AdaptAlp

Risk management and risk prevention

Final Report WP6

Alpine Space 2007-2013 project "AdaptAlp - Adaptation to Climate Change in the Alpine Space"

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Content

1 Introduction

It has been possible to observe a fundamental shift in the paradigms for dealing with natural hazards and related risks throughout the Alps over the past decade. The increased complexity of risk situations and the extent of damage, on the one hand, and the limited financial resources, on the other, led to the development of a new approach. There has been a shift in the focus in the area of natural hazards from the defence against natural hazards through the construction of protective measures as the principal solution to risk mitigation to a more holistic approach that views risk management as involving a variety of individual activities. This change in paradigm began in the late 1980s with the implementation of integrated watershed management in different regions of the Alps and was significantly reinforced by the enactment of laws on risk-based land-use planning and guidelines for risk analysis and risk-based decision-making in the planning of protective measures.

Today, the management of natural hazards and risks in an integrated and interdisciplinary way has become a commonly accepted standard in the Alps. Integrated risk management is the process of finding the most efficient solutions and combinations of measures for risk reduction throughout all phases of risk management (prevention, intervention, restoration). However, the implementation of the integrated approach to risk management often falters due to the persistence of traditional ways of working.

The implementation of integrated risk management in practice varies remarkably between Alpine regions. While some regions focus more on prevention, others focus more on the optimisation of intervention-related work. However, all risk-management stakeholders in the Alps are facing challenging trends in the development of natural risks as a result of human development and changes in the climate.

The 'catastrophic' events of recent years revealed some weaknesses in risk management practice in the Alps. The challenges involved in improving natural hazard and risk management are manifold. Economic development results in the spread of settlements and infrastructure towards endangered zones. At the same time, the values of houses and goods and mobility requirements are increasing. The functioning of local economies is based on the smooth operation of transport, communications, water and electricity supply infrastructure. This leads to an increased dependency of human activities on the continuous functioning of infrastructure and, therefore, to an increase in vulnerability to the effects of natural hazards. Society's demand for absolute safety in the area of natural hazards is growing while, at the same time, individual responsibility is increasingly denied. The growing demands for higher safety standards will also put greater pressure on public finances. Furthermore, the intensity and frequency of natural hazards are expected to increase in specific cases due to climate changes.

With or without the effects of climate change on natural hazards, the challenges facing natural hazard and risk management practice are enormous. As these challenges facing risk management practice affect all responsible institutions in the Alpine Space in almost the same way, similar efforts to find solutions to deal with them simultaneously in all regions in the Alps can lead to a waste of time and resources. Some tasks cannot be dealt with by single institutions alone; the challenges can only

be faced through cooperation between different actors in different legislative and administrative contexts and on the basis of a common strategy.

The Alpine Space 2000-2006 project "ClimChAlp – Climate change, impacts and adaptation strategies" developed recommendations for improving integrated risk management and for adapting risk management practice to the effects of climate change. According to these recommendations, the exchange of information and experience across administrative borders and disciplines plays a very important role in optimising risk management practice. The ClimChAlp project identified improvements in integrated watershed management, the further promotion of the exchange of knowledge and information, the promotion of the individual responsibility of citizens in relation to natural hazards, the increase in the involvement of the public in the planning of protective measures and the improvement of early warning systems as priorities for the further optimisation of risk management practice.

The activities for Work Package 6 of the AdaptAlp project were defined on the basis of the recommendations formulated in the common strategic paper of the ClimChAlp project. The AdaptAlp project should answer the questions that arose during the ClimChAlp project and follow the recommendations. Hence, the work carried out by WP6 of the AdaptAlp project involves a wide range of activities covering the entire cycle of integrated risk management.

2 Taking climate change into account in risk management is a difficult task

A lot of uncertainties and gaps exist in the knowledge regarding the causes and effects of the rise in temperature that started in the last century and continues to the present day, its future development and its effects on the climate. There are significant uncertainties in the emissions scenarios for the next 50 to 100 years, on the one hand, and in the results obtained using global and regional climate models, on the other. This is particularly applicable to the local and seasonal effects on precipitation, its intensity and frequency of occurrence, and its absence.

There is quite high degree of certainty with regard to the fact that the temperature increase due to climate change has already affected and continues to affect the Alpine space. Hence, the impacts of and necessary measures for adaptation to climate change relate to the increase in temperature. As demonstrated by a survey of such examples, adaptation measures for natural hazards resulting from glacier hazards (e.g. glacier lake outburst floods GLOFs) and from permafrost degradation (e.g. accelerated rockfall activities) have already been implemented today. However, these few examples can only be found in the highest regions of the Alps which are most sensitive the increase in temperature.

Whereas the future direct effects of increasing temperature on natural hazards could be assessed as relatively traceable, the effects of climate change on natural hazards relate to extreme precipitation

events, are more difficult to assess and are subject to uncertainties. As the existing hydro-meteorological time-series, which also include data on extreme hazard events, do not usually go back much more than 100 years, it is very difficult to predict the probability of occurrence and extent of the damage of possible extreme scenarios with accuracy. If attempts are made to provide a prognosis despite this, they are hampered by varying degrees of uncertainty. The formulation of scenarios with a return period of more than 100 years by means of extreme statistical values is subject to uncertainties. Moreover, the projected scenarios and effects of climate change on extreme natural hazard processes with a low probability of occurrence extend the already existing uncertainties layiing in the assessment of seldom events. Due to the topographical diversity of the Alpine region, formulating reliable forecasts is an enormous challenge. Hence, the investment of funds in protective measures that cover the potential effects of changes in the climate is also subject to uncertainty.

The topographic, climatic and geomorphologic diversity of the Alps requires the adoption of a locally differentiated view of the potential effects of climatic change on natural hazards. Some areas are likely to be affected by natural hazards related to changes in the climate and others will not experience changes in the current natural hazard situation. Nonetheless, even if there is a general increase in the frequency and intensity of natural hazards, the process involved in managing the related risks will not change remarkably but it becomes even more important. The risk cycle is applicable to risk management under both current and future climate conditions. The principle behind the establishment of the most suitable and efficient combination of solutions for risk minimization is also valid in case of increasing risks due to the effects of climate change.

Even if the "event" in this graphic becomes more frequent and more intensive, the principle of integrated risk management remains the same

Fig 1: System of risk management (cycle)

The risk resulting from natural hazards is defined as a quantifying function of the probability of occurrence of a hazard process and the related degree of damage. The latter is specified by the damage potential and the vulnerability of the endangered object (United Nations 2004).

$R_{i,j} = p_{Si} \cdot A_{Oj} \cdot p_{Oj,Si} \cdot v_{Oj,Si}$

According to the United Nations' (2004) definition, the specifications for the probability of the defined scenario (p_{Si}), the monetary value of the object affected by this scenario (A_{Oj}), the probability of exposure of object *j* to scenario *i* ($p_{Oj,Si}$), and the vulnerability of object *j* in dependence on scenario *i* ($v_{Oj,Si}$) are required for the quantification of risk ($R_{i,j}$).

Apart from the probability of occurrence and the intensity of potential natural hazards what can be increase due to climatic changes also the increasing damages and the increasing vulnerability of endangered objects are influencing the level or risks. In comparison to the potential effects of climate change, the latter parameter of the risk formula affects the resulting risk much more.

With the negative effects of climate change on natural hazards, integrated risk management becomes more important. Hence the improvement of integrated risk management is a crucial requirement for adapting the practice of natural hazard management to the effects of climate change. The following chapter presents the state of the art in the implementation of integrated risk management and identifies the key tasks for improving the practice of integrated risk management.

3 Integrated risk management - state of implementation and key points for improvement

The WP6 working group evaluated the state of the art in relation to the practical implementation of integrated risk management in their regions. On the basis of these evaluations, the working group identified the following key gaps in the implementation of integrated risk management:

- Integrated risk management is an efficient approach to dealing with natural hazards, including the related risks and the effects of climate change on natural hazards. Improvements are still required with regard to the implementation of integrated risk management in practice.
- Integrated risk management requires the coordination of the activities of all relevant stakeholders in risk management. However, coordination within the risk management process is weak.
- A discrepancy exists between the existing knowledge and the practical application of this knowledge in the spatial planning sector. This discrepancy represents one of the greatest deficits in integrated risk management.

- Knowledge transfer between the relevant stakeholders and between different planning disciplines and the exchange of information is not institutionalized.
- The practical implementation of integrated risk management requires a long-term time horizon. The adoption of short-term changes in risk management policies soon after natural hazard events runs counter to the long-term setting of priorities. Up to now, investments in protective structures have been mainly driven by natural hazard events and not by preventive risk analyses.
- The level of awareness of local stakeholders (decision-makers at community level) of natural hazards is weak.
- The awareness of citizens and private property owners of ways of reducing damage in case of natural hazard events and of their personal responsibility for taking preventive measures to reduce their exposure to risk is weak.
- The assessment of natural hazards and risks is affected by many uncertainties, either based on stochastic character of natural hazards or on knowledge gaps in the understanding of the processes itself, and even on financial uncertainties. Taking into account these uncertainties is one of the main challenges in the management of natural risks in the current climate.
- The effects of climatic changes add some more uncertainties in natural hazard assessment. But the observed and expected evolutions of hazards due to climate change have the same order of magnitude as existing uncertainties, so climate change does not drastically change the elements of the problem, although it makes it worse. As pre-existing uncertainties grow, climate change makes it even more imperative to find an adequate way to take into account these scientific uncertainties in public decision-making processes, aimed at preventing natural risks.

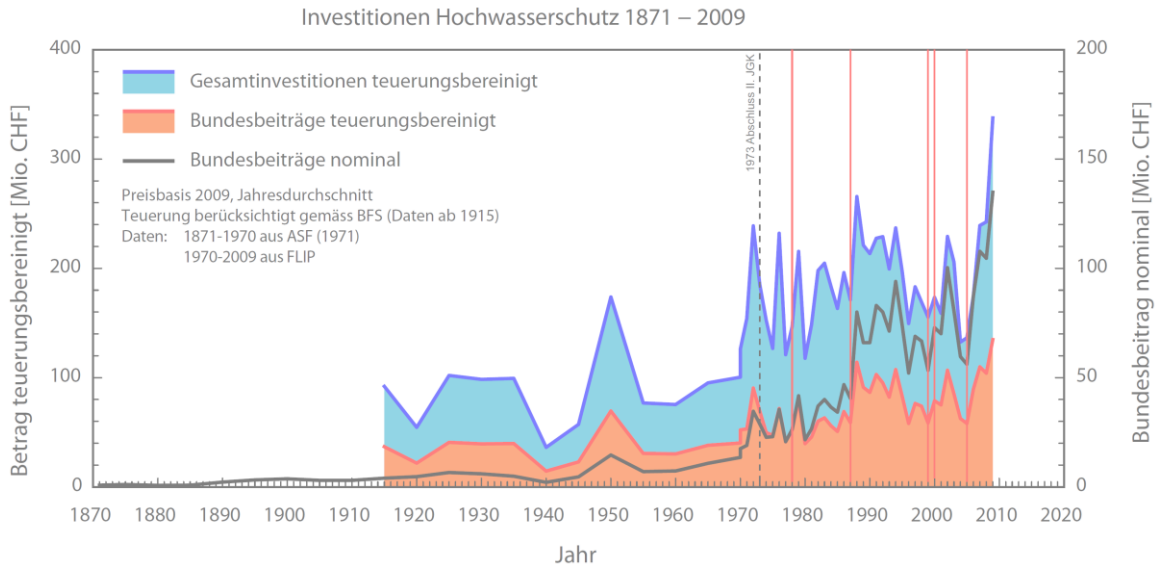

Fig. 2: Investments in flood protection measures from 1871 to 2009 in Switzerland in relation to flood events with damages. Source: BAFU (2008)

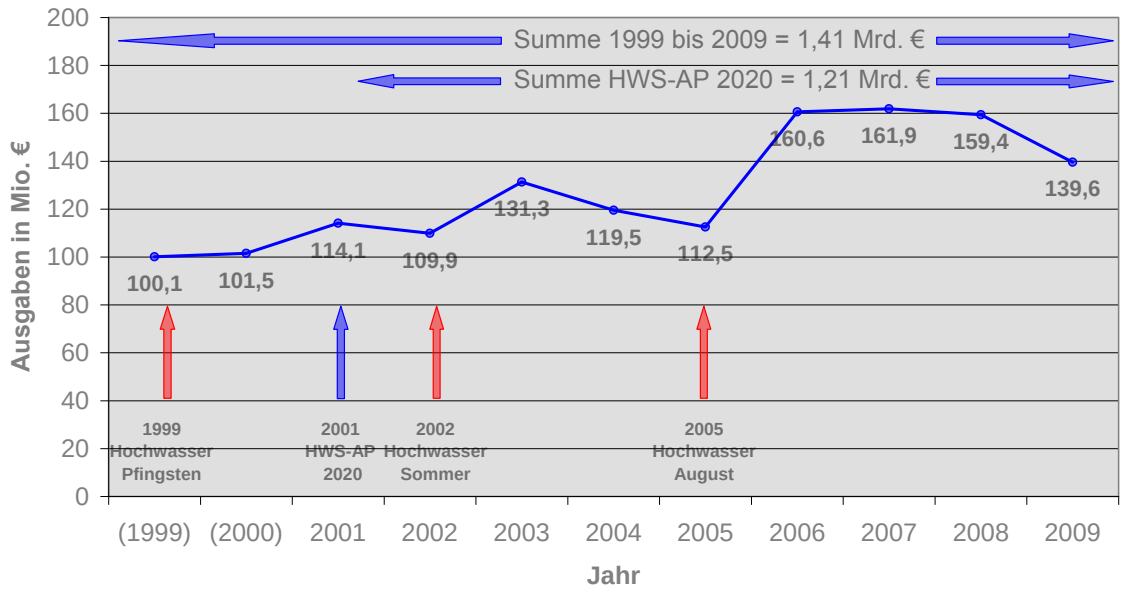

Fig. 3: Investments in flood protection measures from 1999 to 2009 in Bavaria in relation to flood events with damages. Source: Bayerisches Staatsministerium für Umwelt und Gesundheit

The focus of WP6 of AdaptAlp was on the updating the state of the art in integrated risk management, on **risk dialogue at a local level**, on **education, training and communication**, and on the development of **new methods for improving risk management**. All of the described activities contribute jointly to the improvement of integrated risk management.

A large proportion of investments in safety measures for protection against natural hazards are "triggered" by hazard events (fig. 2 and fig. 3). Far more money is still made available for reconstruction after major hazard events than for long-term preventive work. Therefore **it is necessary** to ensure that risk-appropriate and cost-effective solutions are targeted. Following the approach of integrated risk management based on the risk cycle (fig. 1) is supporting a cost-efficient balance between prevention, recovery and reconstruction.

4 Risk dialogue at local level

The aim of risk dialogue is to create the basis for risk-appropriate planning and investment decisions based on the best available knowledge and information, including the dialogue with stakeholders. This objective is applicable to both strategic and operative decisions. Land property, infrastructure and real estate, and the public sector are always involved in the protection against natural hazards. In most of the Alpine countries, the municipalities are the institutions with direct responsibility for the safety of citizens. This means that risk dialogue between those who must take responsible decisions, between those affected by natural hazards and between those who have the necessary knowledge and experience is an inevitable necessity. This is the only way that risk-appropriate, priority-based solutions that are also optimized in terms of cost-effectiveness can be established.

The advantage of the intensive involvement of decision-making authorities is that their awareness is increased and they become participants in the process. This is of particular significance in cases based on knowledge and information characterised by a high degree of uncertainty. The more complex the contexts and the more uncertain the information used to describe the individual hazard processes and their effects, the more holistic and broad-based the risk dialogue must be.

The following basic questions must be answered in all risk dialogues:

1. *What are the risks?*
2. *What level of risk is accepted? What are the inevitable risks?*
3. *What can be done to achieve the targeted level of security?*
4. *Who is responsible for protection planning, realization and decision making? Are the risks falling into the responsibility of the public or into the responsibility of the individual?*
5. *What do the corresponding measures cost?*
6. *Which are the measures with highest priority?*
7. *What are the limits of protection measures? How do we manage residual risk?*

The WP6 working group followed risk dialogue approaches on different levels. The following conclusions may be drawn from these experiences gained within the AdaptAlp project and other projects:

- **Factually sound and well-prepared risk dialogue** generates transparent and comprehensible decision-making bases. Making existing knowledge and information available and making optimum use of the knowledge available among experts and people with relevant experience are preconditions for successful risk dialogue. The decision-making authority should also be involved in the risk dialogue. This should result in increasing the awareness of politicians and in motivating them to engage in preventive protection work against natural hazards and the management of climate change adaptations. The aim is to encourage politics to become more involved in prevention even if it leads to fewer plaudits than the provision of resources in the case of a disaster.
- The introduction of the **risk-dialogue strategy** leads to the adaptation of commonly accepted solutions for risk management within a municipality, region or country.

- The risk dialogue provides the basis for a **problem-resolution process** that begins with the analysis of the problem and ends with the implementation of a measure or combination of measures. The advantage is that it involves participative learning and decision-making processes on an elevated factual level.
- Thanks to risk dialogue it is possible to **reduce the time required for the analysis**, planning and implementation phase considerably and make cost savings accordingly.
- In the context of holistic and sustainable development, risk dialogue offers the **only way of dealing with the influences of climate change** in a factual and risk-appropriate way by forming plausible scenarios and shaping the future.
- The implementation and management of risk dialogue **requires corresponding training** which is currently not available.
- Those who participate in risk dialogue must understand risk management methods so that they can **evaluate and assess the results** that arise from the risk dialogue in terms of their significance and relevance.
- Risk dialogue is the most effective way of **reaching people** who are exposed to natural hazards and of increasing their awareness and personal responsibility for reducing their vulnerability to risk.

Instruments like risk dialogue, in particular, and participative planning processes, in general, should become a minimum standard for further Alpine Space projects dealing with climate change and natural processes and their effects on people.

5 Coordination, communication and education

The practice of integrated risk management requires the interconnected and coordinated effort of many actors and institutions. Integrated risk management is a task to be carried out at transnational, national, regional and local administrative level. Therefore, natural hazard risk management requires the collaboration and coordination of a number of stakeholders on different administrative levels. All responsibilities and actions must be coordinated and must complement each other. The effect and cost-effectiveness of risk-appropriate measures can be considerably increased by the exploitation of the synergy potential between the institutions involved in the risk cycle. The declared aim must be to make optimum use of knowledge, experience and existing data.

The precondition and basis for the efficient coordination of activities of all relevant actors are risk communication and risk dialogue. Without these, the advantages that are offered by integrated risk management cannot be exploited. Therefore, risk communication and risk dialogue must be promoted and appropriate training in these methods must be provided.

Some minimal requirements must be fulfilled to achieve more intensive cooperation between the different stakeholders and disciplines involved in integrated natural hazard risk management:

- The stakeholders involved must be **willing to collaborate** with others (other disciplines, other administrative responsibilities).
- All stakeholders should have a **common understanding** of the **goals and methods** of integrated risk management. Therefore the common goal of establishing a certain safety-level for the public through the implementation of the most efficient measures should be given a higher priority than the goals of the individual institutions.
- All stakeholders should use a **common "language"** in terms of using the same technical terms and meanings.

These requirements can only be fulfilled through the education and training of all of the stakeholders. The basis for education and training is communication. Risk communication or risk dialogue could form part of interrelations between administrations and the public, between experts and students, between natural hazard experts and fire-fighters and between all involved persons.

All of the WP6 activities regarding risk communication and training are summarised in these topics: the different possibilities for the exchange of experience, the educational activities, tools for implementing risk communication, including the testing of video conferencing techniques.

First, the project partners involved in WP6 tested different ways of **improving risk communication between members of a transnational working group**. Following the successful establishment of the working group during the ClimChAlp project, the working group consolidated the collaboration by increasing the frequency of it meetings. A greater number of meetings meant more time was required and travel costs generated in attending such meetings. Travelling around the Alps for meetings also has an impact on climate warming due to the emissions of CO_2 generated. To minimise the

climate impact and the travel time and costs involved, the working group tested different video conferencing techniques. After some technical difficulties and some training in the use of video conferencing technologies, the members of the working group were able to use this information and communication (ICT) technique successfully for the purpose of the work package.

Video conferencing techniques are also frequently used by risk management teams whose members are located in different places, especially during natural hazard events. More than other meetings, video conferences require more sophisticated management on the part of the session leader. In summary, video conferences work well if the team is already set up and its members are familiar with modern ICT tools. Video conferences are not suitable for educational purposes and for meetings with a strong link to a specific location, e.g. a village where flood protection measures have to be planned and constructed.

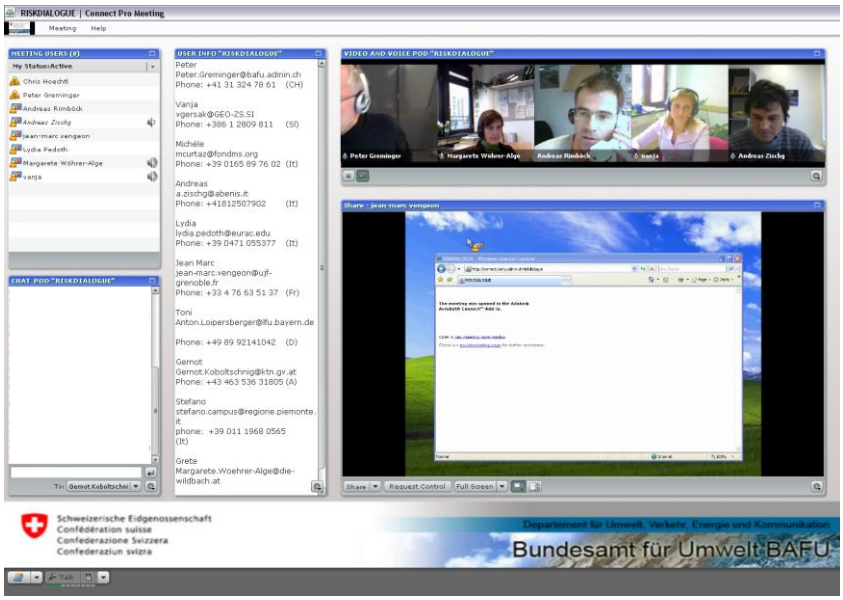

Fig. 4: Screenshot of a video conference meeting of the working group of WP6. New electronic communication tools are reducing travelling time and costs.

The best instrument for the latter purpose – i.e. the search for the most suitable and efficient preventive measure through a discussion between experts from different disciplines – is the **expert workshop**. The working group organized some expert workshops and evaluated their results from the perspective of risk communication. **Interdisciplinary expert workshops** held at an early stage in the process for the planning of natural hazard prevention and involving experts from different regions are very helpful for the discussion of complex situations and finding innovative solutions to the specific local problem. A group of experts from different backgrounds and different disciplines brings more specific perspectives to the problem than a single institution can. Therefore, the number of potential solutions to be evaluated for selection is much higher. This leads to a convergence of the selected solution for a risk situation towards the (unknown) best solution.

Fig. 5: Interdisciplinary expert workshop in Immenstadt 2010 "Risk management in alpine torrents and rivers – Riskplan".

Interdisciplinary workshops are also suitable for coordination between research institutes and prac-

tice. Workshops held for this purpose are organised in form of **expert hearings**. The experts from practice (stakeholders, administrations) ask the scientific experts specific questions. Expert hearings offer a pragmatic way of transferring up-to-date knowledge from science to practice, particularly when the scientific knowledge has not been consolidated and is subject to uncertainties or ongoing evolution (as is typically the case in the assessment of the consequences of climate change). Apart from expert hearings, the associations of practitioners are also important for the dissemination of new scientific findings on climate research. In most cases, these associations have their own information channels (e.g. newsletters or publication series) that could be used to strengthen the direct transfer of new and important scientific findings to practice.

These circumstances underline the importance of **education in risk management**. The dissemination of methodologies and practices to students (and practitioners) is important for the improvement of risk governance in the long-term. During the AdaptAlp project, a workshop was organised between experts of the local and regional administrations responsible for natural hazard management and students. Concepts for protective measures in a community were jointly evaluated at the workshop. Local decision-makers and emergency personnel (e.g. mayors, fire fighters, etc.) are the responsible on-site and have to react promptly and correctly in case of a natural disaster. To fulfil these ambitious requirements a consolidated knowledge about natural hazards and risk management is required. As a training material and as a reference book for non-experts in natural hazards management **a handbook of natural hazards** was compiled. As it is generally intelligible it could also be used for rising awareness in senior classes of schools.

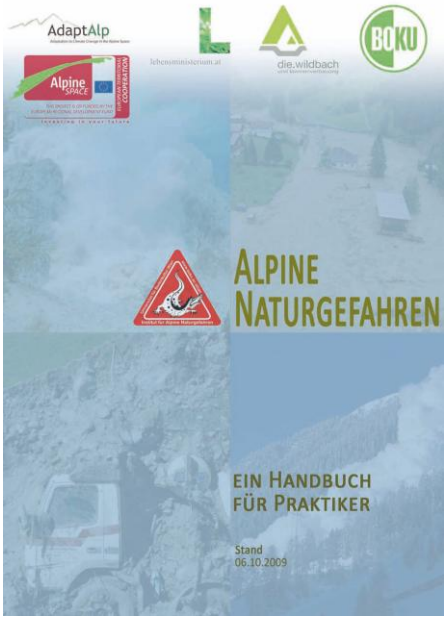

Fig. 6: Handbook of natural hazards for practitioners and students.

Risk-based decision making also requires training. Setting priorities for risk reduction measures on the basis of risk analyses requires evaluating the most efficient use of the available funds for risk prevention. The pilot studies carried out within the framework of AdaptAlp revealed that the software program **RiskPlan** is a valuable tool for training risk-based decision-making. RiskPlan enables the evaluation of the costs and benefits of a variety of different approaches to risk reduction in a specific situation. The most efficient combination of measures within a set of possible risk reduction measures can be identified using this tool. It supports expert workshops and also supports risk dialogue. The results of risk analyses and the result of cost-benefit analyses can be presented shown in the form of simple graphics. The experiences of the project partners in using risk plan showed that RiskPlan is suitable for most of the purposes described in this and in the previous chapters. The tool is available on the website (fig. 7).

The exchange of experience works well on the basis of **best practice examples**. By means of the exchange of these examples, knowledge about integrated risk management or a specific topic could

easily be transferred from one stakeholder to another who is seeking solutions to similar problems. Good practice examples have a clear advantage over all other risk communication methods: they describe solutions that have been implemented and can be evaluated on the basis of facts.

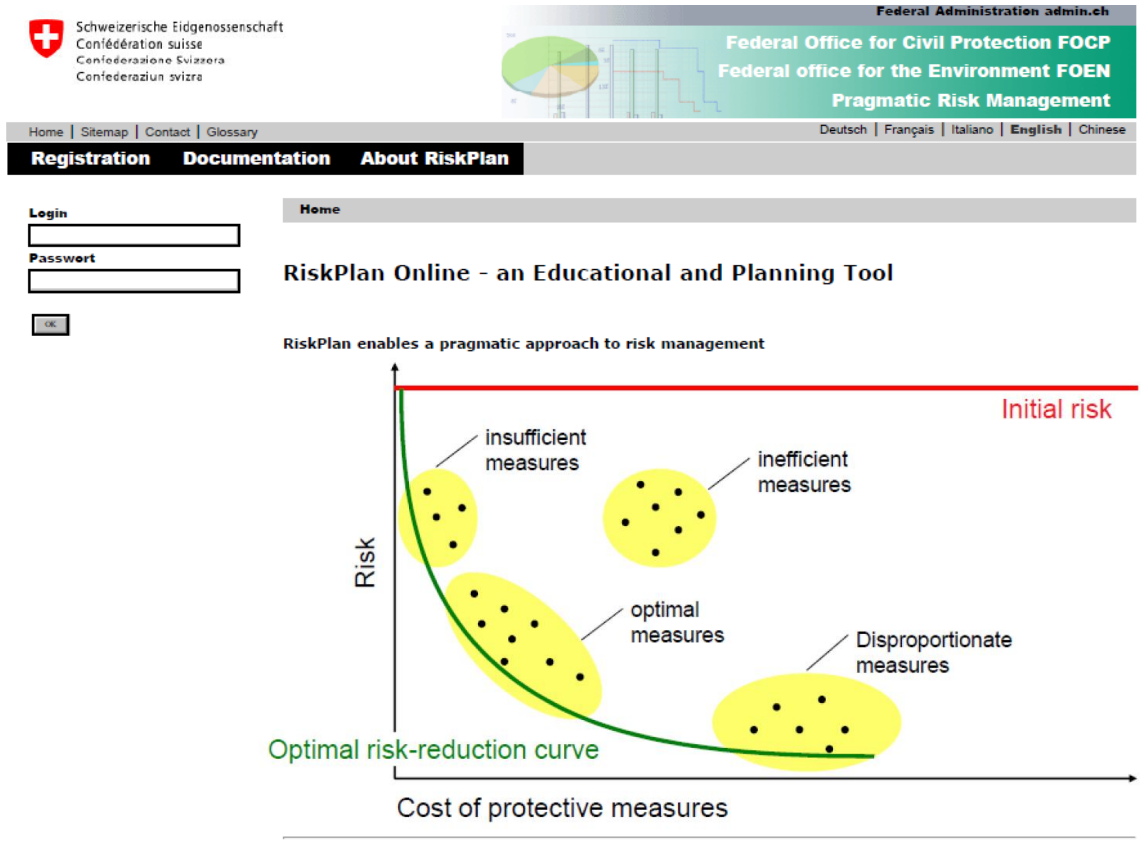

Fig. 7: Screenshot of a the web-based tool for risk analysis RiskPlan (www.riskplan.admin.ch)

Another possibility for bridging knowledge gaps (particularly regarding the effects of climate changes or methodologies for implementing integrated risk management) is the **exchange of practitioners** between institutions, especially between administrations responsible for natural hazards and risk management. While some institutions are specialised in preventive measures, others are specialised in risk analysis or intervention measures. Temporary visits and internships by individuals from different institutions support the exchange of specific knowledge. During the AdaptAlp project, a tool was created for this purpose. A platform for supporting the exchange of practitioners between institutions was developed. The exchange platform “on_alp_exchange”, is located on the INTERPRAEVENT website (www.interpraevent.at -> service -> on_alp_exchange) and was tested by the working group. The platform is well suited for this purpose, but however intensive promotion is needed.

Last but not least, two conclusions could be drawn from all of the activities mentioned here.

1. The coordination of all stakeholders in integrated risk management and risk communication **requires a person/institution who/that works continuously on the promotion and organisation of the process** and assumes the role of a facilitator, who/which identifies synergies and focuses on making rigorous use of the synergies offered by collaboration. A specific job description or position of this kind does not usually exist and the role must be fulfilled voluntarily. Furthermore, depending on the type of target group involved, the communication process must be adapted to the requirements in terms of technical knowledge, appropriate language and jargon, definitions of terms, and type of dialogue. The information provided to all participants must be complete, comprehensible and organised. The professional skills required for this role of a risk manager are not related to a specific kind of natural hazard process and corresponding specialised training should be provided.

2. The **cooperation between the different regions** of the Alps leads to a range of added values. A valuable stock of experience exists in the Alpine area – in form of both best practice examples and in-depth experience. All stakeholders follow the holistic approach of integrated risk management. Stakeholders in the Alpine regions are sometimes specialised in different tasks. The systematic combination of the variety of existing approaches and specific expertise about natural hazards and risk management available in the Alpine Space creates an immense and useful toolbox of methods for facing the challenges that arise in everyday practice. Knowledge transfer between the different specialisations of the Alpine regions plays a key role in adapting risk management practice to the effects of climate change (fig. 8). The variety of approaches in the Alps and transnational collaboration forms a flexible network for responding to the challenges of risk management practice.

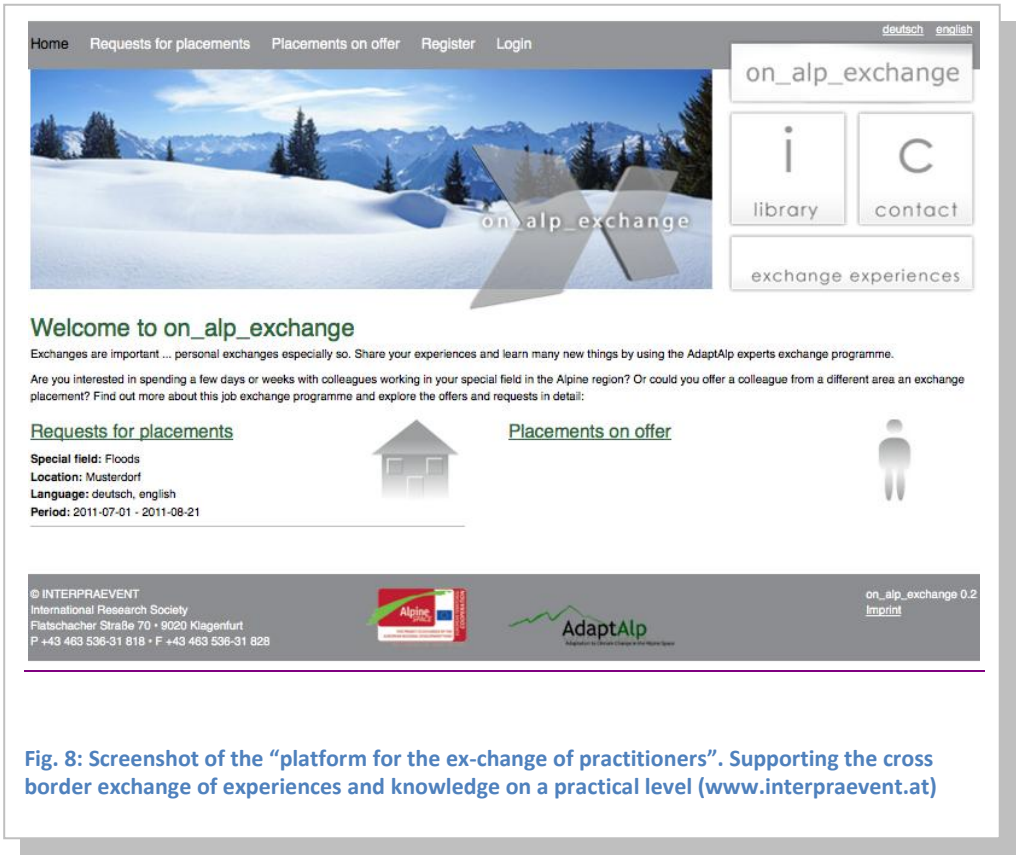

Fig. 8: Screenshot of the "platform for the ex-change of practitioners". Supporting the cross border exchange of experiences and knowledge on a practical level (www.interpraevent.at)

6 New methods for improving risk management

In addition to all of the risk prevention activities, intervention shortly before and during the course of flood events is also an important task of integrated natural hazard risk management. Intervention measures also contribute to the improvement of risk management practice. The precondition for the preparation of intervention measures, such as the installation of mobile flood protection measures, the evacuation of houses or the deployment of fire-fighters, is an **early warning system** that describes the most plausible scenarios. One of the working group's project partners developed and tested a forecasting model for floods and debris flows. This tool analyses the actual environmental situation and the forecasted weather situation and compares it with historical situations. On the basis of this comparison, the tool calculates the probability of a flood or debris flow event. Hence this tool could reduce the uncertainties associated with the assessment of the consequences of a weather forecast and improve the quality of the forecasts of natural hazard events.

Decisions in the context of integrated risk management are ideally based on the results of risk analyses or cost-benefit analyses. Therefore, the results of risk analyses must be understandable and accessible, especially to the general public. Whereas risk analysis is suited for selecting the most efficient risk reduction measures on a local scale, the comparison of risks, e.g. annual fatality risks or monetary risks, is an instrument for setting the action priorities in the area of risk reduction on a broader (e.g. regional or national) scale. One activity of this work package was the development of a tool for **informing the general public about the natural hazard risks in their community** and for the **comparison of the risks** in all communities of a region. The development of a tool for the **visualization of the actual risk situation** (fig. 9) at municipal level provides the basis for the visualization and the dissemination of the results of the preliminary assessment of natural hazards required by the European Flood Directive. This tool shows the potential damages and risks for each community in form of a clear fact sheet and can be accessed on a website. This provides the basis for promoting risk communication in this region.

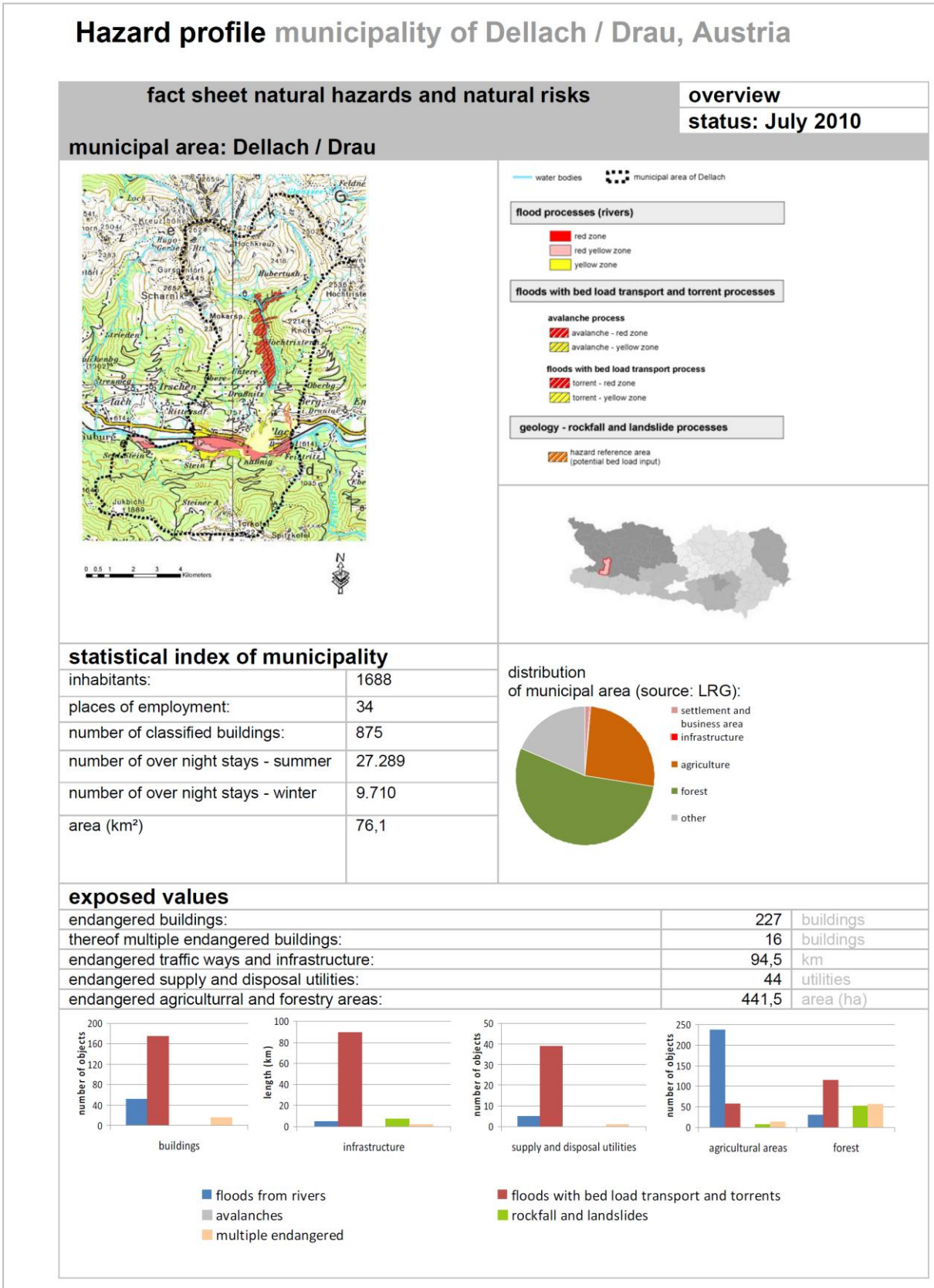

Fig. 9: Example of one factsheet of natural hazard risks in a community of Carinthia.

7 Conclusions and recommendations

The coordinated activities of the project partners of AdaptAlp within WP6 led to the following conclusions and recommendations regarding the topics of interest described in the introduction.

The **holistic approach of integrated risk management offers the only way of dealing with complex situations** (which most risk situations are by their very nature). Integrated risk management is currently widely and successfully implemented in practice. However, it requires ongoing improvement.

First, the coordination of all relevant stakeholders involved in integrated risk management must be improved. The coordination of different activities in risk management must be institutionalized and intensified. Without this, the added value of integrated risk management – benefiting from synergies arising from the coordinated actions of different planning sectors – could not be generated. **It is recommended that a specific institution, organization or a person be nominated for each process of integrated risk management which/who can facilitate the coordination of all activities in the risk cycle and acts as a platform or a channel for risk communication.**

The improvement of the coordination of the activities of all relevant stakeholders requires the **intensification of risk communication and risk dialogue**. Risk dialogue is the only way that all of the relevant stakeholders in risk management and the affected populations can be involved. It is also the most effective way of raising the awareness and the sensitivity of people exposed to natural hazards of their personal responsibility for reducing their vulnerability. The implementation of risk dialogue contributes to the qualitative improvement of preventive work. The implementation of risk dialogue leads, via an iterative, pragmatic resolution process, to risk-appropriate investments in protective measures which are classified on the basis of cost-effectiveness and priorities.

Because a large proportion of the investments in safety measures for protection against natural hazards are “triggered” by hazard events, **it is recommended that a risk dialogue is also held in the case of reconstruction activities after extreme hazard events** to ensure that risk-appropriate and cost-effective solutions are targeted. Far more money is still made available for reconstruction after major hazard events than for long-term preventive work. Thus an expedient approach could be to earmark a small amount of around 5-15% of damage remediation funds for long-term preventive measures and for river renaturalization.

A discrepancy exists between the available knowledge and the practical application of this knowledge in the planning sector. This discrepancy could be minimized through **the exchange of knowledge and information** between relevant stakeholders and through **knowledge transfer** between different planning disciplines. The exchange of information between all actions in the risk cycle must be institutionalized. Knowledge transfer could be supported by the exchange of good practice examples, by expert hearings, by interdisciplinary expert workshop at local level and by the **temporary exchange of practitioners between institutions**. The transboundary exchange of experience through individual exchange visits by experts actively involved in practice is worthy of promotion and financing. “**on alp_exchange**” is an effective instrument that should be used for this purpose. Many organisational framework conditions of the institutions in the different Alpine countries are currently not

suitable for promoting a motivating incentive system for the exchange of practitioners. Because **good examples** of risk-appropriate actions are easy to understand, it is recommended that the existing collection of good examples of risk management activities and good examples for risk dialogue get further developed for the countries of the Alpine region.

Risk-based decision-making is not a standard process in all regions in the Alps. The availability of a methodology that enables the implementation of the analysis of risks, measures and cost-effectiveness based on scenario assumptions is very helpful. Therefore, the use of instruments supporting risk analysis and cost-benefit analyses for risk-based decision-making is highly recommended. One of these tools is **RiskPlan**. It supports risk-based decision-making, risk dialogue and the education of practitioners in risk-based decision-making.

In many cases, municipalities do not have the necessary expert knowledge and capacities to provide their population with existential security in all areas and hence are increasingly reliant on the superior authorities and their services. For this reason, it is recommended that the understanding of the distribution of roles and tasks between municipalities, regions etc. is continuously adapted to current safety requirements. **Local administrations must be supported by risk managers from regional institutions or by experts**. The option of risk management, which involves a risk portfolio (all kind of relevant risks) at municipal, administrative and state level, is basically regarded as a promising way to dealing with all risks.

The cornerstones of the maintenance and improvement of the current level of safety under changing framework conditions are:

- the further development and implementation of integrated risk management
- the promotion of the risk dialogue
- the consistent involvement of all relevant actors and the population in risk management.

The current level of safety is continuously changing as a result of the rise in damage potential, the growing vulnerability of endangered infrastructure, the increasing demand for safety and the effects of climate change on natural hazards. **Climate change is just one element of the changing conditions in the context of risk management**. The continuous improvement of integrated risk management also serves in the adaptation of natural hazards and risk management to the effects of climate changes.

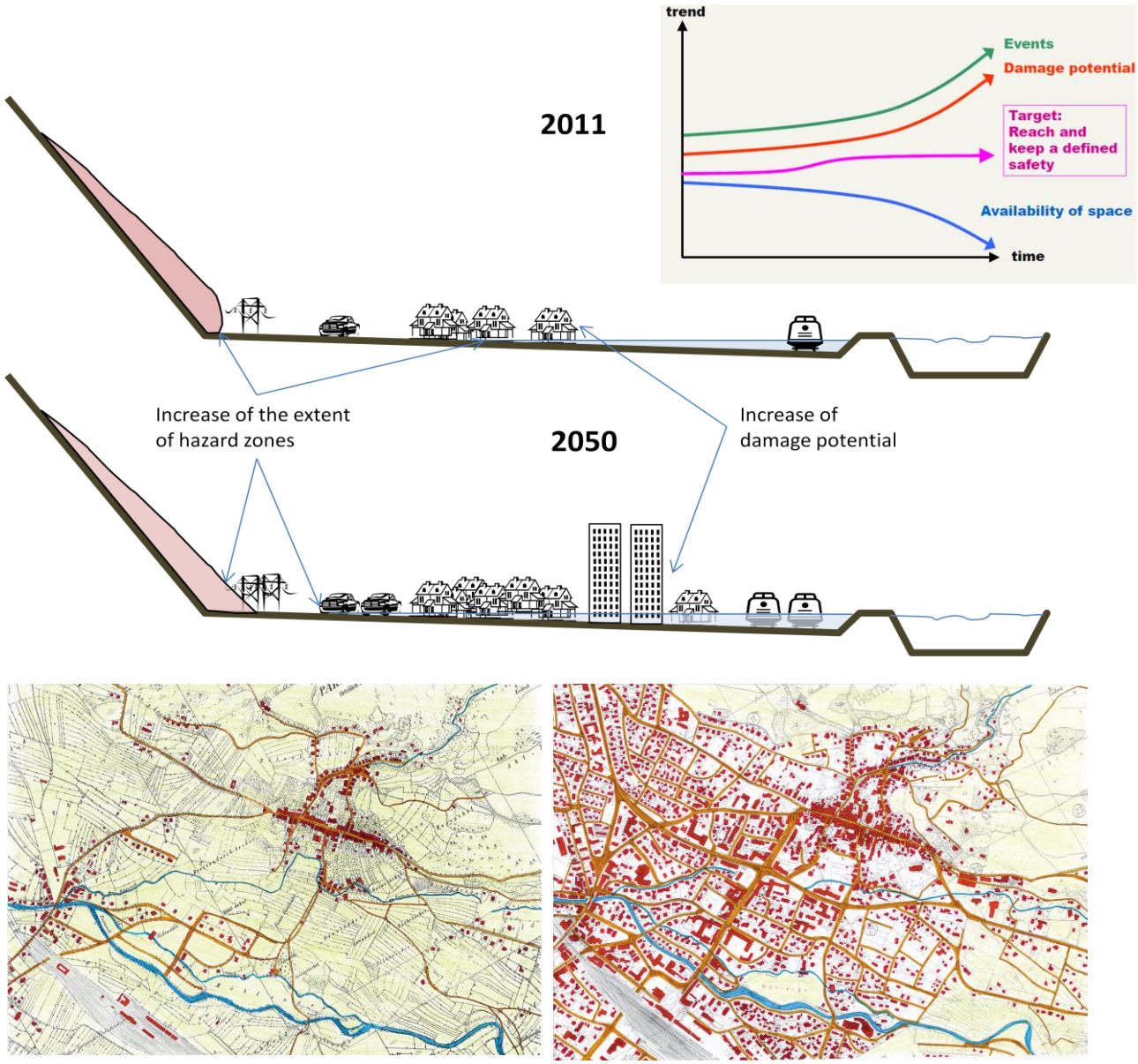

Fig. 10: Example of the development of the village Garmisch-Partenkirchen from 1861 to 1988. The main goal of integrated risk management within a changing environment is to maintain the targeted level of security. The actual trend shows in many regions increasing damage potential.

The effects of climatic change on natural hazards could increase the hazard potential in some situations whereas, in other cases, they also could lead to a decrease in hazard potential. An update of the existing hazard maps is only necessary if the effects of climate change have a notable influence on the hazard process.

Based on the current state of knowledge, it is recommended that the effects of climate change on natural hazards only be considered if the data relating to them are reliable and significant. It is recommended that the general application of some individual effects of climate change to all natural hazards throughout the Alps be avoided.

This requires the following actions

1. Development of a method for the identification of **climate-sensitive areas** in which the effects of climate change have significant negative influences on natural hazards.

2. The establishment of a **monitoring system** for observing the temporal evolution of natural risks in connection with climate data and the development of damage potential. Natural hazard risk analyses must be repeated every 10-15 years. The periodic monitoring of the risks allows the identification of situations in which the effects of climate change have a significant influence on the risks and the targeted level of security decreases as a result. It also makes it possible to distinguish between increasing risks due to climate change and due to increased vulnerability or inadequate land-use.

3. If the risk observation indicates a remarkable increase in natural risks due to the effects of climate change, the risks should be managed through the adoption of the holistic approach of **integrated risk management**.

Irrespective of climate change we must make a greater effort than hitherto to carry out the work necessary to reduce the risks arising from natural hazards or at least limit them.

In this sense, **integrated risk management offers the appropriate approach for dealing with risks induced by the effects of climate change**. The instruments of integrated risk management presented in this report are suited for solving all of the highlighted problems of risk management and hence also for the adaptation of risk management practice to the consequences of climate change.

The most effective strategy in dealing with the influence of climate change on natural hazard processes is the appropriate consideration of natural hazard processes in land-use planning, the reinforcement of personal responsibility for the protection of property and risk-appropriate priority-based investment in all kinds of risk reduction measures such as early warning, prevention, emergency planning etc. This necessitates the efficient coordination of the activities and measures carried out by all participating actors and the targeted introduction of a risk dialogue to enable joint and risk-appropriate decision-making, even in uncertain data situations or an observed increase in risks due to climate change.

8 Follow-up of activities

AdaptAlp identified new approaches and tools for improving integrated natural hazard risk management. The approaches presented in this report only represent a selection of all of the measures that exist for improving risk management and risk governance. However, they have been evaluated as suitable and efficient. Therefore, the working group recommends the use and further optimisation of the described approaches. Hence the following activities, in particular, will be carried out following the completion of the AdaptAlp project:

- **Risk dialogue** and risk communication will be further promoted in all of the participating countries.
- The **handbook on natural hazard management** will be disseminated in Austria and continuously updated.
- The **cost/benefit analysis** method will be further applied and promoted in France.
- The results of the risk analyses at municipality level in Carinthia will be presented and discussed.
- The existing **networks of practitioners and scientists** will continue to be used for the exchange of knowledge and improvement of integrated risk management.
- The improvement in risk management will be subject to **periodic evaluation**.
- The integration of natural hazard management and integrated risk management into sustainable development and into the management of the increasing complexity of the society will be further promoted.

9 Bibliography

United Nations Development Programme, 2004. A global report; Reducing disaster risk a challenge for development.

10 Reports compiled by the project partners within WP6

Further information can be found in the detailed reports compiled within Work Package 6 of the AdaptAlp project. The reports can be downloaded from the project website www.adaptalp.org.

Report on the practitioner's workshop in Immenstadt (StMUG)

Feedback on RiskPlan workshop (RAVA)

Report on the exchange of practitioners between GeoZS and BMLFUW

Report of risk management practice in Bavaria (StMUG)

Report of the use of RiskPlan at university level for education purposes

Report on the Nidwalden case study (FOEN)

Report on the workshop about GLOF hazards (PGRN)

Book article "Transnational collaboration in natural hazards and risk management in the Alpine Space" (EURAC)

Handbook for the use of video conferences in risk communication (EURAC; PGRN; FOEN)

Report "Assessment of methods and tools for risk management in Bavaria and derivation of recommendations for optimisation" (StMUG)

Expert Hearing Report "Torrential Risk Management and Environment - Munich, November 05/06, 2009" (StMUG)

Report Possibilities of adaptation to Climate Change in Slovenia – collecting examples of best practice" (GeoZS)

Report on a round table „Climate changes in the light of risk management and natural hazards" (GeoZS)

Webpage WhoDoesWhat: interactive description of how integrated risk management works all along the risk management cycle concerning Floods, Avalanches, and Mass movements in different regions (PGRN, GeoZS, RAVA, EURAC)

Report “Certainty and Accuracy Analysis of Design Events with Respect to Gravitative Natural Hazards and Derivation of Climate Change Adaptation Strategies“ (BMLFUW)

Report "Examples of Climate Change Adaptation and Mitigation in Geo-hazards Risk Management in the Alps" (BWV)

Fact sheets for the visualisation of risk for pilot-communities in Carinthia (BWV)

Software with report containing a description of the tool for the elaboration of comparative risk assessments, a guideline how to use the tool and an evaluation of the tool (BWV)

11 Glossary

acceptable risk	This corresponds to the level of loss that a community considers acceptable in relation to pre-existing social, economic, political, cultural, and technical conditions. In other words, it is the level of risk beyond /or below which a society does not intend to invest resources for its reduction (for example, because the investments surpass the benefits).
danger	A potential or evolving natural process that can produce negative effects for man or for the environment. Danger is represented by the intensity of the process and by the area involved.
cost-effectiveness	The relationships between (annualised) costs of a risk reduction measure and the effectiveness (in terms of annualised monetary values of reduced damages) is a key factor in decision-making and helps to select the most sustainable and appropriate measure (or a combination of measures) from all possible solutions.
element at risk	The entity (for example, people, property, economic activities, services and infrastructures, etc.) exposed to a hazard.
hazard	The temporal probability that an event of a given intensity involves a certain area during a specific time interval. Hazard includes latent conditions representing a future threat for man and the environment and is generally expressed in terms of annual probability.
integrated risk management	Integrated risk management in dealing with natural hazards in a wider sense is part of the holistic understanding and consideration of natural risks, composed by risk analysis, risk evaluation and risk reduction and risk management in a narrower sense. Integrated risk management incorporates all measures that contribute to the reduction of damage caused by natural hazards. These include, for example, emergency management during disasters, the maintenance of protective structures, repair work, the maintenance of protective forests and structural measures.

intensity	The geometric and mechanical severity of a phenomenon. Intensity can be expressed on a relative scale or in terms of one or more characteristic dimensions of the phenomenon (volume, velocity, energy, etc).
magnitude	A measure of the intensity of some natural phenomena. In particular, in the field of natural risks, the term magnitude is used to express the energy of an earthquake and the volume of the debris flows.
potential damage	The amount of potential losses in case of an event of certain intensity. Conventionally, the expected damage (D) is expressed as the product of the value of the element at risk (E) and its vulnerability (V).
reconstruction, restoration	Actions carried out following an event in order to restore the areas involved to the pre-event living conditions, with particular regard to risk reduction. This generally consists of two main phases: an initial phase consists of the restoration, even if only temporary, of the most important infrastructures (telecommunications, energy, strategic roadways, etc.) during the event and immediately following; a second phase consists of reconstruction of an undetermined duration that must be planned and regards all the structures and infrastructures.
residual risk	Residual risk is the risk that remains when all protective measures have been implemented and is closely related to the question as to which risks are acceptable to individuals and society.
risk assessment	Process of analyzing and evaluating the probability of adverse effects caused by natural hazards
risk dialogue	Risk dialogue should help to inform the authorities, politicians and society about the need for a concerted preventive effort. It is fundamental to risk-appropriate decision-making when planning safety measures and when prioritising the corresponding investments. A sound risk dialogue also enables participative decision-making processes. In addition, it is an opportunity for the proper consideration of climate scenarios and their potential consequences.
risk management	Risk management is the process of analysing and evaluating risks and finding solutions for the reduction of unaccepted risks.
safety	Status for which the remaining risk (residual risk) is rated as being acceptable.
vulnerability	The degree of loss of a certain element of risk, or groups of elements, due to the impact of a natural phenomenon of a given intensity. It is expressed in qualitative and quantitative terms on a scale from 0 (no loss) to 1 (total loss) and is a function of the intensity of the acting process and the typology of the element at risk.