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Harnessing innovation to reduce disaster risks in Austria, France and Switzerland

Synthesis

This report presents the synthesis analysis of the results of the cross-country comparative study of disaster risk prevention and mitigation policies in Austria, France and Switzerland. It builds on and integrates material from the country case studies on the Rhone River basin in France, on the Alpine Regions in Austria and on Switzerland, which have been previously distributed to the High Level Risk Forum. The synthesis analysis summarises countries' approaches to strengthening their risk prevention measures, which include initiatives that aim at increasing risk awareness levels and creating a whole of society approach to disaster risk prevention, improving the understanding of hazards and risks, as well as those initiatives that evaluate the relative costs and benefits of structural investments.

ACTION: delegates are invited to comment and approve the synthesis analysis. Any comments will be received until 7 September

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CHAPTER 1

LESSONS FROM A CROSS COUNTRY STUDY

Despite the achievements of OECD countries to boost resilience to disasters, gaps in disaster risk reduction efforts continue to accentuate their social and economic vulnerabilities to such extreme events. This chapter provides an overview of the findings of a cross-country study of Austria, France, and Switzerland carried out to assess and compare progress and achievements in closing resilience gaps. It looks at how countries have ensured an appropriate policy mix between structural and non-structural measures to effectively reduce disaster risks. It highlights the increasing attention given to non-structural measures, and discusses the challenges associated with the maintenance of protective infrastructure and the associated increases to exposure. The chapter discusses how countries have strengthened organisational efforts to manage disaster risks, even if such measures have not always achieved the desired outcomes. To conclude, the chapter looks at how governance and financing arrangements could help boost the effectiveness of the proposed organisational measures.

Introduction

OECD countries are highly exposed to natural as well as man-made hazards, with storms, floods and earthquakes the sources of major natural hazards. Although OECD countries have been successful in minimising the fatality rates of major natural disasters, certain types of hazards can still cause significant social losses. Extreme weather events, such as the heat wave that swept over Europe in 2003, caused a significant number of deaths. The economic consequences of natural disasters have continued to rise over the past three decades, with single events causing as much as 20 percent of GDP in damages, such as the earthquakes in New Zealand in 2011 and the Chile earthquake in 2010. Man-made hazards, too, have become a growing concern to governments. Potential terrorist attacks are threatening many OECD countries and sophisticated cyber-attacks on critical infrastructure could cause widespread social and economic disruptions.

In 2014 the OECD carried out research on countries' resilience to major natural and man-made disasters. The ensuing report catalogued the social and economic consequences of major recorded disasters in recent decades, and discussed the measures countries have put in place to increase resilience, especially through disaster risk prevention and mitigation measures (OECD, 2014a).

The report found noteworthy some of the achievements in bolstering resilience through disaster risk prevention and mitigation measures in certain OECD countries. Past major disaster events have increased countries' understanding of hazards and vulnerabilities, and in turn improved the knowledge on how associated risk can be managed. Public information campaigns and the integration of risk management tenets in the standard curricula of education institutions has increased the level of disaster risk awareness overall. In many OECD countries governments have dedicated a central leadership function that ensures the integration and coordination of risk management responsibilities across sectors and levels of government.

Nevertheless, vulnerabilities to disaster risks persist across OECD countries, and gaps in disaster risk prevention management are made repeatedly apparent when disasters occur. OECD countries have invested in a significant stock of protective infrastructure, but the maintenance of these assets is often inadequate, which means these assets do not provide the level of protection for which they were initially designed. Regulatory reforms lag behind rapid changes to the built environment in which disaster risks arise. The challenges that countries encounter in enforcing land use and building code requirements has come to the fore. The contributions of the private sector and households to strengthen resilience could be higher despite widespread calls to mobilise all societal actors in this effort.

The OECD report pointed to several factors that explain this lack of engagement in disaster risk prevention and mitigation measures. Certain stakeholders may lack knowledge of measures they can take to increase disaster risk prevention and mitigation. Constrained resources may impede higher levels of investments in disaster risk prevention and mitigation, too. Ineffective institutions may have played a role also, undermining the incentives needed for a whole of-society approach to disaster risk prevention and mitigation to be effective. For example, individual households may have put few resources into protecting their assets against the impacts of disasters because they have had reasons to assume the government would step in to compensate

for any eventual losses. Local governments may have invested more in disaster risk prevention and mitigation measures if there were mechanisms to share costs with beneficiaries in neighbouring jurisdictions. Policy makers at the central government level may be reluctant to increase investments in disaster risk prevention and mitigation, because their benefits are not as visible, especially in comparison to *ex post* support.

The OECD Recommendation on the Governance of Critical Risks (OECD, 2014b) promotes three main areas of disaster risk prevention and mitigation policy for OECD countries: (i) a whole-of-society approach to risk communication; (ii) an effective policy mix of structural and non-structural disaster risk prevention and mitigation measures; and (iii) business continuity planning.

Based on the policy recommendations put forward by the OECD and based on the findings of the OECD report, a cross-country comparative study was designed to document progress that countries have made in strengthening their disaster risk prevention and mitigation efforts. Three country case studies were carried out in Austria, France and Switzerland. As described in the methodology section below, these case studies were selected in part on the basis of similar hazard profiles and designed to ensure maximum comparability of the findings.

This report presents the findings of the cross-country comparative analysis, as well as the detailed results of the three case studies. Chapter 1 provides an overview of the methodology underlying the cross-country study. It then summarises the results of the synthesis analysis. Chapters 2-4 present the case study reports for each country.

Methodology

The cross-country comparative study was carried out in three OECD Member countries: Austria, France, and Switzerland. The research focused on public policies meant to manage the risks arising from natural hazards. The study sought to document, evaluate and compare countries' disaster risk prevention and mitigation efforts. The main national counterparts consulted in all three countries were the ministries of environment, with contributions from the national civil protection authorities and other key national and sub-national institutions that share responsibilities for disaster risk prevention and mitigation of natural hazards. Annex 1 provides a list of stakeholders who responded to questionnaires, participated in fact-finding interviews, and checked facts in the draft case study reports.

The design of each country case study followed practice observed in the OECD peer review methodology whereby peers from different OECD Member countries are invited to examine a defined scope of public policies and practices followed in the country under review. The peer examination facilitates exchanges between the country under review and the participating peers about what has worked in terms of policy making in other countries, which can save time, and costly experimenting, in crafting or reforming national policies.

For the purpose of this report's country case studies, officials from the 3 participating countries were invited to attend the various interviews in foreign countries in order to maximise knowledge exchange. The officials were subsequently asked to share their observations and recommendations with the OECD Secretariat. These observations in turn informed the Secretariat's case study reports, which included an assessment and a set of policy recommendations. A key objective of the exchanges organised during the study was to build a forum for policy discussions among country peers on how to boost resilience across countries. To this end, all study participants/peer reviewers were invited to discuss the results of the case studies during a dedicated session at the OECD High Level Risk Forum that took place in December 2016 in Paris.

To ensure comparability of the results of country case studies, the background country research, the country questionnaires that informed the background reports and the fact-finding missions were designed using the same structure and questions. The country questionnaire is included in Annex 2 of this report. The answers to these questions provide a comprehensive overview of the progress in disaster risk prevention and mitigation efforts across the OECD and will serve as an introduction to the synthesis analysis below.

The process to conduct each country entailed the development of a country questionnaire (Annex 2), the results to which informed the development of a background report. The background report, in turn, informed the questions for the fact-finding missions and gave the peers the necessary information to prepare their mission exchanges. On the basis of the findings of the missions, including summaries of observations made by the peers, case study reports were prepared and fact checked by countries. The final reports, including an overview of the assessment and recommendations, are included in chapters 2-4 of this report.

The cross-country study was designed to identify successful national policies and practices in strengthening disaster risk prevention and mitigation efforts. A selected set of policies and practices highlighted in this report will be included in the OECD's Toolkit for Risk Governance, which features an online portal of risk management practices from risk assessment and preparedness policies to effective disaster risk reduction measures (https://www.oecd.org/governance/toolkit-on-risk-governance/home/), targeted to risk management policy makers and stakeholders at large. The results of this study also inform the reporting on the implementation process of the OECD Recommendation on the Governance of Critical Risks (OECD, 2014b).

In the remainder of this chapter an overview of the risk profiles of the selected country case studies will be provided. It will show how the countries compare in terms of their hazard profiles and the similar disaster risk prevention needs they have. The chapter will then turn to discuss the countries' specific disaster risk prevention efforts, starting with investments in structural disaster risk prevention measures, followed by a comparison of the countries' non-structural measures to reduce exposure and vulnerability. The chapter continues with a discussion about the ability of countries to bring together all stakeholders concerned with disaster risk prevention and mitigation, i.e. their ability to promote a whole-of-society approach, which requires countries to go beyond traditional sectoral or jurisdictional-based approaches. The chapter will conclude with an overview of countries' strategies to finance disaster risk prevention and mitigation measures.

Overview country risk profiles

As mentioned in the methodology section the case study countries were identified and selected based on a comparable geography and set of natural hazards. In Austria and Switzerland around 60 % of the territory is mountainous, ranging from the Alps to the Jura Mountains on the Franco-Swiss border. In France, the Rhône River basin, too, is shaped by its varied topography, with much of the river passing through the mountainous terrain of the Alps and the Central Massif. As a consequence, in Austria, the study focused on Alpine hazards and floods. In France a specific geographic focus was on the Rhône River basin, where predominant natural hazards are floods, related Alpine hazards and earthquakes. In Switzerland, policies concerning all natural hazards were examined, with the predominant hazards very similar to those present in Austria and France.

Floods constitute the most prevalent natural hazard in all three countries. In Switzerland almost a quarter of the population lives in areas at risk of flooding, while in Austria, almost 8% of the population lives in flood risk areas. In the Rhône River basin (population of around 15 million), a third of the population faces flood risk directly or indirectly. Along with the exposed population, agriculture and industrial activity is often concentrated in areas at risk of flooding, particularly in the Rhône River basin and in Switzerland.

Table 1.1 Natural hazard profiles: Austria, France and Switzerland

Hazard types	Austria	France	Switzerland
Hydrological	Floods, flash floods, debris flow, torrential flood	Floods, flash floods, debris flow, torrential flood	Floods, flash floods, debris flow, torrential floods
Climate and meteorological	Extreme temperatures, wild fires, heavy rainfall, storms, hail, lightning, avalanches	Extreme temperatures, heavy rainfall, storms, hail, lightning	Extreme temperatures, wild fires, heavy rainfall, storms, hail, lightning, avalanches,
Geological	Soil erosion, sediment movement, earthquake, rockfalls	Sediment movement, earthquake	Soil erosion, sediment movement, earthquake

Source: OECD (2015); OECD (2016a); OECD (2016b)

Past disasters show the important negative impacts floods have had in the studied countries. The major floods that occurred in Switzerland in 2005 caused an estimated EUR 2.8 billion in economic damages. The 2002 floods in Austria caused around EUR 3.2 billion and the large-scale Rhône floods of 2003 an estimated EUR 1 billion in economic damages.

Extreme temperature events, especially in the form of heat waves, have had significant impact across the three countries. In the 2003 European heat wave, for example, 1 000 people lost their lives in Switzerland, 180 to 345 in Austria, and in France, which was especially affected, around 20 000 deaths were recorded, although numbers vary widely across different sources. Most recently, during the summer of 2015, an estimated 800 people lost their lives to extreme heat in Switzerland.

Earthquake risk threatens the three case study countries in similar ways. Although earthquakes are extremely rare in their occurrence in the studied areas, their damage potential is significant. The 1365 earthquake in Switzerland's Basel region would cause an estimated EUR 46 – 94 billion (CHF 50 to CHF 100 billion) in economic losses if it were to occur nowadays (SED, 2016). An earthquake in the Provence-Alpes-Côtes-d'Azur region is considered to be among the top three major risks threatening France's society and economy.

In all three countries, hazards are assessed and mapped in regular intervals and the results are revisited after major disaster events. The hazard mapping results inform the work of risk managers, for disaster risk prevention as well as emergency preparedness and response purposes (more details on hazard assessments are provided below).

Successful disaster risk prevention: getting the policy mix right

As noted in the OECD Recommendation, an optimal disaster risk prevention and mitigation policy mix consists of both so called structural and non-structural measures (OECD, 2014). The Sendai Framework for Disaster Risk Reduction, too, highlights the need for both public and private investments in structural and non-structural measures to increase economic and social resilience to disasters (UNISDR, 2014). Structural measures, which often require significant public expenditure, seek to physically protect populations and assets through engineering works measures such as dykes and dams for floods or storm surges, retention walls, and so on. The direct costs of non-structural measures to governments tend to be lower, and encompass such efforts as s hazard

zoning, spatial planning, building codes and their enforcement, risk communication measures and business continuity planning, but also measures like natural water retention, green infrastructure or expanding room for rivers to flow.

Additional physical protection measures are used on an emergency needs basis, such as mobile protection measures used in the event of floods, or automatic weather stations to provide early warning information. Generally speaking both structural and non-structural measures aim at limiting the exposure of persons and core services to known hazards to reduce their vulnerability. Table 2 provides a set of examples of natural hazards, their potential negative impacts and exemplary disaster risk prevention and mitigation actions.

Table 1.2 Natural hazards, impacts and disaster risk prevention and mitigation measures

Type of Natural Hazards	Impact examples	Disaster Risk Prevention & Mitigation Measures	Description
Geophysical: Earthquakes, Volcanic Activity, Mass Movement (dry), Geomagnetic Storms)	Losses of human lives, impact on human health	Risk Identification and Assessment	Multi-hazard risk assessment; multi-stakeholder risk assessment; assessing future risks through scenario planning and other methods
Meteorological/ Climatological: Storms, Extreme Temperatures, Droughts, Wildfires	Destruction of physical (private and public) capital and critical infrastructure	Risk Awareness Measures	Public information campaigns, integration of risk in education curricula
Hydrological: Flood (storm surge, coastal), Mass Movement (wet)	Destruction of natural capital (natural resources, natural capital stock, loss of natural habitats, loss of animal stocks)	Technical and Engineering Measures	Dikes, flood gates, rock falls or landslide barriers, retrofitting of buildings, facilities to contain spread of epidemics, elevated roads; back-up and redundant infrastructure

Source: OECD (2014a)

Risk patterns evolve over time, as they are in constant interplay with socio-economic, environmental and technological dynamics and changes. Therefore structural or non-structural disaster risk prevention and mitigation measures need to keep pace and have to be adapted to ever changing consequences that might not always be easy to appraise. The volcanic ash cloud that formed over Iceland in 2010, for example, demonstrated that experts had little understanding about just how much ash is dangerous to planes' engines. To overcome a reliance of policy makers and other stakeholders on past events to inform standards and recommendations, "anticipatory governance" allows for more real-time monitoring, and adapting disaster risk prevention and mitigation measures as swiftly as possible as new risk-related information is collected (OECD, 2014a). In this respect they contribute to the resilience of society.

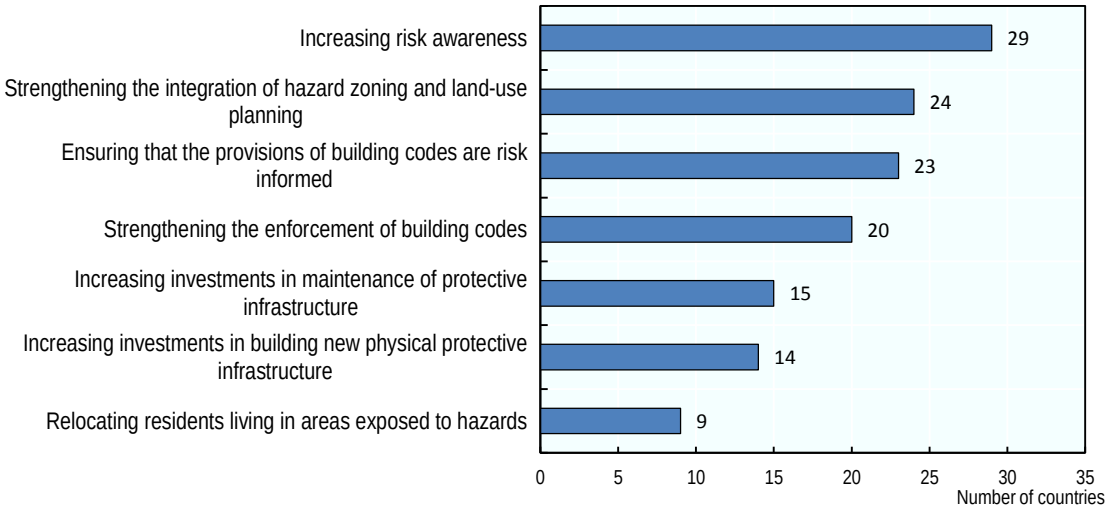
Investments in physical disaster risk prevention and mitigation measures

In a flood risk financing survey carried out by the OECD as part of the work on the Financial Management of Flood Risk (OECD, 2016e), 17 out of 20 responding

countries stated that physical disaster risk prevention investments led to a reduction in flood risks, with some respondents suggesting it is likely the largest contributor to reducing flood risk in their country. A recent survey on the Governance of Critical Risks, carried out in the process of reporting progress in the implementation of the OECD Council Recommendation on the Governance of Critical Risks (OECD, 2014b), assessed the relative importance of structural and non-structural measures as part of countries' policy mixes. The results show that for only 14 out of 35 responding countries "increasing investments in physical protective infrastructure" is a priority in their disaster risk prevention policy mix (Figure 1.1). These priorities may on the one hand reflect the view of central governments, which made up the majority of survey respondents. The view of local governments, that are often in charge of deciding on and co-financing disaster risk prevention investments (Box 1.1), may lead to different answers. On the other hand, these priority considerations may be subject to change. The country case studies provide some insights into this. In Austria, where the central government co-finances about half of structural disaster risk prevention investments, on average, demand from municipalities for protective measures has exceeded the supply that can be co-financed by the central government by about 40%. While in France the current demand and supply for investments in structural measures are more or less in equilibrium, French authorities expect future demands for protective infrastructure investments from the local levels to increase, partly because of increasing exposure to risks and partly because there has been a back log in terms of time it took sub-national authorities to put their requests and planning documents together to have access to central co-financing. In Switzerland, too, increases in demand are expected, as protective infrastructure ages and new and updated hazard maps indicate where additional structural works are needed.

The relatively lower importance that OECD countries seem to attach to structural investments compared to organisational disaster risk prevention measures (Figure 1.1) may also reflect historical legacies. In the studied case study countries, important investments in structural measures were made in the past decades, where an increasing challenge seems to be on how to maintain this large stock of infrastructure so as to ensure that the existing structures maintain the level of protection for which they had been conceived initially. In comparable terms, additional investments in new structural measures may hold lower gains in protection against natural hazards compared to the reinforcement of certain organisational measures.

Figure 1.1. Countries' priorities in strengthening disaster risk prevention and mitigation



Note: Total number of responses 30/35
Source: OECD Survey on the Governance of Critical Risks

Box 1.1 Decision making for structural disaster risk prevention measures

Disasters are felt most strongly in the directly affected communities that suffer fatalities, and the physical destruction of homes, infrastructure and businesses. As a consequence, local stakeholders, such as municipalities and local interest groups, are in many countries considered well placed to signal the need for investments in structural disaster risk reduction measures. Austria and France delegate the initial responsibility to request a disaster risk reduction investment to the local level (e.g. local authorities, communities, or small beneficiary groups).

In Austria funding decisions are shared by the Federal Ministry of Agriculture, Forestry, Environment and Water Management, as well as the Federal Ministry of Transport, Innovation and Technology. Local level requests are made to one or the other depending on the river type, topography and the characteristics of the structural measure. For torrent and avalanche barriers, the need for structural measures are submitted to the regional service branch of the Austrian Service for Torrent and Avalanche Control (WLV), which assesses the protection needs and whether there is public interest in the investment in cooperation with the service's central office. If the assessment is positive, local parties are requested to develop and submit a co-funding proposal and to take the necessary steps to free up the land needed for the construction of a new structural measure. At this stage, the provincial level is also approached for co-financing. If all steps are passed, the WLV will conclude a formal agreement with the requesting party. For structural measures that address other water-related risks, the initial process is similar, although requests are made to the Federal Water Engineering Administration or the Federal Water Way Administration and then negotiated between the federal ministry and the provinces.

In France, local authorities signal the need for a structural measure to the deconcentrated regional service branches of the Ministry of Ecology, the Regional Directorates for Environment, Planning and Housing (DREALs). While requests for measures below EUR 3 million can be directly approved by the respective DREAL, bigger requests are evaluated by the central-level Joint Flood Commission (CMI). The final decision is then taken by the Ministry of Ecology, which typically follows the assessment done by CMI.

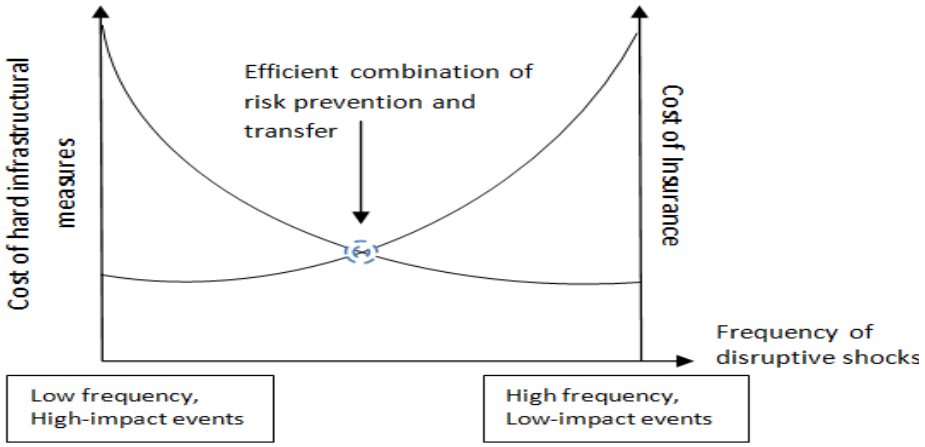
Sources: OECD (2015); OECD (2016a); OECD (2016b)

Maximising the benefits of structural infrastructure investments

Investments in structural protective infrastructure are costly, and their utility is often maximised through complementing them with non-structural disaster risk

prevention measures. Figure 1.2 illustrates this in terms of the potential complementarity between the protection provided by hard infrastructure measures and insurance. The cost of hard infrastructure measures to physically protect against the most extreme events (i.e. low frequency, high impact events which would require a high standard of physical protection) is relatively high compared to the cost of purchasing insurance to provide financial protection against low frequency events. However, the relative cost of insurance is high for higher frequency events which normally can be prevented by more limited investments in hard infrastructure measures. As a result, a combination of the two types of measures may provide an efficient disaster risk prevention policy mix.

Figure 1.2. Illustration of trade-off between hard and soft disaster risk prevention and mitigation measures



Source: OECD (2014a)

Decision-aiding tools, such as cost-benefit analysis can support policy-makers in deciding on whether and where to invest in structural measures, and hence to maximise the benefits from such investments. Such tools enable the comparison of costs and benefits of different investment alternatives, measured on a set of criteria, and in different decision contexts. They can aggregate the flows of advantages and disadvantages of decisions, and highlight distributional impacts (OECD, 2014a).

Given the importance of structural disaster risk prevention investments across the three case study countries, decision aiding instruments have been used widely. In Austria, for all disaster risk reduction investments exceeding EUR 1 million, exhaustive evaluations of direct as well as indirect costs and benefits are required. In Switzerland an in-depth evaluation of costs and benefits of disaster risk prevention investments is required for all investments above EUR 4,6 million. Standard cost and benefit measures include items such as construction and maintenance costs or on the benefits side items like avoided damages to buildings or critical infrastructures. Where countries are confronting more difficulties is how to address criteria that are important, such as the protection of lives, but that are difficult to evaluate monetarily. Austria has addressed this issue by including intangible benefits on a point scale as an add-on to the results of the standard monetised cost and benefits (Box 2). This makes comparison difficult, but at least ensures that this can be taken into consideration by decision makers. In France alternative methods are proposed, such as multi-criteria analysis that allow for commuting different value categories, such as for example the value of a

human life or the value of environmental protection, and attaching different decision weights (usually defined by a pre-set point scale) to them. In Switzerland, the online tool, "EconoMe 4.0" [1] guides the evaluation of costs and benefits of complex projects, including social standards and environmental requirements, and in many cases the project proposal also undergoes a public consultation process.

Box 1.2 Evaluating the costs and benefits of disaster risk prevention investments: an example from Austria

Cost-benefit analysis (CBA) was first introduced formally in 1978 in Austria and has since been revised. Pursuant to article 3 of the legislation on the promotion of hydraulic engineering structures (*Wasserbautenförderungsgesetz*) established in 1985, CBA must be implemented to assess the financial feasibility of disaster risk prevention projects exceeding 1 EUR million in costs and having a significant impact on the population at risk. For all other projects, a standard benefit utility assessment is conducted.

CBA compares the cost and benefit stream of different project options (including status quo) over the 80 years that follow the start of a project. Costs include: construction costs (although generally there are no costs for the authorities to buy land as the interested persons are in charge of providing lots); maintenance and repair costs; costs for technological upgrades.

The benefits are linked to protection goals and hence calculated as the estimated average in avoided damages, including: damage to buildings; restoration costs; damage to streambed and receiving stream; damage to transport infrastructures; damage to supply and sanitation facilities; damage to tourism; damage in business/trade/industry/provision of services; damage to official belongings; intervention costs (civil and military forces).

Intangible and indirect benefits are included on a point scale according to the importance of each criterion. They include: protection of people's lives, prevention against an increase in exposure, feeling of safety, ensuring transport connections, protection of nature, landscape and culture related goods. An evaluation of 120 CBAs showed that intangible factors accounted for an estimated 30% of the tangible benefits, which is why their overall weight was determined at 1.3.

Although it is important to include intangible benefits (such as the value of human lives) through, if possible, a point scale, the key question is how final decisions compare different values. Analytical tools such as multi-criteria analysis could be useful in ensuring equal assessment and clear weighting throughout the different evaluation criteria.

Source: BMLFUW (2006), *Richtlinien für die Wirtschaftlichkeitsuntersuchung und Priorisierung von Maßnahmen der Wildbach- und Lawinenverbauung gemäß § 3 Abs. 2 Z 3 Wasserbautenförderungsgesetz* 1985 [Legal guidelines for cost efficiency analysis and the prioritisation of torrent and avalanche barriers as defined in § 3 Para. 2 Z 3 legislation on the promotion of hydraulic engineering structures 1985].

The maintenance challenge

Over recent decades, Austria, France and Switzerland have created a significant stock of disaster risk prevention infrastructure. The challenge in all three countries has been to ensure the structures continue to provide the level of protection for which they were initially built, through adequate maintenance, rehabilitation and strengthening works.

While financial allocations for structural measures may be a fixed part of sectoral budgets, they do not, or only to a limited extent or for a limited amount of time, include a budget for the maintenance expenses for existing, or newly built, protective infrastructure. In Austria, for example, maintenance costs are budgeted into the initial project allocation that is co-funded by the central government, but after some years these costs have to be assumed by sub-national governments or the immediate beneficiaries of a protective infrastructure (e.g. citizens, communities, businesses). In

France, there is no maintenance funding included in the initial project allocation for building protective infrastructure.

As a result of the lack of financial planning for maintenance of disaster risk prevention infrastructure, the levels of maintenance vary within countries. The heterogeneity has been caused by differing levels of fiscal and technical capacities at the local level. In the worst case, infrastructure frailty as become apparent during past disasters, e.g. when dams cannot hold water levels they were designed to withstand.

In an attempt to understand the scale of the maintenance problem, Austria, France and Switzerland have started to collect information on the level and adequacy of maintenance through a central fact finding process. In Austria, a central database was established by the Ministry of Agriculture, Forestry, Environment and Water Management that contains information on 270,000 protective infrastructures, with information on their physical dimensions, an assessment of their condition, documentation of monitoring and inspections, attendance, corrective maintenance, on rebuilding and potential other changes (Rudolf-Miklau et al., 2014). In France, local level initiatives, such as the SIRS-dike database created by the *Syndicat Mixte Interrégional d'aménagement des Digues du Delta du Rhône à la Mer* (SYMADREM) catalogues existing protective infrastructure along the Rhône downstream of Beaucaire, including inspection observations. In Switzerland, a database (ProtectMe) is currently being developed to monitor the aging process and vulnerabilities of existing protective infrastructure, which should include comprehensive information on the status of maintenance and protection capacity. Such databases have shown to be a useful tool in different countries including in the United States where the Army Corps of Engineers created the National Levee Database[2]. The database contains up-to-date and publicly available information on the location, condition and maintenance of the majority of dikes and dams built across the United States. The information can be illustrated with a mapping tool (OECD, 2013).

To address the uneven maintenance of local risk prevention infrastructure, France has been discussing a reform called GEMAPI (Box 1.3) that seeks to devolve this responsibility to local authorities and to provide them with authority to finance maintenance through taxes.

Box 1.3. Inter-municipal collaboration for flood risk management (GEMAPI)

The French law on modernising local public action and promoting metropolitan regions (*loi de modernisation de l'action publique territoriale et d'affirmation des métropoles*, MAPTAM), passed in 2014, gives the responsibility for managing aquatic environments and flood risk (*gestion des milieux aquatiques et prévention des inondations*, GEMAPI) to municipalities and to intercommunal services (EPCIs – see Box 3). This is intended to facilitate interventions at the local scale and ensure specific institutions are in charge of specified tasks related to the maintenance of protective infrastructure. Tasks for which the local level will be responsible under GEMAPI include:

- Hydrographic basin planning
- Installation and maintenance of water streams, canals and lakes, as well as access to them
- Flood and sea defence measures
- The protection and restauration of water ecosystems (such as flood plains)

To finance these new responsibilities, municipalities or inter-municipal services can raise a maximum tax of EUR 40 per citizen per year, attached to the local property or rental taxes. The

Box 1.3. Inter-municipal collaboration for flood risk management (GEMAPI)
(continued)

municipalities and EPCIs may give the competence of GEMAPI or a part of it to unions that bring together different local-level groups. The law will come into force in 2018 with a transition period until 2020.

Source: http://www.rhone-mediterranee.eaufrance.fr/docs/gemapi/20140127_LoiGemapi.pdf; http://www.eaurmc.fr/fileadmin/grands-dossiers/documents/GEMAPI/2014_AERMC_resume_loi_GEMAPI.pdf

Mobilising non-governmental stakeholders in disaster risk prevention and mitigation investments

While providing safety and protection against damages from natural disasters for public and, to some extent private assets, has long been viewed as a responsibility of the government, in some OECD countries this responsibility is slowly being shared with non-governmental stakeholders. Especially the direct beneficiaries of disaster risk prevention investments have been involved in the decision-making, and the financing. Bottom-up initiatives, like the water boards in Austria (Box 1.4), have proven to be effective in unlocking additional investments for disaster risk prevention management and have also improved ownership, and hence maintenance, of the created assets.

Box 1. Box 1.4 Bottom-up disaster risk prevention initiatives - the case of the water boards in Austria

Water boards are statutory corporations under Austrian law (Water Act of 1959) and can be composed of any number and combination of individuals, municipalities or companies. Each member contributes financially to a common fund, which is intended for use in the development and maintenance of mitigation or prevention measures. The readiness to financially contribute to infrastructure investment can be considerable. For example, in the case of the Saalbach (province of Salzburg) water board, which is relatively large with 600 members, individual contributions can be as high as EUR 50 000 annually. The level of contribution is determined by a point system derived from the exposure of a member's property or dwelling. The initial determination of membership fees is automatically transferred to new property owners.

Water boards may decide to take responsibility for co-financing sometimes costly protective infrastructure, instead of leaving this to local authorities. There are several advantages for taking such an initiative. Water boards can, for example, expedite the request for a protective infrastructure, which serves the interests of those directly impacted by potential hazardous events. Water boards, just like municipalities, can initiate and request the construction of protective infrastructure, and thereby oblige its members to finance the suggested measures. In the case of Austria, investment proposals by water boards receive a faster treatment of their request and a higher central co-financing rate than requests submitted by local government. The difference can be as high as 15% and should thereby reward individual willingness to contribute to financing protective infrastructure.

As water boards become the formal owners of the protective infrastructure they build, they are responsible for maintaining it This has led to significantly better results in the status of protective infrastructure over time, compared to infrastructure for which maintenance is the responsibility of other groups, such as municipalities, that have faced resourcing challenges. Considering the longer-term maintenance requirements of protective infrastructure investment, municipalities may encourage investment by water boards.

Source: OECD (2015)

In Switzerland, the insurance industry plays a strong role in mobilising private investments in disaster risk prevention and mitigation. In many cases, insurers inform

their customers about the hazard exposures as well as about responsibilities and 'how-to' measures for self-protection. Many public insurers tie the amount of individual loss compensation in the event of a disaster to the prior implementation of disaster risk reduction measures. Financial support is offered by cantonal public insurance companies for investments in such self-protection measures.

Maximising the benefit of organisational disaster risk prevention measures

Non-structural or organisational disaster risk prevention measures are those that are focused on reducing exposure and vulnerability to natural disasters through longer term planning and adaptation to hazard patterns (OECD, 2014b). These include measures like risk communication, hazard zone mapping, risk mapping, spatial planning, building code enforcement or the restoration of natural functions of ecosystems to strengthen protection against natural hazards. These measures form an important element of an optimal policy mix for disaster risk prevention management, as mentioned in this chapter's introduction.

Comparing policy priorities in disaster risk prevention management, the OECD Survey on the Governance of Critical Risks reveals that organisational disaster risk prevention measures, such as the integration of hazard zones in land-use planning (24 out of 35 respondents) or the enforcement of building code provisions (20 out of 35 responding countries) are ranked with a higher policy priority across OECD Members than structural prevention investments (14 out of 35 respondents) (Figure 1.1). These policy priorities reflect a historical legacy, i.e. that structural investments have taken priority in the past as compared to today, and hence very much the recognition that there is a limit to what structural disaster risk reduction investments can and should achieve in terms of protection against natural hazards. It could also reflect a cost consideration. Structural investments have, to a large extent, been shouldered by the government. Organisational measures have much lower upfront costs for the government. However, the indirect costs of organisational measures, for example the decrease in property values that might be caused by hazard zoning, can be substantial and have been borne by citizens, communities, or business owners. Policy considerations ideally should take account of the distributional impacts of the different measures being implemented.

In the following an assessment of the different non-structural, or organisational, measures that have been implemented by the case study countries, will be provided.

Hazard (and risk) identification and assessment

In terms of identifying and assessing natural hazards OECD countries have made significant and rapid progress in covering their territories with up to date hazard information. In many countries a central government authority has ensured that hazard assessments are carried out locally (Box 1.5).

Box 1.5 Responsibilities for hazard assessments across levels of government: a cross-country comparison

Responsibilities for hazard assessment tend to be distributed across levels of governments. While the local levels tend to be in the driver's seat of hazard mapping, the central level oversees the process and ensures a common approach by providing guidelines and standards.

Across countries, this approach takes different forms. In Switzerland the Federal Office for the Environment (FOEN) provides national guidelines to conduct hazard assessments for all hazards except earthquakes, while the respective cantonal authorities oversee the hazard mapping done at the local level. In Austria and France, on the other hand, hazard mapping is done by the respective regional offices of the central Ministry in charge of disaster risk prevention. While in Austria, the Ministry finalizes the maps for publication, ensuring comparable high quality maps, in France the respective regional service that does the hazard mapping also decides the approach. As the central level only indirectly oversees the hazard mapping in France, this has resulted in differences in hazard mapping in different regions.

	Hazard assessments		**Review and Updating frequency**
	Guidance and oversight	Hazard mapping	
Austria	• Ministry of Agriculture, Forestry, Environment and Water Management	• Service for Torrent and Avalanche Control (WLV): provincial offices • Federal Water Engineering Administration (BWV): central office makes first drafts; provincial offices complement and detail them with local data	• WLV: on a ten-year basis and after changes in the catchment areas • BWV: every six years and after changes in the catchment area
France	Ministry of Ecology: • *Directions départementales des territoires* (*de la mer*), DDT (M) • Regional Directorates for Environment, Planning and Housing (DREALs)	• *Directions départementales des territoires* (*de la mer*), DDT (M) • Regional Directorates for Environment, Planning and Housing (DREALs)	• For floods (since implementation of UE Floods Directive) : national assessment of flood risks, updated every 6 years • typically updates follow major hazard events or socioeconomic changes • for new disaster risk prevention plans (PPR)
Switzerland	• Federal Office for the Environment (FOEN) • Cantonal authorities • Swiss Seismological Service (SED)	• Local authorities: floods, landslides, rockfalls, and avalanches • Cantonal authorities: spectral seismic zoning studies	• every 10-15 years and after major disaster events

Sources: OECD, 2015; OECD, 2016a; OECD, 2016b

In recognition of the importance of the availability of detailed hazard information, in Austria and Switzerland, for example, the central government authority co-financed, when necessary 100% of the hazard assessment process. In an effort to communicate the results of hazard assessments widely, Austria, France and Switzerland have made hazard information publicly accessible via online platforms that provide hazard information for exact address locations. In other countries, such as the United Kingdom, technical and scientific agencies and government partners cooperate to provide citizens and policy makers alike with regularly updated hazard information

(Box 1.6). In an effort to communicate the results of hazard assessments to stakeholders France has proactively communicated this information to property buyers as part of the legally required documents in the purchasing process. The persisting challenges have been to keep hazard information regularly and sufficiently updated.

Box 1.6 Informing about Hazards – The United Kingdom's Natural Hazard Partnership (NHP)

The Natural Hazard Partnership (NHP) is a collaborative partnership between twelve technical and scientific agencies and five government partners. It provides a forum that allows the exchange of data, information and outcomes of all conducted risks analysis. The partnership also contributes to the National Risk Assessment (NRA), which identifies new hazards and advices on worst-case scenarios.

Through a comprehensive and accessible website, the public can access easily understandable information on all relevant hazards, ranging from flooding and extreme weather to earthquakes and wild fires. In addition to the general hazard information available on the website, the NHP provides Daily Hazard Assessment (DHA), which describes all potential natural hazards and health implications that could affect the United Kingdom over the following five days. The DHA is complemented by a general outlook that covers the following thirty days.

Since its creation in 2011, the NHP has significantly increased the coordination among different stakeholders, avoiding duplication and overlaps, which used to be a key challenge. During the 2007 floods, the overlapping mandates of the multiple involved agencies hindered efficient data and information sharing, causing a paradigm change in the aftermath of the floods.

Sources: OECD (2016), Toolkit for Risk Governance - UK Natural Hazard Partnership, https://www.oecd.org/governance/toolkit-on-risk-governance/goodpractices/page/uknaturalhazardpartnership.htm#tab_description;
NHP (2016), The Natural Hazards Partnership, http://www.naturalhazardspartnership.org.uk/

Hazard maps can be improved in the future to reflect the continuous changes and arising complexities in disasters by:

- Harmonising and integrating maps across different hazards: Hazard maps across OCED Member countries have often been developed by different authorities in charge of managing different types of hazards. This is true for different natural hazards, but also between natural and man-made hazards. In the United Kingdom, the Natural Hazard Partnership (NHP) (Box 1.6) has addressed the challenge of hazard mapping that is spread out across different agencies. The NHP acts as a forum of exchange and integrates hazard information provided by the participating public bodies and research institutes.
- Increasing the assessment of cascading impacts across different types of hazards: Since larger-scale disasters have shown their significant potential to trigger knock-on impacts, such as the Great East Japan Earthquake and the Fukushima power plant accident, there is also significant scope to integrate potential cascading effects in the traditional mapping process. Switzerland shows high awareness of such extreme disaster scenarios and has made concerted efforts to better identify and assess potential cascading disasters. The EXAR project described in Box 1.7 illustrates an example.
- Reflecting the evolution of hazards and risks due to climate change: Climate change is expected to affect both the intensity and the frequency of existing hazards and risks and might create new ones. Levels of precipitation and temperatures are expected to change, affecting among other things the probability of floods and droughts, the stability of slopes and bedrocks, and the intensity of

storms. Comprehensive hazard maps should display climate impact to ensure a forward-looking understanding of risks and hazards.

Box 1.7 EXAR: Assessment of extreme flood risks along the Aare and Rhine rivers (Switzerland)

In 2013 the Swiss Federal Offices for the Environment, Energy, Nuclear Safety Inspectorate as well as Civil Protection launched the EXAR project that aims at establishing a common baseline to evaluate the risk of extreme flood events for infrastructures built close to the rivers Aare and Rhine. In the beginning phase of the project, data were collected and methodologies developed that enable a standard evaluation of extreme flood events along those two rivers, including gauge height, flow velocity, morphological changes of the river and recurrence probabilities. Projections are based on estimated return periods of 10 000 years.

Based on the initial ground work that established the evidence base for modelling extreme flood events of the Aare, in 2016 the Federal Office for the Environment commissioned a study to understand and evaluate interaction scenarios or cascading impacts of extreme flood risk events. These include erosion, landslides, blockages through floating refuse and dyke breaches. The objective of this study is to understand vulnerabilities of infrastructures to extreme flood events.

The results of this exercise are used to inform the implementation of protective strategies for infrastructures and other assets in the high risk area. Specifically, they are used to estimate the risk of an extreme event and cascading impacts for 15 damn structures and re-evaluate the risks for nuclear power plants in that area (Kühleberg, Gösgen, Beznau I and II).

Source: FOEN (2016), *Beurteilung der Gefährdung durch Extremhochwasser der Aare: Hauptstudie lanciert* [Evaluation of extreme flood hazards along the Aare: Main study launched], Federal Office for the Environment (FOEN), Switzerland http://www.bafu.admin.ch/dokumentation/medieninformation/00962/index.html?lang=de&msg-id=60609

Although natural hazard assessments are indispensable for effective hazard management, they are insufficient in determining priorities for investments in disaster risk reduction efforts. Hazard assessments do not include information about the vulnerability and exposure of populations and assets to the identified hazards. Risk assessment describes the process that helps to "determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and their environment" (OECD, 2014b).

Risk assessments are increasingly in all three countries, although the available information is not always comprehensive, and the assessments are not carried out for all hazards. In Austria, individual studies have been carried out that looked for example at the exposure of buildings and residents to flood, torrent and avalanche risks (Fuchs and Zischg, 2014; Habsburg-Lothringen et al., 2009; BMLFUW, 2015). Switzerland has also relied on individual studies, such as the ongoing Mobilar project that seeks to map buildings exposed to natural hazards (http://www.mobiliarlab.unibe.ch/). Neither Switzerland, nor Austria has conducted a systematic risk assessment that includes an assessment of critical infrastructure and critical services for all existing sources of natural hazards. In France, and the Rhône River basin, more detailed risk assessments have been carried out as part of the obligatory development of national and basin-level flood risk management plans (PPRI). Table 1.3 illustrates the result of this elaborate flood risk assessment exercise, which included a comprehensive assessment of citizens

at risk, private assets and public infrastructure, as well as environmental and cultural heritage sites.

Table 1. Table 1.3 Assets at risk in the Rhône basin

	At risk from flooding	At risk from coastal flooding	Relative to total number of each indicator in France (%)	
Population	5,5 million	229,000	33	16
Number of health facilities	819	21	35	13
Potable water facilities	9,044	23	-	-
Total buildings	438 million m^2	21,2 million	34	15
Total business buildings	153,96 million m^2	5,4 million	36	13
Jobs	2,9 million	133,200	32	16
Infrastructure lines (roads and railways)	98,000 km	5,000 km	32	16
Nuclear power stations	57	0	-	-
Nature protection zones (Natura 2000)	6,500 k m^2	2,800 km^2	30	34
Cultural heritage buildings	1,6 million m^2	35,000	25	9
Museums	133	8	-	-

Source: DREAL Rhône-Alpes (2014), "*Plan de Gestion des Risques d'Inondation 2016-2021, Bassin Rhône-Méditerranée*" [Plan for Flood Risk Management 2016-2021, Rhône-Mediterranean Basin], Parties communes au Bassin Rhône-Méditerranée, Project submitted for public consultation Volume 1, http://www.rhone-mediterranee.eaufrance.fr/docs/dir-inondations/pgri/00_Projet_PGRI_volume1.pdf

In the absence of, or in complement to, prospective exposure and vulnerability analysis, data on the socio-economic impacts from past disasters can be highly instructive. Data on economic damages caused by past disasters are an essential building block of probabilistic vulnerability analysis. Evidence from a recent OECD survey on the costs of disasters (OECD, 2016d) shows that many OECD countries collect information on damages and losses from past disasters, but only few systematically register it in a central repository.

Switzerland stores data on economic disaster losses in a centralised data repository. In 1972 the Federal Institute for Forest, Snow and Landscape Research (WSL) was charged by the Federal Office for the Environment (FOEN) with the task of systematically recording both social and economic disaster losses in a central database. Starting out by collecting data on storms, the WSL now takes damage caused by floods, debris flows, landslides as well as rock falls into account. Damage resulting from other hazards, such as avalanches, snow pressure, earthquake, lightening, hail, windstorm and drought is not included in the database. The recording is based on newspaper articles for smaller events and official data from cantons and insurance companies for larger events. Economic damage records are relatively complete for the hazards listed above, particularly in regards to recorded insurance claims, facilitated by the mandatory natural hazard insurance for buildings and content.

While Austria and France do not currently have a centralised data collection system in place, information on the economic impact of major disasters tends to be collected in both countries in quite detail either prospectively or retroactively after a major disaster occurred. In the context of France and Austria the practice has focused on understanding major economic impacts with a view to preparing for a major event, whereas damages resulting from smaller scale events were perhaps viewed as less policy-relevant. In light of policy objectives agreed on in the context of the Sendai Framework for Disaster Risk Reduction, established practices for recording losses might change in the future.

Integrating the results of hazard assessments into land-use decisions

The integration of hazard maps into land-use planning is a core step in reducing the exposure of people and assets to hazards. Exposure is most effectively reduced or avoided through restrictions on land use development in hazard-prone areas or regulations on building design. However, scarcity of land for settlements, or a desire to increase densification to achieve higher economies of scale, have been factors in all three countries that contribute to tension between competing public policies for economic development and disaster risk reduction . It should be noted that in all three countries settlement in some exposed areas took place long before detailed hazard information became available. Such information can now guide the implementation of policies to reduce vulnerability through retrofitting measures, repairs and expansions.

As noted in the previous section, localised hazard information has been made available widely across OECD countries and in the case studies carried out for this report; countries have made concerted efforts to communicate this information widely through specific access friendly web platforms. Difficulties remain in translating hazard information into actual land-use planning and decisions. Where the use of hazard information for land-use decisions is not legally binding, such as in Austria, its integration depends on the final decision makers (such as government officials at the local level). Local interests can be particularly divided between a desire to safeguard the community and to support economic development.

The case studies have shown the integration of hazard information in land-use planning decisions has been most successful in high-risk areas, where construction bans have been issued and successfully enforced in countries like France (Box 1.8). Past disasters have confirmed that such measures reduced damages in those areas. However, countries like Switzerland, where the integration of hazard information in land use decisions is considered good practice, have in the meantime experienced a relatively higher accumulation of damage claims were filed in low hazard zones, where information about the hazard had been provided but no specific land-use requirement had previously been issued. This shows protection or more adapted regulations might have been overlooked in lower hazard zones.

Enforcing hazard informed land-use decisions has been a challenge throughout OECD countries. In the OECD survey on the financial management of flood risk (OECD, 2016e) only two countries (Estonia and Switzerland) of the responding 20 countries indicated that changes in land-use had led to a significant reduction in flood risk, while fourteen indicated that such changes had actually led to a substantial increase in flood risk. In Germany, for example, the increase in construction near rivers has outpaced the rate of construction outside flood zones, despite a 2004 law that

forbids building and commercial usage in such zones. In the United Kingdom, one third of the projected three million properties to be built by 2020 are expected to be located on coastal and river flood plains. In Italy, the effectiveness of strong legislative requirements for assessing flood hazard in new developments has been limited by gaps in compliance and a number of exemptions provided for properties that were constructed without regard to flood hazard levels (OECD, 2016e).

Box 1.8 Integrating land-use planning in hazard assessments in France

In France hazard mapping results in the development of so-called Prevention Plans against Natural Risks (PPRNs). The plans outline hazard zones for possible earthquakes, floods, avalanches, wildfires or landslides. To assess flood risk PPRNs do not take into account the existence of protective measures, such as dykes, so as to account for the eventuality that these structures may fail. The hazard maps are publicly accessible and the public as well as local authorities and other stakeholders are involved in the hazard mapping process.

The responsibility for risk and hazard mapping lies in the hands of deconcentrated arms of the Ministry of Ecology at departmental level (*directions départementale des Territoires* (DDT(M)), with support from the Regional Directorate for Environment, Planning and Housing (*Direction Régionale de l'Environnement, de l'Aménagement et du Logement*, DREAL) and (public) engineering bureaus.

The hazard maps are regularly included in land-use planning. The spatial development code obliges local authorities to take hazard maps into consideration for spatial planning documents, with the Risk Prevention Plan (PPR) as an annex. The Flood Risk Prevention Plans (PPRIs) go even farther and establish clearly designated areas where construction is not allowed, leaving no room for ambiguity. To ensure that hazard maps are included in land-use planning, inspections are carried out up to three years after constructions are completed. Penalties follow if hazards maps were ignored.

Mayors are in the driver's seat of enforcing hazard zones in land use decisions and they are in charge of granting building permits. The department prefect monitors the integration of hazard zones in urban planning decisions. In case of doubts about whether hazard zones were respected in granting a building permit the prefect can initiate a legal procedure against municipalities. Mayors can and have been found liable for ignoring hazard zones. Regions also have a monitoring role and can positively encourage the integration of hazard zones in local land-use decisions.

To show commitment in enforcing this responsibility, mayors can and have been made liable for ignoring hazard zones. For example the mayor of La Faute-sur-mer was condemned to four years in prison for involuntary homicide after more than 50 fatalities were caused by the Xynthia storm in 2010 and some of them directly linked to the granting of construction periods in known zones at risk[3]. The condemnation was a strong signal to local planning authorities and mayors to take the integration of hazard zones in their land use decisions seriously.

Source: OECD (2016b)

Resettlement out of hazard zones

In areas subject to recurrent and large disaster impacts, or areas that could usefully serve to mitigate disaster impacts (such as flood retention areas), resettlement has been used as a disaster risk prevention instrument. Many OECD members have established a legal framework and set-up policies to support resettling populations outside of designated hazard zones, although in some countries this measure has been applied rarely and only as a last resort. Figure 1.1 reflects this, with only 9 of 35 responding countries listing resettlement as a priority policy area in their disaster risk prevention strategies. Since relocations can entail social hardships, good practices in handling this

process can be informative for countries exploring or considering this option in the future. Box 1.9 describes a good practice of how Austrian authorities collaborated across levels of government in the process of a voluntary resettlement program that was organised around the Machland Dam project that saw the creation of a flood canal that expanded into settlement areas.

Box 1.9 Resettlement as a disaster risk prevention measure: the case of the Machland Dam in Austria

The Machland Dam is the biggest flood protective infrastructure work in Austria. The dam, constructed from 2008 to 2012, spans over 36.4 km to protect 22 400 inhabitants spread over 7 municipalities in the Machland region.

The project included the construction of an 8.7 km bypass, or flood canal, spreading from Naarn to Wallsee/Mitterkirchen that is meant to regulate small floods and constitute an element of the integrative flood risk management design of the project. It aims at protecting lives while re-establishing room for the river and preserving the environment. The creation of the flood canal also provided material (soil) for the dam construction.

The settlement structure in the flood-prone area, which was sparse and spread over a large area, made the protection against floods prohibitively expensive. It was therefore decided to offer citizens that were not going to be protected by the dam support to relocate. By 2015, 254 voluntary resettlement agreements for houses located in areas at risk of flooding were concluded, costing EUR 92 million in compensation payments. While resettlement began slowly, successive floods convinced the citizens to agree to move. The 2002 floods sparked a resettlement wave of 221 remaining properties.

Resettlement was successfully achieved because the conditions for citizens were relatively attractive in comparison to the status quo. Compensation for house owners was based on the replacement value of their houses as well as their demolition costs. The authorities provided 80% of the overall costs in compensation: the federal province paid 30% of total costs and the central level of government 50%. Property owners did not lose land titles of their initial belongings; however, land had to be re-dedicated to pasture land, revoking the possibility to construct on it. New lots for rebuilding houses were made available and were reserved in adjacent communities to protect relocated citizens from price hikes in land prices and to ensure that communities could be rebuilt in proximity.

Sources: http://www.machlanddamm.at*;* Oberösterreich Landesrechnungshof (2014), *LRH-Bericht, Initiativprüfung, Hochwasserschutz Machland Nord, LRH-100000-12/9-2014-LI.*

Risk Communication

Risk communication is a fundamental element of a sound risk management framework that seeks to reduce future losses and damages from disasters. Governments have a basic responsibility to engage with all actors in society, encouraging a whole-of-society approach, to notify them about their exposure to major hazards. Communicating risks effectively increases the awareness of households, businesses and communities about their exposure to risk and their vulnerabilities, and also informs them of what specific prevention, mitigation and preparation measures they could take. Such knowledge can also spur an informed debate on the need for public investment in prevention, mitigation and preparedness, and is thus a key element of good governance in risk management policy.

Even though risk communication and raising risk awareness has been the most important policy priority in terms of disaster risk prevention across OECD countries,

all three studied cases have struggled with persistently low levels of risk awareness among their citizens, especially in the absence of recent major disasters. For example, a regular survey carried out in the Rhône River basin shows risk awareness levels have decreased after the major flood events in 2003, when the DREAL Rhône-Alpes decided to launch regular risk awareness surveys. The surveys, conducted in 2006, 2009, 2013 and 2016, showed only 18% of the population in risk zones took measures to protect themselves in 2016, against 21% in 2009. The results have been low despite significant efforts of local authorities to communicate to the population about risk exposures and the measures people can take to protect themselves. In France, a DICRIM is a local risk communication tool that can be highlighted as an effort in this regard (Box 1.10). Switzerland has observed low risk awareness levels especially among those citizens that have never been exposed to a natural disaster. This is especially challenging with regard to earthquake risks, since the last major earthquake occurred a long time before the current generation of Swiss was born.

Box 1.10 DICRIM – Local community information document about major prevailing risks (France)

DICRIM, introduced in 1990 in France, obliges every community, under the responsibility of the mayor and his municipal council, to draw up an information document about the safety measures to take in the event of a potential threat. The document is tailored to the locally prevailing hazards and includes information on:

- Locally prevailing natural and technological risks
- Measures taken by the municipality to reduce risk exposure
- Safety measures to be taken in the event of an emergency or an alarm (for example behavioural measures, securing assets from areas at risk, mounting electricity and gas meters above a potential flooding level)
- A list of critical public infrastructures (including retirement homes, schools etc.)
- How land owners and those renting premises have to communicate about the safety measures stipulated in the DICRIM

The objective of the DICRIM is to raise awareness among citizens about local major risks to which they could be exposed to. The DICRIM should inform about the nature of the threats, their potential consequences and the measures citizens can take to protect themselves or reduce their exposure and potential damages. The DICRIM recognises that the local administrative boundaries may not reflect the right scale for analysing hazards and encourages inter-municipal hazard analysis, based on which local prescriptions can be developed.

Source: http://www.risquesmajeurs.fr/le-document-d%E2%80%99information-communal-sur-les-risques-majeurs-dicrim

Low risk awareness levels have translated to a relatively low take-up of disaster risk prevention measures among citizens and businesses. For example, 17% of survey respondents in the Rhône River basin thought that preventive measures would be ineffective in providing individual protection. For risk management authorities in the studied countries such results indicate the continued reliance of individuals and businesses on the government to provide protection, undermining their efforts of establishing a whole-of-society approach to disaster risk prevention management. In Switzerland, authorities fear for further repercussions that low risk awareness may have. Owing to Switzerland's direct democratic culture, the risk awareness of citizens also is a crucial factor influencing the amount of public resources allocated towards disaster risk prevention management.

In an attempt to boost the effectiveness of risk communication efforts, countries have partnered with the private sector. In Switzerland cantonal insurance providers have played an instrumental role in informing citizens about disaster risk prevention measures they can take. Some of them provide automated text messages about weather warnings or imminent disasters. In France, through its *Mission Risques Naturels*, partnerships and platforms have been established that facilitate exchanges between public authorities and private sector actors to discuss risk communication strategies and to jointly train actors responsible for risk communication (*Mission Risques Naturels*, 2015). Similarly, the Austrian Civil Protection Association is a private organisation with nine regional branches which informs the public about risks and self-protection measures (Box 1.11).

Box 1.11 The Austrian Civil Protection Association: private sector risk communication on behalf of the government

The Austrian Civil Protection Association is a collective term comprising ten associations – one federal organisation and nine regional offices –, whose mission is to inform the population about civil defence in Austria, particularly on protective measures in emergency situations. According to the association´s statutes of 1993, its mission is the following:

- To promote the idea of self-protection through events, presentations and the dissemination of information to the population
- To coordinate and collaborate with the regional offices
- To train and advise the population in matters of civil defence, collaboration with the responsible authorities and intervention organisations
- To prepare and assess proposals for the creation of regulations within the framework of civil protection
- To exchange experience with foreign civil protection organisations.
- The association is, unlike the fire brigade and rescue organisation, not active on an operational level, but one whose main task is to disseminate risk-related information to the population. The association acts, in this matter, on behalf of the Federal Ministry of the Interior and forwards all information on self-protection to the public through two different channels:
- General public information on civil protection
- Organisation of safety and security information centres (SIZ) at a local community level.

Sources: Ministry of Interior, Austria (2016), Information on Austria's Civil Protection Agency, www.bmi.gv.at/cms/BMI_Zivilschutz_en/national/civil/start.aspx; Austrian Civil Protection Association, www.zivilschutzverband.at/home.

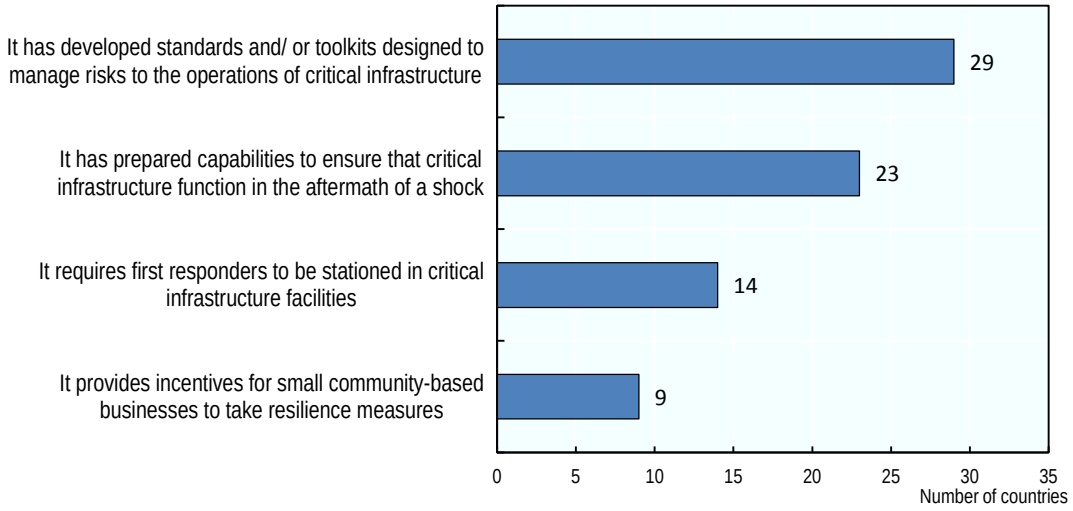
Policies to encourage businesses to take steps to ensure business continuity planning

Business continuity planning constitutes a key element to reduce the potential disruption of the supply of goods and services, especially in vital systems such as hospitals, water and energy, public security, transport and communications. The importance of business continuity for a country's resilience to disaster has been recognised in international policy guidance, including the OECD Recommendation on the Governance of Critical Risks (OECD, 2014b) and the UN Sendai Framework (UNISDR, 2015).

After a disaster, the economic recovery of a country or region may depend heavily on the continued productive capacities of such essential services. For public and private sector organisations alike, the first step in business continuity planning is to model the potential impacts and consequences of a hazard on the organisation's entire range of activities and identify its essential parts and functions as distinct from what can be discarded temporarily.

OECD countries have recognised the importance of business continuity plans, with governments providing strategic services, establishing standards or developing toolkits to manage risks. They also prepared capabilities to ensure the functioning of critical services in the aftermath of a disaster (Figure 1.3). However, there is little evidence yet available on the uptake and success in implementing these in practice. In Switzerland for example, the implementation of national guidelines is increasingly gaining speed. Although the Swiss "Guideline for the Protection of Critical Infrastructure" is not binding, economic associations and critical infrastructure providers increasingly apply it (Box 1.12).

Figure 1.3. Measures through which countries have encouraged the private sector to take steps in business continuity planning



Note: Total number of responses 32 out of 35.
Source: OECD Survey on the Governance of Critical Risks

Despite the high cost disasters can inflict on businesses, many businesses have remained unaware of the prevention and mitigation measures available to them. Governments have therefore increasingly undertaken efforts to include businesses in their disaster risk reduction efforts. In some countries, such as France, programmes specifically tailored for businesses have shown success in increasing their resilience. The business vulnerability reduction programme to floods in the Loire river basin combined targeted risk communication with detailed on-site risk analysis and led to an increase in risk awareness and in preventive measures taken. In the Rhône river basin specific measures to make agricultural activity flood resilient were promoted and introduced (Box 1.13).

Box 1.12 Encouraging business continuity planning: a good practice from Switzerland

Switzerland has recognised that there is a joint responsibility by the operator of the critical infrastructure and the public authority to take potential consequences of a critical infrastructure failure that are of importance for the general public into account.

To support the critical infrastructure owners and operators in this endeavour, the Swiss Federal Office for Civil Protection (FOCP) has issued a "Guideline for the Protection of Critical Infrastructure". It applies a holistic approach for dealing with relevant hazards and considers all conceivable disaster risk prevention and mitigation measures. In the risk assessment process, natural hazards as well as man-made hazards and technical failures are considered. A broad variety of measures are evaluated, ranging from organizational adjustments to structural-technical provisions. As absolute protection is not possible, nor feasible, proportionality of cost and benefits as well as a continued process of disaster risk prevention and mitigation measures are important.

The more likely a risk occurs and the larger its potential damage to the community, the more extensive and comprehensive should protective and mitigation measures be. The Guideline includes a monitoring and evaluation step in order to evaluate the success of the measures implemented.

As the Guideline is non-binding and the FOCP is not a regulatory agency, critical infrastructure operators are not obliged to apply the Guideline. More and more economic associations and specific critical infrastructure owners are however interested in the application of the Guideline.

Source: FOCP (2012). *Nationale Strategie zum Schutz kritischer Infrastrukturen* [National Strategy for the Protection of Critical Infrastructure], Federal Office for Civil Protection, Bern, www.admin.ch/opc/de/federal-gazette/2012/7715.pdf: http://www.babs.admin.ch/en/aufgabenbabs/ski.html.

Box 1.13 Reducing business vulnerability along the Loire and Rhône basins

The business vulnerability reduction programme to flood in the Loire river basin is a basin-wide initiative that aims to accompany businesses situated in flood zones in taking disaster risk reduction measures in order to reduce a flood's impacts on business activity. The programme included a risk communication campaign and a risk awareness survey that was directly aimed at businesses in the Loire river basin. As a second step, businesses located in flood risk zones were offered an on-site flood vulnerability diagnosis with subsequent suggestions on concrete disaster risk reduction measures. To ensure the uptake of the suggested measures, local authorities provided financial support through co-funding.

The programme resulted in more than 20 000 businesses learning about their flood risk exposure, around half of which had not been previously aware of their exposure. An analysis of the on-site risk assessments showed that potential cumulative damages from flooding could reach up to EUR 3.3 billion, while implementing the proposed disaster risk reduction measures would reduce the cost by one third.

Given the importance of agriculture in the Rhône River basin for securing livelihoods and the importance of agricultural land in providing flood retention areas, the Plan Rhône introduced a diagnostic instrument to assess farmer's vulnerability to floods and suggests preventative

measures for farms. In the first pilot phase the Regional Directorate for Environment, Planning and Housing (DREAL) Rhône-Alpes assessed around 230 farms. Following the assessment 85 farms decided to put prevention measures in place. Investments were co-financed at a maximum rate of 80%. Where necessary, new and more effective water pumps were installed, air conditioning was moved to higher ground and safe zones for important machinery were created. Finally, the DREAL Rhône-Alpes seeks to encourage farmers to put measures in place that avoid erosion (such as by planting grass).

Sources: OECD (2010), *Étude de l'OCDE sur la gestion des risques d'inondation: Bassin de la Loire, France 2010*, OECD Publishing, Paris.http://dx.doi.org/10.1787/9789264056817-en

Making disaster risk prevention work: the need for crossing jurisdictional and sectoral boundaries

Effective disaster risk prevention and mitigation management requires the involvement of local communities as much as that of central governments. As highlighted in the OECD Recommendation on the Governance of Critical Risks (OECD, 2014b), clear distribution of responsibilities and coordination across levels of government and with strong leadership at national level are key for effective risk governance. The Sendai Framework for Disaster Risk Reduction (UNISDR, 2015), too, draws attention to the need and value of overcoming silo approaches and single-handed solutions.

Disaster risks are not confined to jurisdictional or sectoral borders. The limits of traditional governance structures have shown to be incapable of addressing the complexities that arise from events that affect multiple municipalities, regions and industrial sectors. In Austria, for example, the responsibility for managing flood risks from navigable rivers, which are the Danube, March and parts of the Thaya, lies with the Federal Ministry of Transport, Innovation and Technology Management, whereas small rivers are in the hands of the Federal Ministry of Agriculture, Forestry, Environment and Water. Particular vulnerabilities have appeared at the intersection of smaller rivers flowing into large rivers, where specific integrated hazard assessments and joint disaster risk prevention measures are needed. In terms of local jurisdictions the issue is a similar one. The risks stemming from natural hazards, such as floods, are most often shared by more than one local jurisdiction. This can become an issue especially in countries with a high number of small municipalities. Tackling flood risk just from one jurisdiction's perspective is hardly an efficient approach for all affected communities. Governance structures need to recognise and reflect these cross-jurisdictional and cross-sectoral issues to ensure that disaster risk prevention and mitigation operates at the adequate scales and to avoid fragmented approaches that undermine, instead of complement, each other. In the case of shared river areas, where up- and down-stream interests need to be coordinated, cross-jurisdictional governance arrangements are particularly important.

Bridging sectoral divides

Different types of natural hazards require different sets of expertise to be adequately identified, assessed, prevented and responded to. Many countries have therefore assigned responsibilities across different sectors or ministries. Table 4 gives an overview of the authorities in charge for different types of natural hazards in the countries studied. In Switzerland, for example, the Federal Office for the Environment is in charge of managing early warning for hydrological hazards. For climate-related and meteorological hazards this becomes a shared responsibility between Environment, the Federal Office for Meteorology and Climatology, and the Swiss Federal Institute for Forest, Snow and Landscape Research. The Swiss Seismological Service is in charge of managing seismic risks.

Table 1.4 Distribution of risk management responsibilities across sectors (and levels of government)

	Civil protection	Hydrological hazards	Climate-related & meteorological hazards	Geological hazards	Policy implementation
Austria	Ministry of the Interior (BMI)	Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW); Federal Water Engineering Administration (BWV); Federal Ministry for Transport, Innovation and Technology (BMVIT)	Research Institute for Meteorology and Geodynamics (ZAMG)	Federal Service for Torrent and Avalanche Control (WLV); Research Institute for Meteorology and Geodynamics (ZAMG)	Sub-national branches of federal authorities (e.g. of WLV and BWV); Provincial governments; local governments/ municipalities
France	General Secretariat for defence and national security (SGDNS)	Ministry of Ecology, Sustainable Development and Energy (MEDDE) - Directorate General for Risk Prevention (DGPR); Joint Flood Commission (CMI);	Ministry of Ecology, Sustainable Development and Energy (MEDDE) - Directorate General for Risk Prevention (DGPR)	Ministry of Ecology, Sustainable Development and Energy (MEDDE) - Bureau for Geological Research and Mining (BRGM)	Prefectures & Departmental Commissions of Major Natural Hazards; Regional Directorates for Environment, Planning and Housing (DREALs); local governments/ municipalities
Switzerland	Federal Office for Civil Protection (FOCP)	Federal Office for the Environment (FOEN):	Federal Office for the Environment (FOEN); Federal Office for Meteorology and Climatology (MeteoSwiss); Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)	Federal Office for the Environment (FOEN); Swiss Seismological Service (SED)	Cantonal governments; local governments/ municipalities

Source: OECD Survey on the Governance of Critical Risks 2016; OECD, 2015; OECD, 2016a; OECD, 2016b

Cross-sectoral coordination and collaboration is important for several reasons. First of all, different sources of natural hazards interact with each other. One risk, such as for example earthquakes, can trigger risks of flooding or mudslides. A joint approach is needed to map knock-on effects and cascading risks, and design disaster risk prevention provisions accordingly. Second, heavy precipitation, for example, can lead to the flooding of both small and large rivers. A joint approach to managing such cascading risks is addressed in Austria with the help of the National Flood Risk Management Plan, which assesses risks at the basin level regardless of competences. Third, resources to manage risks are finite. Prioritisation in terms of the allocation of resources does not only have to be made within a specific sector, but also across different sectors in charge of managing different risks. This requires a coordinated

approach and a central government lead to steer the cross-sectoral allocation decision process.

In the three case study countries is an increasing recognition and concrete actions taken to manage policies across sectors in charge of different hazard types:

The Swiss National Platform for Natural Hazards (PLANAT)

The National Platform for Natural Hazards (PLANAT) in Switzerland is a good practice example in creating a multi-stakeholder platform to coordinate a cross-sectoral approach to managing disaster risks. PLANAT was founded as an extra-parliamentary commission to improve disaster risk prevention across Switzerland. It brings together representatives from the federal government, cantonal governments, the research community, professional associations, the private sector and insurance companies to work on strategic priorities in risk management, to introduce and foster a culture of risk that integrates ecological, social and economic aspects in disaster risk prevention management, and to coordinate disaster risk prevention efforts in Switzerland to avoid duplication and increase synergies between the different actors' activities. PLANAT's core objective is to ensure that the management of risks remains present in political and public discussions. The composition of PLANAT with members from the different national and sub-national agencies, but also research and insurers and other private sector actors has been important to achieve this.

The Austrian Spatial Planning Conference (ÖROK)

In Austria, the Austrian Spatial Planning Conference (ÖROK) has proved to be a useful platform for coordinating risk management across sectoral responsibilities, as well as levels of government. Founded in 1971, ÖROK was established by the federal government, the provinces and municipalities to co-ordinate spatial development at the national level. ÖROK is in charge of developing and publishing an Austrian spatial planning concept, last published in 2011, which represents a nationwide spatial planning strategy. The body is chaired by the Federal Chancellor and its members include all federal ministers and heads of the provinces, the presidents of the Austrian Association of Cities and Towns and the Austrian Association of Municipalities, and the heads of the social and economic partners that have a consulting vote. ÖROK plays an instrumental role in bringing all interest groups together to discuss how disaster risk prevention policies and actions can be better integrated into spatial planning decisions, building codes and other legal frameworks. As many of the past damages of floods have been attributed to weaknesses in enforcing disaster risk prevention measures in spatial planning practice, ÖROK plays a key role in increasing Austria's disaster risk management capacity by providing a platform for stakeholder dialogue and establishing key policy recommendations.

Bridging jurisdictional divides

The impacts of disasters are rarely confined to municipal borders and may not stop at regional or country borders. Therefore, governance structures should ensure that disaster risk management operates at the appropriate scale. Inter-communal collaboration is needed, especially for the development of joint spatial planning strategies for shared river areas and the development of compensation mechanisms between municipalities that pay for protection measures and others that may benefit or

have additional costs. Collaboration methods include a range of partnerships, from establishing informal discussion fora and exchanging hazard information, to coordinating land-use planning activities or implementing joint protection measures.

A government's funding policies can influence the interest of local governments to cooperate across its jurisdictional borders. Austria's governance system for structural measures, as seen above, is organised around provincial service branches that are a deconcentrated arm of central service units (the case of the WLV and the BWV), which require local municipalities to request funding for projects. This governance structure may risk overlooking cross-jurisdictional risks and investment needs. In an attempt to address these issues Austria is increasingly using catchment-wide planning approaches, facilitated by the National Flood Risk Management Plan. Municipalities may have a stronger incentive to obtain the maximum amount of funding for their own projects, and investment by one municipality may create benefits (or costs) for others that could lead to an under-investment in protection. Aside from protection, potential environmental conflicts and potential synergies have to be considered flood risk management. Conflicts between up- and down-stream river communities can arise where retention zones developed by upstream municipalities created benefits for downstream municipalities who refuse to participate in the costs.

To address this geographical fragmentation problems, governments can change the way projects are financed, for example by rewarding joint project proposals with higher central level funding shares, and by regulating the way local risk assessments, prevention and preparedness measures are conducted and implemented. In Austria, the example of water boards (Box 4) is one that takes this direction and can be highlighted as a good country practice. Water boards are statutory can be composed of any number and combination of individuals, municipalities or companies, which together contribute financially to a common fund that finances the construction and maintenance of structural disaster risk reduction measures. Water boards have been rewarded with higher central-level co-funding and sometimes expedited processing of their co-funding request by the central government too. They have thereby been rewarded for working across jurisdictions and ensuring the appropriate scale for disaster risk prevention measures.

The subsidiarity arrangements in Switzerland are designed in a way that they ensure that disaster risk reduction measures are implemented on a functional level. To ensure coordination across administrative borders of cantons, cantonal authorities need to submit their proposals for protective infrastructure investments to the national level. Based on the degree of collaboration across cantons, different coordination models are used, where either both (or several) or just one canton takes the lead in the implementation process. Accordingly, co-financing arrangements are made. In case of differences between the cantons, the federal government acts as a mediator. When a protective measure is installed upstream, it needs to be proved that it does not worsen the situation further downstream.

Another emerging good country practice that illustrates the growing recognition of the importance of managing risks at the appropriate geographical or functional level can be found in France. The currently debated GEMAPI (the management of aquatic environments and flood risk prevention) law should equip France's existing inter-municipal collaborative bodies (EPCIs) with a strong role in flood risk management, which will include a responsibility for maintaining and building new structural

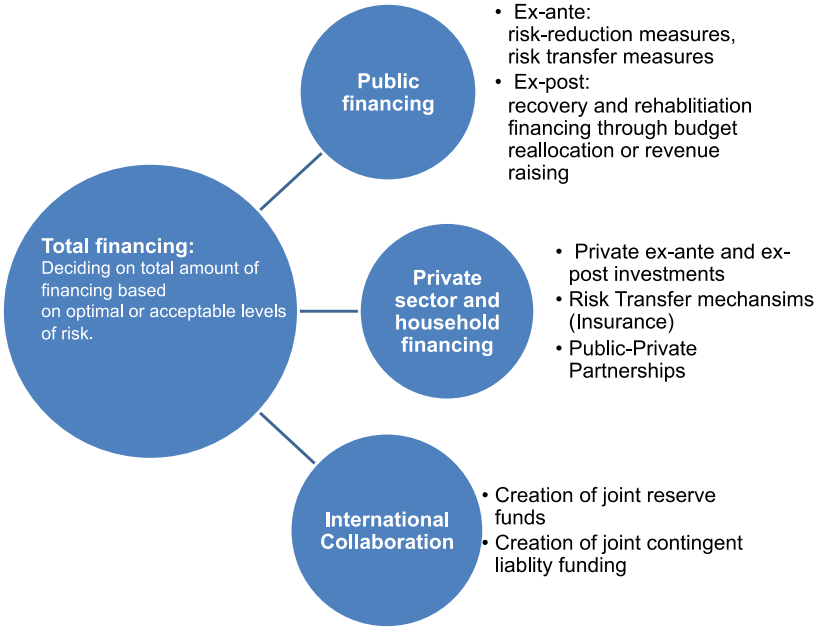
measures in the EPCI's shared area, as well as a transfer of ownership of existing protective measures. To fund their activities, EPCIs will have the right to raise local taxes. EPCIs with local flood risk prevention plans (PAPI and PPR) also qualify for prevention funding through the *Fonds Barnier*[4]. Currently, shared Flood Prevention Action Programs (PAPIs and PSRs) are already in place to encourage joint flood risk management across municipalities that are grouped in the same risk area. As an additional layer of cross-jurisdictional cooperation between all relevant actors from along a shared river river plans have been adopted for all major river systems, including for the Rhône (*Plan Rhône*), supported by consolidated financing for joint projects.

The cooperation in the Natural Hazards Platform of the Alpine Convention (PLANALP), established in 2004 by the Alpine Convention[5], is a good example for ensuring trans-boundary risk management across multiple countries. In PLANALP eight countries[6], including Austria, France and Switzerland, as well as the European Union, work together to develop joint approaches to prevent natural hazards in the shared Alpine area. Through cross-border exchange of experiences PLANALP facilitates a coordinated and appropriate risk management across the Alps. To make sure that PLANALP is more than a 'toothless tiger', the participating parties mandated the platform to implement subsequent measures, including flood (risk) management plans. Other examples for good transboundary risk management include joint measures, such the European Flood Awareness System (EFAS). Since 2012, EFAS is fully operational and provides probabilistic, flood early warning information up to 10 days in advance to the participating National Hydrological Services.

Financing disaster risk prevention and mitigation

The OECD Recommendation stresses that governments should allocate sufficient resources throughout the risk management cycle and at all levels of government to build preparedness and reduce risks. Disruptions from disasters have an impact on individual households, businesses, and the public sector alike. Therefore, all actors should have an interest in investing in disaster risk prevention and mitigation. Governments across OECD countries face three main challenges when it comes to designing their approach to risk financing. The first entails determining the overall amount of resources to be allocated to managing risks, and what risks they choose to retain. The second constitutes the choice of how to finance risks, whereby a myriad of instruments are at the disposal of governments and each entails different distributional effects. The third is that in order to alleviate the financial burden on governments, countries need to leverage the private sector and individual households to participate in financing disaster risk prevention and mitigation measures or investing in individual risk transfer arrangements. They also need to collaborate with other countries to jointly finance risks (Figure 1.4). The recently adopted OECD Recommendation on Disaster Risk Financing Strategies (2017) provides guidance to governments on how to design a strategy for managing the financial impacts of disasters, including by leveraging the contribution of insurance and other risk transfer instruments.

Figure 1.4. Available risk financing tools



Source: OECD (2014a)

Solidarity has been a key guiding principle when it comes to financing investments in disaster risk reduction in the three countries studied. Recognising that risk exposure is unevenly distributed, they share the financial burden of disaster risk reduction ensures that a more equal level of protection against natural hazards is achieved throughout their national territory. Among the insightful examples and lessons on how solidarity can be built into disaster risk prevention financing schemes are the following:

In France, risk financing builds on the natural catastrophes compensation scheme CATNAT (*Catastrophes Naturelles*) and the Fonds Barnier. It is sourced from an obligatory insurance contribution made by all holders of household, business and motor vehicle insurance policies and serves a double purpose. On the one hand it provides funds for compensating damages suffered from natural disasters to individual households and businesses, while on the other hand a share of its funds is reserved and used for disaster risk prevention investments under the Fund for the Prevention of Major Natural Hazards (*Fonds de Prévention des Risques Naturels Majeurs*), or "Fonds Barnier". 12% of the total premiums collected are invested in the Fonds Barnier. This corresponds to EUR 185 million per year.

In Austria, the KatFonds (*Katastrophenfonds* - Catastrophe Fund) is similar in that it is also a reserve fund used to finance ex-ante disaster risk prevention investments and preparedness measures, as well as to provide post-disaster assistance. Contrary to the CATNAT in France, the KatFonds is financed by 1.1% of the total federal tax income, including income, wage and corporate taxes. Since 2010, an additional EUR 10 million is added annually from income tax receipts, which has been

earmarked for state roads repairs. Three quarters of the available funding are allocated to the Federal Ministry of Agriculture, Forestry, Environment and Water and the Federal Ministry for Transport, Innovation and Technology for disaster risk prevention investments. The remaining funds are used to finance preparedness measures and for compensating losses incurred by households and businesses in the event of a disaster. At the federal level, on average EUR 250 million are spent annually on disaster risk prevention measures. So far, investments in prevention and mitigation measures have been sufficient to balance risk exposure, but if not increased soon the financing is expected to lag behind a growing municipal demand and need for protection against risks.

In Switzerland, the responsibility for financing disaster risk prevention has been shared across levels of government. The federal government bears at least 35% of the cost of disaster risk reduction measures. The cantons provide the same share, and the remainder is borne by the affected municipalities and beneficiaries. The budget for disaster risk prevention is positively correlated, given certain procedural delays in the budgeting process, to the occurrence of significant disaster events. The actual annual allocation for disaster risk prevention funding fluctuates in Switzerland, and responds strongly to the occurrence of significant disaster events. This is perhaps explained by the direct democratic elements built into the Swiss budgeting process and hence reflects the short term memory of citizens alike when major disasters occur. Studies have shown that in 2007, for example, the national government spent some EUR 450 million on prevention measures. It is expected that funding will become tighter in the coming years, given an increase in protective infrastructure investments and a potential central level funding requirement for maintenance costs.

Table 1.5 Annual federal spending on natural disaster risk prevention and mitigation

	Austria	France	Switzerland
Annual estimated average in million EUR	250	185	450

Source: OECD (2015); OECD (2016a); OECD (2016b)

The central governments are not the only source of financing disaster risk prevention measures. Sub-national governments that require such investments are co-financing them in all studied countries:

In France, an estimated 60% are paid by sub-national authorities for disaster risk prevention investments. Between 30 and 40% are shouldered by the central government. In Austria, the usual co-financing share from the central level is 50%, 20% are borne by the provinces and 30% by the local governments. In Switzerland, the national average co-funding share is at least 35%, but can be as high as 45% if investment projects show to embrace good risk management principles (such as considering participatory planning). Before 2008, central co-funding for disaster risk prevention took the relative income level of cantons into consideration, but this is no longer practiced given the new equalisation mechanisms that are built into national budget redistribution processes. Different to Austria and France, Switzerland's central government provides disaster risk prevention funding on a programmatic, 4-year basis,

with the exception of large investment projects (above CHF 5 million), which require a separate funding approval process.

Table 1.6 Disaster risk prevention financing: average co-funding across levels of government

% of risk prevention funding provided by…	Austria	France	Switzerland
… the central government	50	40	35-45
… the sub-national government (i.e. provinces)	20	60	30-40
… the local government (i.e. municipalities)	30	60	15-30

Source: OECD (2015); OECD (2016a); OECD (2016b)

What can households and businesses expect in terms of damage compensation by the government in the event of a disaster?

The OECD Recommendation on Disaster Risk Financing Strategies (OECD, 2017) suggests developing public compensation and financial assistance arrangements that are coordinated across levels of government and that provide timely, targeted, transparent and equitable assistance for uninsurable losses to vulnerable segments of the population and/or economy and financial transfer mechanisms to provide support to sub-national levels of government facing fiscal constraints, with the aim of minimising economic disruptions and facilitating a stable supply of financing to the economy. In complement to this, the OECD Recommendation on the Governance of Critical Risks (OECD, 2014) emphasises the need for governments to promote a whole-of-society approach to risk management. Such an approach ensures the risk management efforts of the government are strengthened, instead of undermined, by contributions of non-governmental stakeholders such as households and business. The design of government compensation of losses and damages incurred by businesses or households during a natural disaster is a crucial determinant for the level of private contributions to self-protection. The case studies show practices that are not everywhere ideal in fostering the participation of non-governmental actors in disaster risk prevention and mitigation.

Ambiguity in the amount of compensation provided by the government is not effective in terms of encouraging self-protection investments by recipients of potential government compensation. In Austria there is no legal entitlement to receive government compensation in the event of a disaster, which is paid out of the *Katfonds*. Studies show that the average compensation rates vary between 20 and 100% of losses incurred by households or businesses during a natural disaster. Some individuals can be fully compensated at times, where others can be left with significant costs to repair damage they suffered. No clear compensation rules are applied. Compensation paid out by the *Katfonds* is complemented by payments made by provinces and local jurisdictions. Varying approaches to compensation by provinces and local jurisdictions, and variations between national compensation rates for different events, lead to significant uncertainty about expected compensation.

In France, despite the existence of an insurance scheme through the CATNAT, damage compensation is not always 100%. For example, the 2003 floods of the Rhône have shown that only half of the damages incurred by individual households were

compensated by the state. The average compensation rates in France are estimated to be 60-80%. A significant amount of costs are incurred by temporary relocation of households, which are not covered by insurance. However, financial assistance for such expenses is often provided by local authorities.

In Switzerland, natural hazard insurance for buildings and content is linked to fire insurance and broadly acquired. In 19 cantons, building insurance is provided by cantonal monopoly insurers, which are public, non-profit companies. In the remaining seven cantons natural hazard insurance for buildings is provided by private insurance companies. Insurance must be provided for all buildings in a canton, regardless of their risk exposure. Coverage for building insurance is similar across the country and premium tariffs are affordable. In all but four cantons building insurance is mandatory. Deductibles can vary between 10% and 15% of damage, with a minimum of CHF 200 and a maximum of CHF 2000 per year. Finally, Switzerland created a fund for natural hazard damages that cannot be insured, which, in short, is called the elementary damage fund. It was founded by the Swiss Communal Society (*Schweizerische Gemeinnützige Gesellschaft*) and is funded by taxes and insurance premiums. The fund provides support for damages from natural hazards such as storms or floods that were not predictable or insurable.

Table 1.7 Average estimated damage compensation rates for individual households and businesses

	Switzerland	Austria	France
Federal damage compensation rates for individuals and businesses (including insurance)	85%-90% (cantonal insurance)	Variable (12% on average) (government compensation)[1]	60%-80% on average (insurance)
Sub-national complements	No	Yes (Amount undefined, average of 18%) (government compensation)	Yes (amount undefined)
Other insurance compensation	None	Less than 10% (based on sum insured)[2]	None

Sources: http://www.oecd.org/daf/fin/insurance/OECD-Conference-financial-management-flood-risk-presentation-session-5.pdf; http://www.vvo.at/vvo/vvo.nsf/sysPages/xFFDA3422FD062B89C1257FA200413B58/$file/VVO_JB_2015_220x280_WEB_Cover_Datenteil_Einzelseiten.pdf

There are several shortcomings in the funding schemes found in France and in Austria. The premium paid by insurance holders (12% of household and business insurance and 6% of motor vehicle insurance) in France is not adjusted to households' or businesses' actual risk exposure. It thereby discourages insured stakeholders to reduce their exposure or vulnerability to natural hazards by self-protection measures such as securing cellars or house walls against floods. In Austria, the *Katfonds*' funding through a fixed percentage of tax income earned by the government makes it disconnected from the levels of exposure of affected people as well. The ex-post compensation of losses, even if not clearly determined, provided through the *Katfonds* may act discouraging towards disaster risk prevention investments by households and businesses as well. Since the *Katfonds* compensation for businesses and individuals is channelled through local authorities, it is difficult to understand the actual level of

compensation individuals receive and hence the efficacy of the instrument remains difficult to evaluate.

Swiss insurance authorities are conscious of the potential moral hazard risk that arises when insured clients rely on insurance pay-outs instead of investing in disaster risk prevention prior to a disaster. Therefore, insurance companies have been actively engaged in not only informing citizens about their individual responsibility in terms of adapting their behaviour in the event of a disaster, and in terms of investing in self-protection measures, but enforcing it when providing eventual pay-outs for damage compensation. For example, if expected disaster risk reduction measures were not installed, the provider would decrease the pay-out amounts.

Conclusion

This report's cross country investigation demonstrates that there is a wide recognition of the need to strengthen disaster risk prevention and mitigation efforts to boost countries' resilience against disasters. While the investment in structural disaster risk prevention and mitigation may have been the focus of countries' policies earlier on, a marked shift can be observed towards emphasising non-structural or organisational disaster risk prevention and mitigation. This has included:

- A country-wide coverage with high-quality, and publicly accessible hazard information to inform disaster risk prevention investments and disaster preparedness measures
- A recognition of the need to strengthen the integration of hazard assessments in land-use plans and decisions
- A continued focus on communicating risks to raise awareness, tapping into various channels including through the integration in standard education curricula
- An acknowledgement of the importance of business continuity planning to determine a society's ability to bounce back to normal and regain function after a disaster
- A policy discussion that spans beyond a country's sectoral responsibilities as well as beyond jurisdictional and country borders, to capture the functional area that a disaster may impact and the triggers of knock-on effects it may send across the globe
- An awareness that government financial assistance for post disaster needs has an influence on preventative action across society and levels of government

This report documents how countries have advanced in all of the above disaster risk prevention focus areas, and highlights areas where further progress could be made in the future.

Countries' focus on non-structural prevention measures is welcome and important. It demonstrates awareness by governments that disaster losses can be significantly reduced by measures that have relatively high risk reduction returns. Many of the non-structural measures discussed in this chapter require a re-focus in policies and how they are implemented and do not necessarily have a significant direct cost for governments. However, in assessing these measures, it needs to be acknowledged that substantial indirect costs may be shifted on to sub-national levels of government and non-governmental actors. Even though the sharing of costs is an effective step towards establishing a whole-of-government and a whole-of-society

approach to disaster risk prevention, such policy shifts need to acknowledge the consequences this may have in terms of the level and quality of the implementation of disaster risk prevention measures.

In the process of shifting policy priorities, however, countries may have overlooked the continued, and perhaps in some areas growing need, for investing in structural protection. Even though a significant stock of protective infrastructure has been accumulated in all studied countries, this is an insufficient determinant for how much, in what form, and where this might be needed in the future. Risk patterns are changing. On the one hand socio-economic dynamics have shifted, often favouring concentration in some places at the expense of others. On the other hand environmental conditions are deteriorating and factors like climate change are expected to contribute to future changing risk patterns. These are important factors that require a shift in how structural protection is managed. In addition, the legacy of structural investments has become a liability at times, where failing maintenance and rehabilitation have exacerbated the losses suffered during a natural disaster, instead of reducing them. Countries will be confronted with managing both the stock of historical investments in protection, as well as carefully evaluating the need of allocating resources towards future new infrastructure investments.

Notes

[1] More information about the EconoMe 4.0 Platform: https://econome.ch/eco_work/index.php

[2] See website: http://nld.usace.army.mil/egis/f?p=471:1

[3] www.lemonde.fr/planete/article/2014/12/12/xynthia-l-ancien-maire-de-la-faute-sur-mer-condamne-a-quatre-ans-de-prison-ferme_4539436_3244.html

[4] Fund for the Prevention of Major Natural Risks (*Fonds de Prévention des Risques Naturels Majeurs*, FPRNM or short, *Fonds Barnier)*

[5] The Alpine Convention is an international treaty between Alpine countries (Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland) as well as the EU that sets out to ensure the protection of the Alps and stresses the high value of sustainable development of the Alpine region. (http://www.alpconv.org/en/convention/default.html).

[6] Austria, Italy, France, Switzerland, Germany, Slovenia, Liechtenstein and Monaco

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