

Chapter 3

Boosting resilience through innovative risk governance: the case of the Rhône river in France

This chapter summarises France's progress in bolstering resilience against natural disasters through innovative risk governance across the Rhône River Basin. Due to the basin's large size, natural hazards include river and coastal floods, but also torrents, storms and earthquakes. The chapter shows that a major Rhône flood is considered a critical risk for France, given the basin's size and economic importance. The chapter explains that recent floods have sparked a number of disaster risk prevention reforms, emphasising the need for a basin-wide approach, as well as giving local communities an important role in engaging in local risk management. It is shown that during reform processes it is key to dedicate adequate financial and technical competences to those with new disaster risk prevention responsibilities. Finally, the chapter emphasises the large untapped potential of a whole-of-society approach to risk management, where clear roles are assigned and risks are effectively communicated to all stakeholders.

Summary

The Rhône River basin is one of France's largest river systems. Due to its size it covers a wide range of different topographies and diverse climatic conditions. These subject the areas around the river to a variety of natural hazards, including river and coastal floods, torrents and sediment movements, storms and storm surges, but also earthquakes are a potential threat.

The socio-economic vulnerability of the Rhône River basin against major disaster events is high. The basin area accounts for a major share of France's energy production. Around 5.5 million basin inhabitants are potentially exposed to the risk of flooding. Critical infrastructure and industrial sectors located in close proximity to the river render a potential flood a critical risk for France. The last large-scale floods of 2003 caused an estimated EUR 1 billion in damages.

Key findings

The Rhône's flood risk prevention management has a long history, with some of its major structures established as early as 1856, in response to devastating floods. Although flooding and related events have been relatively frequent along the Rhône, a large-scale flood comparable to the one of 1856 has not occurred in the recent past. This makes it important to assess whether current disaster risk prevention levels are sufficient to confront similar events that are expected to take place in the future.

A number of governance reforms have been implemented to improve disaster risk prevention management. In response to the devastating 2003 floods in the Rhône River basin, a basin prefect has taken the role of coordination of all basin level activities. Strategic frameworks like the Plan Rhône or the Plan Gestion des Risques d'Inondation have provided an important basis for achieving a better basin-wide flood risk prevention management. At the national level reforms have been underway to strengthen local level responsibilities in risk management. It is therefore a good moment to assess the progress and challenges in disaster risk prevention management in the Rhône River basin.

Key recommendations

Improve the evidence base on the potential occurrence and on the costs of disasters

- Harmonise hazard evaluation criteria and maps across the basin area, across different local jurisdictions so as to ensure effectiveness and efficiency when deciding on disaster risk reduction investments. To further improve the understanding of the type and scale of potential disaster events, it could be useful to more systematically assess the concomitance of different disaster types as well as the impact of potential disasters on the basin's critical infrastructures.
- To inform policy making for disaster risk prevention in the Rhône River basin, a more systematic accounting of social and economic losses of past disasters is needed. This evidence does not only help in identifying potential disaster hot spots, but they also inform the refinement of hazard models over time and give policy

makers an understanding of whether their disaster risk reduction measures are effective in reducing losses from disasters over time.

Strengthen risk governance mechanisms

- Ensure clear lines of responsibilities between national and sub-national actors and enhance ownership and accountability for disaster risk prevention.
- To implement ongoing territorial reforms effectively, it is important to build technical capacity and ensure financial resources to carry out new responsibilities.
- Consider the establishment of a basin-level authority for stronger coordination and integration of disaster risk prevention efforts.

Continue to foster an integrated approach between structural and non-structural measures.

- Clarify and consistently apply central-level prioritisation for co-financing local disaster risk prevention investments. This will become more important as funding requests are expected to increase, without central funding necessarily being adjusted.
- Strengthen the quality of maintenance of protective infrastructure across the basin area. Ensure that current reforms do not stop at clarifying ownership and maintenance responsibilities of protective infrastructure, but that they provide the necessary technical capacity building measures and financial solutions.

Embrace a whole-of-society approach to disaster risk prevention and mitigation

- Increase the investments in self-protection by private stakeholders, such as households and businesses. Consider setting financial incentives, such as tax credits or subsidies, to encourage such investment efforts.
- Boost risk awareness measures in a way that informs stakeholders about the value and effectiveness of investing in individual self-protection measures.
- Systematically collect evidence on the degree of vulnerability of private assets. Engage critical infrastructure operators in regularly assessing their vulnerabilities.

Design smart disaster risk financing mechanisms

- Increase clarity and transparency about ex-post loss compensations, not only by the central fund, but also for the co-payments made by provincial and local governments.
- Address the financing gap for maintenance and rehabilitation works of existing protective infrastructures.
- Consider the establishment of “joint maintenance bodies” that work across jurisdictions and that are co-financed by different municipalities and potentially higher levels of government.

Introduction

The Rhône River basin¹ is the largest river system in France. It covers a wide range of topographies making it subject to important flood risks, but also risks from coastal flooding, torrents, sediment movements, storms and storm surges. Earthquakes are an additional risk in the region of Provence-Alpes-Côte d'Azur.

The Rhône River basin accounts for a significant share of France's economy, which has been facilitated by the river's multiple uses: as a key navigation route, as a key source of irrigation for its large agricultural industry, but also by supporting an important share of France's hydro and nuclear power production. The socio-economic importance of the Rhône River basin makes a potential large-scale flood a critical risk for France, similar to a major flood of the Seine River in Paris or a significant earthquake in the Provence-Alpes-Côte d'Azur region.

Although flooding and related events have been relatively frequent along the Rhône a large-scale flood comparable to the one of 1856 has not happened in the recent past. The equally large-scale floods of 2003 were geographically more limited, but nonetheless highlighted the challenges accompanying Rhône River floods once more. This makes it important to assess whether current disaster risk prevention engagements are sufficient to confront similar events in the future.

The Rhône River's flood risk prevention management has a long history with some of its major structures established as early as 1856, in response to the devastating floods. Given the large territory of the Rhône, its many actors with often very different legacies, flood risk prevention levels are heterogeneous throughout the basin area. The floods in 2003 made some of this apparent as important protective infrastructure gave in to the floods and contributed to devastating damages mounting to over EUR 1 billion. These floods were a wake-up call and led affected regions to establish a more formal collaboration to jointly work on reducing existing vulnerabilities. A basin prefect should from then on take the role of coordination of all basin level activities. Strategic frameworks like the *Plan Rhône* or the *Plan Gestion des Risques d'Inondation* have provided an important basis for achieving a better basin-wide flood risk prevention management.

The present case study report assesses the progress, achievements and potential challenges of the Rhône River's disaster risk prevention system, with a particular emphasis on its institutional design. The latter plays a significant role in facilitating or hampering the effective engagement and investments of governmental and non-governmental stakeholders in disaster risk prevention and mitigation. For example, the decision of an individual household not to invest in protecting their own home may be the result of an expectation about the government doing so for them. A local government decision not to invest in a protective measure may be the result of neighbouring jurisdictions potentially freeriding on them. On the central government level, for example, actors may be reluctant to invest more in disaster risk prevention and mitigation, because ex-ante investments are not visible for their electorate and hence individual rewards too low.

This report is part of an OECD cross-country comparative study that assesses and compares disaster risk prevention and mitigation systems across a set of OECD countries. The objective of the analysis is to monitor the progress in countries' disaster risk prevention policies, to identify good practices as well as challenges that may persist and that may impede a whole-of-society approach to disaster risk prevention and mitigation, bringing both governmental and non-governmental actors together. The case study of France's Rhône River informs this comparative analysis.

The following case study report will first provide an overview of the Rhône River's hazard landscape as well as its socio-economic relevance (Section II). This will inform the remainder of the document, where France's and the Rhône River's core disaster risk prevention institutions, actors and their financial set-up will be reviewed to analyse whether roles and responsibilities as well as incentives are aligned to ensure each actor's expected contribution to a whole-of-society approach to disaster risk prevention. Section III will provide an overview of the principal legal frameworks and responsibilities and Section IV and V will look at how this plays out in the actual disaster risk prevention implementation processes.

Hazard sources and risk exposure of the Rhône river basin area

Section Highlights

- The Rhône River basin, the largest river system in France, has a varied topography and diverse climate making it subject to hazards such as (coastal) flooding, torrents and sediment movements, storms and storm surges and earthquakes.
- On average, the region experiences three floods a year; the largest recent floods were those of 2014, 2010 and 2002, with floods rarely affecting the entire basin area; the floods of 2003 that occurred in Valence, downstream of Lyon caused damages worth more than EUR 1 billion.
- The Rhône River basin accounts for a major share of France's economy, with two thirds of hydropower supply and one fourth of nuclear power produced there.
- A major flood of the Rhône River basin and a major earthquake in the region of Provence-Alpes-Côte d'Azur constitute two critical risks that France could be confronted with, similar to a large-scale flood of the Seine River in the Paris region.
- 5.5 million basin inhabitants are potentially threatened by floods, with a significant exposure of critical infrastructure and the industrial sectors in close proximity to the river; 6 of the 16 identified areas of high flood risk that are of national importance are located in the basin of the Rhône.

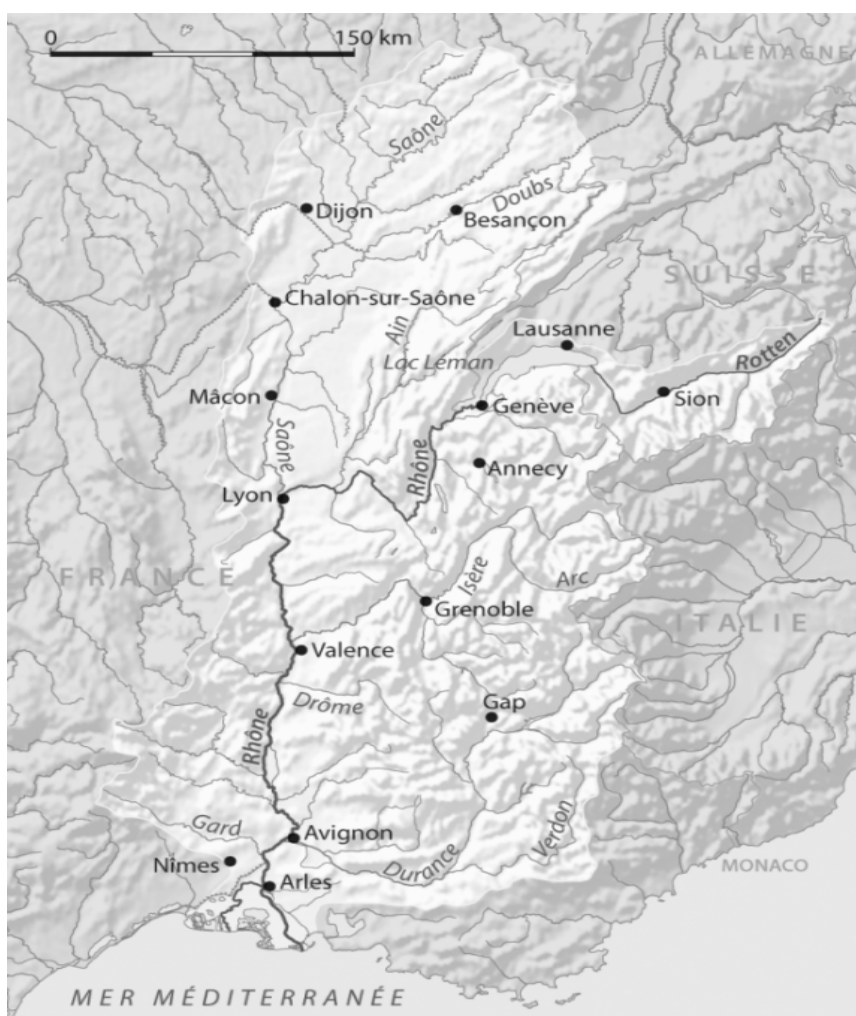
Hazard sources

France's topography is one of the most varied in Europe. It ranges from sea landscapes of the Atlantic and the Mediterranean over hilly landscapes in Brittany and Normandy to Europe's highest elevations, such as the Mont Blanc. A number of mountain ranges cover the country, including the Ardennes Plateau in the northeast, the Vosges, the Alps and the Jura Mountains towards the east of the country and the Pyrenees in the south. The Massif Central, topped by extinct volcanoes, occupies the south-central

area. At the centre of France is the Paris basin. It occupies one of France's main river systems, the Seine. Besides the Seine, the Rhône, the Loire, the Rhine and the Garonne are major river systems in France.

The Rhône is one of France's major river systems. It extends over 813 kilometres and its major tributary, the Saône, over 480 kilometres. The Rhône basin covers an area of 96 500 km². It provides a pass way (Figure 3.1) from the Paris basin and eastern France to the Mediterranean (Bravard and Clémens, 2008).

Figure 3.1 The Rhône river basin

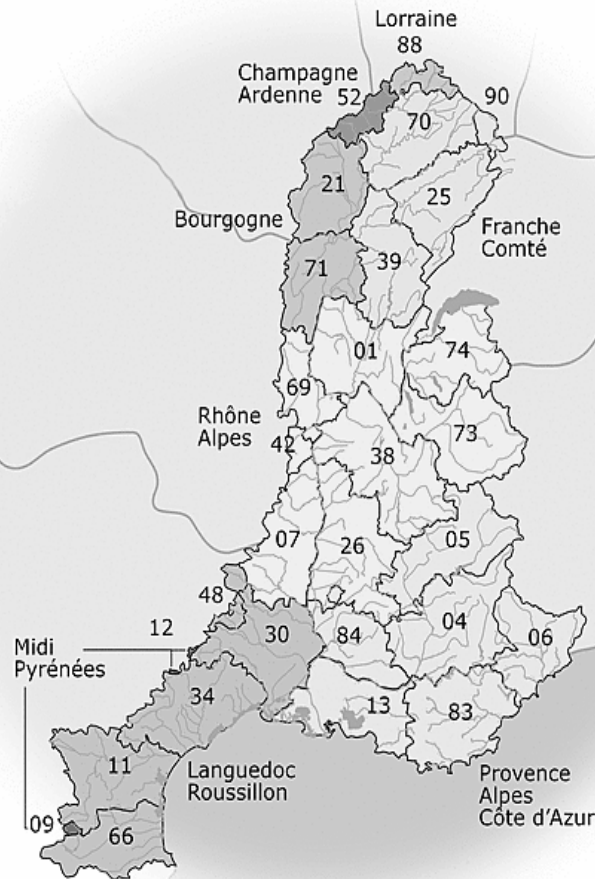


Source: GTOPO-30 Elevation Data by USGS via Wikimedia Commons:
https://commons.wikimedia.org/wiki/File:Rhone_bassin_versant.png#/media/File:Rhone_bassin_versant.png

The Rhône river basin (also referred to as the *Rhône-Méditerranée* basin) is located in the southeast of France, encompassing 5 of France's 22 Metropolitan² regions and 25 departments (Figure 3.2). Prior to the territorial reform (see Box 3.4) implemented in

January 2016, the regions were Burgundy, Franche-Comté, Rhône-Alpes, Languedoc-Roussillon and Provence-Alpes-Côte d'Azur (PACA). Since January 2016 the regions surrounding the Rhône river basin are Burgundy-Franche-Comté, Auvergne-Rhône-Alpes, the Occitania Region and Provence-Alpes-Côte d'Azur (PACA). Approximately 15 million people inhabit the area of the Rhône basin.

Figure 3.2 Regions and departments in the Rhône river basin (in 2015)



Source: Water Agency Rhône Méditerranée Corse (2016), <http://www.eaurmc.fr/le-bassin-rhone-mediterranee/les-caracteristiques-du-bassin-rhone-mediterranee/perimetre-administratif-du-bassin-rhone-mediterranee.html>

The Rhône is not only among the largest rivers, but especially one of the most complex river systems in France. Rising in the Swiss Alps and passing through Lake Geneva, it gathers its major tributary, the Saône, at Lyon, the biggest agglomeration along the river. It continues southward through France into the Mediterranean Sea. In Arles, the river divides into the Great Rhône and the Little Rhône, creating a delta of the Camargue region. The Rhône passes through mountain ranges of the Massif Central and the Alps. Its water stems from several lakes as well as from Alpine glaciers and underwater sources (Bravard and Clémens, 2008).

The Rhône is a river that has been subject to significant regulatory action to ensure its multiple uses as a resource for hydro power, as a key navigation route, a source for agricultural irrigation, but also potable water and various environmental and leisure services.

As a consequence of its varied topography and its diverse climate, the Rhône basin is confronted with various hazards in its different regions. River flooding is a great concern in the upstream Rhône, whereas the downstream part is also confronted with coastal flooding. Various hydro-meteorological hazards exist along the area. Slow on-set floods can develop over a large area along the Saône or the Rhône rivers, whereas rapid flash floods can occur along its smaller catchment areas, together with torrents and sediment movements. Finally, areas along the Rhône can be exposed to strong periods of precipitation, storms and storm surges such as along its coast line causing coastal flooding.

The basin of the Rhône River is prone to frequent flooding. On average the region experiences three floods a year, with crisis declarations in over 6700 municipalities over the last 30 years. Since 1982 19 municipalities declared³ on average one flood event every two years and 147 municipalities declared one every three years. In terms of coastal floods, disasters were declared by eleven municipalities every four years on average. It is estimated that one in three inhabitants and one in three jobs are at risk from flooding. Put in a national context the Rhône river is most exposed to floods and ranks third in terms of risk of coastal flooding (after the regions of Escaut-Somme and Loire-Bretagne). 95 municipalities, especially in the more mountainous areas are at high risk from torrents (PGRI, 2014, p.26).

The Camargue region is particularly exposed to hazards. Its flat topography and potential concomitance with storm surges and coastal flooding make floods persistent risks. Floods and storm surges tend to occur during the same periods, between September and November. Areas remain flooded for an extensive period of time, as pumping flood water into the sea is complex and other disaster risk reduction options are limited. Dike breaches, that are difficult to predict, can aggravate the impacts of floods, as demonstrated during the 2003 flood in Camargue, where the wetlands around the Rhône were saturated from the flood, causing dike breaches that increased the impact of the flood (Bravard and Clémens, 2008, p. 131).

Disaster risk exposure

Given its varied topography and different land uses near its banks, vulnerability and exposure characteristics differ quite significantly along the Rhône River. There is a difference in exposure between the heavily urban areas (such as Greater Lyon) and the rural ones as well as in the areas of the Rhône's tributaries compared to the main river. Vulnerability also differs on the Rhône's right and the left bank, as well as between the areas channelled by dams and those where floods can expand into agricultural land. Again other vulnerability aspects arise in industrial sites where technological hazards are a major threat such as the chemical industry around Lyon or the nuclear power plants in Donzère.

Generally speaking the Rhône River basin has been an important area for development in human habitat and economic activity in France. Counting just the regions of Rhône-Alpes and Provence-Alpes-Côte d'Azur they account for a fifth of France's GDP, which makes them economically speaking the most important regions after the Paris Metropolitan Area. A major flood in the Rhône River basin therefore constitutes a critical national risk in France, similar to a major flood of the Seine River in Paris or a major earthquake in the region of Provence-Alpes-Côte d'Azur.

The basin's core economic activities are closely intertwined with the Rhône River. Agriculture, for example, accounting for 16.7% of the basin's regional GDP, is largely located in flood plain areas. Industrial activity, contributing some 20% to the regional GDP, is concentrated along the river. Tourism, which makes for 30% of the region's GDP, peaks particularly during seasons where floods are most likely to occur (PGRI, 2014).

Table 3.1 Assets at risk in the Rhône basin

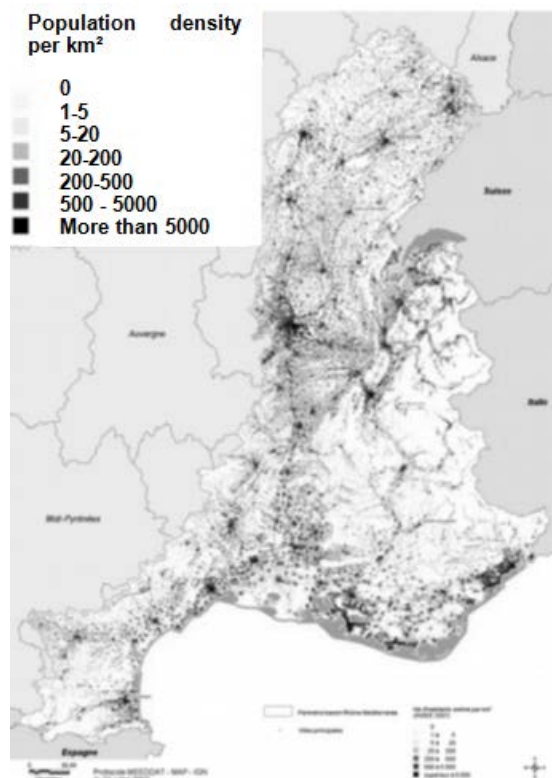
	At risk from flooding	At risk from coastal flooding	Relative to total number of each indicator in France (%)	
Population	5,5 million	229,000	33	16
Number of health facilities	819	21	35	13
Potable water facilities	9,044	23	-	-
Total buildings	438 million m ²	21,2 million	34	15
Total business buildings	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

A significant amount of power is produced along the Rhône River, which is exposed to several sources of risk. Along the Rhône River two thirds of hydropower supply of France is produced, as well as one fourth of France's nuclear power. Vulnerabilities arise from two particular sources. First, energy production along the Rhône is influenced by Switzerland, which is using the river upstream for its own energy production, having an impact on the speed and volume of the flow of the river as well its temperature further downstream. These elements are crucial especially for the cooling capacity of nuclear power stations along the Rhône. Second, a number of nuclear power production facilities are located in flood risk areas. (Bravard and Clémens, 2008)

With regard to human habitat Figure 3.3 demonstrates that population density is particularly high in close proximity to the river. Since the 1960s flood retention zones have had to increasingly give way to settlements, through urban expansion, which was sparked by an increase in population of 11% since 1999, and facilitated by infrastructure development (e.g. roads). Furthermore, urban vulnerability has significantly increased by allowing the residential use of basements. Although urban areas along the Rhône are relatively well protected, exceptional flood events could cause major damages (DIREN Rhône-Alpes, 2009).

Figure 3.3 Population density in the Rhône River basin



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], Volume 1: Parties communes au Bassin Rhône-Méditerranée, project submitted for public consultation

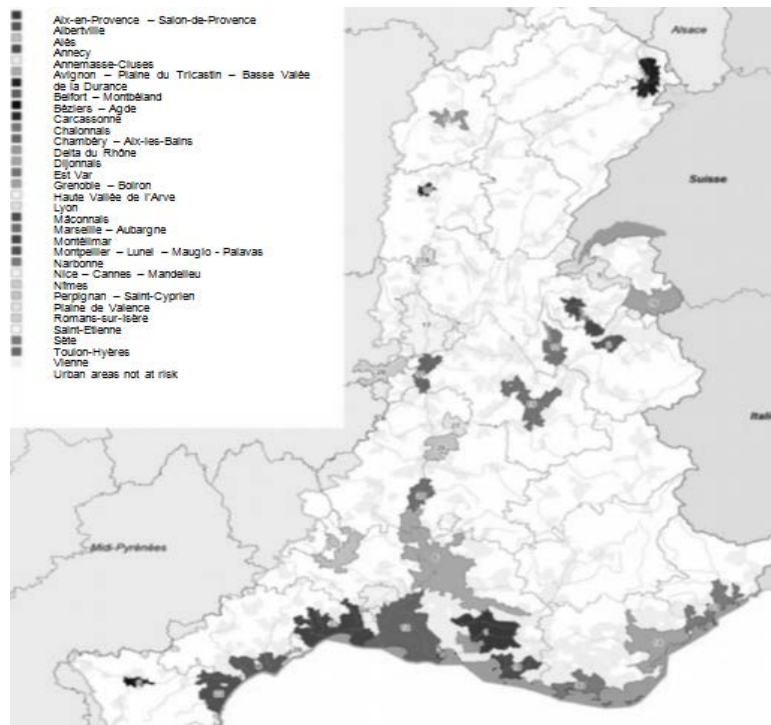
A significant flood in the Lyon agglomeration could cause an estimated EUR 1.25 billion in direct damages and EUR 6.2 billion in indirect damages (Bravard and Clémens, 2008) (Table 3.1), not accounting for existing protective barriers. A preliminary evaluation concluded that this flood scenario would translate into the following estimates in the Rhône-Méditerranée hydrographic district (PGRI, 2014):

- 5.5 million inhabitants, a third of the basin's population are directly or indirectly at risk from floods, including coastal flooding;

- A sizable number of health facilities, over 800, are exposed to floods and coastal floods;
- Above 9 000 potable water facilities are at risk;
- Around 3 000 businesses, with 100 000 jobs and more than 1 000 000 hectares of agricultural land are threatened by potential floods.

Figure 3.4 depicts areas identified as having a high risk of flooding (HRAs), based on the national risk catalogue⁴. The zones at risk were identified based on hazard levels, demographics, taking into account seasonal flux of population based on tourism. Among the high risk zones are the urban areas of Aix-en-Provence, Avignon, Chambéry, Lyon, Marseille, Montpellier, Nice, Nimes and Perpignan. The national risk catalogue identified a total of 122 high flood risk areas (HRAs) in France, out of which 16 are of national importance given the potential impacts. The Rhône basin amounts for 31 of the 122 flood risk areas, out of which 6 are of national importance.

Figure 3.4 Areas at significant risk of flooding



Source: DREAL Rhône-Alpes (2014), DREAL Rhône-Alpes (2014), “Plan de Gestion des Risques d’Inondation 2016-2021 [Plan for Flood Risk Management 2016-2021, Rhône-Mediterranean Basin], Bassin Rhône-Méditerranée”, Volume 1: Parties communes au Bassin Rhône-Méditerranée, Project submitted for public consultation

As mentioned above, the Rhône’s river flow has become heavily regulated. This implies a long history of construction of dams and dikes to protect socio-economic activities along the river. As a consequence and generally speaking protective infrastructure along the Rhône River has provided a relatively high protection level. There are however certain particular vulnerabilities:

First of all, the large number of dikes has led to a varying degree in their maintenance. Some were built in the last decades by the National Company of the Rhone (*Compagnie Nationale du Rhône*, CNR), and are primarily used to produce hydropower and facilitate navigation. Others are older, mostly constructed throughout the 19th century in reaction to the floods of 1840 and 1856 to protect against flooding.

Some of them, especially the ones operated and maintained by the National Company of the Rhone have provided a very strong protection level against one-in-1000-year floods. Other infrastructures provide protection levels that are much lower, such as against the flood levels of a 100-year flood, or of 30-year-floods and of floods with lower probabilities of occurring in a given year. The dikes built by the CNR were built to keep the water levels that have been increased to create the flow for the generation of hydropower. As an unintended consequence the land upstream of the hydropower plant enjoy better protection against floods, often to the level of a 1000-year flood. The remaining dikes (those not managed by the CNR) are often either the property of municipalities or owned by public enterprises. Some are also owned by private entities, grouped in dike unions (*associations syndicales autorisées*, ASA). Besides these, some dikes are abandoned and not officially owned by municipalities or dike unions. No clear responsibility for maintenance exists for these abandoned structures and it is not clear, if they still offer protection.

Moreover, although floods occur frequently along the Rhône River, the absence of a major river flood may have blurred the collective risk memory. This has contributed to the emergence of a sense of safety that lowers continued commitment and investment in flood risk management. This may be particularly threatening for large metropolitan areas such as Lyon.

Socio-economic impacts of past disasters

Larger scale hazard events occur relatively frequently in the Rhône River basin. The most important flood events since records exist are listed in Figures 3.5 and 3.6. Some past floods of the Rhône had an impact on the entire area of the river, such as the 1856 flood, a 250-year-flood, with the highest peak discharge rate recorded at 12 000 m³/s. Other significant floods have only affected a part of the river's area, such as the 1957 flood that impacted the area downstream of Lyon or those of 1910, 1928, 1944 and 1990 that affected the area upstream of Lyon. The floods of 1994, 2002 and 2003 affected the regions downstream of the river, including the Camargue (Bravard and Clémens, 2008).

Although multiple hazard events have occurred and were recorded in the past, little systematic knowledge about the extent of their negative socio-economic impact exists. Particularly in the Rhône basin this is the case. On average France experiences an estimated EUR 650 to 800 million in damages from floods each year. Floods along the Rhône are frequent and have caused damages above EUR 1 billion, such as the floods in 2002, 2003 and 2010, the latter of which also accounted for 23 casualties. The floods of Nîmes in 1988 caused an estimated EUR 610 million in damages, while the flood of the Aude in 1999 cost around EUR 500 million (Bravard and Clémens, 2008).

Table 3.2 Significant floods measured in discharge rates of m³/s of the Upstream Rhône

	Pougny 1925-2006		Bognes 1853-2006		Lagnieu 1891-2006		Perrache 1900-2006	
1	24/11/1944	1 520	20/01/1910	2 000	16/02/1990	2 445	25/11/1944	4 250
2	15/11/2002	1 440	23/12/1918	1 920	27/11/1944	2 400	16/02/1928	4 150
3	13/01/2004	1 300	03/10/1888	1 900	25/12/1918	2 100	25/12/1918	3 900
4	14/05/1999	1 300	30/05/1856	1 800	22/01/1910	2 090	26/02/1957	3 700
5	22/09/1968	1 280	25/09/1863	1 800	16/02/1928	2 025	21/01/1910	3 550

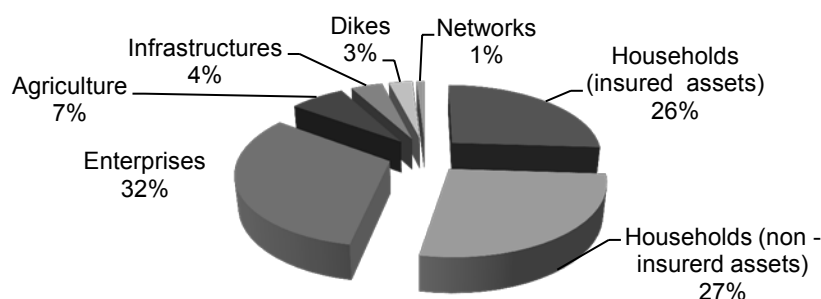
Source: Bravard Jean-Paul and Anne Clémens (2008), "Le Rhône en 100 questions" [The Rhône in 100 Questions], <http://mediterranee.revues.org/6386>.

Table 3.3 Significant floods measured in discharge rates of m³/s of the Downstream Rhône

	Ternay 1895-2006		Valence 1855-2006		Viviers 1910-2006		Beaucaire 1840-2006	
1	26/02/1957	5 320	31/05/1856	8 300	03/12/2003	8 000	31/05/1856	12 000 12 500
2	16/02/1928	5 120	01/11/1896	7 400	09/10/1993	7 715	03/12/2003	11 500
3	20/01/1955	5 075	08/10/1993	6 700	07/01/1994	7 590	08/01/1994	11 000
4	26/11/1944	4 850	16/11/2002	6 620	17/11/2002	7 580	11/11/1886	10 200
5	02/11/1986	4 830	11/11/1886	6 620	21/11/1951	6 660	10/10/1993	9 800

Source: Bravard and Clémens (2008), "Le Rhône en 100 questions" [The Rhône in 100 Questions], <http://mediterranee.revues.org/6386>.

Even though systematic evidence regarding floods in the basin is not available, the economic losses caused by the major events have mostly been studied in quite some detail. For example during the 2003 floods that occurred downstream of the Rhône the assets destroyed by the flood were recorded in great detail (SIEE, 2005). The floods seriously impacted downstream cities, such as Arles, Comps, Codolet or Bellegarde, which were submerged in water for an extensive period of time. In Arles and in Laudun-l'Ardoise, two important industrial zones were flooded, with significant local economic consequences. A number of infrastructures were also affected by the floods, including some major transport routes between Arles and Bellegarde that were closed off for 11 days. In total, an estimated 30,000 houses were flooded and 32,000 persons had to be temporarily relocated. The floods also caused 4 dikes to breach. Of the overall estimated damages of over EUR 1 billion Figure 3.7 shows that a great share of damages was suffered by households (53%), followed by businesses (32%) and the agricultural industry (7%).

Figure 3.5 Damages among stakeholder groups of the floods 2003, Rhône

Sources: Bravard and Clémens (2008), "Le Rhône en 100 questions" [The Rhône in 100 Questions]; Société d'Ingénierie pour l'Eau et l'Environnement (SIEE) (2005), "Inondations du Rhône et de ses principaux affluents de décembre 2003 en aval de viviers dans les départements de la Drôme, de l'Ardèche, du Gard, du Vaucluse et des Bouches-du-Rhône"

In a more forward-looking manner a detailed ex-ante evaluation of potential damage was undertaken briefly before the 2003 floods. A 10-year-flood was estimated to cause direct damages worth nearly EUR 500 million. A 100-year flood could cause nearly EUR 2 billion in direct damages, and a major flood nearly EUR 5 billion (see Box 3.1).

Box 3.1 Potential direct damages of major floods along the Rhône

A study of the entire Rhône River (*Etude Globale pour le Rhône*), conducted between 1993 and 2003, aimed at developing a flood plain management plan to improve flood predictions and associated early warnings. It also aimed at informing and improving flood-based land use management, including the designation of flood expansion zones. Also part of this study was an evaluation of potential damages under different flood scenarios occurring along the Rhône.

Table 1 shows the results of this analysis. The potential direct damages could range from EUR 500 million, for a 10-year-flood, up to nearly EUR 5 billion for a flood with a reoccurrence period of above 100 years. Agricultural damages are expected to be particularly high, accounting for more than half of the total expected damages. It is expected that this would already be the case under the least-impact scenario.

The calculations in Table 1 only include direct damages linked to an increase of water levels. They do not include the potential increase in damages caused by dike breaks (with the exception of the Camargue). These figures are therefore expected to underestimate potential direct damages, especially in light of the floods that followed in 2003, where a number of damages were caused by the breach of protective infrastructures.

Direct damages of different flood scenarios along the Rhône River

Direct damages (not taking into account dike breaches)	Intermediary flood (10-year return period)	Strong flood (100-year return period)	Major flood (above 100-year return period)
Agriculture	150-300	260-530	400-800
Businesses	140	770	2150
Individuals/Households	110	630	1860
Total Direct Damages	400-550	1660-1930	4410-4810

Note: Figures in million Euros

Source: Compagnie Nationale du Rhône (CNR)/ Etablissement Public Territoire Rhône (2003): *Étude Globale pour le Rhône* [Rhône Study] (not published officially)

Conclusion

A number of efforts have been undertaken to identify and map natural hazards in the basin area of the Rhône. An overview of hot spots of potential hazards and important risks that emerge out of it, for example, due to the density of economic activities, has been well established. In the future, it could be useful to have a more understanding of the existing risks in relation to the existing protective infrastructure. This section highlighted a number of cases, where different types of protective measures could significantly reduce the negative socio-economic impacts of a disaster. It is important to link vulnerability with public and private assets at risk to prioritise disaster risk reduction measures. Taking the potential occurrence of two simultaneous hazard events, for example a flood triggers an industrial accident, into account, would also help to enhance the understanding and management of the potential future a complex disaster.

Finally, the basin area could benefit from a better understanding of the potential socio-economic impacts of major disasters. Although detailed ex-post assessments of socio-economic losses have been conducted after some floods, for example following the 2003 floods, this could be done in a more systematic manner. Ex-post assessments could make greater use of existing information and more strongly involve national and regional actors already engaged in this effort. A basin-wide understanding of such vulnerabilities is key to prioritise joint actions at along the entire river.

Risk governance in the Rhône river basin

Section Highlights

- France's disaster risk prevention policy framework is guided by the principles of solidarity on the national level and of subsidiarity across levels of government, whereby a complex web of national and sub-national actors has emerged that all play a role in the planning and implementation of flood risk policies of the Rhône basin.
- Ongoing territorial reforms could help regrouping many of the more fragmented sub-national actors and to maximise the pay-offs of disaster risk prevention efforts, to increase ownership by the direct beneficiaries and to improve accountability of the responsible actors to their citizens.
- The process of decentralising flood risk management responsibilities may face several challenges: in a country with a mostly unitary tradition, sub-national actors may not all have the technical and financial capacities to fulfil their new responsibilities; the regrouping of local jurisdictions will not solve cross-jurisdictional conflicts arising from negative and positive spill over effects of disaster risk prevention investment up- and downstream of the Rhône River, but also between the main river and its tributaries.
- The strategic framework provided by the Plan Rhône has been an effective and successful instrument to integrate economic development and flood risk management, bringing all relevant actors together to work on commonly agreed priorities, supported by consolidated financing across levels of government. However the absence of a governance body for disaster risk management questions for the entire river basin reinforces the challenges of balancing interests across different parts of the river.

Main legal and strategic frameworks governing disaster risk prevention

From the Barnier Law to the “Great River Plans”

After devastating floods in 1982, 1995 and 2003 a number of new laws to improve disaster risk prevention management in France were passed. These new regulations were guided by a disaster risk prevention policy framework based on the principles of subsidiarity between the various tiers of government and of national solidarity to help France’s exposed population cope with prevailing risks.

The 1982 law on Compensation for Victims of Natural Disasters introduced an insurance system, the CATNAT (*Catastrophes Naturelles*) compensation scheme (see more in the financing section) that was coupled with a new land use policy and urban development regulation (*Plans d’exposition aux Risques Naturels Prévisibles*, PER) to decrease exposure to hazards.

A requirement for local strategic action plans for flood risk management was subsequently introduced. In 1995 the Barnier law was passed to better manage urban development in floodplains. It introduced the requirement of Flood Risk Prevention Plans (*Plan de Prévention du Risque Inondation*, PPRIs) that should be created at the local level, overseen by the prefect of the department. The plans will include maps delineating hazard zones as well as, in a second step, assets at risk. Mining disaster risk prevention plans were introduced in 1999, followed by technological disaster risk prevention plans that were introduced in 2003 in response to an industrial accident at a fertiliser plant in the city of Toulouse that caused nearly 30 casualties.

To finance local strategic disaster risk prevention actions a central disaster risk prevention fund was established. Under the Barnier law the Fund for the Prevention of Major Natural Hazards (*Fonds de Prévention des Risques Naturels Majeurs*, FPRNM) or “Barnier Fund” was created to finance disaster risk prevention measures, including the resources involved in drawing up PPRIs. PPRIs constitute the basis of flood risk management between the local and central level. Based on the PPRIs Flood Prevention Action Programs (*Programmes d’Action de Prévention des Inondations*, PAPIs) are developed at the local level. They identify the prevention measures to be financed through the central Barnier Fund, administered by the Ministry of Ecology and, for projects above EUR 3 million, also approved by the Joint Flood Commission (*Commission Mixte Inondations*, CMI). The PAPIs rally central government stakeholders and local authorities to co-operate on integrated, comprehensive prevention projects for flood-prone river systems. Local contracting authorities develop the programmes and submit them to central government for financial support in a competitive selection process. Preventative measures under PAPIs can include improved risk knowledge and awareness of risks, forecast and early warning systems, vulnerability reduction through land-use and urban planning and protective infrastructure. The OECD Seine study (2014) found that the selection of projects (90% of which are structural measures) may not always have been based on previously identified High Flood Risk Areas (HRAs), a key requirement for allocating funds.

In recognition of the need to address flood risk management at the appropriate geographical and functional scale basin-level, strategic action frameworks were established. The great river plans aim at coordinating flood prevention initiatives at the territorial or basin level. Launched in 1994 with the Loire River, the great river plans have been adopted for all major river systems, including for the Rhône (*Plan Rhône*). They are intimately linked with France's State-Region Contracts (*Contrats de Plan État-Région*, CPER). These contracts constitute the basis of an agreement between the central government and the regional council on the tasks to be accomplished over a certain period, for which the central government provides co-financing (Box 3.2). In the case of the Plan Rhône, the Plan aims at consolidating disaster risk prevention action at the basin level and negotiates one central co-financing agreement, rather than for several local-level PAPIs scattered throughout the basin.

Box 3.2 France's State-Region Contracts

France's State-Region Contracts (*Contrats de Plan Etat-Région*, CPER) are planning instruments particularly key in accompanying the recent territorial reform of France launched in 2014. They are a tool for local investment whereby the State and the regions jointly set up a multi-annual (for 5 to 7 years) funding and programming document ("contract") to identify development projects at the territorial level. The contracts aim at generating and multiplying local investments. The process is steered by a general commission under the prime minister's office that aims at fostering territorial equality and managing spatial planning.

Several regions can group together in the same contract with the State, which in turn serves as leverage for obtaining additional funding from the European Union's regional development funds (particularly on issues relating to rivers and mountains, as well as for regional cross-border cooperation projects).

The previous contracting period during which the Plan Rhône received over EUR 600 million (see more in financing section) ended in 2013. The current planning phase spans from 2015 to 2020 with an expected funding envelope of EUR 850 million. This new generation of contracts, with a total funding of EUR 12,5 billion, fosters 6 goals that seek to foster employment as an overarching goal:

- Multimodal mobility (EUR 6.7 billion)
- University education, research and innovation (EUR 1.2 billion)
- Ecological and energetic transition (EUR 2.9 billion)
- Digital (EUR 32 million)
- Innovation (EUR 50 million)
- Territories (EUR 994 million)

Source: OCDE (2014), "Seine Basin, Île-de-France, 2014: Resilience to Major Floods" OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264208728-en>.

The Plan Rhône

In terms of funding the Plan Rhône⁵ is the best equipped amongst the basin plans in France (Table 3.4). Following several damaging floods along the Rhône in the 1990's and the large floods in 2003 a strong consensus on the need for strategic action across the river basin to improve disaster risk prevention management emerged. The elaboration of a global strategy for flood risk prevention along the Rhône, which was informed by a large-scale study on how to reduce risks in the basin, laid the foundation for the plan. The Plan

Rhône builds on these previous studies and seeks to foster sustainable development in the region, of which flood prevention is one key pillar.

Three regions (Rhône-Alpes, Provence-Alpes-Côte d’Azur and Languedoc-Roussillon⁶) agreed to implement the Plan together. The regions of Bourgogne and Franche-Comté as well as the National Company of the Rhône (CNR) became additional partners of the Plan Rhône. The French energy producer Électricité de France (EDF) became a partner in 2015. All partners agreed that the activities implemented under the Plan Rhône should aim at preserving solidarity both up- and downstream of the river but also across its tributary arms.

Table 3.4 Flood risk prevention funding envelopes of France's major river plans

	Flood prevention funding (million €)	Financial contribution by level of government (€ million)		
		State	Regions	Others
Rhône Plan	310	108	83	38
Loire Plan	127	72	45	8
Seine Plan	70	42	24	3
Garonne Plan	42	33	9	-

Sources: adapted from OCDE (2014), “Seine Basin, Île-de-France, 2014: Resilience to Major Floods” OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264208728-en>.

Like the other basin level plans in France, the Plan Rhône aims at developing a strategy for the sustainable economic, environmental and social development of the basin level regions. Under the leadership of coordinating Prefect of the Rhône basin the regions and partners have been collaborating to establish an integrated development approach between river and flood risk management and the economic activities in the region to achieve a sustainable future. The region Rhône-Alpes also plays a special role as authority in charge of the management of the interregional programme of the European Regional Development Fund (*Programme Opérationnel Pluri-Régional Fonds européen de développement régional*, POP FEDER) implemented in the 2014/2020 period. The Plan is currently being renewed for the next five years until 2020, with a total allocation of EUR 849 million (see section V for details). Of the five regions that originally contributed to the flood risk management pillar only two have committed to continue their contribution (Provence-Alpes-Côte d’Azur and Languedoc-Roussillon). The current plan identifies 6 fields of action:

1. Culture along the River
2. Floods
3. Water quality, resources and biodiversity
4. Energy
5. River transports
6. Tourism and cultural heritage

The flood risk management pillar (2) is coordinated and managed by the Regional Directorate for Environment, Planning and Housing (*Direction Régionale de l'Environnement, de l'Aménagement et du Logement*, DREAL) Rhône-Alpes. Its specified objectives for the flood part are:

- Reducing the exposure to risks;
- Reducing vulnerability for better managed urban planning;
- Increase risk awareness and preparation for better living with flood risk.

The Plan Rhône's key governing bodies are the executive committee and the steering committee. The executive committee is composed of the basin coordinator prefect, the president of the basin committee and the three presidents of the regional councils of Rhône-Alpes, Provence-Alpes-Côte d'Azur and of Languedoc-Roussillon. The executive committee ensures that the implementation of the Plan follows its general orientations. The steering committee has a broader membership and includes representatives from the urban agglomerations of the Rhône, as well as from regional chambers of commerce and inter-municipal unions. The central government and the local communities work together to implement the Plan Rhône and to coordinate with partners across national borders, such as in Switzerland. A close collaboration is also ensured with a key partner on the Rhône, the National Company of the Rhône (CNR).

The Plan Rhône is grounded in open and democratic consultation processes that include stakeholders from citizens to journalists, unions and the founding partners of the Plan. Stakeholders are organised in committees, whereas each part of the river (upstream, middle and downstream) has its own stakeholder committee, presided by the prefect and an elected official of the basin committee. The geographical distinction takes account of the specific features of each zone along the river.

The Plan Rhône's major success lies in its ability to bring all key actors together that share a common interest in preserving the Rhône River's core functions for sustainable economic development of the Rhône River basin. Through the Plan Rhône regional and local actors created a key coordinating platform that jointly leverages disaster risk prevention investments.

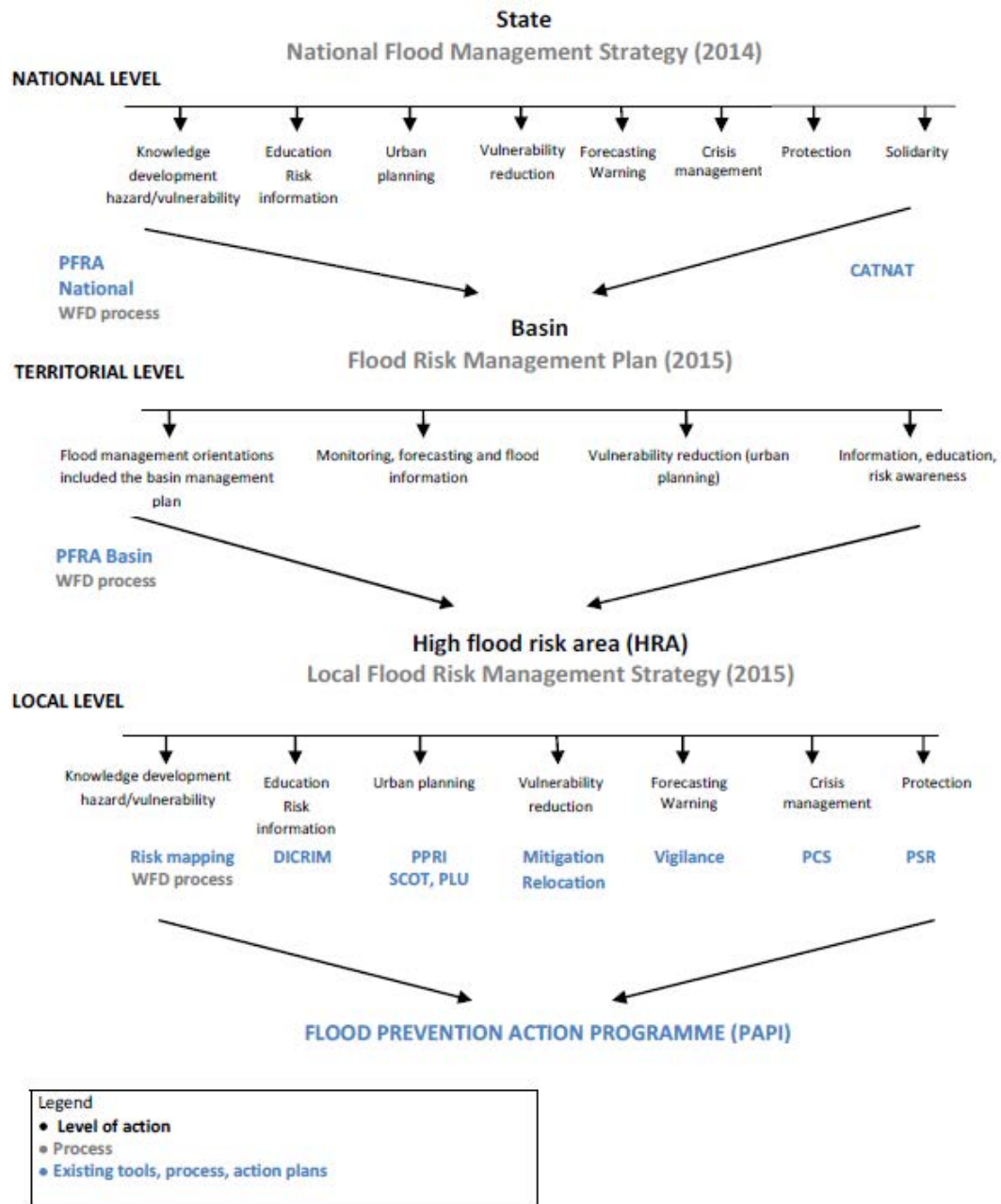
Nonetheless challenges in the Plan Rhône's governance system at the basin level remain. The below governance overview will demonstrate that there are numerous different actors in flood risk management in the Rhône basin that operate on different scales and with different political affiliations and historical legacies. This has led to heterogeneous outcomes in the flood risk protection levels across the basin. It has also fostered the development of silos that undermine the better coordination of up- and downstream, as well as tributary versus main river interests along the Rhône. In the following this point will be more closely elaborated.

The Rhône Flood Risk Management Plan (PGRI)

In addition to the Plan Rhône a Flood Risk Management Plan (*Plan Gestion des Risques d'Inondation*⁷, PGRI) was established, covering the Rhône-Méditerranée basin from 2012-2016 (Table 3.5). The plan comes as a result of the implementation of the EU Floods Directive that prescribes the development of a flood risk management strategy at

basin level. Based on the basin level plan, local flood risk management strategies have to be developed for the identified High Risk Areas (HRAs) (Figure 3.8).

Figure 3.6 Overview of the French national flood risk policy formulation process



Source: OECD (2014), "Seine Basin, Île-de-France, 2014: Resilience to Major Floods", OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264208728-en>; based on Direction générale de la Prévention des risques (2011), "La politique nationale de gestion des risques inondation: Ce qui change aujourd'hui" [National flood management policy : What changes today], Ministry of Ecology, Sustainable Development, Transport and Housing, Paris.

Table 3.5 Strategic documents for flood risk management of the Rhône

Document	Period	Area	Key stakeholders	Objectives
Rhône Flood Risk Management Plan for the basin (PGRI)	2016-2021	Rhône-Mediterranean basin; Rhône and Saône rivers and tributaries	<ul style="list-style-type: none"> Regional Development Agency (DREAL) Rhône-Alpes Departments Ministry of Environment 	<ul style="list-style-type: none"> Better integration of risks in urban planning; Increase safety of flood exposed population; Improve resilience of exposed territories; Organise actors and skills Foster knowledge of flood and their risks
Plan Rhône	2005-2025; renewed in 2010, 2015, 2020;	Rhône basin	<ul style="list-style-type: none"> Rhône-Alpes region EU Other regions (Burgundy, Franche-Comté, Languedoc-Roussillon, Provence-Alpes-Côte d'Azur) Regional Development Agency (DREAL) Rhône-Alpes, Economy and Employment Agency Rhône-Alpes, Navigation Routes of France, Water Agency of Rhône-Méditerranée-Corse, Environment Agency and the Energy Management Agency; The basin committee The electricity provider EDF The National Company of the Rhône (CNR) 	<ul style="list-style-type: none"> Reinforce capacities to confront flood risk Support river transport Preserve and restore wetlands, the flow of the water and promote heritage

Source: Plan Rhône, www.planrhone.fr; Plan Gestion des Risques d'Inondation, <http://www.developpement-durable.gouv.fr/Les-plans-de-gestion-des-risques-d,40052.html>

In line with the priorities spelled out in the France's National Flood Risk Management Strategy (*Stratégie Nationale de Gestion des Risques* d'Inondation, SNGRI), the PGRI for the Rhône River basin includes five priority pillars:

- Better taking risk into account when deciding for urban planning and keeping costs under control: decrease the territory's vulnerability and improve the knowledge about it; respect the principles of spatial planning integrating flood risks;

- Increase the safety of the population exposed to floods while taking into account the natural functioning of the aquatic environments, the torrential risks, coastal erosion, and ensuring the performance of protective infrastructure;
- Improve the resilience of the exposed territories: act on surveillance and forecasting, prepare for crises and learn to better live with floods, foster risk awareness among the population through awareness campaigns, fostering of a memory of risk and information sharing;
- Organise the actors and skills: enable the synergy between the different public policies: risk management, environmental management, spatial planning and coastal management;
- Foster knowledge about flood risks; foster knowledge sharing.

The Rhône Flood Risk Management Plan is well positioned to become an effective complementary planning instrument to the Plan Rhône. It puts an important emphasis on improving organisational measures in risk management such as urban planning and vulnerability, safety, preparedness and risk culture.

Risk awareness: A key weakness that has been observed is the low risk awareness of the Rhône River basin's inhabitants. Although the state and sub-national authorities may be the main investors in core disaster risk prevention infrastructure, citizens have a key role to play in decreasing vulnerability. Citizens are in the driver's seat of limiting or reducing damage potential in existing built-up areas in risk zones. This includes organisational measures to take when a flood event is imminent, but also *ex ante* measures that improve the resistance of properties against flood damages, for example. For all these contributions to happen risk awareness is a key foundation.

Risk Governance: The governance gaps have appeared as a consequence of the multitude of disaster risk prevention actors. This has created key discrepancies in the level of protection achieved along the Rhône River. Bringing actors together to create synergies and to work across sectoral frontiers can be key to fill some of the prevailing governance gaps to harmonise flood risk management approaches across the basin and to ensure negative and positive spill overs are accounted for. The Rhône Flood Risk Management Plan aims at overcoming existing governance obstacles.

In the following we will zoom into the multi-level governance context that characterises the disaster risk prevention efforts in France in general, and that of the Rhône basin in specific. With a traditional unitary administrative culture France has recognised the need to transfer more disaster risk prevention responsibilities to local levels, as they are the core beneficiaries of disaster risk prevention measures and hence the owners of such investments. The challenge however will be to gradually address the gap that has been arising between new local level responsibilities and the availability of the necessary technical and financial capacities.

Governing Disaster Risk Prevention and Mitigation: Main National Institutions and Actors across Levels of Government

Given its traditional unitary culture, the central government in France also plays a key role in disaster risk prevention management. Central government services are in charge of drawing up national flood prevention policies, but do not play a direct role in implementing policies on the ground. However, the tools, apparatus and funding mechanisms they develop to implement laws and regulations directly affect policies implemented at the local level (OECD, 2014).

In France, the main central level responsibility for disaster risk prevention and mitigation sits with the *Ministry of Ecology, Sustainable Development and Energy (Ministère de l'Ecologie, du Développement durable et de l'Energie (MEDDE))* and within it the Directorate General for Risk Prevention (*Direction Générale de la Prévention des Risques (DGPR)*) is in charge. Within the MEDDE an interministerial delegation is in charge of coordinating the management of major risks across France's ministries. The DGPR manages three types of hazards, which constitutes its three main services:

- The hydraulic and natural hazards service
- The technological hazards service
- The environmental pressure and environmental quality service

The hydraulic and natural hazards service is composed of:

- A central hydrometeorologic and flood forecasting service in charge of national flood prediction. It coordinates and centralises the sub-national prevention services;
- A technical service in charge of electric energy of big dams;
- The Office of Territorial Action in charge of the deconcentrated services (including the regional development agency of Rhône-Alpes);
- The Office of Meteorological Risks in charge of the national flood risk policy;
- The Office of Natural Earth Risks in charge of the national policy of seismic, volcanic, mountain, forest fire and landslide risks;
- The Office of preventative information, coordination and prospection in charge of risk awareness.

The DGPR coordinates policies for developing disaster risk prevention plans and has drawn up calls for funding local level prevention plans (*Programmes d'Action de Prévention des Inondations (PAPIs)* and *Plan Submersion Rapide, PSR*) established as a new contractual instrument (see section IV) to obtain funding from the Barnier Fund (see financing section for more details). The DGPR is in charge of implementing the EU Flood Directive. It conducted a nation-wide flood risk assessment, developing the criteria for determining High Risk and High Flood Risk Areas (H(F)RAs).

The Ministry of Territorial Equality, Housing and of Rurality (MLETR) coordinates regional development and planning matters. In terms of disaster risk prevention the ministry ensures that risk is taken into account in urban and spatial planning and that building codes are adapted to prevent or reduce risks to the built environment.

Through the Insurance Markets and Products Bureau, the *Ministry of the Economy and Finance* is involved in regulating the principal preventive funding tool in France, the CATNAT compensation scheme and the associated Fund for the Prevention of Major Natural Hazards, or Barnier Fund (see financing section for more details) (OECD, 2014).

Other ministries that contribute to disaster risk prevention are the Ministries of Research and Education, Cultural Affairs, Foreign Affairs and International Development.

The Joint Flood Commission (*Commission Mixte Inondation*, CMI) was established in 2011 to draw up national strategy options for implementing the EU Flood Directive. The CMI is in charge of steering the national policy for flood risk management, notably the monitoring of the implementation of the National Flood Risk Management Strategy and the Flood Prevention Action Programs (PAPI) as well as the Coastal/Flash Flood Plans (*Plan Submersions Rapides* (PSRs)). The CMI also considers and approves financing for prevention projects submitted by local governments under the PAPI/PSR scheme, opening the way to state funding under the Barnier Fund (see financing section for more details). The Joint Flood Commission is composed of state bodies, local government and civil society bodies.

Governing preparedness and response: main institutions and actors

The *Ministry of the Interior* is in charge of crisis management matters. Its General Directorate for Civil Protection and Crisis Management (*Direction Générale de la Sécurité Civile et de la Gestion des Crises*, DGSCGC) is responsible for developing public policy instruments for crisis management and crisis preparedness. These instruments have important links with managing business continuity plans. This directorate also has an operational role in managing major crises that require coordination of resources at national or international level (for all others the local levels are in charge).

The Operational Centre for Interministerial Crisis Management (*Centre Opérationnel de Gestion Interministérielle des Crises*, COGIC) is activated as soon as local emergency responses so require. The unit has powerful information systems and databases on hazards and the vulnerability of populations and regions. The Disaster and Emergency Response Organisation (*Organisation de la Réponse de Sécurité Civile*, ORSEC) was created as a single structure that mobilises and coordinates the whole network of emergency response stakeholders under the sole authority of the Prefect at the administrative level appropriate to the crises. The same law that created this single structure also obliges all municipalities that have a PPR to draw up a local level emergency response plan (OECD, 2014).

Sub-national disaster risk prevention and preparedness responsibilities in the Rhône River basin

Given France's rather unitary state set-up, sub-national responsibilities are shared between deconcentrated service arms at sub-national level and decentralised, i.e. locally elected, public authorities. Until now, the central government has been essentially prescribing flood risk prevention policy, implementing it through its deconcentrated

service arms. Due to the ongoing territorial reform process, local decentralised authorities have recently also started to assume more responsibility in flood risk prevention management.

Deconcentrated services

The *prefecture* is the sub-national representative of the central government overseeing a department or region, or basin or (defence) zone, and ensuring the adequate implementation of central level policies. The prefectures are an arm of the Ministry of Interior in charge of managing crises if they surpass the borders of a municipality. In terms of disaster risk prevention the prefect presides over the Departmental Commission of Major Natural Hazards (*Commission Départementale des Risques Naturels Majeurs* (CDRNM)). As part of his role the Prefect can inform municipalities about the Particular Intervention Plan (*Plan Particulier d'Intervention* (PPI)) for industries and the Natural hazards and Technological Risks Prevention Plan (*Plan de Prévention des Risques*, PPR). The regional prefecture coordinates flood risk prevention policies at the sub-national level.

The Regional Directorate for Environment, Planning and Housing (*Direction Régionale de l'Environnement, de l'Aménagement et du Logement* (DREAL); DEAL in overseas territories), as well as their *departmental arms* are the deconcentrated arm of the central Ministry's (MEDDE) disaster risk prevention services. The DREAL Rhône-Alpes and the DREAL of the Rhône-Méditerranée basin are the deconcentrated service arms at the regional level responsible for implementing the *Plan Rhône*. Its complement exists at the departmental level. They play a key role in implementing the EU Flood Directive, through risk assessment and mapping, and flood forecasting. On the regional scale, they also coordinate with all DREALs and with the sub-national service arms at the department level (*directions départementales des territoires (de la mer)*, DDT (M)).

The Interregional Zonal Operations Centre assembles the Prefect for Defence and Security, the Prefects of the Departments, the regional director of public finances, whose scope includes the administrative centres of the defence and security zones, the general officer of the defence and security zones, when appropriate also the general in command for the territorial zone, the commanding admiral for the maritime district, the general in command for air defence and air operations, the general in command for the gendarmerie of the defence and security zone, the head(s) of military staff of the defence and security zone, the delegates of the defence and security zone representing the deconcentrated services of ministers, as well as the director general of the regional health agency.

The Rhône-Méditerranée Corse Water Agency is the public body regulated by the MEDDE. Its role is to help elected representatives and local communities, economic stakeholders and inhabitants use water resources rationally and fight against the pollution and deterioration of aquatic environments. To achieve its goals, it collects charges based on the "polluter-pays" principle. It also funds initiatives for the conservation and exploitation of aquatic environments, in the form of subsidies paid to public or private developers.

The Flood Commission of the Basin (*Comité Inondation de Bassin*, CIB) is the sub-national version of the Joint Flood Commission, bringing together all district

hydrographical services. This commission participates in drawing up the Flood Risk Management Plan for the basin level (PGRI).

Decentralised authorities

Up until now, the powers of the three tiers of local government, as stipulated in French law, are so that local levels can become involved in any public policy issue in which their interests are at stake. Municipalities, departments and regions can thus play important roles in flood risk prevention along the Rhône River:

- Regions have no formal disaster risk prevention role. They nonetheless often make important contributions to improving local level resilience. First of all regions are in charge of transport and have thus a key interest and an important role in improving the resilience of their transport infrastructure. Second, in financial terms the regions play a significant role in establishing the state-region contracts (Box 2), which – through the Plan Rhône - enable sub-national actors to have access to key disaster risk prevention financing from central resources (such as the Fonds Barnier), but also through European structural funds. Third, regions also have an observer and monitoring function over spatial planning, which enables them to encourage mayors to integrate hazard zones in their land-use decisions. Fourth, regions have the liberty to finance disaster risk prevention projects at their own discretion, which some of them have used to invest for example in risk awareness campaigns. Finally, regions can be an important intermediary between the local and the central level, which can be useful to channel feedback for better policy making.
- The departments and their elected representatives of the general council (*Conseil Général*) do not have any specifically defined responsibilities on disaster risk prevention. However, they have been contracting authorities for structural measures or have managed sewerage systems against the risks of flooding. Some departments have made significant investments into the prevention of flood risks by co-financing related projects in their territory.
- The municipalities (*communes*) have a number of key functions regarding disaster risk prevention management. They are responsible for protecting their citizens from risks and for planning and development matters in their jurisdiction. They need to draw up local emergency response plans for crisis management and continuity of public services and to annex the risk prevention plan (PPR) to their local urban development plan. Where required, they are responsible to integrate the risk prevention plan developed by the state into their communal or intercommunal urban planning documents. They are also required to inform citizens of the risks to the municipality in local community information documents about major prevailing risks (*Documents d'Information Communal sur les Risques Majeurs*, DICRIM). Besides this, municipalities are also responsible for the provision of potable water and sanitation services, with several municipalities often choosing to share responsibilities in so called inter-municipal collaborations (*Établissement Public de Coopération Intercommunale*, EPCI - Box 3). It is expected that this inter-municipal collaboration through the EPCI will become mandatory on 1 January 2020.

- Finally, the mayors are responsible for spatial planning and the security of their territory. The mayor thereby has to monitor risk information, take risk information into account of spatial planning and has to organise evacuation in times of crisis.

Inter-municipal cooperation has become an important form of governance in disaster risk prevention management. In addition to the inter-municipal collaboration body established through the EPCIs (Box 3.3), unions have become a frequent form for municipalities to work together to address certain aspects of risk management.

Along the Rhône a number of large unions have emerged that have become key players and experts in local disaster risk prevention management. This includes for example the *Syndicat du Haut Rhône* (SHR), the *Syndicat Intercommunal du Bassin de l'Yzeron* (SAGYRC) or the *Syndicat Mixte Interrégional d'aménagement des Dignes du Delta du Rhône à la Mer* (SYMADREM) :

Box 3.3 Inter-municipal collaboration in France (Établissement Public de Coopération Intercommunale, EPCI)

Between France's different tiers of sub-national government (regions, departments and municipalities) EPCIs are an intermediate form that groups municipalities into "public establishments for inter-communal co-operation". Due to their specific purpose EPCIs are distinct from the other sub-national collectives whose mandates are more general. To encourage inter-municipal cooperation the state in 1999 decided to increase the basic grant given to local authorities forming an EPCI. While voluntary in the beginning, it has since become obligatory for municipalities to be part of an EPCI. In 2014 36.614 French municipalities (of 36.680 in total in 2014) were part of an EPCI.

EPCIs are created either to operate large-scale infrastructure facilities or to make major investments (such as shopping malls, office spaces), with a view to benefit from economies of scale and to avoid negative externalities arising to some while accruing benefits to other municipalities. It has yet to be shown that cost reductions were realized, as EPCIs have often led to parallel administrative structures, that of the municipalities and that of the inter-municipality body, the EPCI. Instead of reducing positions new ones were created.

EPCIs can either be financed by budget contributions from the municipalities or from their own taxation powers. The later can either be "additional" in form of a levy on local taxes or exclusive, whereby the business tax is attributed to the EPCI instead of the municipalities. The exclusive business taxation became the most common form of EPCI financing. Since the EPCI business tax harmonisation led to some municipalities having to share significant business tax revenue with others whose revenue may have been a lot smaller equalization rules for redistributing resources have been introduced. Corresponding to their increased responsibility and revenue raising authority, the members of the EPCIs with own taxation powers are directly elected since 2014. The executive body is steered by a president assisted by vice presidents.

Sources: OECD (2006), OECD Territorial Reviews, France, OECD, Paris. http://www.collectivites-locales.gouv.fr/files/files/BIS_98.pdf

SYMADREM is a union (and an EPCI) in charge of the construction, reinforcement and the maintenance of protective infrastructure along the Rhône, including dikes and protection against coastal flooding the Rhône delta. The SYMADREM also intervenes for the implementation of environmental measures (e.g. in the creation of wetlands) in compensation of structural projects, such as the construction of dikes. The SYMADREM

owns over 250 km dikes in the downstream Rhône, which makes it one of the biggest such unions in France. The second mission of SYMADREM is to implement the Plan Rhône in their area, which includes building new dikes as well. The SYMADREM came together as a result of participating municipalities wanting to work together, sparked by the Camargue floods in 1983. To operate and maintain their dikes a budget of EUR 4 million is available annually.

Empowering the local level in flood risk management – the impact of France’s territorial reform on flood risk governance

The ongoing reform for the territorial reorganisation of France has important consequences on how flood risks are managed locally. The reform (Box 4) reduced the number of regions from 22 to 13, which affects 6 former regions along the Rhône that will be merged into 3, namely Auvergne-Rhône-Alpes, Midi-Pyrénées-Languedoc-Roussillon and Bourgogne-France-Comté. Regions will take up a key role in driving the regional economy and overseeing important sectoral work across the region. The former responsibilities of departments will be split between the region and local authorities. In terms of risk management local authorities will become the key players.

Another ongoing reform called GEMAPI (Box 3.5), which stands for the responsibility for managing aquatic environments and flood risk, entails transferring more responsibilities for flood risk management to municipalities and to inter-municipal collaboration bodies (EPCIs). Through this reform more municipalities and EPCIs will be given the ownership of existing structural measures in their localities (such as for dikes that currently belong to the department council or to the state) and will be in charge of building and maintaining new structural measures. To finance their new responsibilities the local authorities will have the option to introduce a local tax of a maximum of EUR 40 per citizen and year.

The role of unions will likely remain the same under the current territorial reform. Municipalities and inter-municipal bodies will have the option to delegate their responsibilities to existing or newly created unions. This will ensure that currently well-functioning inter-municipal collaboration based on unions can continue the work.

Although the reform has the potential to increase the efficiency of flood risk management through clarifying roles and determining local ownership, there are several potential gaps that still need to be addressed:

- The first concern is reform speed. With a strong unitary tradition it is important that the transition to more local responsibilities is carefully managed. A number of local authorities may still have some way to go to acquire the necessary technical capacities to fulfil their new functions, which is why the GEMAPI reform will only come into force in 2018.
- The second concern is resourcing. The reform recognises that there has been a gap in ownership and maintenance of existing protective infrastructure that has contributed to an increased vulnerability in recent flood events. Although local ownership is a desirable outcome, this new competence needs to be backed by adequate resources.

While the local level receives a revenue raising opportunity through a potential tax, it has been highlighted that this may neither be a feasible nor a sufficient instrument for all local authorities to cover their financial resource needs.

- The third concern is persisting fragmentation. Resolving local governance questions is crucial and the reform makes a good attempt in solving this. However, the problem of governance fragmentation along the Rhône River will remain unsolved and will continue to make coordination between interests up- and downstream of the river areas as well as between the main river and its tributary arms on both sides very difficult. It is important that any new reform is designed in tandem with a basin-level orientation of interests.

Box 3.4 France's Territorial Reform of 2004

A territorial reform was started by the French government in 2014 aiming at simplifying and rationalizing sub-national competences at the regional, departmental, municipal and inter-municipal level. The envisaged reform entails three core objectives:

- Reduce the number of regions from 22 to 13.
Reinforce the role of the regions and gradually decrease the role of departments: the regions will be responsible for their economic development, including the promotion of small and medium enterprises, innovation and professional training. Regions will also be in charge of fostering sustainable development, especially spatial development, mobility, environmental pollution, energy, housing and waste management. Regions will take over the competences that belonged to departments: such as ownership of colleges, road and school transportation.
- Reinforce the role of inter-municipal collaborations (EPCIs) by increasing their number of inhabitants by reducing their total number and organizing them around functional areas. They will gain more competences (such as tourism, waste treatment, as well as from 2020 on also wastewater treatment) too. Departments can delegate competences to the EPCIs.
- Transform urban agglomerations into metropolitan areas, which means that inter-municipal cooperations (EPCI – Box 3) can become metropolitan areas, if they have more than 400.000 inhabitants. They will have a special status, responsible for economic, social and cultural development as well as spatial planning, the environment and the management of local public services (such as water). The new urban agglomerations will be distinct from the inter-municipal cooperations (EPCIs) and will include the functional areas of Paris, Aix-Marseille and Lyon. The Greater Lyon metropolitan area that was created in January 2015 takes over the competences of the Great Lyon EPCI and those of specified areas in the Rhone department.

Sources: <http://www.gouvernement.fr/action/la-reforme-territoriale>;
<http://www.vie-publique.fr/actualite/dossier/reforme-collectivites-territoriales/collectivites-territoriales-nouvelle-reforme-2014.html>

Additional state operators and state-controlled businesses

The Central Reinsurance Fund (*Caisse Centrale de Réassurance*, CCR) is a business governed by private law, fully owned by the French state. It provides insurers with

reinsurance solutions guaranteed by the French central government. The CCR participates in the CATNAT compensation scheme by offering reinsurance for the scheme while collecting a levy on the premium surcharge for disaster risk prevention that the insurance companies transfer to the CCR to place in the Barnier Fund. The CCR conducts significant work in risk assessment and disaster-related damage estimations (OECD, 2014).

The National Company of the Rhône (*Compagnie Nationale du Rhône - CNR*), created in 1933, is a company funded mostly by public capital. Its three historical tasks are electricity, navigation and irrigation. The CNR is the second most important electricity producer in France and the most important producer of renewable energy. Half of its investments are public (*Caisse des Dépôts*, local governments). The CNR is also constructor and owner of (and thereby responsible for) the structure protective measures along the Rhône, including hydropower stations, dams and dikes. The CNR would be well placed to play a key role in managing and especially reducing flood risk through its infrastructure. There is potential for reinforcing this role that could perhaps be more exploited in the future.

Box 3.5 Inter-municipal collaboration for flood risk management (GEMAPI)

The French “MAPTAM” law on modernizing local public action and promoting metropolitan regions, passed in 2014, gives the responsibility for managing aquatic environments and flood risk (GEMAPI) to municipalities and to intercommunal services (EPCIs – see Box 3). This should facilitate interventions at the right scale and ensure specific institutions are in charge of specified tasks, where responsibility has not been clear (as has e.g. been the case for 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 restoration 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 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.

Sources: 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

Various network providers (such as the French Railway Corporation SNCF), energy sector (RTE, EDF and ERDF) are key actors in securing business continuity and avoiding knock-on impacts of floods. Moreover, EDF has provided important funding for the renewed Plan Rhône.

Associations

The European Centre for Flood Risk Prevention (*Centre Européen de Prévention du risque d'inondation* (CEPRI)) assists local governments in their prevention initiatives.

The role of citizens

With the development of recent new legislation, the responsibility for citizens has been increasing, aiming at a culture of risk for better preparedness for risks. In France information is available to citizens on:

- Various documents on the major existing risks and their consequences for citizens, assets and the environment. They can be consulted at the city hall or on the internet. They also provide information on measures that citizens can take to protect themselves and to act when an emergency situation arises.⁸
- Since 2006 owners or renters of a home have to be informed about their asset's exposure to potential risks; this includes the location in an unsafe zone or the radius of a disaster risk prevention plan.

International actors and institutions

France cooperates in the Alpine Convention⁹ and is engaged in a cross-border dialogue with Switzerland on the border management of the Rhône. France envisages putting in place a coordinating body with Switzerland that can work on an agreement framework on the management of the Rhône. An important aspect of this collaboration will be on the management of the quantity and continuity of water flowing downstream.

Conclusion

This section's aim was to provide an overview of the main governance arrangements and actors in charge of the Rhône's disaster risk prevention and mitigation management. This section has delineated each actor's formal role and responsibilities, with a focus on establishing the facts. A number of observations can be made:

First, in terms of strategic frameworks the Plan Rhône and the basin-level disaster risk prevention management plan (PGRI) are effective instruments in determining flood risk priorities based on hazard and risk assessments at the basin level. Given the increased shift in responsibilities to the local level it is crucial that strategic frameworks are consulted with, translated to and co-owned by the local authorities, if they are to achieve actual results and induce changes on the ground.

Second, although many strategic frameworks exist for flood risk management, little has been done to create integrated risk management strategies, based on an all hazards approach and considering important interactive and cascading impacts between risks. Such a strategy could also be useful to improve the prioritisation of disaster risk prevention funding in the Rhône River basin. Although local level disaster risk prevention plans aim at establishing a local multi-risk strategy, such an approach could be equally useful for the elaboration of basin-level plans.

Third, there has been a wide recognition in the Rhône River basin that flood risk is best managed when resources are pooled and flood risk is managed across municipalities. A number of differently sized unions have emerged that have established effective and successful cross-jurisdictional collaboration. Unions have been effective in increasing the public's engagement and solidarity and should therefore be strengthened and reinforced in future reform programs.

Fourth, the high number of actors across levels of government has blurred the clear lines of responsibilities and ownership for risk management on the ground. This dynamic has led to the weak or sometimes fully absent maintenance of a number of protective infrastructures and has contributed to the increased vulnerabilities during recent flood events. The current reform processes are set out to address some of these issues.

Fifth, the absence of a single governance body at the Rhône River basin level has amplified the effect of fragmented governance structures. The Rhône river basin does not have a governance body that oversees the entire basin area. This has impeded the coordination of interests in disaster risk prevention investments between up- and downstream users as well as between the main river and its tributaries. Positive and negative externalities arise from flood risk prevention investments and if they are not addressed they can undermine the efficiency and effectiveness of disaster risk prevention investments. Similarly, at the international level, there is no governance body that can coordinate interests along the Rhône across national boundaries, although bilateral agreements with Switzerland are currently discussed.

Lastly, the ongoing territorial reform discussions envisage the local level to take the driver's seat in future disaster risk prevention management. This reform is laudable as it brings clarity of ownership and responsibilities and also determines the right functional level at which core disaster risk prevention interventions should be managed, namely the local one. It also comes as a direct and logical sequence of the increased responsibilities at the local level for disaster risk prevention since the regulatory changes in 2003. Nevertheless important accompanying measures need to be put in place to ensure local authorities will have adequate technical and financial resources to live up to their responsibilities.

In the following the objective will be to evaluate how each specific disaster risk prevention task (categorised in structural and non-structural measures) is approached by different actors and whether in practice the right incentives are in place for each actor to fully assume their roles, as well as to work together and coordinate tasks, assuming that hazards occur neither isolated, but often rather simultaneously, nor that they stop at local administrative or provincial borders.

Management of Structural and Non-Structural Disaster Risk Prevention and Mitigation Measures

Section Highlights

- The programmatic, bottom-up approach to central disaster risk prevention co-funding under PAPIs and PSRs has been particularly successful in rallying

subnational disaster risk prevention stakeholders to join forces in reducing flood risks and to jointly mobilise co-funding by the state.

- Although PAPI and PSR funding proposals for disaster risk prevention investments are evaluated against a set of criteria, priority so far seems to have been given on a first come first serve basis; instead of allocating funding to areas at highest risk this may have favoured those local authorities with stronger financial and technical capacities; allocation mechanisms could be further strengthened to better reflect equity concerns and different levels of exposure to risk.
- The territorial reform process puts inter-municipal bodies (EPCIs) in the driver's seat of disaster risk prevention, which gives clear ownership structures at the local level. Two challenges will remain: (i) in a traditional unitary state careful sequencing of reforms will be required to ensure that local level bodies will have time to acquire the necessary financial and technical capacities to fulfil their new responsibilities; (ii) the consolidation of responsibilities at the local level will not resolve conflicts arising from disaster risk prevention investments up- and downstream of the Rhône River and between the main river and its tributaries; complementary governance arrangements that ensure coordination may still be necessary at the basin level.
- Hazard maps build the core for effective flood risk management, the delineation of high risk areas through a national hazard mapping exercise is a very good practice; the same homogeneity and coherence in terms of hazard criteria should be applied to develop local level hazard maps across the same river system. Hazard maps in the Rhône River basin could also benefit from integrating multiple hazards and cascading impacts on e.g. critical infrastructure such as nuclear power stations.
- Although businesses and households have been mobilised through various disaster risk prevention activities in the Plan Rhône, awareness and as a consequence investments in self-protection remain rather low. A whole-of-society approach should seek to mobilise contributions from all disaster risk prevention actors to increase the effectiveness and the multiplying effect of public disaster risk reduction investments.

Flood prevention funding at the national level in France is mainly provided by the obligatory insurance-based CATNAT system and its Fund for the Prevention of Major Natural Risks (*Fonds Barnier*; see financing section for details). Eligible for using this fund are municipalities or inter-municipal bodies (EPCIs) that have a flood risk prevention plan (*Plan de Prévention des Risques*, PPR) and that have, based on this, developed a local level flood prevention action plan (*Programmes d'Action et de Prévention des Inondations*, PAPI) or the equivalent for coastal flooding or flash floods (*Plan Submersions Rapides* PSR¹⁰) that includes concrete project propositions for disaster risk prevention. The central level can co-finance up to 50% of the costs of prevention measures.

France has moved from a project- to programme-based funding for disaster risk prevention. The motivation for introducing PAPIs in 2002 - and later also PSRs - was to move away from a project-by-project funding mechanism to a more programmatic approach that bundles several disaster risk prevention measures in one action plan. This

should incentivise the proposition and financing of complementary measures, such as infrastructure investments alongside flood plain extensions or organisational measures such as risk awareness campaigns.

Management and implementation of structural measures

In recent years a paradigm shift has emerged calling for more room for the Rhône River. Originally, a considerable stock of protective infrastructure has been accumulated along the Rhône, with the first big dams constructed in the aftermath of the 1856 floods. Large areas of the Rhône River are so heavily protected by built infrastructure that they leave little space for new protective measures. A further limitation to increasing safety by physical protective infrastructure has been the limited utility of dams to retain water in the event of floods given the sheer size of the river.

As a consequence, in recent years the focus has changed towards prioritizing more room for the Rhône River. Maintaining and enlarging existing flood retention areas has thus become a key priority for disaster risk prevention investments in the Rhône River basin. This paradigm change has been embraced by the Plan Rhône.

Securing land as retention areas has been a major challenge in implementing this new paradigm. Firstly, it focuses on preventing the urbanisation of the land identified as retention areas that for a great part is currently in agricultural use. In the framework of the Plan Rhône, agricultural land has been identified for water retention purposes and farmers get support for disaster risk prevention measures to protect their livestock and machinery. In certain areas of the Rhône-Méditerranée outside the coverage of the Plan Rhône, a process of over flooding certain areas usually flooded during floods with the goal of optimizing its water retention capacity. In that case, the compensations aim especially at indemnifying the losses in harvest, as well as the damages to fields, material and livestock.

Decision making process

The need for a structural measure as part of a prevention action plan (PAPI) is identified by the project owner (*porteur de projet*), such as a municipality, based on technical surveys that are often conducted by private engineering bureaus. The project documents are then submitted to the deconcentrated regional service branches of the Ministry of Ecology, the Regional Directorate for Environment, Planning and Housing (DREAL). The DREAL can directly approve projects that cost less than EUR 3 million. For projects above EUR 3 million the DREAL has to send the proposals for evaluation by the central-level Joint Flood Commission (*Commission Mixte Inondation, CMI*), that consists of a number of central- and local-level stakeholders (see section III for a detailed description). Formally the final decision lies in the hand of the state, represented by the Ministry of Ecology, however the recommendations of the Joint Flood Commission are usually followed.

Financing is allocated based on an assessment of 12 criteria, including safety and economic efficiency. Economic efficiency is determined by a Cost Benefit Analysis that was introduced in 2011 and that includes all current project and longer term operational

costs (Box 6). Given the analytical constraints of this method, especially the difficulty of monetising all important costs and benefits, has proven to undermine a project's complete and thorough assessment. To allow for a better integration of all the possible costs and benefits of disaster risk prevention measure projects a new Multi-Criteria Analysis¹¹ tool will be implemented to overcome shortcomings experienced with Cost Benefit Analysis (CBA).

Box 3.6 Cost-benefit and multi-criteria analysis

The cost-benefit method described in PAPI project specifications provides for project promoters to follow a minimum range of criteria. The study must focus on the structural measures of projects, if they exceed EUR 2 million or 25% of the project. In terms of cost, it must consider both the initial costs as a whole from the time of the study until commissioning, and maintenance and operating costs over time. In terms of damage assessment, the method adopted involves assessing the average annual damage with or without planning in order to obtain the average annual damage avoided.

To achieve this, the minimum direct tangible damage must be assessed for four types of asset (housing, economic activity, agriculture and public infrastructure) and three flood scenarios (frequent, average – ~100 years – and extreme). The cost-benefit ratio will then be obtained by dividing the total discounted benefit by the total updated cost in the timeframe of the analysis, which must not exceed 50 years, and by using the discount rates established by the French planning authorities. This is referred to as the net present value (NPV). This calculation must be completed by a sensitivity analysis. This figure thus allows the economic efficiency of a project to be determined. It also enables several development options in the same basin to be compared.

It is, however, more difficult to use to compare projects in different basins, since the methods involved are generally too dissimilar. In order to also factor in the more intangible impacts highlighted by the Floods Directive in particular, the Ministry of Environment developed a multi-criteria analysis method to complete the cost-benefit analysis. This method considers impacts on human health, the environment or cultural heritage without having to monetise them. Some 20 indicators were thus defined, and a guide for project managers is has been drawn up (published in July 2014).

Source: OECD (2014)

Central-level steering for large disaster risk prevention projects needs to ensure equitable allocation of available resources. There is a clear advantage of having a central decision making process for large disaster risk prevention projects to ensure that high risk areas across the country are identified and addressed accordingly and that funds are distributed in an equitable manner. Despite the catalogue of criteria that has been elaborated funding allocations have tended to be made on a “first come first served” basis. This has certainly been enabled by the fact that available funding at the beginning of the PAPI funding process more or less equalled the demand for projects that needed funding. However this process cannot be sustained in the future, for two main reasons:

- First central-level funding is projected to become more constraint, since demand for disaster risk prevention investments will rise as more areas will be in the position to present a PAPI. This will necessitate the application of stringent evaluation criteria and a clear and transparent prioritisation process.

- Second the current process gives rise to considerable inequities. Instead of favouring the allocation of funds for the areas most exposed to risks, it has favoured disaster risk prevention investments on a first come serve basis. For those areas where the determination of local priorities and negotiation among interest groups has taken more time funding will become much more difficult and competitive to obtain in the future.

The balancing of interests up- and downstream, but also between the main river and its tributaries is crucial to ensure equity in disaster risk prevention management. The programmatic approach to deciding on disaster risk prevention funding allocation has been effective in rallying local level stakeholders to draw up a disaster risk prevention action programme (PAPIs or PSR), often across municipalities. However, the approach has not addressed the challenge of balancing interests of those communities upstream that may for example invest collaboratively in protective infrastructure and others that may gain further downstream without contributing to its financing. That is a challenge that for example a union upstream of Lyon (*Syndicat du Haut Rhône*, SHR) has been confronted with. The Plan Rhône could envisage the development of a PAPI that covers the entire area between Lyon and the Rhône's Delta or at least a way to coordinate existing PAPI's with a view to balance interests, but without a governance body in charge of the entire basin area this type of larger scale collaboration among interests along the river will be difficult to achieve.

Operating and Maintaining Structural Measures

Operating, maintaining and rehabilitating protective infrastructure is as crucial as their construction. The Rhône River basin, as many other areas in Europe, has had to witness key weaknesses in the existing infrastructures during recent flood events. The 2003 floods of the Rhône saw several dike breaches that aggravated the negative socio-economic impact. Inadequate maintenance does not only lead to failed protection, but can also increase the negative consequences of hazardous events by producing unexpected cascading impacts.

In France, the responsibility for operations and maintenance of protective infrastructure has been a shared one. Responsible at the state level has been the Ministry of Environment. At the department level under the control of the prefect the water police has been in charge of inventorying hydraulic works and of classifying them according to the assets that they protect. At the regional level the regional deconcentrated services of the environment ministry (DREAL) have been in charge of monitoring this task, under the supervision of the regional prefect. Figures indicate that across France the state has managed 750 kilometres of dikes¹², local authorities 3700 kilometres and other organisations (such as unions, associations etc.) manage some 4700 kilometres. Even for dikes where the state has not been the official owner it still has a duty to oversee the maintenance work, which is usually assured by its deconcentrated services (DREAL).

At present a significant heterogeneity in the level of maintenance of existing protective infrastructure can be observed in the Rhône River basin. Of the river's 1000 kilometres of dike infrastructure 57% are managed and well maintained by the National

Company of the Rhône (*Compagnie Nationale du Rhône*, CNR) and 21% by the SYMADREM union (*Syndicat Mixte Interrégional d'Aménagement des Dignes du Delta du Rhône à la Mer*). The remaining 22% are not clearly owned and maintained by anyone (Table 3.6). The dikes managed by the CNR are recent whereas the dikes that are not well maintained are old ones built in the middle of the 19th century. The level of protection they had been designed to provide also differs. While CNR dikes are prepared to deal with flood events of 1000 years return period, the others have a maximum protection level of 100 year return period floods. The dikes managed by the CNR were not actually built primarily to protect from flooding but rather to manage hydro power production.

Table 3.6 Management of dikes of the Rhône River basin

Dikes managed by...	... km of dikes managed	% of total
CNR	570	57
SYMADREM	210 (+ 25 along the sea)	21
"Orphaned and otherwise managed dikes"	220	22

Source: Bravard and Clémens (2008)

Several contributing factors can help explain the significant difference in the level of maintenance of protective infrastructure:

- The initial project funding by the central government does not include coverage of the future maintenance costs of the infrastructure. Instead this is expected to be covered by the local level, which is the designated owner of the infrastructure.
- Different levels of local capacities have led to heterogeneous maintenance outcomes. In areas where a strong union or other type of organisation (such as the National Company of the Rhône, CNR) has taken charge of maintenance works the protective infrastructure tends to be in better shape than in areas where no such equivalent exists. Unions thus have a significant leverage effect on bundling resources and technical capacities to ensure adequate maintenance.
- Local ownership of infrastructure has not always been clear-cut. Over time a considerable stock of protective infrastructure has accumulated that was built in different periods and under different regulations. As a result there is a significant stock of infrastructure that is not officially owned by any municipality, inter-municipal body or union. As a consequence these infrastructures have degraded and can no longer be expected to provide the level of protection for which they were originally designed.

The ongoing territorial reform process, especially the law on the management of aquatic environments (GEMAPI¹³) provides a clear guidance for solving the existing problem. GEMAPI prescribes a clear responsibility of operations and maintenance of protective infrastructure that is to be given to inter-municipal bodies (EPCIs) that can in turn contract for example unions to carry out the work. GEMAPI can thereby clarify

ownership questions of existing, including “abandoned”, dike structures. In doing so there could be a risk that currently engaged actors feel no longer in charge, which risks losing valuable existing capacity. It is important that the re-structuring of responsibilities is coupled with the necessary financial capacities. Although GEMAPI introduces a new tax raising power for local authorities (ca. EUR 40 per person per year) a large finance gap could arise as local authorities may face constraints in imposing an additional tax and unions may begin to compete for potential funding raised through the tax.

In the meantime, a number of local initiatives have started to address problems of inadequate maintenance in the Rhône River basin area:

The *Syndicat du Haut-Rhône* (SHR), in line with the national laws regulating hydraulic works’ operations and maintenance, has recently conducted a survey, with support of the Plan Rhône, to establish the current ownership of each structural measure upstream in the Rhône and, in its absence determine the operator that will take charge of the infrastructure in the future. Similarly the DREAL Rhône-Alpes financed a study carried out in Donzère Mondragon by the local union (SIAGAR) to study the functioning of protective measures not belonging to the *Compagnie Nationale du Rhône* (CNR). This study gave an important impetus to major renewal works of structural measures.

As part of the Plan Rhône the DREAL Rhône-Alpes has been dedicated to the securitisation of the protective infrastructure of the delta sector of the Rhône. This has been carried out through the *Pré-schéma Sud* approved in 2006 and adopted also in the flood risk management scheme of the downstream Rhône in 2009. This scheme is implemented by the *Syndicat Mixte Interrégional d’Aménagement des Dignes du Delta du Rhône à la Mer* (SYMADREM). An innovative practice that comes out of that work is a database created by the SYMADREM that catalogues all existing protective infrastructure (called SIRS-dike¹⁴), including inspection observations to optimise monitoring of structural measures.

To counter the arising local technical capacity gap the catalogue that was developed on the construction, operations and maintenance requirements by the MEDEE and in collaboration with multiple stakeholders can guide regional and local efforts (MEDEE, 2015).

Cross-jurisdictional collaboration

Given its large number of municipalities France has recognised the importance for cross-jurisdictional collaboration. The creation of inter-municipal collaborative bodies (EPCIs) has been an attempt to address local public policy issues at a functional scale, to maximise efficiency and economies of scale.

With the creation of the Flood Prevention Action Programs (PAPIs and PSRs) flood risk management has been addressed jointly by municipalities that are part of the same risk area and that jointly develop an action programme that has received priority funding through the central Barnier Fund.

The new territorial reform enhances cross-municipal collaboration, but it does not necessarily address flood risks at a functional scale. To enhance flood risk management across municipal borders the GEMAPI law places EPCIs in the driver's seat for local disaster risk prevention by giving them, among others, the ownership of protective infrastructure as well as the responsibility for maintaining them. This provision will be made mandatory starting from 2018. However, GEMAPI may continue to address disaster risk prevention problems at an administrative rather than a functional scale. Equally, without anticipating the structural governance reform, GEMPAI will not solve some important flood risk governance issues, such as balancing interests up- and downstream of the Rhône River and between the main river and its tributaries.

The role of the private sector, critical infrastructure providers and citizens in providing protective infrastructure

With regard to structural measures the electricity provider EDF and the *Compagnie Nationale du Rhône* (CNR) have and will support the financing of structural measures to be implemented under the Plan Rhône. For the next financing period of the Plan Rhône the EDF will contribute approximately EUR 11 and the CNR EUR 8.5 million respectively. These amounts correspond more or less to the financing of measures protecting industrial areas. Apart from the Plan Rhône industrial companies have invested in protective measures to protect their assets without benefiting from public financial support.

The role of the CNR as a potential key investor in flood risk prevention has not been fully embraced. As described earlier the CNR has been investing in flood risk prevention infrastructure without this being directly its mandate. The CNR's core mission is to produce hydro power, but its works especially in terms of securing its dams is at the heart of flood risk management of the Rhône. The CNR's important role has to be fully embraced and requires a close collaboration between basin level and other local actors to ensure the right measures are implemented, especially in the event of a flood (e.g. adjusting discharge rates). For the time being the CNR participates in measuring discharge rates and monitoring flood risk.

Generally speaking citizens have invested very little in their self-protection and financial support does not seem to be the only impediment. In the Rhône River basin a number of surveys demonstrated that few citizens invest in self-protection measures against natural hazards. The reasons given by survey respondents is most often that they think they are not concerned by suggested prevention measures of the Risk Prevention Plan (PPRI) and many believe the suggested measures may not be effective. Only some survey respondents mention money has been the barrier to their investments in self-protection.

How are non-structural measures managed?

Hazard assessment and mapping and land-use planning

France's hazard mapping results in the development of so-called Prevention Plans against Natural Risks (PPRNs). Those plans delineate hazard zones, regarding

earthquakes, floods, avalanches, wildfires or landslides. To evaluate flood risk PPRNs take obstacles into account that could prevent the river to flow, including in rivers' retention zones. Sometimes maps are renewed on the basis of a new risk prevention plan (PPR), after a major hazard event justifies a re-zoning or if major socio-economic changes necessitate an expansion of the existing maps to take into considerations new developments. Hazard maps are not adjusted once protection measures are built; thereby new constructions behind protective infrastructures are discouraged.

Hazard maps can be accessed by the public¹⁵. The public, as well as local authorities and other stakeholders, are implicated in the hazard mapping process by being consulted in public meetings and by responding to surveys conducted after the consultation meetings.

The responsibility for risk hazard mapping lies in the hands of deconcentrated arms of the Ministry of Ecology. PPRNs have to be drawn under the auspices of the department prefect, either at the municipal or inter-municipal level. The deconcentrated services of the ministry at departmental level (DDT(M)), supported by their regional services (DREAL), carry out hazard mapping. The actual mapping is often outsourced to (public) engineering bureaus and afterwards controlled by various stakeholders. It has happened that counter-assessments have been requested. Finally the DREAL verifies the adequacy of maps developed. This ensures that maps are developed impartially and are technically accurate.

Since the responsibility for hazard mapping is not fully centrally guided, heterogeneity in the quality of hazard mapping exists, impeding comparability across existing hazard maps. Given that hazard mapping is a local responsibility it can happen that along one and the same river one finds different specifications in hazard mapping. For example, in accordance with the national doctrine, a part of the river's hazard maps may be based on flood events with a return period of 100 years, whereas other parts, where more extreme events have happened, are based on longer return periods of up to 200 years. This essentially leaves the maps along the same river hardly comparable. Taking this into account, methodological work was conducted in partnership with departmental stakeholders in order to develop a hazard map based on homogenized water levels and data. With the implementation of the EU Flood Directive France carried out a national flood risk assessment based on which 122 areas of important flood risks (HRAs) have been identified and for which maps have been established identifying all hazards. These maps have been developed at the national level, with the help of sub-national service arms (DREAL, DDT(M)). The hazard mapping exercise carried out for the Rhône River basin identified six High Risk Areas (HRAs) from a national perspective, which include Lyon, Vienne, Valence, Montélimar, Avignon and the plain of Tricastin as well as the Rhône delta. Based on this national identification process six detailed hazard maps were developed. Both national and regional mapping exercises can be accessed online¹⁶.

There are several instruments that aim at integrating hazard maps in land use decisions. To integrate hazard mapping in spatial planning decisions, the spatial development code obliges local authorities to take into consideration hazard maps in their spatial planning documents, the so called *Schéma de Cohérence Territoriale*, the *Plan*

Local d'Urbanisme (PLU) and the *Carte Communale*. The Risk Prevention Plan (PPR) has to be annexed to the local planning documents. This allows making zones either unfit for construction or developable under certain prescriptions. Penalties can be given if such prescriptions are ignored and discovered during control visits. These control visits can be carried out by the prefect, the mayor or his delegates as well as officials and commissioned agents of the ministry in charge of urban development. These control visits can be carried out up to three years after constructions were completed. A stronger integration yet of hazard zones in planning decisions has been achieved through the Flood Risk Prevention Plans (PPRIs) that create a hard constraint on constructions in hazard zones. Whereas previous annexations of hazard maps to planning documents was rather loose, the PPRIs clearly designate areas that are unfit for construction. The PPRI should thereby leave no more room for ambiguity, at least in those municipalities that have a PPRI.

The responsibility for respecting hazard zones in land use decisions lies with mayors, whereby department prefects have a monitoring function. The mayor has the responsibility of informing the population of existing hazards and risks. The mayor is in the driver's seat of enforcing hazard zones in land use decisions the mayor is in charge of granting construction permits. The department prefect is in charge of monitoring the integration of hazard zones in urban planning and can launch a legal procedure against a municipality at the administrative tribunal if (s)he has doubts about whether hazard zones were respected in granting a construction permit. The prefect can impose works to protect planned constructions from hazards or call a project off if it is suggested to be built in a high risk zone.

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 and some of them directly linked to the granting of construction periods in known zones at risk¹⁷. 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.

Regions have a monitoring role and can positively encourage the integration of hazard zones in local land-use decisions. Regions are in charge of developing regional spatial plans. They can exercise their oversight role by encouraging mayors to respect hazard zones when taking land-use decisions. The region of *Provence-Alpes-Côte d'Azur* for example sees it as its role to ensure that no new constructions are built in risk prone zones, including for example behind new protective infrastructure. The challenge though for the region seems to be avoiding additional constructions to existing building stock in areas at risk.

For the Rhône River basin it would be desirable to not just have high risk areas delineated through a general mapping exercise, but to also strengthen the efforts to ensure more homogeneity and coherence across the local hazard maps that are being developed. Hazard maps build the core of effective flood risk management and it is therefore of key importance to ensure the same hazard mapping criteria and models as well as the same hazard criteria or levels of intensity of projected hazard events.

Hazard mapping for the Rhône should eventually be expanded to include the potential impacts of climate change on the local level, but also to better understand the cascading impacts and resulting complex risks emerging from the concomitant occurrence of hazardous events. This includes studying not only the impacts of one natural hazard on another (such as landslides and floods) but also the impact of for example floods on critical infrastructure such as nuclear power stations or an ensuing tsunami as a result of an earthquake.

It would be desirable to have clear prescriptions in terms of building codes in hazardous areas for all hazards. Clear building code regulations exist for different levels of assessed seismic risks. Building code consequences for other risks are less clear.

Risk Communication

General responsibility for informing about natural hazards and increasing risk awareness lies within the department through the *Dossier Départemental sur les Risques Majeurs*. Mayors are obliged to publish risk information documents in the city hall, which includes the risk prevention plan (PPR) and the local community information documents about major prevailing risks (DICRIM – Box 3.7).

Risk awareness in the Rhône River basin seems rather low. Following the large downstream floods in 2003 the DREAL Rhône-Alpes decided to launch regular risk awareness surveys, which have been conducted in 2006, 2009 and 2013. The surveys show that in the absence of major floods risk awareness is relatively low: Only 18% of the population in risk zones took measures to self-protect them, against 21% in 2009. Reasons provided for this low engagement are varied. 36% of respondents do not see themselves as concerned by this, 17% thought that such preventive measures would be ineffective and only 5% give financial constraints as a reason for not having invested in individual disaster risk reduction measures. These developments show the difficulty of establishing a culture of risks and underline the prevailing notion that disaster risk prevention is the sole responsibility of the state and not of individual actors (DREAL, 2013).

The DREAL Rhône-Alpes through its *Mission Rhône* supports risk communication activities in various ways. First it supports and engages in more traditional ways of communication such as the organisation of risk exhibitions or newspaper information campaigns. More innovative actions include a project call for creating a culture of risk in 2008-09 as well as a photography campaign of the Rhône River. It has also been dedicated to publishing research studies, providing website information and engaging in consultations for the flood risk pillar of the *Plan Rhône*.

Risk awareness is not only key to make sure all actors have the information they need to act individually to invest in self-protection, but also to ensure people are aware about why for example a tax is raised locally to finance prevention measures. This is key to forming acceptance, for example for local revenue raising measures for disaster risk prevention investments, such as the introduction of local taxes through GEMAPI.

Box 3.7 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 to reduce their exposure and potential damages. The DICRIM recognizes that the local administrative boundaries may not reflect the right scale for analyzing 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>

Business continuity planning

The DREAL has initiated actions to increase the resilience of public services and critical infrastructure providers. In some initial experiments two health facilities, a clinic and a medical centre near Valence have engaged in evaluating their business continuity in case of a flood event. Based on this measures have been identified to increase their resilience as part of a business continuity plan.

Similarly a number of water energy and transport providers have engaged in working groups on business continuity planning with a view to identify potential vulnerabilities and creating an action plan.

Business continuity planning has also been introduced in the agricultural sector, where losses due to natural disasters have been more important in the Rhône River basin than in other basin areas such as for example the Loire River basin. Disaster risk prevention and mitigation measures for agricultural land do not only aim to secure agricultural livelihoods, but are also an important part of conserving agricultural land as flood retention areas. Since farmers have no access to conventional prevention funding under PAPIs and PSRs special disaster risk prevention and mitigation activities have been supported by the Plan Rhône (Box 3.8).

It will be important to mainstream these initial actions across all critical infrastructure providers and business in the basin area. The pilot introduction of disaster risk prevention and mitigation measures for critical infrastructure providers and

businesses at large are an ideal opportunity to evaluate the effectiveness of proposed measures and to improve actions as they are being mainstreamed.

Box 3.8 Measures to making agricultural activities flood resilient in the Rhône River basin

The 2003 floods of the Rhône caused so significant damages to farmers that some of them had to shutter their businesses. Given the importance of agriculture in the Rhône River basin for securing livelihoods but also its importance for providing important flood retention areas, the Plan Rhône introduced a diagnostic instrument to assess farmer's vulnerability to floods as well as preventative measures they could undertake. This exercise was inspired by the Plan Loire that recognised the importance of raising awareness of farmers that their agricultural land serves as an important flood retention area, thereby discouraging them from building dikes to protect their assets.

The DREAL Rhône-Alpes assessed some 230 farmers in the first pilot phase based on which 85 farmers decided to put prevention measures in place. Investments were co-financed at a maximum rate of 80%. Measures included:

- The installation of new and more effective water pumps (while inhibiting the purchase of bigger pumps that could increase productivity);
- Moving air conditioning for refrigeration from underground to higher ground;
- Building of a safe zone where important machinery (such as tractors) could be stored in the event of flooding;

Finally, the DREAL Rhône-Alpes seeks to encourage farmers to put measures in place that avoid erosion (such as by planting grass), but the DREAL is in no position of mandating farmers to do so.

Source: <http://www.planrhone.fr/front/277-252-0-Reduire-la-vulnerabilite-des-exploitations-agricoles>

Risk Management Financing Section Highlights:

- It is difficult to establish figures indicating the total amount of investment for disaster risk prevention on the national level, but also on the Rhône River basin level, across levels of government and across different sectors.
- The CATNAT obligatory disaster risk insurance scheme is an important solidary mechanism in France's risk financing system. The CATNAT insurance premiums are paid by each contributor independent of their risk exposure, which has disincentivising effects on individual disaster risk prevention efforts. Complementary policies should be considered that support individual households and businesses in investing more in self-protection measures. This could increase the efficiency and effectiveness of public investment in risk reducing measures.
- Although until present the available funding from the Barnier Fund was sufficient to cover the demands from local authorities for co-funding of protection measures, this is expected to change in the near future as more funding requests will be made based on the wider adoption and elaboration of disaster risk prevention plans. Considering that sub-national co-funding rates have been quite considerable already (around 60%), other options and sources of additional financing may have to be explored.

- The territorial reforms require sub-national authorities to be in charge of not only managing but also financing considerable disaster risk prevention tasks, such as maintenance of protective infrastructure. The ongoing reforms need to ensure sufficient funding for sub-national actors for co-financing disaster risk prevention investments through the Barnier Fund. A thorough disaster risk prevention financing mechanism has to be elaborated to ensure the reform can at least maintain, if not increase, the level of disaster risk prevention in France and of the Rhône basin in particular.

France's main natural catastrophes compensation & disaster risk prevention funding scheme - CATNAT

The natural catastrophes compensation scheme CATNAT (*Catastrophes Naturelles*) builds the core of France's risk financing system. 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 (Barnier Fund):

The CATNAT insurance scheme is a public-private partnership inscribed in France's constitutional principle of solidarity. The CATNAT scheme was established in 1982 to offset shortcomings of the insurance market by making insurance available to cover all individuals and businesses against disaster risks. It does not cover losses suffered by municipalities through destroyed infrastructure. The scheme is funded by an additional premium at a mandatory uniform state-fixed rate, which applies to any insurance contract for damage to or loss of property, irrespective of its exposure to natural disaster risks. Its proceeds go to the CATNAT reserve and a state guarantee is provided by the Central Reinsurance Fund (*Caisse Centrale de Réassurance, CCR*).

The CATNAT insurance scheme has proven its effectiveness since its foundation. The CATNAT has allowed broad coverage and compensation for disaster events where a state of emergency was declared. Disputes and appeals have not been common, and civil society stakeholders and insurers agree on the usefulness of the mechanism. Initially established at 2.5%, the premium has now risen to 12% for all-risk home and business insurance and 6% for motor vehicle insurances (Gislain-Létrémy and Calvet, 2012). The CATNAT covers insured assets only. This excludes damages to public assets, as well as damages accrued by people that are not insured. In Metropolitan France 99% of assets are insured, whereas only 52% of assets are insured in France's oversea territories. Insured losses are only a part of total economic losses. It is estimated that insured assets make up 50-60% of disaster-related economic losses (EPRI *nationale*).

The CATNAT insurance scheme by its design also has a number of shortcomings. The lack of insurance premium adjustment in line with risk levels creates moral hazard by discouraging insured parties to reduce their exposure or vulnerability to natural hazards by investing in self-protection measures such as securing cellars or house walls against floods. Similarly, prevention efforts by individuals are not rewarded by lower premiums.

In addition, the too-frequent triggering of the mechanism, even for events with a low recurrence interval of up to a mere ten years, hinders prevention measures (French Senate, 2012; OECD, 2006). This system, initially envisaged for extreme events, deludes the public and decision makers into assuming that they can take advantage of it irrespective of the circumstances. These consequences have brought about a number of minor modifications to the system and many recommendations over the years, plus an unsuccessful bill drafted to overcome its failings.

To back the CATNAT insurance scheme a wholly state-owned reinsurance, the CCR, was established as a state guarantee to fund compensation in extreme events. Despite its substantial reserves, the CATNAT resources could be heavily restricted by two other major risks in metropolitan France: a major flood of the Loire (OECD, 2010) or an earthquake on the Côte d'Azur. In that event, the call for the state guarantee could then come into play. The state guarantee was used following multiple natural disasters in 1999. This led to the additional insurance premium to be raised from 9% to 12%.

Apart from serving as an insurance fund the CATNAT has since 1995 funded France's core Fund for the Prevention of Major Natural Hazards (*Fonds de Prévention des Risques Naturels Majeurs* FPRNM), or short *Fonds Barnier* (Barnier Fund). A fixed percentage of sums collected has since been retained to provide funding for disaster risk prevention investments. The *Fonds Barnier* thereby has the advantage of being disconnected from direct state budget resources. Initially established at 2.5% of the total additional premiums collected via CATNAT, the 2003 Bachelot Law allowed this rate to be adjusted by decree, which led to its gradual increase to 4%, 8% and at present 12%. EUR 185 million have been retained (Figure 3.9) through this contribution.

The Barnier Fund became the principal instrument for co-funding disaster risk prevention measures proposed by sub-national government levels. The Barnier Fund has been used to fund the drawing-up of disaster risk prevention plans (PPRs) and structural as well as non-structural, organisational measures against (coastal) flood risks. It generally involves co-funding from local authorities, with a fixed rate by type of activity ranging from 100% for preparing PPR-type regulatory instruments or departmental documents on major risks, and 40-50% for all other measures.

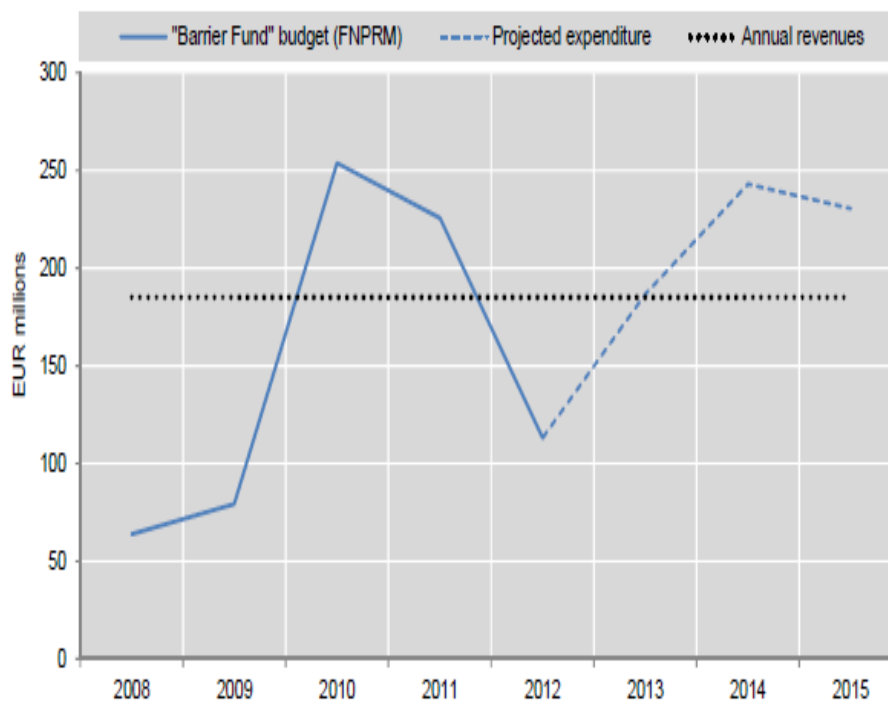
The system's strength lies in the reliability of its funding, but fund disbursements have been more variable. Although the Barnier Fund has consistently retained EUR 185 million for disaster risk prevention investments, disbursement rates are variable as they depend both on recent disasters and on public prevention policy guidelines. The variations in disbursement are shown in Figure 3.9. To continue fulfilling the CATNAT's double function of insurance compensation and prevention funding it has been projected by the Ministry of Economy that its reserves will eventually require higher contributions.

It seems that the level of damage compensation has remained constant over the past 20 years. This takes into account new constructions. This shows that prevention investments have been somewhat effective in reducing damages over time.

A financing gap for disaster risk prevention measures may arise in the next years. To date the central level Barnier Fund has been big enough to finance all project proposals

that were received. It is projected though that in the current phase of financing that lasts until 2022 demand for central level financing will exceed the Fund's capacities to finance projects. This will necessitate either an increase of insurance contributions that feed the central Fund or a higher number of projects whose proposal for funding will have to be declined. The Joint Flood Commission (CMI) will have to ensure that only projects focusing on flood risk prevention will be financed through the Barnier Fund and refuse projects, like they did in the past already, whose flood risk prevention focus is only a minor aspect of the project proposal. Furthermore rigorous selection criteria will have to be applied to enable a clear prioritisation of project proposals.

Figure 3.7 Development of the Barnier Fund budget and forecast, 2008-2015



Source: OCDE (2014), "Seine Basin, Île-de-France, 2014: Resilience to Major Floods" OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264208728-en>.

Co-financing arrangements

The calls for proposals under PAPI and PSR have put local authorities in the driver's seat for initiating disaster risk prevention investments. As highlighted earlier, contracts between the state and local authorities (*Contrats de Plan État-Région*, CPER) enable local flood risk protection funding to be mobilised in tandem with central state funding. For natural hazard risk management such co-funding agreements can be established during the development of Disaster Risk Prevention Plans (PPRs) and Flood Risk Prevention Action Programmes (PAPIs or PSRs) at basin level and via the major river plans at catchment level, including the departments and regions and their different groupings.

Financing of the Plan Rhône

The major river plans, including the Plan Rhône, use the state-region contracts to mobilise local and state level financial contributions for the implementation of the plan. The Plan Rhône seeks complementary funding from the European Regional Development Fund (ERDF), which are funds dedicated to support collaboration on watercourse planning and flood risk prevention in particular.

The Plan Rhône was a key instrument to leverage funding for flood risk prevention among regional and local interest groups. In the period of 2007 to 2013 EUR 137,2 million of the Plan Rhône financing were dedicated to structural measures, of which the majority (EUR 128 million) went towards the implementation of the *Pré-schéma Sud*. The central government co-financed EUR 41 million and gave budget loans over EUR 12.7 million. For the next financing period (2014-2020) EUR 223 million will be invested in disaster risk prevention management, of which EUR 76 million will be financed by the central government, EUR 60 million from the region Provence-Alpes-Côte d'Azur, EUR 13 million from the region Languedoc-Roussillon, EUR 8.5 million from the CNR (and EUR 11 million from the electricity provider EDF).

Table 3.7 Plan Rhône financing from state-region contracts and EU 2007-2020

	Total (in EUR million) 2007-2013	...of which	Total (in EUR million) 2014-2020	...of which
State-Region Contracts	613.8	State: 228.41 Regions 200.44 CNR: 185	849	State: 170.31 Regions 153 CNR: 200 EDF: 65
EU funding 2007-2013	33.8	-	32.01	-
Total funding flood risk prevention	321.1		259	

Sources: Document de préfiguration du contrat de plan interrégional état régions plan Rhône 2014-2020 [Blueprint for the interregional state region plan Rhône 2014-2020], http://www.planrhone.fr/module/00003/19/data/Files/ACTUS2014/Actu_2/CPIER/Projet_cpier_Plan_rhone_2014_2020.pdf; *Projet de Contrat de Plan Interrégional État Régions Plan Rhône 2015-2020* [Contract Project of the interregional state region plan Rhône 2015-2020], http://www.planrhone.fr/module/00003/19/data/Files/ACTUS2014/Actu_2015/Projet_Cpier20152020_15042015.pdf; *Contrat de Projets Interrégional Plan Rhône 2007-2013* [Contract Project of the interregional state region plan Rhône 2007-2013], <http://www.datar.gouv.fr/sites/default/files/datar/plan-rhone-2007-2013.pdf>; *Objectif compétitivité régionale et Emploi, Programme Opérationnel Interrégional FEDER Rhône Saône 2014-2020* [Regional competition objectives and employment, Interregional Programme Feder Rhône Saône 2014-2020], www.europe-en-france.gouv.fr; *Objectif compétitivité régionale et Emploi, Programme Opérationnel Plurirégional FEDER Plan Rhône, 2007-2013* [Regional competition objectives and employment, Interregional Programme Feder Rhône Saône 2007-2013], http://www.planrhone.fr/data/Files/Plan_rhone/POPMODIFVALID_mai2014.pdf; *Accompagnement du volet inondations 2007-2013* [Flood support component 2007-2013], http://www.rhone-alpes.developpement-durable.gouv.fr/IMG/pdf/AP_Valorisation_BDT-20-06-2010_cle749a5e.pdf

The Rhône River basin receives a large share of central level funding, albeit a high sub-national co-financing rate. Three calls for programmes have been launched since the

introduction of PAPI's, with the first one in 2003. An audit report in 2009 showed that of the total of EUR 884 million spent during a first financing phase, 60% were co-financed by sub-national authorities. Figures for the Rhône suggest a co-financing rate that is slightly above this average. Of the EUR 739 million that were invested during the first phase of PAPI projects in the Rhône River basin EUR 268 were funded by the central fund. This corresponds to a co-financing rate of the sub-national level of 64%. In the second phase 18 PAPIs were financed for a total of EUR 329, of which EUR 128 million were funded by the state. This corresponds to a sub-national co-financing rate of 61% (DREAL Rhône-Méditerranée, 2013). These figures demonstrate that a large share of the central level funding for flood risk prevention was allocated to the Rhône River basin.

Who bears the cost in the aftermath of a disaster?

By looking at the 2003 floods of the Rhône (that occurred downstream of Lyon), Figure 3.7 (in section II) shows that half of the total estimated damages accrued to individual households. Of these damages, it seems only half of them got compensated by insurance. This figure seems relatively low and on average one would expect the damage compensation of households to be at least 60-80%. A significant amount of costs to households are temporary relocation costs, which are not covered by insurances. They could explain, at least to some extent, why the insured costs make up a lower share of the total costs accrued to households. Temporary relocation costs are often covered by local authorities, rather than households themselves.

When looking at France's overall level of disaster risk insurance penetration, it looks like more than 95% of private assets are insured in metropolitan France (FFSA, 2013), which contrasts with 52% in France's oversea territories. How much is compensated in terms of damages suffered by a household depends on the clauses of the insurance contract.

Assessment & Recommendations

The Rhône River basin is one of France's largest river systems. Due to its size it covers a wide range of different topographies and diverse climatic conditions. These make the areas around the river subject to a variety of natural hazards, including river and coastal floods, torrents and sediment movements, storms and storm surges, but also earthquakes are a potential threat.

The Rhône River basin accounts for a major share of France's economy, with two thirds of hydropower supply and one fourth of nuclear power produced in the area. It is estimated that around 5.5 million basin inhabitants are potentially exposed to the risk of flooding. Critical infrastructure and industrial sectors located in close proximity to the river make a potential flood a critical risk for France. six of the 16 identified areas of high flood risk of national importance are located in the basin area of the Rhône.

The Rhône's flood risk prevention management has a long history, with some of its major structures established as early as 1856, in response to devastating floods. Although flooding and related events have been relatively frequent along the Rhône, a large-scale flood comparable to the one of 1856 has not occurred in the recent past. This makes it

important to assess whether current disaster risk prevention levels are sufficient to confront similar such events that are expected to take place in the future.

Identification and monitoring of current and future risks

Hazard maps build the core for effective disaster risk management. There is a relatively good understanding of the nature of different prevailing threats in the basin area of the Rhône. France's effort to identify areas of particularly high flood risk has also informed the identification and prioritization process in the basin area of the Rhône that includes 6 of the 16 identified national high flood risk areas. It would be desirable to apply the same homogeneity and coherence in terms of hazard evaluation criteria for the development of local level hazard maps across the Rhône river system. To improve hazard maps in the Rhône River basin further, it would be helpful to assess the potential concomitance of hazards in the same areas, including their potential cascading impacts on critical infrastructure such as nuclear power stations.

To refine hazard models and maps over time, and to inform future effective disaster risk prevention and mitigation policies, it is crucial to understand the socio-economic impacts of past disasters. This information also serves as a key variable in assessing the effectiveness of disaster risk reduction investments over time. Although some detailed estimations of socio-economic losses have been recorded such as for the 2003 flood events, the basin area of the Rhône could benefit from more systematically recording social and economic losses of disasters. France has a long-established insurance and re-insurance system to compensate for losses and damages from disasters accrued by individual households and businesses. Recorded insured losses can be an important starting point to eventually get a better understanding of total direct economic, and eventually also indirect economic losses in the basin area. To improve this evidence base for the Rhône, collaboration with national and regional public and private sector partners already active in this field could be useful.

Legal and institutional frameworks for disaster risk prevention management

France's risk governance system has been tested during a number of major natural disasters. Past lessons learned informed reforms aiming at improving the national disaster risk prevention management system. As many other countries' disaster risk prevention governance frameworks, France has set-up one that is guided by solidarity on the national level, which the national compensation scheme CATNAT represents, for example, and subsidiarity across levels of government, whereby local level actors are in charge of identifying locally prevailing risks and developing local prevention action plans. France has also recognised the importance of managing risks at the appropriate geographical or functional level, which led to the development of its great river plans, including the Plan Rhône.

Over time however, a complex web of national and sub-national actors has emerged that has blurred the lines of responsibilities. Fragmented governance arrangements at the sub-national level have contributed to the heterogeneous protection levels one can observe across the Rhône River basin, which have been made apparent during recent major flood events. The ongoing territorial reforms of France could help regrouping many

of the more fragmented sub-national actors and efforts to maximise the pay-offs of sub-national and national disaster risk prevention efforts, while strengthening the ownership of disaster risk prevention actions by direct beneficiaries, thereby improving accountability of the responsible actors to their citizens.

The ongoing reform process, which aims at increasing the level of decentralised functions for flood risk management may face several challenges that need to be addressed, if the reform were to yield its expected outcomes. In a mostly unitary tradition, subnational actors that will receive more flood risk management responsibilities may not all have the technical and financial capacities in place today to fulfil their new duties. The reform should therefore allow for sufficient time in the transition process to acquire the necessary capacities to fulfil their new roles, as well as take into account the possible political economy obstacles that could arise with new, albeit limited, revenue raising authority by sub-national actors.

The strategic framework provided by the Plan Rhône has been an effective and successful instrument to integrate economic development and flood risk management, bringing all relevant actors together to work on commonly agreed priorities, supported by consolidated financing across levels of government. However, the absence of a governance body for disaster risk management questions for the entire river basin reinforces the challenges of balancing interests across different parts of the river. The ongoing territorial reform that seeks to regroup local jurisdictions will not solve cross-jurisdictional conflicts arising from negative and positive spill over effects of disaster risk prevention investments up- and downstream of the Rhône River, but also between the main river and its tributaries. Further governance or coordination mechanisms that aim at covering the entire river or basin area could be useful.

Managing structural and non-structural measures to foster disaster risk prevention

The programmatic, bottom-up approach to central disaster risk prevention co-funding under PAPIs and PSRs has been particularly successful in rallying subnational disaster risk prevention stakeholders to join forces in reducing flood risks and to jointly mobilise co-funding by the state. Although PAPI and PSR funding proposals for disaster risk prevention investments are evaluated against a set of criteria, priority so far seems to have been given on a first come serve basis. This has been facilitated by a more or less equal demand and supply of risk protection financing. However, the number of demands for financing is expected to increase in the future as more local authorities will start to develop their disaster risk prevention strategies. This will necessitate a stronger and equitable prioritisation of funding allocation decisions, as otherwise those local authorities will have an advantage that have stronger and more readily available financial and technical capacities to put their disaster risk prevention programmes together.

The significant stock of protective infrastructure is becoming increasingly difficult to maintain

Given the Rhône River basin's multiple and vital functions for the social and economic development of its inhabitants, investments in structural protection measures date back a long time and the stock that exists today is testimony to continued investment in protecting lives and economic development along the river. In order to keep the level

of protection, for which structures were initially conceived, up, maintenance works are necessary. Weaknesses in maintenance levels have been made apparent during past flood events, such as the ones in 2003, which showed heterogeneity in the level of maintenance of protective infrastructures across the basin area. Some of this heterogeneity can be explained by the number of different actors, with sometimes different levels of technical and financial capacity, that are in charge of maintenance along the river. For some protective infrastructures there might not even be a specific actor in charge. Recent efforts to address this shortcoming, including the recording of all existing infrastructures, their owner and maintenance level, show the recognition of the underlying problems.

Although the ongoing territorial reform process seeks to clarify ownership of protective structures at the local level, it is important that this is accompanied with the necessary technical and financial capacity to carry out this responsibility in the future.

Emphasising the importance of non-structural disaster risk prevention measures

Non-structural or “soft” disaster risk prevention measures are important complements to physical disaster risk reduction investments. They can be often low cost measures, in comparison to the costs of physical infrastructure, which yield potentially high returns. Non-structural measures include hazard identification and mapping, land-use planning or risk communication.

The integration of hazard zones into land-use planning and land-use decisions is a key non-structural measure that serves to avoid a future increase in risk exposure, while also informing about the potential adjustments that can be made to existing land-uses to render them more resilient. France has developed a number of effective instruments that allow for a systematic and effective integration of hazard information into land-use planning, such as the flood risk prevention plans (PPRIs). Monitoring and subsequent penalisation of mayors that grant construction rights in known zones at risk have shown France’s strong commitments to this measure.

There is scope to more strongly engage all societal actors in disaster risk prevention management along the Rhône

The disruptions disasters can cause have an impact on individual households, businesses, and the public sector. Hence all actors have to decide to which degree and how they will invest in disaster risk prevention and mitigation. A whole-of-society approach to disaster risk prevention requires everyone to share the burden of financing disaster risk reduction in order to ensure that public disaster risk reduction investments yield their expected benefits.

Although businesses and households have been mobilised through various disaster risk prevention activities in the Plan Rhône, investments in self-protection remain rather low. Surveys have shown that this low engagement may be due to a number of reasons, but most concerning of all a belief that individual risk protection investments are ineffective. Risk awareness raising campaigns must inform not only about the individual exposure of risks, but the also the potential options there are to invest in reducing this exposure.

The public compensation scheme of the CATNAT may not necessarily be conducive to achieving a whole-of-society engagement in disaster risk prevention. Its premium structure does not differentiate between different levels of risk exposure. This means that in the event of a disaster individual investments may not be rewarded - neither in the premium structure, nor in the eventual pay-outs. This necessitates complementary policies that support individual households and businesses in investing more in self-protective measures. This could increase the efficiency and effectiveness of public investment in risk reducing measures.

Current risk financing arrangements may be insufficient in meeting medium- to long-term disaster risk prevention investment needs

Although it is difficult to establish a global picture of total available disaster risk prevention investments at national and sub-national levels, there are indications that existing funding available through France's national prevention fund may not be sufficient to meet future demands for prevention investments. As sub-national levels increasingly gear up to establish their disaster risk prevention plans and financing needs, more demands for co-funding from the central prevention funds are expected. To ensure that France's risk protection levels can be maintained over time, a risk financing plan should be elaborated that identifies investment needs and potential additional or alternative sources of prevention funding.

The impacts of ongoing territorial reforms on sub-national financial capacity to perform their given tasks remain uncertain. It needs to be ensured that the reform does not reduce the financial resources for carrying out important prevention investments or maintenance tasks. At the very least the reform should ensure that financial resources maintain the same level, or increase them where possible and where needed.

Notes

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- ¹ In this document Rhône River basin corresponds to the Rhône-Méditerranée River Basin.
- ² Excludes regions in overseas territories of France. In total there are 18 regions and 101 departments.
- ³ Note: “declared“ here means an event that triggers the French CATNAT compensation scheme.
- ⁴ Note: the process of elaborating the Rhône flood risk management plan called PGRI (mandated by the central level and based on the EU flood directive) prescribes the identification of high risk areas (HRAs), based on a preliminary flood risk assessment (called EPRI)
- ⁵ www.planrhone.fr
- ⁶ Since the territorial reform implemented in January 2016, the regions are part of Auvergne-Rhône-Alpes, Provence-Alpes-Côte d’Azur and Occitanie.
- ⁷ <http://www.developpement-durable.gouv.fr/Les-plans-de-gestion-des-risques-d.40052.html>
- ⁸ www.prim.net is a portal that informs about the prevention of major risks; www.georisques.gouv.fr is a portal that provides dynamic risk maps.
- ⁹ The Alpine Convention is an international treaty between Alpine countries (Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland) as well as the EU, aimed at promoting sustainable development in the Alpine area and at protecting the interests of the people living within it. It embraces an integrated approach, including environmental, social, economic and cultural dimensions in developing the Alpine area’s future (<http://www.alpconv.org/en/convention/default.html>).
- ¹⁰ After the damages caused by the storm Xynthia an additional funding and project decision mechanism has been established particularly for coastal flooding, called the PSR. Structural measures providing protection against coastal flooding are thereby prioritised and put under particular technical scrutiny.
- ¹¹ Multi Criteria Analysis allows comparing different scenarios, including the status quo, integrating monetary and non-monetary values incorporating environmental, cultural heritage and social criteria along economic ones.
- ¹² It is envisaged that the state no longer owns any dikes by 2024.
- ¹³ GEMAPI was supposed come into full force in January 2016 but it seems it will require two more years for the EPCIs to prepare themselves for such responsibilities.
- ¹⁴ www.france-digues.fr/sirs-digues/
- ¹⁵ www.georisques.gouv.fr; <http://carmen.naturefrance.fr>; http://carmen.developpement-durable.gouv.fr/index.php?map=risques_naturels.map&service_idx=8W; http://cartelie.application.developpement-durable.gouv.fr/cartelie/voir.do?carte=cartelie_ADS&service=DDT_72
- ¹⁶ www.rhone-mediterranee.eaufrance.fr/gestion/inondations/artes.php#carto
- ¹⁷ 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

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