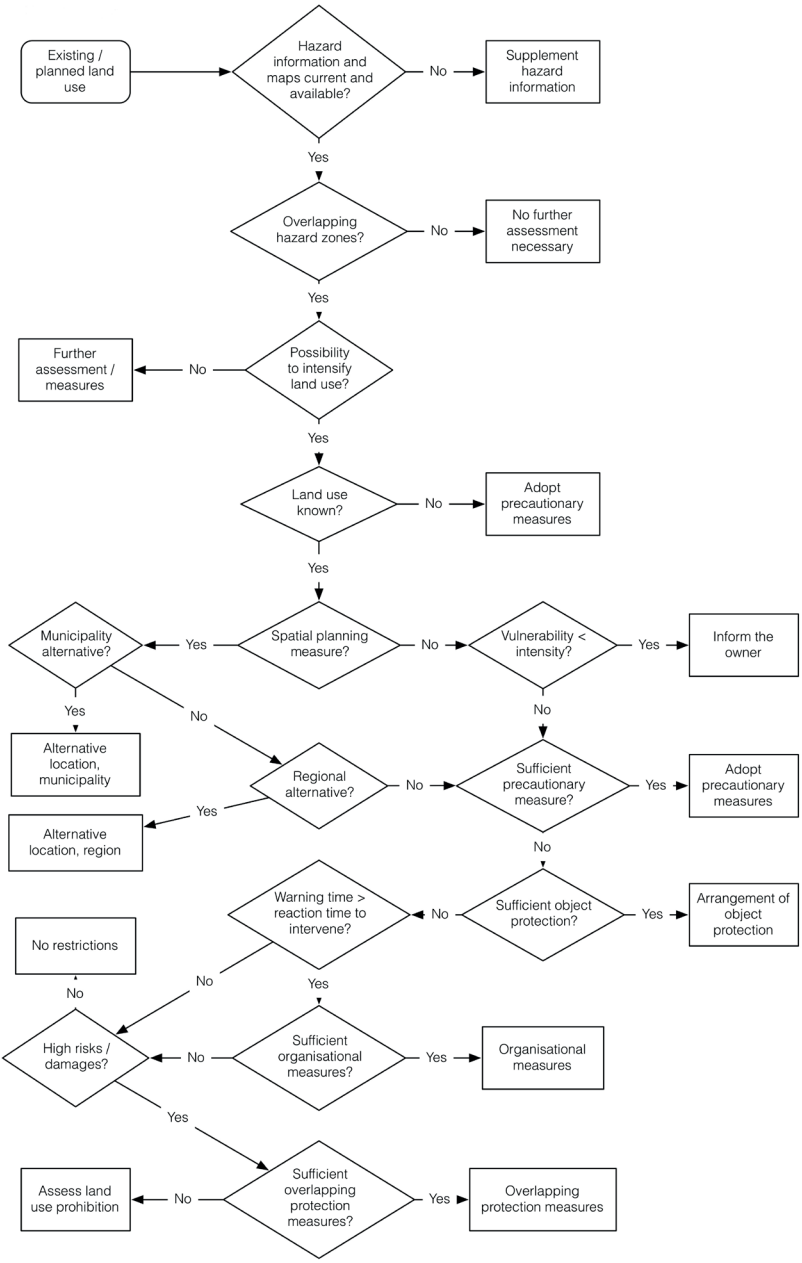

Figure 3: Schematic representation of the most relevant decision-making criteria and options for action of the decision-making tree (extract from PLANAT/BAFU/ARE, 2014).

providing information to the landowner, without further action on the part of the authorities, through to a full ban on land use.

Generally speaking, the sooner in the planning process that risk-based spatial planning is applied, the greater the leeway for negotiation within the project as a whole. For example, the following steps can still be taken in the early planning stages:
– New zoning in at-risk areas can be avoided;
– Risks can be assessed and alternative locations considered;
– Land use can be adapted in the best way to the prevailing risks and land use restrictions;
– There can be an early discussion of residual risks and their acceptability. This is particularly important for land use entailing high risks to individuals or other special risks.

At a later stage in the process, such as when a building permit has already been issued, the room for manoeuvre is often significantly smaller. This is mainly because changes to the planned project can involve a disproportionate amount of effort. It is true, however, that in some cases it is only at this time that the true land use is known in detail. Ultimately, it is the type of land use that dictates the measures required to mitigate risks. Risk-based spatial planning may still be of value in such situations. Those affected may be made aware of the associated risks and will thus be able to take meaningful action. The decision-making tree was designed to offer specific, practicable recommendations for different situations. The three examples described below show possible counter-measures that can be implemented in different phases of spatial planning:
– Single property protection: protection measures applied directly to a property can reduce its vulnerability, and thus the damage caused during an event (e.g. reinforced construction);
– Multiple-property protection: if protection measures can be applied to multiple objects simultaneously (e.g. a diversion dam installed along several buildings), there may be advantages in terms of both design and cost-effectiveness. Special land use planning is a tool that allows binding measures to be imposed on land-owners;
– Emergency planning: with sufficient advance warning time, clearly defined intervention measures taken by emergency personnel or local residents can minimise property damage.

FINDINGS FROM THE CASE STUDIES

The case studies have shown that the scope for negotiation in spatial planning depends heavily upon whether the case involves new building zones, or the intensification or modification of existing land use. For new land use projects, it may be possible to negotiate an alternative local or regional location, for example. There is less opportunity to influence the situation where land use is to be intensified within an existing land use zone.

It is essential that current and complete hazard maps and information are available to facilitate an adequate assessment of the risks involved. Furthermore, since risk-based planning should

factor in a variety of information in addition to hazard maps, the process also requires further data such as scaled intensity maps and risk maps.

To ensure that risk-based planning is executed effectively, close cooperation between spatial planners and natural hazard experts must be established at an early stage. This is crucial both at this planning stage, and in the later implementation process.

The action which should be taken in a particular situation depends on various factors. The specific hazard process plays an important role of course. Where this is gradual, there is usually sufficient advance warning time to evacuate persons and, if possible, property. Furthermore, intervention measures can reduce the extent of damage should an event occur. In the case of sudden events, there is little or no advance warning time. Here, it is important to consider the effectiveness of protection measures to cope with the intensity of such events. The key factor to remember is that protection measures must always be selected according to how the land is used.

CONCLUSIONS

The two land use planning case studies have been used to take initial development steps towards a systematic approach to risk-based spatial planning. The new method facilitates the effective implementation of measures designed to reduce risk at both the level of local land use planning, and as part of the building permit procedure.

At the same time, interest in risk-based spatial planning must be generated. The need for greater awareness in handling hazards and risks must be demonstrated to representatives of communal and cantonal authorities, planning and engineering offices and insurance companies. Furthermore, greater support must be given for close cooperation between spatial planners and natural hazard experts, with the inclusion of those who are affected. The concept of risk-based spatial planning should not be applied to land use planning alone, but to every stage of the spatial planning process, i.e. cantonal structural plans, land use planning and the building permit procedure.

The next step is to take the findings from this and other ongoing risk-based spatial planning projects and use them as input into a new working guide or the revision of the 'Spatial Planning and Natural Hazards' recommendation (ARE / BWG / BUWAL, 2005). First of all, however, any outstanding issues should be examined in more depth, and the current methodology should be applied and tested in further practical examples.

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