



# ESPON-TITAN Territorial Impacts of Natural Disasters

Applied research

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Synthesis of Case Studies**

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## Abbreviations

ALPARC	Alpine Network of Protected Areas
CIPRA	International Commission for the Protection of the Alps
CLISP	Climate Change Adaptation by Spatial Planning in the Alpine Space
CCA	Climate Change Adaptation
DAS	Deutsche Anpassungsstrategie an den Klimawandel
DdARACC	Documento di Azione della Lombardia sull'Adattamento ai Cambiamenti Climatici
DRM	Disaster Risk Management
D. Lgs.	Decreto Legislativo – Legislative Decree
ECP	Energy and Climate Programme of the Free State of Saxony
ESPON	European Territorial Observatory Network
EU	European Union
EUR	Euros
EUSALP	European Union Strategy for the Alpine Space
FBC	Federal Building Code
GDP	Gross Domestic Product
LEP	Landesentwicklungsplan
l.r.	Legge – Law
MAP	Multi-Annual Work Programme of the Alpine
MITERD	Ministerio para la Transición Ecológica y el Reto Demográfico - Ministry for the Ecological Transition and the Demographic Challenge
NBS	Nature-based Solutions
NRM	Natural Risk Management
PCAET	Plan Climat Air Énergie Territorial
RPV-OEOE	Regionaler Planungsverband Oberes Elbtal/Osterzgebirge
RTP	Regional Territorial Plan
SEA	Strategic Environmental Assessment
SRADDET	Regional Planning, Sustainable Development and Equality Scheme
SRCAE	Schéma Régional Climat Air Énergie

## Executive summary

Productive mono-specialization in the context of Climate Change and associated natural hazards (pre-existent, but more intense since) is a combination that usually leads to a negative economic impact. This has been seen very clearly in the case of tourism (as in the Alpine region), but also in that of creative and cultural industries (as in Lombardy-Po River Basin) and industry and secondary activities (as in Dresden Region).

According to case studies, general feeling is that **investing to prevent the impacts of natural hazards recoups**. In this sense, a greater effort is needed to highlight these economic costs, both direct, and especially indirect. There is evidence of a lack of updated and continuous information, not limited to after each single disaster. Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 already provided for the need to prepare a cartography to integrate Disaster Risk Management (DRM) into land-use planning, through well-defined cartography of risk areas. Maps and observatories to support decision, providing evidences from databases and scientific reports, appear as necessary tools (as in Rotterdam and Nouvelle-Aquitaine).

Mapping hazards is an important element for DRM for emergency management (e.g.: development of contingency plans), as well as for risk prevention (e.g.: as a basis for urban/spatial planning decisions). Regarding the dynamics of hazards (e.g.: climate change) and vulnerability (e.g.: urban growth, social inequalities), any hazard assessment, including hazard mapping, should be based not only on the past, but also future dynamics and most vulnerable areas in selected scenarios. Preventive proactive spatial planning can be based on such kind of information and scenarios.

An adequate strategy for the wise and creative management of natural and heritage resources requires that interventions reach a sufficient size to be effective, which requires territorial cooperation between localities, regions, or of a cross-border nature. Natural regions do not understand borders, so ecological-functional regional political regions should be emphasized. This demands new governance practices in order to consider a multi-level approach, as well as to coordinate territorial and environmental planning instruments,

However, adaptation strategies and the need to consider the natural hazards patterns in territorial planning, to implement a new model of sustainable, resilient and low-carbon development in line with the EU Green Deal, and the recovery plan in the current context of COVID-19, are very recent. They have not more than ten years old, with short life in all cases, and taking different routes to follow. Spatial planning systems in Member States begin to consider the effects of Climate Change, but in an incipient and diversified way; according to path-dependence in each context (political and planning system tradition – as in Andalusia, Po River Basin, Nouvelle-Aquitaine, City of Pori, Prague), from which to be forward to a new path-creation (as in Rotterdam, Nouvelle-Aquitaine and City of Pori, for instance).

So, in the Netherlands there is a project on going in order to integrate Spatial Planning Act into the Environmental and Planning Act (the new National Strategy on Spatial Planning and the Environment – NOVI); France, in order to coordinate in an integrated way the national and supraregional, opts for new instruments of integrated cross-sectoral planning, which must finally translate into new land-uses, which nevertheless is the responsibility of local entities. These local entities can be municipalities, as in the case of Andalusia or Pori, or groups of them for this purpose, as in the Po Valley and in Nouvelle-Aquitaine. On other occasions, local action is chosen in specific projects and actions well embedded in previously defined plans and programs (in the case of the cities of Pori and Rotterdam; and with a more reactive ex-post in the case of Prague).

Interventions for adaptation and protection can be both hard (engineering, based on technical rationality, more consolidated and with long experience to which one can depart, still preferred by decision makers, officers and business, and enterprises beneficiaries of these projects) and soft (nature-based solutions, using ecosystem services provided by Blue and Green Infrastructures, a bit more experimental and fuzzy). Both are complementary and necessary, and their combination should be promoted. For instance, Green Infrastructure could be useful in order to overcome the problem of conflicts with private land ownership when deciding feasible land-uses in areas of natural risks.

By now, **climate are not sufficiently addressed in spatial planning** and additional efforts should be made. The case studies have shown that there is **no overall DRM approach**. However, there are two commonalities in all of them, based on the importance of **EU Directives as first pillar policy** (Community Method), whose guiding value should be reinforced: The Strategic Environmental Assessment – SEA (Directive 2001/42/EC in 2001, amended for the last time in 2014 by the Directive 2014/52/UE), and The Flood Risk Management Directive (Directive 2007/60/EC). **Spatial planning and civil protection are often formally not well connected**. Risks should be also included, as spatial landscape and heritage, as part of SEA scoping in binding SEA process (public participation included) within any spatial plan and intervention with environmental impacts. Involving all the actors is crucial to achieving risk governance.

The planning process involves politicians (they initiate the procurement of planning documentation and decide on its approval), officials (e.g. municipal offices with extended powers procure plans and relevant authorities comment on them), and designers (who process the documentation). The process of issuance of binding planning documentation involves the engagement of the general public (citizens and civil society organizations) and private sector (Real estate developers and owners). In this sense, education on climate change adaptation strength demonstrates very useful (as in Rotterdam, with its communication tool for participation – an online application called 'Climate Game' has been developed – as good example of 'Geo-governance' practice).

Generally speaking, urban growth and agglomerations press ecological systems in urban and surrounding rural/mountain/natural areas. New ways of urbanisation and more sustainable and cohesive urban growth, improving urban-ecological relationships (Nature-based Solutions – as in the Czech case study – Green Infrastructures and Belts Base, Circular Economy, New Ecological Services...), should be taken into account in order to promote smart sustainable health resilient urban growth and land-use. At macro-scale, climate change challenge, with sea level rising and more frequent and intense meteorological extreme episodes (as seen in Nouvelle-Aquitaine, City of Pori and Po river basin, in Lombardy), could be more efficiently managed through specific actions at local and regional level (good practices in Rotterdam and City of Pori). In a reactive way, when necessary, but also in a proactive and preventive way; that means to re-consider spatial planning role for our sustainable next future. Not only through paying more attention to this policy but also including risk prevention and flexible management in its main stream: i.e. revisiting strategies to combine traditional hard infrastructures fighting natural risks (as Delta system in the Netherlands) with soft ones, including reconsideration of zoning by promoting sustainable and smart zoning. If necessary and unavoidable, also opting for combining uses when natural hazards occur (e.g. including flooding areas on developable land for economic, green infrastructure or public spaces, as in the case of the City of Pori).

Risk management and climate change adaptation are related to each other. That leads to a reflection on the need of a systemic (integrated and multi-scalar) perspective in order to provide a better understanding, as well as alternative solutions, in the short, medium and long-terms. Experience demonstrates that clear laws, hierarchical procedures (when voluntary coordination is not possible), citizens involvement and clear and concrete definition of interventions within the framework of plans and programmes, help. Every planning instrument, adaptation strategy and action program has to be able to be applied and managed, not only taking into account long periods of recurrence, but also in the short-term (as in the case of pluvial flood by a 10-year term in Rotterdam).

The plans must take into account those of their same level, basically to guarantee that they do not block each other. The integration into a single comprehensive instrument (as in Nouvelle-Aquitaine or in the Netherlands) can facilitate the integration of different approaches to decision-making based on risk prevention and adaptation to climate change. However, the challenge is how to make it operational and more regularly from an administrative point of view without being dependent on a particular top-down initiative or leadership. Maintenance and future safety can only be ensured if responsibility for them lies with clearly identified officials and good teams. Good technicians teams are needed in responsible administrations, to facilitate adequate multilevel and cross-sectoral governance, which is not always maintained when trying to outsource these functions to civil society or private services.



Spatial planning is mainly the result of the administrative coordination process based on a land-use perspective and a sectoral approach that includes the risk management and climate change issues previously decided (on the contrary, in Dresden Region spatial planning is considered a tool for coordination between sectoral policies). Rotterdam Climate Office works in coordination with other departments of the city government, integrating personal from climate office into the other areas. These measures are well-considered towards not only to adapting to climate change, but also to improving quality of life; it can be seen as good practice to emulate. Sharing experiences and lessons learnt, and demonstrating the consequent effects, are considered as very useful to reach this purpose of CCA and improving quality of life.

# 1 Introduction

The TITAN project includes eight case studies, trying to focus on particular risks and local specificities and events:

**The Alpine Region**<sup>1</sup> is a unique natural space in Central Europe (EEA 2016) ranked as one of the most vulnerable areas to climate change in Europe by the EU White Paper on Adaptation (Platform on Natural Hazards of the Alpine Convention), specially the Alpine glaciers that have been melting for decades. As climate change progresses, the settlements, population and infrastructure of the Alps will become increasingly vulnerable to such natural events as avalanches, landslides, floods and more (CHEERS and Interreg Alpine Space). Over the last thirty years, the Region has experienced a rapid economic development, in which the tourism industry is taking the leading position (Veyret & Diem). However, tourism is highly dependent on seasonal weather conditions. Low snowfall in winter and high precipitation in summer result in negative capital investments for the Alpine region. This issue grows considerably as the climate continues to change. This case study focuses on cross-border/macro-regional scale cooperation and coordination.

**The Dresden Region**<sup>2</sup>, located in the East of Germany, is characterised by a great diversity in landscapes: the river Elbe runs through the region, the northwest there are lowlands and primarily agricultural areas, while the southern part is mountainous (Eastern Ore Mountains, Saxon Switzerland). It coincides with one of the four planning regions of the federal state of Saxony: the Upper Elbe Valley/Eastern Ore Mountains (“Oberes Elbtal/ Osterzgebirge”). It is a rather densely populated region with roughly 300 inhabitants/km<sup>2</sup>. Approximately 800.000 people live in the agglomeration of Dresden – which population and the one from adjacent municipalities is predicted to rise while peripheral areas population losses are expected (RPV OEOE) – and about one million, in the entire planning region (AG Regionalverbände). Some notable industries have settled down in the region (the largest site of European semiconductor industry, the largest chemical site in Saxony (RPV OEOE). Universities, research and development institutions, and small precision engineering and metal processing companies can be found in the region (Euroregion Elbe Labe, 2020). The case study focuses on flood hazards and vulnerability, due to high population density.

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<sup>1</sup> The Alpine countries include Germany, Austria, France, Italy, Liechtenstein, Monaco, Slovenia and Switzerland (cf. German Environment Agency 2018: 6).

<sup>2</sup> It consists of the counties of Meißen (“Landkreis Meißen”) and Saxon Switzerland-Eastern Ore Mountains (“Landkreis Sächsische Schweiz-Osterzgebirge”) and the capital of the federal state, the city of Dresden (“Landeshauptstadt Dresden”).

**The Nouvelle-Aquitaine** is the largest administrative region in France, created in 2014 through the merge of three regions: Aquitaine, Limousin and Poitou-Charentes. It is a mixture of the different geographies of the coast, the Pyrenees-Central Massif and the agricultural land. With an area of 84.061 km<sup>2</sup> and a population of 5.956.978 inhabitants (Jan 2017), the region has a density of 70 inhabitants/km<sup>2</sup>. In 2018, the GDP reached EUR 159,8 billion; with the GDP per capita of EUR 26.825. Although the region is exposed to varied hazards, this case study focuses at a regional scale, on the Xynthia storm occurred in 2010, that severely affected the region due floods, sea water entrance to inlands, dunes erosion, even causing human deaths.

Located in the south of Spain, **Andalusia**<sup>3</sup>, represents 17,3% (87.597,7 km<sup>2</sup>) of the national surface and is the fourth biggest European Union region (overcoming 14 of 28 countries). There is a natural and cultural heritage present in Andalusia, but with some imbalances in ecological aspects, and with not enough territorial cohesion. Andalusia has importance in the primary economic sector as it represents 4,9% of the GDP in the region, while in Spain is around 2,5% and in EU-27 is about 1,8%. Despite the progressive decrease suffered, the primary sector recently increased again, as a consequence of the losses in secondary and the tertiary. About these sectors, the less important, quantitatively, is the secondary (23,4% GDP), lower than Spain (27%) and EU-27 (25,4%). Tertiary sector (71,7% GDP) is balanced with both Spain (70,5%) and EU-27 (72,8%). Floods and drought are the main hazards to which Andalusia is vulnerable. This is a regional-scale case study.

**Pori** is the seventh-largest urban area in Finland situated 237 km northwest of Helsinki, Satakunta region's capital (pop.224.028) and part of the Pori subregion (pop.136.905). The city has a population around 84.318 inhabitants in 2.062 km<sup>2</sup>, with a density of 101,09 inhabitants/km<sup>2</sup>. Located in the Kokemäenjoki river basin, the topographically low-lying delta area is one of the most flood-prone areas in Finland, where about 15 thousand people live. The river is known for harmful winter floods and ice breakup jams. A severe summer flood caused damages worth EUR 22 million in Pori in August 2007, considered the most devastating urban flood event ever observed in Finland. In Pori, even more attention is necessary to flood protection in the future. The case study focusses on the local scale.

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<sup>3</sup> Delimited by Portugal (west), Extremadura and Castilla-La Mancha autonomous communities (north), Murcian Region (east), and Atlantic ocean and Mediterranean sea (south). The Andalusia Region groups 4 territorial systems defined by geographical characteristics and demographic density: Sierra Morena-Los Pedroches (mountainous zone), Valle del Guadalquivir (related to the Guadalquivir River valley, densely occupied and with a large area of land), Sierras y Valles Béticos (with diversity of landscapes like mountains, valleys, forests, and deserts); Coastal area (the most transformed area in the region, it is a dynamic space, in both natural and social-economical aspects, that produces territorial transformations).

**Po river basin in the Lombardy Region**<sup>4</sup>. Lombardy is located in northern Italy and covers 23.000 km<sup>2</sup> with 10 million inhabitants. The case study presents the region's experience in the broader territorial context of the Po basin. As a hydrographic basin, it is the most suitable unit for the implementation of organic actions aimed at the protection of the territory and the naturalistic safeguarding of waterways (law 183/89-Law for soil defense). Nevertheless, the study case area is affected by all the typologies of natural hazards. Besides, there is a large amount of data available, and the responsible governments set in place a sound and coherent toolbox of policy measures and strong cooperation. This report presents, at the regional scale, the "second generation" set of measures, since in the Po basin, the modern approach to DRM started after the disaster occurred in Valtellina and other mountain territories in 1987. The Lombardy production system is currently one of the most developed in Italy and Europe. The Region has been recognized as an outstanding centre of creative and cultural industries in Europe (third place among European regions), with a component of knowledge-intensive services. Landslides are specially considered in this case study.

**Prague** is the largest city in Czech Republic with 12,3% of the national total of 1,3 million (in 2019) (Eurostat, 2020). It is close to the Vltava riverbanks, which runs through the city for 30 km, explaining the rather rugged topography. Prague has a regional status, divided into ten municipal districts, 22 administrative districts, 57 municipal parts, and 112 cadastral areas. The concentration of strategic, political, and economic functions and the proximity of key players in the capital makes Prague a distinct centre of development at a national level; it is among the most developed regions in the EU, especially in Central and Eastern Europe (Eurostat, 2020). Like most of ESPON-TITAN case studies, the main natural hazard in Prague is flooding, although drought is also present in the area (approached secondarily in this case study).

**The city of Rotterdam** is part of the Rotterdam-The Hague metropolitan area. Rotterdam is a coastal city situated in the province of South Holland, at the delta of the rivers Scheldt, Rhine and Meuse. The city is opened to the sea and under the sea level. The hazards impacts (from floods – for sea level rise, rivers overflow, pluvial flooding and from groundwater –, extreme temperatures and drought) are determined by the urban environment characterized by (i) a high population density (3.120 inhabitants/km<sup>2</sup>: i.e. 651.376 inhabitants in 209 km<sup>2</sup>), (ii) the location of critical infrastructure (the largest Europe's seaport is located in the city), and (iii) the low level of rivers that prevents the inland navigation. At the European level, information on certain hazards as pluvial flooding and subsidence is scarce, and since those hazards have been widely managed by the city of Rotterdam, the city's experience in management of the hazards and some changes in patterns makes it valuable as a case study at a local scale.

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<sup>4</sup> Lombardy region includes 11 Provinces, the Metropolitan city of Milano and 1506 Municipalities.

Figure 1. ESPON-TITAN Case Studies



## 2 Existing baseline

The aim of this report is to provide evidence on the direct and indirect economic impacts of natural hazards, extreme events and disasters, identifying trends and territorial patterns from the case studies. One of the results of this research is about what the territorial patterns of economic impacts of natural disasters across European regions and cities are, in terms of direct and indirect costs. Moreover, a related and additional result is which sectors are most vulnerable to those natural disasters.

Beyond the specific economic losses (that may be available at the individual reports), in this section, some evidences on economic impacts and risk behaviour resultant from the case studies' analysis are presented. In ESPON-TITAN, to estimate the magnitude of the economic impacts derived from risk, the data analysed preferably include both direct (induced by direct damage to capital stock) and indirect costs (induced by disruption of economic activities in other, linked regions).

By analysing the case studies, it is clearly noted that floods is the main risk among the ones considered (floods, droughts, earthquake, storms and, secondarily, landslides). Furthermore, floods appear in all of them as responsible for causing the highest economic impacts. Floods, just like earthquakes, affect a greater surface than droughts, storms, or landslides, producing impacts and causing direct and indirect economic losses, both at rural and urban areas. They can be presented as a short-term event, usually less aggressive but more frequent, as well as a long-term event, more dangerous but less repeated, and more intense or extraordinary. Besides, floods is not an individual risk, since it may be closely related with spontaneous cascade effects. It may be a consequence of other events, such as storms, as well as of climate change, which may affect the violence of the events.

Risk management and climate change adaptation are related to each other. Due to that, the importance on considering the systemic perspective – integrated and multi-scalar – that may provide a better understanding and allow the implementation of alternative solutions in the short, medium and long-terms, is increased. Experience demonstrates that clear laws, hierarchical procedures (when voluntary coordination is not possible), citizens involvement and clear and concrete definition of interventions within the framework of plans and programmes, help. Every planning instrument, adaptation strategy and action program has to be able to be applied and managed, not only taking into account long periods of recurrence, but also in the short-term (as in the case of pluvial flood by a 10-year term in Rotterdam).

There is a common perspective in all case studies about cascade effects as a consequence of climate change; higher temperatures increase droughts, and make storms stronger and concentrated in time (affecting flood intensity). Scenarios that consider climate change, together with adaptation measures, contribute to better face natural hazards and their risks, and decrease potential impacts. The formulation of risk maps in this context, which may help to identify the most vulnerable areas, although not necessarily presenting future dynamics.

The transformation of the territory is a consequence of the urbanization process, present in all the case studies and at all levels – from local to Euroregions – and it does not always respond to a sustainable model. In those cases, most risk and hazard assessment and climate change adaptation have been considered after most of the developments are already in place.

Indeed, there are many activities located in dangerous areas – potentially affected by future events – resulting in an important political and economic effort in terms of replanning and reallocating uses and developments. Rehabilitating urban areas are usually more demanding and time-consuming than creating new ones in appropriate places. In summary, a proactive approach is much more efficient than reactive one, even though this last sometimes comes first, according to urgency and necessity.

Spatial planning cannot contribute to prevent damages already-built areas under risk, since growth and territorial transformation are already done. However, it is a powerful tool when including measures to correct and prevent risk, in most cases previously developed by sectoral policies, to anticipate its effects (mapping current situation, and also introducing feasible scenarios and alternatives).

All ESPON-TITAN cases studies have suffered some sort of disaster; nevertheless, their economic impacts have been reduced as far as introduction of preventive and adaptive measures started. As logical, it has been noted that impacts are higher in areas where preventive actions are inexistent. It is true preventive measures represent an additional cost (previous investment is necessary to identify proper benefits), however, at the end, it is more strategic (at the end, sometimes even cheaper) to invest in preventive measures than paying never-envisaged ex-post measures for recovery after a hazard event. Most information about economics related to risks and hazards are related to estimations about the future costs related to events; less quantified are the budgets prepared for investments related to prevention and adaptation. These costs are closely related with the role of insurance companies, which both, public and private, have special importance in relation to agricultural and farming activities (in rural and peri urban areas).

**Error! Reference source not found.** summarizes the economic information presented in the individual report (the values presented do not follow a common methodology and were not calculated withing ESPON-TITAN – they were indicated by each case individually):

Table 1. Economic impact information

Case study	Hazard	Affected sector	Direct cost (EUR)	Indirect cost (EUR)
Rotterdam	Floods	Financial	36 million/year	-
		Settlements	2 to 14 million (expected)	-
Prague	Floods	Total costs (2002)	(27 billion Czech koruna)	
Po River Basin/Lombardy	Storms	Total costs (1987)	2,1 billion present value	
	Earthquake	Total costs (2004 and 2012)	11,2 million	
City of Pori	Floods	Total costs expected	3 milliard	
		Total previous events	39,4 million	
Andalusia	Floods - Storms	Emergency works	18 million	
Nouvelle-Aquitaine	Storms (1999)	Total costs	6.900 million	
	Storms (2010)	Total costs	1.500 million	
Dresden Region	Floods (2002)	Total costs	1,8 billion	
	Floods (2010)	Total costs	850 million	
	Floods (2013)	Total costs	560 million	
Alpine Region	Not enough information			

Source: Own elaboration.



## 3 Disaster Risk Management (DRM)

### 3.1 Formal DRM measures highlights

Regarding the relationship between spatial planning and DRM, there is a common position among the case studies: in most of them, sectoral policies (water management) have a strong influence on spatial planning decisions. In the Dresden Region, regional planning has a stronger coordination function regarding spatial development and sectoral planning. On the contrary, in the rest of the case studies the inverse procedure is applied: the sectoral policies establish the criteria that are subsequently collected in spatial planning. This is evidenced by the role of risk and hazard cartography in this study, with the Pori, Po River Basin and Rotterdam being the most significant examples.

The formal measures found in the case studies can be classified into two large models: centralized (City of Pori, Prague, Nouvelle-Aquitaine and Rotterdam) and federal-decentralized (Andalusia, Po river basin and Dresden Region).

In the **City of Pori**, the legal planning framework for managing flood risk is implemented at a national level, following the Flood Risk Management Act (Laki tulvariskien hallinnasta 620/2010) and the Flood Risk Management Decree (Valtionneuvoston asetus tulvariskien hallinnasta 659/2010), both in line with the Flood Risk Management Directive 2007/60/EC. The purpose of these laws is to reduce flood risks, to prevent and mitigate the harmful consequences of floods, and to promote flood preparedness. Also, these laws aim to coordinate flood risk and other management of the river basin districts, considering the needs for the sustainable use of water resources and protection. Under the Flood Risk Management Act, flood groups are set within risk areas (in each river basin district and coastal area) to cooperate in the preparation of the Flood Risk Management Plans, with a clear participative dimension. Other national legislation that is related to risk management of floods, and complements the one cited above, include the Dam Safety Act (Patoturvallisuuslaki 494/2009), the Rescue Act (Pelastuslaki 379/2011), the Land-Use and Construction Act (Maankäyttö- ja rakennuslaki 132/1999), the Water Act (Vesilaki 578/2011), the Act on Environmental Impact Assessment of Government Plans and Programs (Laki virannomaisten suunnitelmien ja ohjelmien ympäristövaikutusten arvioinnista 200/2005) and the Act on Environmental Impact Assessments (Laki ympäristövaikutusten arviointimenettelystä 468/1994).

In the case of **Prague**, the main bodies involved in DRM are the government of the Czech Republic, ministries and other administrative authorities, as the Czech National Bank, regional authorities, municipalities and designated bodies with territorial competence. Their function in DRM is to ensure analysis and evaluation of possible threats to its security, planning, organization, implementation and control of activities in connection with preparatory measures and crisis management. Crisis management is ruled by Act No. 240/2000 Coll.

The legal framework for flood risk management is also based on the EU Flood Risk Management Directive which is complementary to the Water Framework Directive; the process

of implementing both of them and the planning cycle should be addressed in a mutually consistent manner. The implementation of the EU Flood Directive in the Czech Republic began in 2009 with transposition into the Water Act – both in Title IV Water Planning and Title IX Flood Protection. As a result, water planning takes place in six-year cycles, reflected in the flood risk management plans. In this case, the main preventive measures against river floods were implemented after each of the two big flood events occurred in 2002 and 2013.

In the **Nouvelle-Aquitaine**, information and knowledge of risks are primarily the responsibility of the French National Government. It uses different instruments as the Departmental Document on Major Risks (Document Départemental sur les Risques Majeurs) and the development of Risk Prevention Plans. The last ones are the main instruments for risk management, which tackle the problem of several hazards (flood, marine submersion, land movement, forest fires, etc.) and define the prescriptions. These plans can lead to construction bans in the event of a significant hazard. The methodological frame for the risk prevention plans has its origin in 1997, being the main instrument, the Risk Prevention Plan/Submersion Marine.

The risk prevention policy is defined at the national level by the General Directorate for Risk Prevention (Direction générale de la prévention des risques). The departmental level is in charge of its implementation through the Departmental Directorates of Territories and the Sea (Directions Départementales des Territoires et de la Mer), with regional coordination by means of the Regional Directorates of Environment, Planning and Housing (Directions régionales de l'Environnement, de l'Aménagement et du Logement). The implementation of the Regional Planning, Sustainable Development and Equality of Territories Plan (Schéma Stratégique, Prescriptif et Intégrateur pour les Régions) allows to identify in advance risk areas and community vulnerabilities. The regional level carries out the flood management at a scale that incorporates hydrographic basins coherently.

In **Rotterdam** case study, at the national level (NL) the most important documents addressing disaster risk management are the Water Act and the Delta Act. The Water Act contains the most important regulations for the use and management of water. It determines flood protection standards for all dike-ring areas (polders) in the Netherlands. The water authorities, municipalities, provinces and Rijkswaterstaat implement the Water Act. The Delta Act is the legal basis for climate change adaptation. It ensures that the Netherlands is well protected from flooding, adapts to extreme climate impacts and has adequate supplies of fresh water. The Act also specifies that there must be a Delta Programme Commissioner who oversees the updating of the Delta Programme and the way it is carried out. At a Rotterdam region level, the city climate change adaptation is led by a wide set of policy documents as the Rotterdam Weather Wise Urgency Document, the Rotterdam Climate Change Adaptation Strategy (2013), the Waterplan 2 (2007) and the Municipal sewerage plan (2016-2021) (Gemeentelijk rioleringsplan).

In **Andalusia**, there is a basic civil protection legislation that contains the guidelines for the preparation of territorial emergency plans. This regulation is constituted by the National Civil Protection System law (Ley 17/2015, de 9 de julio, del Sistema Nacional de Protección Civil) and the Basic Civil Protection Standard (Royal Decree 407/1992, of April 24 – Norma Básica de Protección Civil) at the national level, and on Emergency Management in Andalusia (Law 2/2002, of November 11 – Gestión en Emergencias en Andalucía) and Local Autonomy of Andalusia (Law 5/2010, of June 11, Autonomía Local de Andalucía) at the regional level. In this context, the Territorial Emergency Plan of Andalusia is the normative instrument through which the organic and functional framework is established, as well as the mechanisms of action and coordination between different Administrations and entities under the directive function of the Regional Autonomous Government (Junta de Andalucía). In this Territorial Plan, a wide variety of risks are identified and analysed, including drought, major storms, strong winds, floods and plagues. More focused on climatic adversities, at the national level there is a permanent commission for climatic or environmental adversity (Comisión Permanente para situaciones de Adversidad Climática o medio Ambiental, regulated by Order AAA/2272/2013, of Nov. 27).

In the case of floods, the transposition of the EU Flood Risk Management Directive into the Spanish legal system occurred through the R.D. 903/2010, of July 9, of evaluation and management of flood risks, being the basic legislation that regulates the content and the procedure of elaboration and processing of the Flood Risk Management Plans for the entire Spanish territory. Those Plans are approved in conjunction with the Hydrological Plans of each river basin district. In the agricultural sector, to complement and reinforce the abovementioned legal framework, the Department of Agriculture, Livestock, Fisheries and Sustainable Development (Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible) drew up the Risk Plan for the Andalusian agricultural sector (Plan de riesgos del sector agrario andaluz) in the area of preventive investments contemplated in measure 5 of the Rural Development Program 2014-2020 (Programa de Desarrollo Rural 2014-2020). In this context, the National Agricultural Insurance System (Sistema Nacional de Seguros Agrarios) in risk assessment and management outstands.

In the **Po river basin – Lombardy Region**, the risk prevention and mitigation regulation are composed of two legislative decrees established at a national level (IT): an Environmental act (D. Lgs. 152/2006 - Norme in materia ambientale) and a Civil Protection Code (D. Lgs. 2 Gennaio 2018, n. 1 Codice della Protezione Civile). The Civil Protection Code is related to the decentralization process as it recognizes the importance of the regional level and the need for regional states, with administrative and economic procedures. In this context, the Lombardy region developed its regulation: the Spatial Planning Law (l.r. 11 Marzo 2005, n. 12 - Legge per il Governo del Territorio), the Regional law on soil protection, hydrogeological risk prevention, and mitigation, river and stream management (l.r. 15 Marzo 2016, n. 4 - Revisione della normativa Regionale in materia di difesa del suolo, di prevenzione e mitigazione del rischio idrogeologico e di gestione dei corsi d'acqua), and the Regional Code of Civil Protection (l.r. 22 Maggio 2004, n. 16 – Testo Unico delle disposizioni regionali in materia di Protezione Civile).

In this case study, the competent institutions in risk prevention (spatial planning), soil protection, and DRM are the following: Po basin Authority, the Lombardy Region, provinces and the metropolitan city of Milano, the municipalities, Regional Agency Environment Protection (Agenzia Regionale Protezione Ambiente), Lombardy Foundation for Environment (Fondazione Lombardia per l'Ambiente), Po Interregional Agency (Agenzia Interregionale Po) and voluntary bodies.

In the **Dresden Region**, at a national level (DE), the federation only owns framework competences regarding risk assessment and management. In this line, since 2009 risk assessment is legally included in the Civil Defence and Disaster Relief Act (Zivilschutz- und Katastrophenhilfegesetz). However, the executive power is at the state level. Thus, Saxon State Law on Fire Safety, Emergency Services and Civil Protection (Sächsisches Gesetz über den Brandschutz, Rettungsdienst und Katastrophenschutz) explains that the State of Saxony, the counties and larger county-free cities are the responsible bodies for disaster control and emergency response. This legislation was drawn up aiming to emphasise the synergies, networking and cooperation of all involved parties, such as emergency services and civil protection, working together in a single operations centre.

In the same way, the Water Management Act is the primary legal framework for DRM regarding floods. The Saxon State Office for Environment, Agriculture and Geology (Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie), is in charge of the detection of potential flood hazard areas according to the Saxon Water Act (Sächsisches Wassergesetz) and those areas defined as for improving water retention in the regional plan (RPV OEOE 2017:99).

Finally, the **Alpine region** shows that there is no common approach to dealing with natural hazards within the member states of the Alps, as they follow national and individual approaches (Schindelegger Kanonier 2019, Alpine Convention Online). Nevertheless, the main transnational associations in the Alpine Space present DRM as a common task that members should follow in one direction. In this line, the Alpine Convention includes, among many other topics, climate change and natural hazards issues. Some programs such as the Alpine Networks, International Commission for the Protection of the Alps (CIPRA), the network of municipalities Alliance in the Alps, the Alpine Town of the Year Association and the Alpine Network of Protected Areas (ALPARC) contribute greatly to the implementation of the Alpine Convention (German Environment Agency/UBA 2018:8). Also, the Working Group 8 of the EU Strategy for the Alpine Space (EUSALP) focus on DRM as well as CCA, spatial planning and spatial development strategies (Heil, 2020).

Besides, a series of protocols supporting the goals of the Alpine Convention constitute the framework for dealing with natural hazards in the Alpine region (e.g. the Protocols on Mountain Farming and Mountain Forests or the Protocol on Soil Conservation). Moreover, the Alpine Convention promotes a wide range of activities that are used for the management of natural hazards (e.g. the Water Platform or the Mountain Forests Working Group). For flood risk management, however, there is a common approach among the EU Member States of the

Alpine Region due to the implementation of the EU Flood Risk Management Directive, even though the national adaptation to this directive is not identical in all cases.

### 3.2 Overall DRM approach: commonalities

The case studies have shown that there is no overall DRM approach. However, there are two commonalities in all of them, based on the importance of EU Directives as first pillar policy (Community Method):

- The **Flood Risk Management Directive 2007/60/EC** has set a common framework for flood risk assessment, management and information of the relevant authorities; thus, there are common definitions and procedural steps, although in practice there are differences in the detail of implementation.
- The **Strategic Environmental Assessment (SEA)**, which came into force by EU Directive 2001/42/EC in 2001, and was amended for the last time in 2014 by the Directive 2014/52/UE, shows material and procedural similarities to risk assessment and management. Therefore, an integration to meet the requirements of the SEA is possible and necessary. Along these lines, spatial planning plays an important role as one of the main elements of the Directive, as well as for risk management. As it was stated for Territorial Impact Assessment, as complementary alternative to SEA or even leading to an 'Integrated Assessment' embracing them, then the criteria was: no more procedures, no more institutions, no more funds. Similarly, risk could be also included, as spatial and landscape and heritage dimensions, as part of SEA scoping.

Special mention should be made to **Rotterdam** and **Nouvelle-Aquitaine** case studies in this regard, when trying to **manage DRM from an integrated point of view**. In Nouvelle Aquitaine, the integration into a single instrument (STRADDET) of spatial and sectoral planning (Regional Plan for Ecological Coherence - SRCE, Regional Plan for Climate, Energy and Air - SRCAE, Regional Plan for Infrastructures, Transport and Intermodality - SRIT, Regional Waste Prevention and Management Plan - PRPGD) can facilitate the integration of different approaches to decision-making based on risk prevention and adaptation to climate change.

In Rotterdam, DRM is made with a series of documents such as the Rotterdam Weather Wise Urgency Document: This document develops the Delta Program according to which the design of Netherlands has to respond to climate-resilience and water-robustness by the year 2050. The way to develop the Delta Program is: (1) **KNOWING: information** related to the effects of changes in the climate through impact assessments or stress tests that are developed and concreted in maps and research; (2) **"WANTING" or "RISK DIALOGUE"**: stakeholder **participation** in map content and deliberation to identify what is considered important and what is not, based on the costs associated with certain decisions, a climate agenda can emerge from it; (3) **WORKING: actions** arising from the integration of the climate agenda into the planning system, to carry out research or generate knowledge, social actions such as communicating, stimulating or physical related for example to **green areas and vegetation** (e.g. by adding 20 hectares of green space by 2022 compared to 2018 as new Green infrastructure).

### 3.3 Interlink of different kind of measurements

Spatial planning and civil protection are formally often not well connected. In fact Civil Protection has usually presented an ex-post nature in order to manage disasters, i.e. when they happen, concentrating in the definition of emergency strategies (ex-ante), but not usually connected with other planning. For instance, in the **City of Pori**, interviewees explain that Risk Management Plans are not elaborated in collaboration with spatial planning, although, risk and hazard maps are available for spatial planning use afterwards.

In other cases, civil protection and spatial planning are well connected. In the case of **Andalusia**, the planning and management of the flood risk, associated with a specific river basin district, is framed within the Sectoral Planning for Water (Hydrological Planning). This planning is closely linked with other spatial planning instruments (especially with the Spatial and Urban Planning Plans) and with other areas of sectoral planning (Civil Protection Plans, Infrastructure Planning, Agriculture, etc.). Thus, flood risk planning and management has interactions with other planning domains at the local level in land-use planning. Similarly, in the **Po river basin**, according to the regional Spatial Planning Law of Lombardy Region, it is an obligation to carry out geological, hydrogeological, and seismic hazard analysis in preparation for every level of urban planning. In this context, civil protection plans (at all levels) consider hazards, scenarios, and actions to mitigate the consequences in case of an event. This shows that this connection could be ensured in all cases by including the risk dimension in Strategic Environmental Assessment (SEA).

### 3.4 Added value of practices beyond the formal planning

These additional values are depending on contextual conditions, as previous experience on risk management and planning system. In this regard, with different styles, some interesting initiatives could be noted.

For instance in **Rotterdam**, when developing its “Rotterdam’s Weather Wise, Urgent Document” that includes updated maps for the hazards, a description of the problem and of the methodology to construct the map (technical innovation), the location of the vulnerability objects, the challenges and the response lead actors are included. Besides traditional ones, additional maps are produced: rainfall, heat, drought, flooding, groundwater, land subsidence and, to be noted, opportunities map, in fact very useful to define futures (visions) for more accurate planning in the future. In **Prague**, for the development of its Climate Change Adaptation Strategy, one encourages the development of Implementation Plans containing specific adaptation measures and pilot projects, which contribute to climate change mitigation, their monitoring and effectivity, and effectiveness assessment.

In the **City of Pori**, budget is depending on municipality, and in Rotterdam, damages are usually paid by owners, then effectiveness of measures should be encouraged.

In case of an event, emergency response units and the voluntary help of the community play a considerable role. In this line, in the **Po River Basin**, interviewees highlighted that even if emergency management is a “procedure-driven” sector, personal networks are quite useful, sometimes fundamental during emergencies. Emergency situations often lead to rapid changes, so, in the framework of well-known procedures, informal decisions and checks help the system to cope and manage all the different aspects.

Also, involving all the actors is crucial to achieving risk governance. Thus, in **Dresden Region**, the Saxony Climate Network (Klima-Netzwerk Sachsen) is a think tank where authorities, universities and research institutes work together to strengthen their existing successful relation by coordinating their activities more precisely. Also, in the **City of Pori**, Flood Groups shall, at the different stages of the preparation of the flood risk management plan, establish adequate interaction with the authorities of the river basin district and significant coastal risk area, as well as with operators, land and water owners, water users and representatives of relevant organizations. Another example, valid for most of the case studies, is the **Nouvelle-Aquitaine region**, that showed how the local governments have developed strategies for the engagement of the public and stakeholders in the protection of the communities (e.g., Survey 17 project, MAREA project or the Seamaphor tool). Besides, in the **City of Pori**, the Flood Protection Instructions web page offers several guidebooks on how to prepare for floods, what to do after they occur, general instruction on flood risks and safety, and even how to be financially prepared for an event. Moreover, case studies as the **City of Pori** and **Andalusia**, have shared the importance of providing available telephone numbers where citizens can alert about the occurrence of an event.

Thus, formal measures are not by themselves a guarantee for successful DRM, as the implementation of these measures has to be supported by coordination and cooperation activities. This has to be built on a risk communication process which is basic for success (trust building, information exchange, harmonisation of concepts, data etc.). The case studies have revealed several cooperation and/or communication examples between experts from the same sectors, between preventive and emergency response units, and between government, non-government and the public.

## 4 Climate change adaptation

Currently, the most important strategic document at the European level is the European Union Strategy on Adaptation to Climate Change. The basis for it is the white paper titled “Adapting to climate change”. The transnational strategy calls on the EU Member States to adopt adaptation strategies, although introduced very recently (more tradition in the case of **Rotterdam**); they are still incipient with short life and level of development and concretion to be effective, and follow several routes. One of them is through urban planning (at municipal level as in **Andalusia, City of Pori, Prague**, or grouping them, as in **Lombardy**); in other cases with a more comprehensive way both from an intermediate level, as in the new French region of **Nouvelle-Aquitaine**, or from a National scale, by way of great adaptation strategies (with the intention, as in the **Netherlands**, on trying to integrate Spatial Planning to Environmental one – through the envisaged new National Strategy on Spatial Planning and the Environment – NOVI). Besides, in some cases, local concrete interventions (projects) are taken place, as in the case of **Pori, Prague** and **Rotterdam**, usually as lesson learnt of previous events).

Spatial planning is seen as a tool to achieve long-term adaptation to climate change (CLISP Alpine Space: 47). A number of relevant documents relating to climate adaptation also dedicate a role to spatial planning. The European Commission’s White Paper emphasises the role of spatial planning in climate adaptation issues. Spatial planning, with its strategic and long-term approach, has a high capacity for coordination, which can link sectors such as the economy, transport, regional development, environment, industry and others.

### **Alpine region (Trans-national cooperation in climate change adaptation)**

The Climate Action Plan, an instrument derived from the Alpine Convention, although not a mandatory instrument, is the only politically significant transnational policy document to date that covers both adaptation to climate change and mitigation options (Probst, T., Hohmann, R., 2019). The Multi-Annual Work Programme of the Alpine Conference 2017-2022 (MAP) is an instrument for mitigation and adaptation for the long-term implementation (Permanent Secretariat of the Alpine Convention, 2017) Its approaches to minimise the consequences of climate change are integrated into different policy areas (agriculture, transport, spatial planning and economic development). The idea behind MAP is that the challenges facing the Alpine Space can be better identified through a bottom-up approach (Permanent Secretariat of the Alpine Convention, 2017). In other words, thinking globally but acting locally with very specific targets and place-oriented interventions within the general framework.

Although no uniform approach to adaptation can be found within the countries of the Alpine region (Plattform Naturgefahren der Alpenkonvention), under the Interreg B programme “Alpine Space”, two projects were initiated, that substantially promoted transnational cooperation for climate change adaptation: the strategic project “**ClimChAlp – Climate Change, Impacts and Adaptation Strategies in the Alpine Space**” (2006-2008), created a basis for climate adaptation by developing the Flexible Response Network. In two years, a methodological basis for adaptation to climate change in the Alpine Space was established and



a set of recommendations on how to further intensify the transnational cooperation have been elaborated (Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz, Referat Klimaschutz).

The issue of the role of spatial planning for climate adaptation in the Alpine Space is based on the results of the project “*CLISP – Climate Change Adaptation by Spatial Planning in the Alpine Space*”. Regarding sufficiency, only the German partners have described the instruments of spatial planning for adaptation as sufficient (numerous adaptation activities are possible thanks to the spatial planning law anchored at national level in Germany). The other Alpine countries claimed that the existing spatial planning instruments for CCA were either insufficient or the problem was due to their incorrect implementation (Pütz M. Kruse, S., 2011). In the comprehensive surveys, some partners indicated that informal planning practices<sup>5</sup> for climate adaptation are not yet widely used, although their role in CCA has been recognised by Member States. Sectoral instruments, as water management, soil protection, forestry and natural hazards, among others in the field of adaptation to climate change, are widely used at national and regional levels. As a result, horizontal cooperation between spatial planning and sectoral planning is one of the most important ways of action regarding the adaptability of planning systems (Pütz M. Kruse, S., 2011).

### **Dresden region (DE)**

The basic document for CCA policy in Saxony, the ECP (2013), is a programme for climate protection and CCA. It contains a medium-term plan for energy and climate policy until 2020, and a climate adaptation action plan that includes climate impact monitoring (initiated in 2010), that allows to identify and monitor those changes, at an early stage, for goal orientated planning and implementation of CCA measures and strategies (Klima Sachsen). Apart from this, in the State Development Plan Saxony, published in 2013, principles and objectives for spatial planning and development are set out, and links to CCA exist. Statements made by the Saxon State Development Plan (LEP-“Landesentwicklungsplan”) are used to update regional plans as a planning framework (UBA, 2019).

The so-called Climate Protection Amendment, 2011 (Law on the promotion of climate protection in the development of cities and municipalities “Gesetz zur Förderung des Klimaschutzes bei der Entwicklung in den Städten und Gemeinden”), that added a climate protection clause to the Federal Building Code, makes it clear that municipalities are responsible for climate adaptation at local level. In the amendment, the planning objective of sustainable urban development is outlined and climate protection, as well as adaptation, are brought into urban land-use planning. Furthermore, climate protection and climate change adaptation have to be equally weighed out alongside other concerns in planning considerations (FBC).

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<sup>5</sup> Informal planning practices refers to regional agreements, spatial development concepts at all levels, participation procedures and exchange between different stakeholders, systematic assessment procedures -impact, scenarios-.

In general, regional planning and land-use planning authorities have instruments at hand to integrate adaptation measures into spatial planning. Most important is the opportunity to designate the use of certain areas within inner zone of a municipality with binding effects for both local land-use as well as sectoral planning (Greiving, 2010).

All in all, it does not become clear what data is available and used in the case study area. Also, it remains vague whether the results of the climate impact monitoring were further processed and used. The same applies to the integrated climate adaptation programme, which has been drawn up during the REGKLAM-project (2008-2013)<sup>6</sup> and it is doubtful if it has been implemented. One good practice example is the strategy of the ECP action plan with the update of ReKIS, as the transboundary and regional networking between the actors shall be improved. In addition to that, another strategy aims at securing the regional planning objectives for CCA in the context of updating the regional plan in Saxony (cf. UBA 2019a). (Note the source of this conclusion is the Individual report Dresden Region Case Study).

Other projects<sup>7</sup> have been formulated regarding assessment and/or adaptation to climate change impacts in the case study region or in the entire Saxony, but no information can be found whether and how the implementation into practice has been successful.

### **Nouvelle-Aquitaine region (FR)**

The legal instruments that develop the determinations of the PNACC (National Plan for Adaptation to Climate Change) at the regional scale are key to get the desired objectives of decreasing climate change and avoiding its dire consequences through a change in the actors' ways of proceeding. The planning for this is wide and includes regional planning, economic planning and protection to the communities from the natural risks related to global warming.

The Regional Council leads the development of tools on energy transition as the Territorial Air Energy Climate Plan (Plan Climat Air Énergie Territorial - PCAET) at the subregional level; at the regional level, the Regional Ecological Coherence Scheme (SRCE) and the Regional Climate Air Energy Scheme (Schéma Régional Climat Air Énergie - SRCAE); the last one is the main document to deal with climate mitigation and adaptation matters that has been

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<sup>6</sup> The project area is mainly identical with the case study area, but adjacent parts of the counties of Bautzen and Central Saxony with the city of Freiberg were added. (evaluated climate trends, developed scenarios and derived adaptation measures) with the collaboration of different stakeholders from science as well as public and private institutions (e.g. Dresden Groundwater Research Centre e.V. or Leibniz Institute for Ecological Spatial Development).

<sup>7</sup> The model project KLIMAFit (2009-2011), which concerned the area of the CS specifically the regional planning association Upper Elbe Valley/Eastern Ore Mountains. It was one out of eight German model projects of regional planning ("Modellvorhaben der Raumordnung") in order to develop strategies and concrete actions to tackle climate change (PROJEKT KLIMAFIT 2011). Apart from that, a cooperation exists within the framework of a work group on climate change impacts ("AG Klimafolgen") that brings experts from the Saxon State Ministry for Energy, Climate Protection, Environment and Agriculture and the Saxon State Ministry of the Interior together. In addition, authorities, universities and research institutes joined their forces in form of the climate network Saxony ("Klima-Netzwerk Sachsen") to strengthen their existing successful relation by coordinating their activities more precisely. (cf. UBA 2019a).

developed in the 3 previously joint regions of New Aquitaine and will be evaluated for consideration for the writing of the Regional Planning, Sustainable Development and Equality Scheme (SRADDET): a new regional plan with a global approach.

Specifically, the Planning Code is the instrument that regulates the land-use, but it contains only one mention to climate change in the general objectives of the document (page 3, Grenelle law). Something similar happens to other urban planning instruments, as the Territorial Coherence Schemes, Local Town Planning Plans, Municipal Maps and more specific tools for authorising individual interventions as building permits: they do not consider measures related to climate change.

### **Andalusia Region (ES)**

The Plan of 2010 (Plan Andaluz de Acción por el Clima), and its associated Program (Programa Andaluz de Acción por el Clima), is the framework at the regional level to facilitate the development of the sectoral adaptations. It is aimed to minimize the negative impacts thanks to the improvement of the adaptation of the territory through spatial planning. Following the recent Law 8/2018 (Medidas frente al cambio climático y para la transición hacia un nuevo modelo energético de Andalucía), it is expected to include the climate change effects on the urban plans, besides the inclusion of sectoral reports. To solve the lack of previous experience in these questions, experts in environmental assessments have developed a checklist and some guides to facilitate this kind of content in the local planning. Besides, local urban plans, that also consider risks, started to include the climate change impact in their contents, however, this is still very recent and not yet very common.

Adaptation initiatives include all the sectors and resources at risk, from agricultural activities, public health, to industry, tourism and water management; they produce knowledge for future situations, improving the coordination in the administrative actions, and favouring social formation and participation. The Agriculture, Livestock, Fisheries, and Sustainable Development Counselling, responsible for these initiatives, developed the climate change report that compiles all the sectoral reports developed by the different Counselling, including adaptation initiatives based on the evaluation and diagnosis of every sector to be evaluated by the economical-political commission.

Environmental Ministry of Spain (MITECO – National Level) is developing a Strategy for coastal adaptation. The province services of coastal areas (Cádiz, Almería, and Málaga) will present the Strategy to the coastal municipalities in order to adapt the national strategy to Andalusia.

### **City of Pori (FI)**

The National Strategy for Adaptation to Climate Change, at the national level, insists on the integration of adaptative measures into planning, with a sectoral perspective. Both adaptation and mitigation measures have been applied in the City of Pori, where adaptation is crucial (as flooding is recurring), such as the usage of green energy, reduction of waste and recycling, ponds, strengthening levees against river flooding (started five years ago and still ongoing), and draining the river. Between them, the most applicable, as stormwater reservoirs and

retention ponds, represent the most attractive initiatives for the smaller municipalities with limited resources for implementing climate adaptation strategies in full.

About the relation between climate change and water risk, adaptation to climate change measures will be addressed in the River Basin Management Plans 2021, based on the EU Water Framework Directive.

According to the Kokemäenjoen Flood Risk Management report, the declining floods cannot yet be taken as a starting point for planning, even though floods in many parts of Finland will shrink in most climate scenarios, due to the amount of snow and spring floods decrease. Climate change impacts beyond the magnitude of the flood risk have not been considered in the development of measures. There are also no potential indirect effects of climate change on flood risk management consideration.

There is an assessment of the resilience of the measures to climate change to the flood risks in the CLIMWATER project, considered in the planning of Flood Risk Management in Pori.

### **Po River Region / Lombardy Region (IT)**

The normative for Lombardy Region includes the Regional Climate Change Adaptation Strategy of Lombardy Region 2014 (Strategia Regionale di Adattamento ai Cambiamenti Climatici della Lombardia) and Regional Action Plan for Adaptation to Climate Change 2016 (Documento di Azione della Lombardia sull'Adattamento ai Cambiamenti Climatici – DdARACC). During the implementation phase of the DdARACC, it will be possible to evaluate and monitor the implementation of selected adaptation measures. Besides strategies and plans, Lombardy region has developed a community engagement/education initiative that launches information including actions that can be carried out by social actors or private citizens.

In the frame of spatial planning, the revision and update of RTP – to be finalized by 2020 and to be approved by Consiglio Regionale in 2021 – contains a specific pillar dedicated to resilience and climate change adaptation (PILASTRO 3 – Resilienza, sicurezza e governo integrato delle risorse). One of the aims is the target of zero net land consumption by 2050, considering the territorial vulnerability to climate change impacts.

The climate change issue is integrated into several regional planning instruments related to different sectoral policies: the Plan for Air Quality, that addresses progressive reduction of pollutant emission; the Water Protection Plan, that is aimed at regulating water resources; the Rural Development Plan of Lombardy Region, that includes measures for a sustainable and climate-proof agriculture; the DG Agriculture, that is implementing forest management plans.

The Lombardy region counts on some financial instruments, mainly focused on green areas at both regional and supraregional levels: the current European LIFE IP project GESTIRE 2020 which main beneficiary is Lombardy; at the regional level, the Lombardy Fund for Green Areas with the Regional Law 12/2005, that is aimed at compensating environmental loss due to soil consumption and transformation.

The National Strategy for Adaptation to Climate Change insists on the integration of adaptive measures, with a sectoral perspective, into planning.

### **Prague (CZ)**

The Prague Climate Change Adaptation Strategy aimed at enhancing the long-term resistance and reducing the vulnerability of the city to climate change impacts; it is aligned with the Strategy on Adaptation to Climate Change in the Czech Republic, approved in 2015. Following a step-by-step implementation, the measures are preferably focused on nature-based solutions that use ecosystem services provided by blue and green infrastructures. Green infrastructure has a key role in this strategy, as it contributes to natural disaster prevention. If NBS cannot be applied or are ineffective, suitable technological (also called grey) and soft measures, e.g. early warning systems or communication, education, and public awareness/environmental education campaigns, is used. The green infrastructure concept considers land-use/territorial planning as a key tool allowing multi-purpose use of the landscape. In a broader sense, the Green Infrastructure also covers water areas, that supports water availability for the green infrastructure in towns and cities accumulation, i.e. polders, water reservoirs, artificial wetlands, and other Blue Infrastructure components.

Assessment of vulnerability to climate change effects in Prague, including the non-action option, is based on the scenario's policy. Following this general rule, from past events experience, future measures are developed.

### **City of Rotterdam (NL)**

At Rotterdam region, the Rotterdam Weather Wise Urgency Document develops the Delta Programme<sup>8</sup> according to which the design of Netherlands has to respond to climate-resilience and water-robustness by 2050. The city follows this approach, although according to its vulnerability in terms of location in the Dutch Delta, it is under ambitious. The measures seek a more intense adaptation, addressed to build a climate-resilience based approach and to face other goals, such as circular economy and energy transition. The objective is to minimize the increase in the damage caused by hazards, as well as consider them when constructing residential areas, commercial buildings, renovating urban and green areas and infrastructure maintenance (e.g. roads and sewerage system).

The Rotterdam's Weather Wise Urgent Document shows the maps for the hazards and vulnerable objects, the challenges and the response lead actors. It also includes the Opportunities Map that identifies pilots for energy, re-densification and re-naturalization areas, among others.

The basics of the Rotterdam Climate Change Adaptation Strategy (2013) are: (i) robust system, referred to the management of the defense infrastructures as water barriers, lakes, canals,

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<sup>8</sup> Derived from the Delta Act, the legal basis document containing the determinations for adaptation to climate change in the Netherlands

dykes, outlets, sewer system and pumping stations; (ii) adaptation, including solutions to make the robust system more flexible and liberate it from extra-stress, and to adapting the functioning of the city to the changing natural behaviour of the delta and its water levels. Besides this, wide application throughout the city of small-scale responses are planned.

One of the sources of basic information for conducting climate change impact assessments in the Netherlands, also called resistance tests, are the climate change scenarios, developed by the national Delta Program.

In the Netherlands, administration of different levels, perform climate change impact assessment, since they have a responsibility for adaptation measures according to their competencies. The national government produces and communicates knowledge, generates policy at this level, and exercises leadership over other governments; the provinces and cities – as the case of Rotterdam –, are responsible for spatial planning (the regional planning includes infrastructure, housing and facilities); and the local level is the one in which the spatial planning is mostly developed.

### **Common approaches**

Although the cases respond to different scales, at the national level the countries have strategies or plans for adaptation to climate change from which the measures at the regional or local scale are derived. For Dresden Region, the German Adaptation Strategy to Climate Change 2008 (DAS - “Deutsche Anpassungsstrategie an den Klimawandel”) addresses as cross-cutting topics: the spatial, regional and urban land-use planning, as well as civil protection and disaster control (UBA, 2018). For the Nouvelle-Aquitaine, it is the National Plan for Adaptation to Climate Change (PNACC) which focuses on helping actors to adapt to changes in the still unknown climate. In Andalusia, the National Climate Change Adaptation Plan is the framework to coordinate the different public administrations in evaluation, assessments, and adaptation actions in climate change matters. This plan is under revision, expecting to be approved in 2021, and to be effective until 2030. In Prague, the Strategy on Adaptation to Climate Change in the Czech Republic was approved in 2015. For the City of Pori, since 2005, the National Strategy for Adaptation to Climate Change insists on the integration of adaptive measures, with a sectoral perspective, into planning. For the City of Rotterdam, the national basis document, containing the determinations for adaptation to climate change in the Netherlands, is the Delta Act, that mandates the existence of the Delta Programme, which is the main roadmap for adaptation of climate change – defined over 3 steps (i) impact assessments, (ii) stakeholder participation, (iii) actions arising from the integration of the climate agenda into the planning system.

## 5 Cooperation and coordination

In general, in the ESPON-TITAN case studies, these are recognized as the most problematic issues: coordination and cooperation represent a challenge mainly due to fragmentation in public administration. While cooperation is voluntary, coordination means hierarchy, in the sense that it needs a coordinator with clear legal basis. In this sense, it is clearly recognized that coordination is done in a top-down approach (from national to local levels). The big issue then is how to make this coordination operative in a routine and smooth way, based on an inter-administrative cooperation and collaboration principle. Also, public-private coordination and cooperation are tough to be established; even though they seem much easier after an event occurs – when reaction is necessary (instead of prevention) to recover and support with any kind of resources (mainly public or publicly induced budget – as catastrophic area declaration in order to obtain fiscal insurances – and other benefits by private owners).

There is a great diversity of modes to put in practice cooperation and coordination within traditional policy systems (e.g. Lombardy with provinces key role and intermunicipal cooperation; the Cities of Pori and Rotterdam with strong local resources and powers; Nouvelle-Aquitaine and Prague, centralized countries with a tendency to administrative regionalisation, that seems to fit better with hydrographic basins; constitutional regions as in Andalusia case, etc.) and in the way in which policies with territorial impact are applied. Government routines and new governance practices are diverse (risk analysis, diagnosis, strategies-plans-programmes definition, civil protection measures, specific interventions), due to each case own conditions and path-dependence, that are starting points for introducing spatial-institutional innovations, as it is the case for DRM and CCA.

The case studies represent a diverse sample, including different kind of cooperation and coordination, from local to transnational levels, but also with different political cultures, administrative forms and so on. However, it is still possible to identify similarities between the case studies related to under which circumstances there are a better cooperated and coordinated actions.

The European influence is evident in different ways. Euroregions have a positive impact, as a consequence of transnational cooperation, based on European budgets and investments, to promote traditionally forgotten areas by national administration. It is possible to face challenges in transnational spaces – conformed by countries and regions with their own legal frameworks – thanks to the creation of a common perspective, norms and targets, in a coordinative form. This is especially remarkable because on transnational perspective, it is more evident cooperative instead of coordinative initiatives. Although, cooperation is not very often seen between administrative levels in the same country, which are usually related to each other in a hierarchical form, instead of a strategical way, typical from cooperation.

Another example of European influence is the normative development the Member States include in their legal framework. In relation to DRM and CCA – focused in ESPON-TITAN –, they are both issues that can be influenced by European policies. In this sense, the influence of water management and flood risk management is a clear example. Meanwhile, climate change has a particular role. The transversal perspective of Climate Change has a direct impact on the coordinative action between administrations. It is related to the development and implementation of Climate Change Adaptation Strategies and the necessity to include all the sectors and administrative levels affected, with an integrative perspective between risk management and climate change effects. Of course, spatial planning has a role on risk, hazards and climate change measures. However, spatial planning is mainly the result of the administrative coordination process based on a spatial or urban development perspective and a sectoral approach, that includes previously decided risk management and climate change issues. Instead, considering spatial planning as the tool for coordination between sectoral policies appears in our Dresden case study.

The administrative structure reconfiguration, derived from the subsidiarity principle in EU policies, also affects coordinative actions. The national level has to share competences with both local and regional levels. It inevitably increases the complexity of the system, particularly in centralised models, when including of non-politicians' profiles, mainly related to technical support and collaboration from universities, that support the local levels with technical knowledge, supervising local works. Beyond technical profiles, the private sector and civil society are also included sharing their particular perspectives and interests, and also creating knowledge and information about risk management and climate change adaptation by providing information and developing routines to face dangerous events.

In order to consider coordination and cooperation successful, administrative and legal structure, as well as some routines, are important to be established. It will only work well if there are personal connections, mutual trust and if different groups are encouraged and invited to share experiences and learn from one another and share experiences in an open-minded way. This way, the coordination and cooperation would be long-lasting, sustainable and effective.

Below the most relevant aspects in terms of cooperation and coordination related to the ESPON-TITAN case studies are presented, from a more local to a transnational level.

In **Rotterdam**, climate change policies have the a main role in these issues. Sustainability and Climate Adaptation Offices are in charge of coordinating activities related to climate change, sustainability and resilience. As a consequence of the transversal perspective of climate change, every sectoral policy has to include considerations about these questions. For this aim, there are strategic documents that introduce guidelines for sectoral policies development. Rotterdam Climate's Office works in coordination with other departments of the city government, integrating personal from climate's office into the other areas. These measures are well-considered for a successful climate change adaptation, but also for improving the quality of life of its inhabitants.



In **Prague**, cooperation is found through structural and functional reconsideration on its administration. Analysis on existing cooperation are positive, even in the transnational perspective, with initiatives controlled by the national level. However, coordination represents a challenge as a consequence of the administrative fragmentation in a country with a strong centralised tradition.

In the **City of Pori**, the planning system is centralised at the national level, counting on the participation of sectoral ministers and other administrative bodies (including provinces and municipalities). This planning system includes participative elements and coordinative issues related to flood risk management. Coordination between local (with their goals and interests) and the national level (pursuing common welfare) occurs at national participating committees (although with a lack of relation between participating interests and sectoral approach of the meetings). In terms of climate change, there is a group that encourages and supervises the implementation of the strategies in a coordinative form, however, in general terms, there is a predominant sectoral approach.

**Po river basin** is particular because it does not correspond to a traditional administrative division but a natural one (basin river area). Po river basin includes, even if partially, seven different Regions, with different specific laws. They all participate in the District Authority, where common rules and goals are discussed and approved. By considering this administrative level according to the territorial necessities, management is improved – to concrete initiatives at the local level in relation to risk management, land-use planning includes risk maps contents. Previously to the local level, the attention is on medium-size areas (cascade model) where prevention initiatives take place.

In **Dresden Region**, civil protection response depends on the county level, which coordinates it. Both coordination and cooperation depend on information exchange as a prerequisite. Digitalization has a preeminent role in the future, particularly for DRM. The most remarkable issue in Dresden Region is related to Spatial Planning system. Regional planning (“Raumordnung”) is prioritised over sectoral planning, in particular over water management, as its objectives have to be considered and included in spatially significant planning measures and procedures. By means of the regional level, a link between a state-wide perspective on development and decisions that influence the local level is established. It is a clear example of integrated planning style.

In **Andalusia**, sectoral committees represent the main coordination activity. They are responsible for cross-sectoral and multi-level coordination for planning, which is restricted (only part of the society and administrations participates passively on the public information process). Climate change forces, as a transversal topic, to develop cross-sectoral and multi-level working groups with an integrative perspective. Civil Protection has relevance in the multi-level coordination between national to the local level, particularly for flood risk management. Civil protection provides technical support to the local level and supervises their plans, providing information to the national level.

In the case of the **Alpine Region**, cooperation is the sense of the existence of this (due to its Euroregion condition). The framework developed in its constitution provides protocols and specific objectives to achieve a homogeneous response from different national and regional normative and instruments; DRM represents a common goal. For this reason, it has a related strategic agreement that also includes climate change.

As already mentioned, in **Nouvelle Aquitaine**, legal instruments develop at regional scale the determinations of the PNACC (National Plan for Adaptation to Climate Change) that are key to decreasing climate change impacts through a change in the actors' ways of proceeding. The planning for this is wide and includes regional and economic planning, and protection to the communities from the natural risks related to global warming. Besides, local governments have developed strategies for the involvement of the public and stakeholders in the protection of the communities. In this sense, this case study confirms the territorial management tradition – or *Aménagement du Territoire* –, with strong cross-sectoral coordination in a clear top-down (hierarchical) approach. Despite, there have been some process of decentralisation: to regions (even though with still not clear impact of their reorganization/reduction of their number in big new regions), but mainly to local level enforcement since Law No. 99-586 of 12 July 1999, related to the strengthening and simplification of inter-municipal cooperation (contracts), known as the Chevènement Law, dedicated to inter-municipal cooperation in France.

## 6 Lessons learnt

**Territories should focus more on risk prevention activities rather than response/reaction, as it has a relevant cost but is worth it.** Nowadays, even if climate change causes more intense events, and anthropic pressure becomes harder, there are fewer damages as a consequence of an event than in the past, as shown in Prague, Andalusia, Po river Basin, City of Pori and Rotterdam. The Dresden Region and Rotterdam show that authorities should focus on long-term decisions as, because of climate change, the conditions might get worse faster than anticipation and decisions are made, in terms of preventive measures.

**Risk cannot be avoided nor reduced to zero, but they can be managed.** Thus, residual risk should be accepted and managed through a sound preparation and disaster management measures. In this line, it is important to create an effective alert and rescue system, as seen on the Dresden Region. Moreover, compensation systems to mitigate the effects after an event are crucial, as seen on the Andalusia case. In the context of emergency management, the importance of the human factor has been highlighted in the Po river Basin.

**Mitigation and prevention are processes that include a whole toolbox of measures.** In these lines, funds for constant maintenance are needed, and the responsible institutions must be clearly identified, as seen on the City of Pori, Po river Basin and Nouvelle-Aquitaine.

**New methodologies must be implemented for risk assessment, providing maps and systems of observation, evaluation and scenarios** (as in Nouvelle-Aquitaine), not only in the long, but also in the middle and short-term, also counting on public participation and education (as in Rotterdam). For instance, flood prevention areas should be designated based on hazard intensity, considering parameters like flow speed and water depth instead of the probability of occurrence, as seen on the Dresden Region. Moreover, the use of return period (historical information) must be completed with methodologies based on scenarios, as seen on the City of Pori, Po river Basin and the Dresden region.

The case studies showed the **importance of binding laws regulating every aspect of DRM.** In this line, the Cities of Pori and Rotterdam highlight the importance of including prevention measures, maintenance periods or update frequency in the law. The Po river Basin is a good example of legal obligation, linking risk assessment to spatial planning. The local level is important for a successful DRM strategy, as every administration level must be aware of risks and allocate the necessary resources to manage them, as seen on the Alpine Region, Andalusia and the Po river Basin. But the legal binding character is not enough, as it should be complemented with support from the other – also informal – administrative instruments. Thus, the regional and national level should offer the local level financial support, guidelines and knowledge, as reflected in the Po river Basin. On the other hand, a generalized criticism is that local authorities should prioritize risk assessment and management, as seen on the Cities of Pori and Rotterdam, for instance.

Prevention is based on this knowledge, applied to the determination of urban and buildable areas. **Municipal planning must consider risks much more than they do nowadays, because at the end, it is the key instrument which regulates land-use.** Authorities should pay special attention to areas where buildings have been installed without much consideration or outdated methods concerning risk management in the past, as seen on the City of Pori, Po river Basin or Nouvelle-Aquitaine. Possible solutions are gradual delocalization, insurance, or urban rehabilitation. In this line, it must be highlighted that the support of urban rehabilitation, along with the “2050 zero land-take” objective of the EU, must consider the climate change impacts and its associated risks, redesigning cities and territories in this direction. Urban planning irregularities were revealed, and are associated with high costs. To protect people's lives and incur the lowest costs, the most effective alternative is to avoid the urbanization of high-risk areas, whose maintenance and future safety can only be ensured if responsibility for them lies with clearly identified officials.

A top-down approach is still predominantly followed, although **vertical coordination and cooperation are very important for DRM and CCA.** Some good examples are the common geographic information platform of the Po river Basin case study, the role of Civil Protection in Andalusia case study or the interactive and online tools for DRM enhancing cooperation between the different administrative levels and the inclusion of citizens in the Dresden Region. Concerning CCA, adaptation strategies and action plans developed at the national and regional level should be transferred to the local level through adaptation measures.

**Intersectoral coordination should be improved in all areas of risk management, as well as in the management of adaptation to climate change.** In this context, policies for risk management and CCA cannot remain sectoral, but should be integrated with spatial planning and development programs as seen with several paths on the Dresden Region, in Nouvelle-Aquitaine and in the Netherlands. In the future, cross-sectoral measures should be better integrated with, and promoted, as part of adaptation measures. A good example of vertical coordination is the Rotterdam case study, in which the national government produces and communicates knowledge, generates policy at this level, and exercises leadership over other governments; and at the local level the spatial planning is mostly developed. The examples from Rotterdam<sup>9</sup> show the need/possibility of rethinking land-uses under areas where flooding is foreseen to suffer changes resulting from climate change.

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<sup>9</sup> Semi-detached dams to provide collective public space and defending against floods; recreational waterways serving a similar purpose. (Rotterdam Climate Initiative, 2014). Spaces that store water, floating adaptable buildings (Rijnhaven) (Rotterdam Climate Initiative, 2014) (Braw, 2013), water squares for collective use (Bellamyplein). (Braw, 2013) and the blue roofs (Kruisplein and in Museum Park). Rowing lane as water retention area near Zevenhuizenplas; the floating forest and floating pavillion near Wilhelminapier, the floating Park in Rijnhaven (not yet built), the water storage in Museumpark parking garage, the Vierhavenstraat multifunctional flood defence with park and shopping mall, and water squares like Benthem water square.

**A sound strategy for DRM and CCA should involve all the relevant actors of the territory,** as seen on the Dresden Region, City of Pori, Rotterdam and Po river basin. This cooperation and collaboration benefits from their innovation capacity, as professionals, universities, and enterprises are constantly developing new solutions and new skills, as seen on the Dresden Region and Po river basin.

**Natural phenomena do not care about administrative borders, so cooperation between regions must be put in place.** This cooperation must exist between regions within a country, as seen on the Po river basin, but also between countries, as seen on the Alpine Region and the Dresden Region. Cross border cooperation is important for transnational spatial planning, DRM and CCA. In this line, the Alpine Region showed the importance of transnational programmes, such as EUSALP, and transnational projects like GreenRisk4Alps.

**The supranational level should set common standards for DRM and CCA strategies within the European Union.** The success of the Flood Risk Management Directive 2007/60/EC is a good example of what can be done in the European institutions.

The case studies analysed showed that **in the long-term, sustainable and effective cooperation must be built on formal agreements, but it can only be filled with the human component.** Thus, personal connections, mutual trust and open-mindedness to share experiences and learn from each other is a key factor. In this line, the URBACT and INTERACT programs are good examples of how the European Union can foster this kind of exchanges. By keeping clear subsidiarity and proportionality principles, European dimension is necessary as a common house of benchmarking to help driving common improvements in these fields; by learning from the best practices, but also with decided leadership from Directives for First Pillar Policies and those in which territorial cross-border cooperations demonstrate specially potential and usefulness, as it is the case of DRM and CCA.

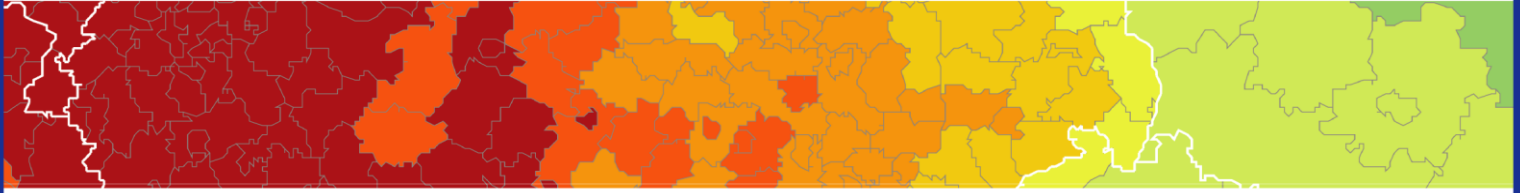
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