ECONADAPT

The Economics of Adaptation

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Policy and decision context of case studies

Paolo Scussolini, Onno Kuik (VUA); Kateřina Kaprová and Jan Melichar (CUNI); Elisa Sainz de Murieta and Ibon Galarraga (BC3); Manuel Lago, Josselin Rouillard, Jenny Troeltzsch (ECOLOGIC INSTITUTE)

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Authors:	Paolo Scussolini (VUA), Kateřina Kaprová and Jan Melichar (CUNI), Elisa Sainz de Murieta and Ibon Galarraga (BC3)
Other Contributors	Manuel Lago, Josselin Rouillard; Jenny Troeltzsch (ECOLOGIC INSTITUTE), Onno Kuik (VUA)
Date:	
Contact details	Paolo Scussolini, paolo scussolini@vu.nl
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To find out more about the ECONADAPT project, please visit the web-site: www.econadapt.eu

For further information on the ECONADAPT project contact Alistair Hunt at: ecsasph@bath.ac.uk

Executive Summary

What is the aim of this deliverable? Please summarise in about 150 words.
Work Package 6 (WP6) of the ECONADAPT project is concerned with two “real-world” economic appraisals of investments in climate change adaptation, in the European context. The two selected case studies deal with adaptation to a higher risk of floods. **The Vltava case**, centred on the Vltava river impacts on Prague, Czech Republic; and **the Bilbao case**, centred at a the sea-level rise-related impacts of the Nervión river in a district of Bilbao, Spain.

In this report we describe the contexts of the two case studies, with particular attention to the areas of policy and of decision-making.

Why is the work of this deliverable important? Please explain in about 400 words.
This document forms the basis from which the other tasks of WP6 are developed. Also, a main scope of this report is to make sure that the research questions and the objective are uniform across the two case studies. This is important to secure the cases’ comparability, and thus the feasibility of distilling a lesson learnt from the set of two case studies, and the extraction of guidelines to inform decision making in the EU context. These are two main scopes of the rest of WP6, and of the contribution of WP6 to the methodological toolbox that is planned within ECONADAPT.

Which method was used/developed? Please provide a description of about 700 words of the methods used. The text should describe the general methodological steps involved.

We investigated the broad framework of each case study, focusing on reporting information about: the geo-socio-economic context at the country- and at the case-specific-scale; the main issues treated in the case study; the general and detailed research goals; the policy and stakeholder contexts, providing an account of the main actors that need to be considered in the domain of the cases, from institutions and from private parties, as well as the relevant legislative and regulatory matter that applies at the various policy levels.

What are the main strengths and limitations of the method used?
A context analysis such as the one presented here allows the practitioner to get a complete overview of any type of factor that should be contemplated in decision-making, and in the economic appraisal of the adaptation investment. The limitation is that obviously the analysis is constrained in time, and it cannot aspire to be exhaustive.

What are the key results? 400 words

The Vltava case is centred on adaptation to flood risk in this basin in the Czech Republic. The geographical, climatological and hydrological characteristics of the area are depicted, as well as its main socio-economic traits. Further, historical and phenomenological accounts of the hazard of flooding are provided.

The institutional analysis reports that flood protection in the country is formally a private-citizens' preoccupation, and that citizens can only partially insure their assets against flooding; apart from that, public institutions enforce flood protection. On the policy level, we briefly review the existing relevant EU and Czech documents. Regarding stakeholder analysis, we have compiled a list of relevant institutions, agencies, companies and departments that either play a role in decision-making and investments in flood risk (mainly the Povodí Vltavy, state enterprise), or are involved in the managing the flow of water in the Vltava upstream of Prague (mainly ČEZ, a.s., a hydroelectric power company).

It is recognized that, although flooding is a stringent paradigm in this area, two key problems persist: 1) development in flood-prone areas is widespread; and 2) adaptation initiatives so far lack coordination, from a political and legislative point of view. This is therefore reflected in sub-optimal decision-making and in failing to meet the needs of several stakeholders. The aim of the case study is to contribute to a rational approach to flood risk adaptation, by performing a comprehensive economic appraisal of measures of adaptation to flood risk. The methodology chosen is a cost benefit analysis; particular attention will be dedicated to the methods to cope with large uncertainties associate with the appraisal of impacts of climate change.

The Bilbao case is concerned with a specific adaptation investment to reduce flood risk in a district of this Basque city, situated in a historically flood-prone area. Also for this case, the various contextual aspects are analysed, and particular attention is devoted to describing the Zorrotzaurre district, and the adaptation measure that is planned there. From the viewpoint of institutional analysis, the management of coastal areas is scattered across multiple central and regional institutions. Water management largely corresponds to the EU Water Framework Directive and is developed through Hydrologic Plans, which also cover the topic of flood risk. The relevant stakeholders touch on the areas of flood prevention, with main representative the Basque Water Agency, and urban planning of the district, which involves many local and institutional (at various scales) actors that are represented in the Management Commission for the Urban Development of Zorrotzaurre.

The aim of the case study is to apply adequate appraisal methods to support economic decision-making in the presence of strong uncertainties.

What does it mean for policy and decision-making?

With this work, we intend to provide the supporting information that is necessary to carry out the two economic appraisals of adaptation planned in WP6. In particular, this document is relevant for policy and decision making at the local level of the two case studies, but also at a general level, as it shows which are the necessary preliminary steps that should be taken to contextualize and inform any such appraisal exercise.

Table of Contents

1 Introduction

1.1 Aims and structure of the ECONADAPT project

The ECONADAPT FP7 project carries out research in the context of Europe's adaptation to man-made climate change. The economics that underpins decision-making about adaptation action are examined, and particular attention is bestowed to the inherent aspects of uncertainty and multiplicity of scales in the climate change predicament.

The project's aims are to provide decision-makers and stakeholders, at the various scales applicable in the European context, with economic methodologies, evidence and appraisal criteria to guide and coordinate adaptation action. The climate change areas on which the project focuses range from the short-term effects of extreme weather events, to the long-term costs of climate-related risk, and from the macroeconomic consequences of impacts, to the assistance to developing countries in their response to expected climate developments.

To facilitate the project's scopes, ECONADAPT is organized in three methodological Work Packages (WP) (WPs 2 to 4), that are meant to inform and provide operational input to five WPs (WPs 5 to 9) that are centred on policy case studies. Besides these, other work packages focus on the project-supporting aspects of the framing of the policy-focussed economic analysis (WP1), stakeholder engagement (WP11), the final set-up of a toolbox for economic assessment of adaptation (WP10), dissemination (WP11) and project management and integration (WP12).

Work package 6

Among the policy case studies WPs, WP6 is dedicated to the economic appraisal of projects of adaptation to climate change. The aim here is "to provide illustrative examples of prototype appraisals in real-world contexts"[1]. To represent a different climate risk contexts and different scales, two case studies are selected:

- fluvial flood protection in the Vltava river basin in the Czech Republic (Vltava case study);
- the restructuring of a district, Zorrotzaurre, in the city of Bilbao, Spain (Bilbao case study).

The Vltava case study is led and conducted by the Charles University, Prague (CUNI partner), and the Bilbao case study by the Basque Centre for Climate Change, Bilbao (BC3 partner).

The two case studies explicitly address the two main threats that climate change poses to Europe, namely increased hazards from river floods, originating from modifications in the

[1] From the ECONADAPT project Description of Work.

precipitation patterns in continental regions (Vltava case study), and increased pressure on coastal zones from rising sea levels and intensifying storm surges (Bilbao case study).

The two case studies will present the evaluation of the benefits and of the costs, and the estimation of the uncertainties thereof, in the two concrete projects of adaptation in the Czech and Spain contexts. Projections of the effects of climate change, in the form of altered rainfall and of rise in sea level, and projections of socioeconomic developments will be explicitly taken into account. The methodologies applied will at least partially be derived from work in the methodological WPs of the project.

Aims of this report

This report, Deliverable 6.1, aims to describe the contexts of the Vltava and Bilbao case studies, dedicating particular attention to the areas of policy and of decision-making. This constitutes the basis from which the other tasks of WP6 are elaborated.

For each case study the report presents: the broad framework, with information about the geo-socio-economic context at the country- and at the case-specific-scale; the main issues treated; the general and detailed research goals; the policy and stakeholder contexts, providing an account of the main actors that need to be considered in the domain of the cases, from institutions and from private parties, as well as the relevant legislative and regulatory matter that applies at the various policy levels.

Further, while the two case studies differ in a number of aspects, a main scope of this report is to make sure that the research questions and the objectives are uniform across the two case studies. By this, the later discussion on the lessons learnt and the extraction of guidelines to inform decision making in the EU context, two main scopes of the project and of WP6, are secured. Table 1 summarizes the differences and similarities across several aspects of the appraisal exercise for the two case studies, whereas details are provided in the remainder of this document.

Table 1: Summary of the main aspects of the appraisal in the two case studies of Work Package 6.

	Vltava case study	*Bilbao case study*
Climate-related hazard	River flood	River and coastal flood
Climate information source	A combination of information from local sources and from ECONADAPT partners (the University of West Anglia and the Danish Meteorological Institute)	
Scale	River basin	District
Main objective	Appraise cost and benefits, and relevant uncertainties of several adaptation investments	
Stakeholders and insitutions involved	Several research institutes in the field of water, soil and climate; the state energy company; the Ministry of Environment; the river basin management entities; municipalities	Basque Water Agency; Management Commission for the Urban Development of Zorrotzaurre
Financial sources	From country- to EU-level	From municipal- to country-level
Main EU regulations involved	Water Framework Directive and the Floods Directive	
Main specific regulations	Water Act (National level); Plan of main river basins; National Flood Protection Strategy	Regional Hydrologic Plan
Methodology	Cost-Benefit Analysis	Real Option Analysis
Uncertainties	Uncertainties will be incorporated from different sources to be determined	

2 The Vltava case study

2.1 Introduction and geo-socio-economic context

Context and main issues of case study

This case study focuses on flood risks in the Czech Republic. The Czech Republic has experienced an increased number of flooding events in the last several decades, and the predictions on the development of climate conditions suggest that the problems with the hydrological regime may be further exacerbated in the future (MoE, 2009). Since the first extensive flood event in the country in year 1997, much consideration has been given to the creation of planning documents and the development of instruments to help solve this problem, and to help the area adapt to the changing conditions and uncertainties about the future stability of the hydrological regime.

While many measures have been or are being adopted to deal with the consequences of past floods and to help particular regions withstand future flood events, they have not succeeded in coordinating the needs of different stakeholders (regional needs to manage the river basin as a whole, versus local problems in particular municipalities within the catchment area; lack of cooperation among the administrations of river basins with mutual hydrological influence). Also, the discussion still continues on how to proceed with the adaptation in water management, and on which measures are favourable from the societal perspective, still continues. Furthermore, as stated in the report of Directorate General Regional Policy (2006), flood protection still requires large investments in the Czech Republic.

We therefore aim to contribute to the debate and assess the investments into measures of adaptation to flood risk. For this task, we have chosen the study site of the Vltava river basin, which over the years underwent several important flood events. The most catastrophic of recent flood events was the flood in 2002, which caused large-scale damage through increases in discharge pollution and microbial level in water courses, through contamination of the soil near flooded industrial plants and through direct damage to the flooded real estates and to the landscape.

Possible adaptation strategies under consideration are the following:

i) increasing the safety of water works to prevent overflowing,
ii) investments into reconstruction and modifications of existing water reservoirs, polders, reservoirs, dykes, increasing the flow capacity,
iii) increasing the water retention ability of the landscape,
iv) water management measures centred on changing water runoffs in time.

Goal and research objectives

The study aims to appraise several strategies/measures of adaptation to flood, for which the corresponding investments and social benefits will be calculated, comparing adaptation to the reference case of business as usual. The inputs into the definition of adaptation are a literature review on infrastructure investments in the region, yielding an inventory of costs and benefits, and also a review of scenarios of climate change and socio-economic development that may influence the investment in the long term.

Furthermore, the impacts of these adaptation measures on different stakeholders groups will be analyzed, investigating the trade-offs among various uses of the study area. Key to the assessment is to incorporate uncertainties into the economic appraisals.

The results from these research steps will provide the basis for a cost-benefit analysis (CBA) of the adaptation measures that will shed light upon the following questions:

- i) which adaptation measures are beneficial from the societal perspective,
- ii) who are the main beneficiaries (including geographical specification and description of particular groups of beneficiaries),
- iii) who bears the cost of the measure/scenario,
- iv) what are the main uncertainties that affect the resulting recommendations.

Research challenges in the case study are to:

- i) define the "business as usual" situation, and several flood adaptation measures/strategies for the Vltava river basin in the Czech Republic; gather corresponding investments and social benefits of the flood adaptation measures in a similar contexts in the EU and beyond;
- ii) appraise the investments into flood adaptation measures in the Vltava river basin using a CBA, and to compute net present value for each defined flood adaptation measure;
- iii) investigate the trade-off between different functions of waterworks placed in the Vltava river basin. The case study will concentrate on trade-offs between flood protection function (maintaining lower water levels), utilization of hydro energy, maintaining navigability of certain parts of Vltava river, withdrawing water for industrial and drinking water purposes, and new possibilities for new recreation sites.

Geographical characteristics

The case study area is the Vltava river basin, which covers southern Bohemia and a part of central Bohemia. Technically, it consists of two river basin districts, the Upper Vltava and the Lower Vltava; both are managed by Povodí Vltavy, a state enterprise, but planning is done for each of them separately.

Apart from the two river basin districts, Povodí Vltavy manages also the Berounka river basin district, and the river Berounka flows into the Vltava river in the south of Prague. In the case study, we focus on adaptation measures that are planned in the river basin districts of the

Upper and the Lower Vltava. The location of the Vltava study site and both its river basin districts is depicted in the following figure.

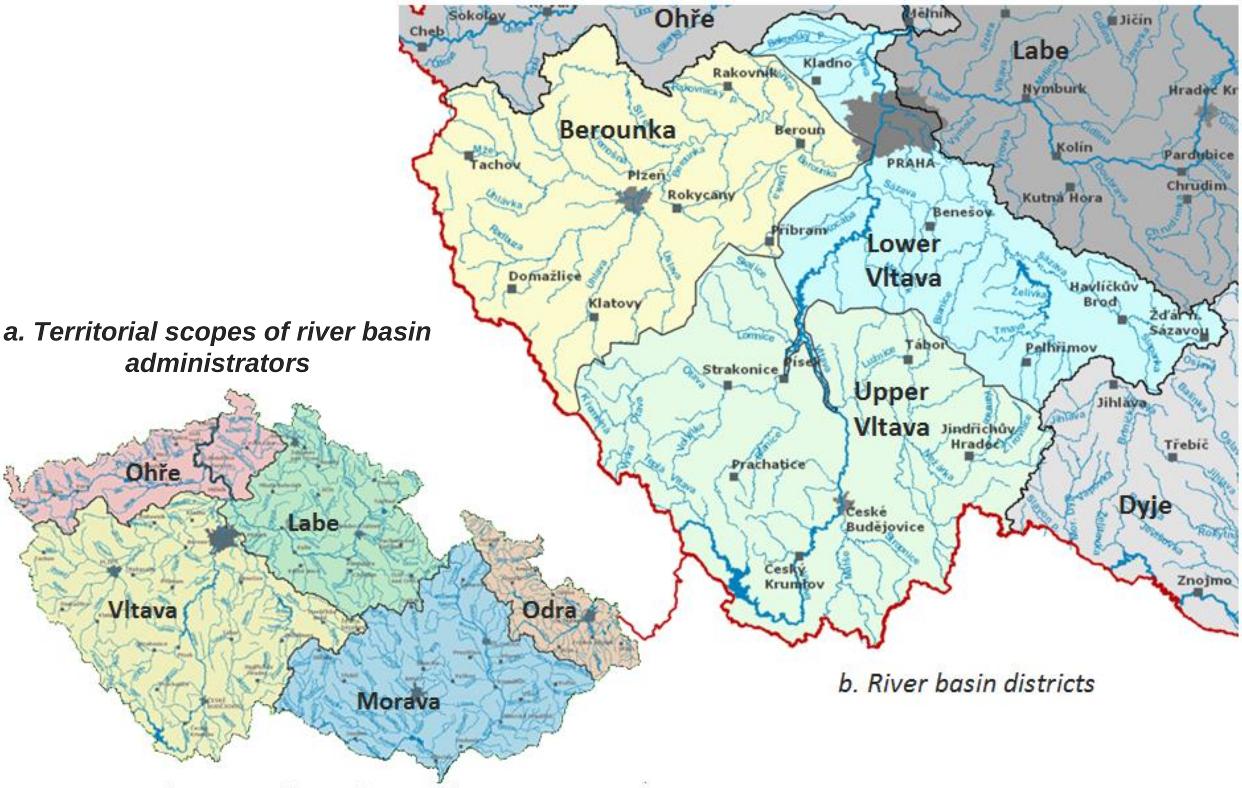

Figure 1: Vltava river basin in the context of territorial scopes of 5 river basin administrators and river basin districts.

The Upper Vltava river basin district is located in the Southern Bohemian basin, which is surrounded by the Šumava mountains in the south, the Brdy upland in the northwest, the Central Bohemian upland in the north, the Českomoravská upland in the east and the Novohradské mountains in the southeast. The Lower Vltava river basin district lies in the mostly hilly area of the Central Bohemia, which turns into a relatively flat area between the Vltava and Labe rivers. The area of both river basin districts is around 18,307 km^2 (Povodí Vltavy, 2007a, b).

In the Upper Vltava river basin district, the main land use is forest and seminatural vegetation (over 40%) and agricultural land (over 35%). In the Lower Vltava river basin district, more land is used for agriculture (51%), followed by forest and seminatural vegetation (27%), mixed agricultural areas (10%) and, compared to Upper Vltava river basin district, a larger share of artificial surfaces (8%; Ibid.).

In the river basin, a system of nine water dams for electricity generation and of waterworks was developed, called the Vltava cascade. The following table summarizes the technical characteristics of the Vltava cascade reservoirs.

Table 2: Overview of reservoirs in the study site. Source: Povodí Vltavy (2007a, b).

Reservoir	***Construction (year)***	***Area (sq. km)***	***Length (km)***	***Installed capacity (MW)***
Lipno I	1952-59	48.70	48	120
Lipno II	1952-59	0.33	7	1.5
Hněvkovice	1986-92	2.68	17.5	9.6
Kořensko[1]	1986-91			3.8
Orlík	1954-66	27.30	68	364
Kamýk	1956-62	1.96	10	40
Slapy	1951-54	13.92	44	144
Štěchovice	1937-45	1.14	9.4	22.5
Vrané	1930-36	2.51	13	13.88

[1] *The Kořensko water reservoir retains water until water level in the Orlík reservoir reaches its maximum (353 m above sea level); after that, it is inundated with Orlík water.*

Topography and climate of the study site

The Vltava originates in Šumava at 1172 m above sea level. The upper stream flows through the Šumava National Park and Protected Landscape Area, on the border of which the largest reservoirs in the Czech Republic, Lipno I and Lipno II, have been constructed. Then it continues through the Český Krumlov uplands, along the boundaries of the Blanský forest Protected Landscape Area, into the České Budějovice plateau, where its basin widens substantially and lowers its slope gradient. Near Hluboká nad Vltavou it enters the Tábor uplands where it flows through a deep basin. There, other Vltava cascade reservoirs are set up, such as Hněvkovice, which serves for supplying the Temelín nuclear power plant with cooling water), and the submerged dam Kořensko at the end of lake of Orlík reservoir. Further on, the Vltava continues through Benešov uphill with another large reservoir, Slapy, crosses the Prague plateau and, near Kralupy nad Vltavou, enters the area of the Mělník basin, where it flows into the Labe river. In the section Slapy-Mělník the watercourse is navigable for boats up to the weight of 700 tons. The total length of the Vltava river is 424 km (Povodí Vltavy 2007a,b).

The Vltava river basin has, just as the whole Czech Republic, a mild European continental climate with modest oceanic influence and regular seasonal cyclicity. At present, extremization of the hydrological cycle is observed, whereby the frequent occurrence of intense convective precipitation in summer results in flash floods, and whereby also increasing the recurrence of hydrological and hydrometeorological droughts (CGS, IH AS CR, 2011). The major factor influencing the hydrological balance is the increasing temperature in the area with uneven distribution of precipitation over the year (CHMI et al., 2012).

Development of hazards in the Czech Republic and the Vltava river basin

According to historic records (Ministry of Environment, 2004) extensive high floods were quite common in the Czech Republic in the second half of the 19th century (1862, 1872, 1890). Then the occurrence frequency shrank substantially, so that the 20th century was almost eventless up until recent years. In 1997, 2002 and 2006 three extreme flood events occurred in the Czech Republic, affecting also areas far beyond the Czech boundaries. The range and depth of inundation, together with catastrophic consequences of these events were exceptional even on the long time scale. Almost every year some of the urban areas located in river floodplains experience minor floods.

The following graph compares culmination flow rates on Vltava river from 1827 to the last extreme flood of 2002. The subsequent graph shows the more recent development of average annual flow rates on all hydrometric sections related to the study site.

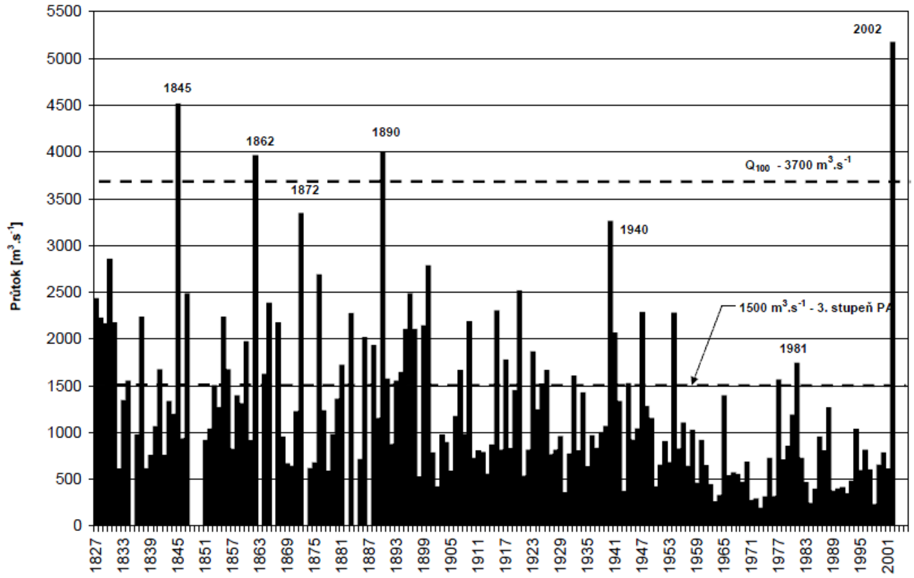

Figure 2: Development of culmination flow rates on Vltava river in years 1827-2002. Source: TGM WRI (2009).

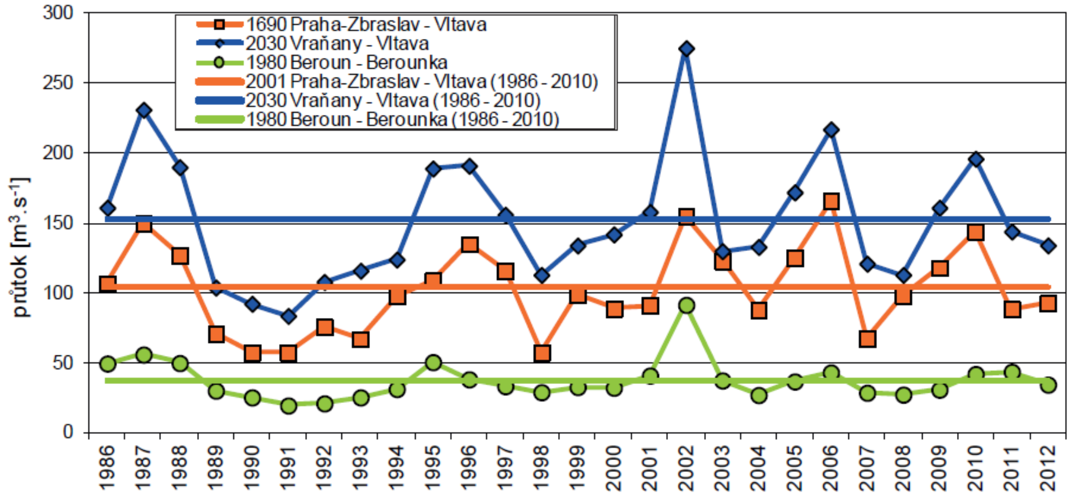

Figure 3: Average year flow rates on selected hydrometric sections. Source: CHMI (2013)

In 1997, a catastrophic inundation covered 11,000 km^2 in the east of the country. It was the first event of such a magnitude after several decades and thus the starting point of the debate on the new flood-control management. After 1997 another extreme catastrophic flood occurred in 2002 and afflicted almost the whole Czech Republic, including the study site. The total affected area mounted to 17,000 km^2. Locally, the culmination flow exceeded the rate of 500-year and even 1000-year flood (Q500 and Q1000) (MoA, 1998). Direct damages were estimated at 73.1 B CZK, which is 3.2 % of national GDP of 2002. According to MoE (2004), the precipitation of 2002 flood, although anomalous, reached merely 68 % of the worst-case precipitation scenario expected by MoE in the river basin. As follows, there exists a real risk of flooding even much more devastating than in 2002. As seen by MoE, the probability of repeating flood of such an extent seems so far unpredictable (MoE, 2004), though there were cases of accumulation of years with vast floods on the Vltava river in the past (1872, 1890, 1897, 1899).

In 2006, two more remarkable flood events reached the north-western, southern and eastern area of the country. The damage caused by spring floods was estimated at 5.5 B CZK. In 2007, there were three flood events from spring to autumn in the northeast of the country, reaching culmination flow rates Q5 up to Q50. The east of Prague was flooded in mid-August. In 2008, only a single major flood event occurred in March as a consequence of cyclone Emma. The highest culmination was reached on the river Otava (Q20 to Q50); other affected areas were the north and the south of the country. The Vltava was culminating at the headwater of the river, so only part of the study area was subject to the flood (MoA, 2009). In 2009, two flood events afflicted the south, southeast and north of the country. The summer flood locally exceeded Q100, mainly along minor creeks. The total damage mounted at 8.4 B CZK (TGM WRI 2009). The last flood event on the Vltava river was experienced in 2013, when constant regional and local torrential precipitation in June increased the water level to an extreme extent on minor watercourses throughout nine regions in the Czech Republic. The study site was affected indirectly by the water inflow of these minor creeks. The total damages are estimated at 15.4 B CZK, out of which the damage to water management hydraulic structures and objects was 2.5 B CZK (CHMI, 2013).

Table 3: Reported flood events in the Czech Republic - summary[1]. Source: MoA (2003); Čamrová and Jíková (2006); TGM WRI (2009; 2010); CHMI (2010; 2013).

Year of flood event	***Type of flood***	***Study site afflicted (yes/no)***	***Total damages (billions CZK)***
1997	Summer	N	62.5
1998	Summer	N	1.8
2000	Spring	N	3.8
2002	Summer	Y	75.1

2006	Spring/summer flash floods	Y	5.5[2]
2007	Spring, summer	Y	*n/a*
2008	Spring	Y	*n/a*
2009	Spring, summer	N	8.4
2010	Spring, summer	N	15.1
2013	Summer	Y	15.4

[1] *Estimates are valid for the whole area of the Czech Republic; usually only major floods are subject to a complex damage estimation*
[2] *Estimate is available for spring flood only*

Apart from these large flood events, in recent years the Czech Republic has experienced around 60 to 100 flash floods annually, causing damage to municipalities located mainly in the upper parts of watercourses, in the mountain areas and in the foothills (CHMI, 2012).

Based on the analysis by CHMI et al. (2012), climate change projections foresee exacerbated extremes in the hydrological regime up to 2100, both in flooding and hydrological drought. Some of these projections are associated with situations when the population needs are not met for water supply and dilution of discharged wastewater (in case of drought), or for the protection of inhabitants and property in flood-prone areas against floods. Both extremes may lead to widespread damages to ecosystems, whereby not only the ecosystems directly associated with watercourses, but the whole Czech landscape may be affected.

Socio-economic characteristics

The Vltava river basin encompasses several densely-populated areas located around the river, including the capital Prague in the lower part of basin. The density of population in the municipalities located within the Upper and Lower Vltava river basin districts is depicted in the following figures.

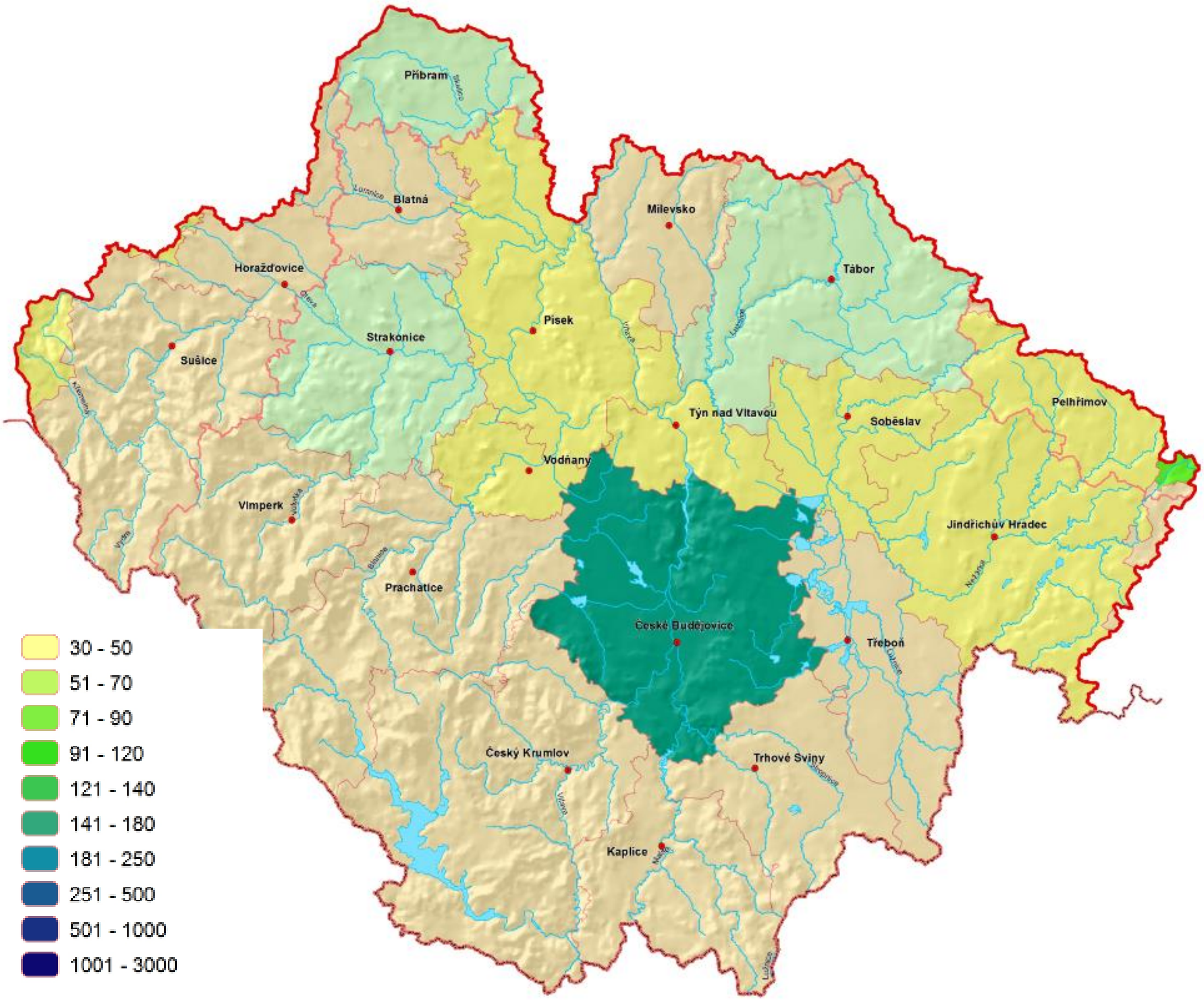

Figure 4: Population density in the Upper Vltava river basin district (for districts of municipalities with extended competence, per square kilometer). Source: Povodí Vltavy (2007a).

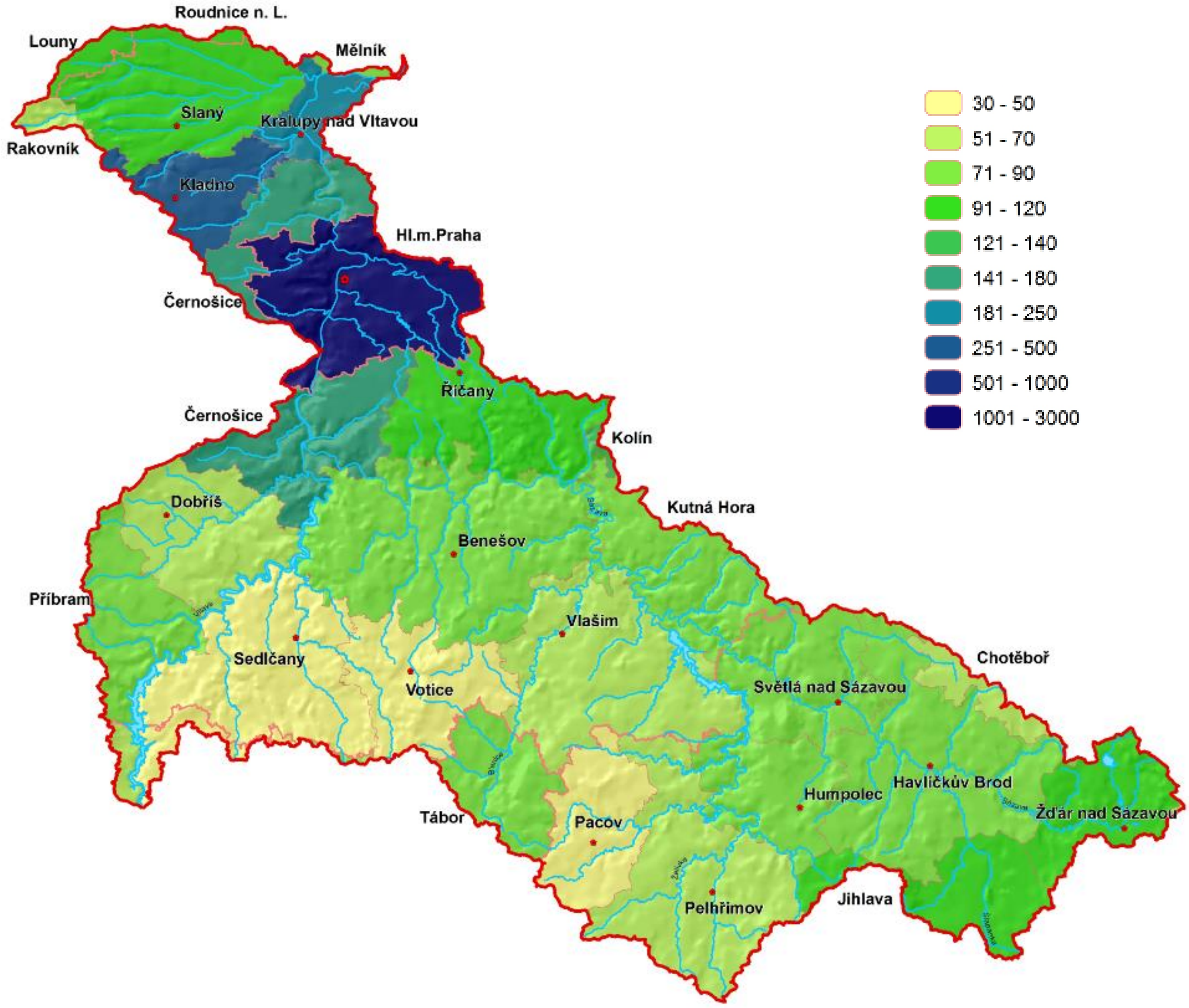

Figure 5: Population density in the Lower Vltava river basin district (for districts of municipalities with extended competence, per square kilometre). Source: Povodí Vltavy (2007b).

The long-term economic situation of most regions within the study site as measured by regional GDP is below the average of the Czech Republic (see Table 4). The absolutely dominant economic unit in the area of river basin is then the capital city of the Czech Republic, Prague.

Table 4: GDP per capita in regions (NUTS 3 level) within the study site (in % of EU 28 yearly average). Source: Povodí Vltavy (2007a, b), CZSO (2014).

Region (NUTS 3)	***Area of region within the Vltava river basin* (km²)**	***GDP PPS per capita* (in % of EU 28)**				
		2008	**2009**	**2010**	**2011**	**2012**
Jihočeský kraj	9.559	67.7	70.8	68.6	68.3	68.9
Středočeský kraj	4.539	74.8	74.0	71.5	72.6	72.1
Vysočina	2.612	65.0	67.9	65.5	67.6	68.0
Plzeňský kraj	1.140	69.1	71.5	71.6	72.7	72.2
Prague	413	174.9	176.1	173.0	171.1	168.9

Ústecký kraj	46	64.8	69.2	65.5	64.6	65.4
Czech Republic	**18.308**	**80.9**	**82.6**	**80.8**	**81.2**	**81.0**

As for the types of economic activities in the basin, the Upper Vltava district is predominantly an agricultural area with developed fish farming (the total area of ponds used for fish farming is around 25 thousand hectares) and forestry production. Main crops are cereals, oil plants, fodder plants and potatoes. The industry is not so developed compared to other regions of the Czech Republic. The largest firms within the district are the nuclear power plant Temelín (belonging to electricity producer ČEZ), the brewery Budějovický Budvar, s. e., the textile factory Jitex Písek, and the machine works ČZ Strojírna, in Strakonice. Also, two paper mills are located in the area: the Papírny Vltavský mlýn, in Loučovice near Lipno reservoir, and the Jihočeské papírny, in Větřní.

The Lower Vltava district contains several important industrial areas, out of which the most substantial is Prague; others are Posázaví around river Sázava, with large enterprises such as the glass producers Sklárny Kavalier a. s. and Crystalite Bohemia, mechanical engineering company ŽĎAS, manufacturer of steel and aluminium alloy castings METAZ Týnec, and ammunition manufacturer Sellier a Bellot; and the area to the north of Prague along the Vltava river, encompassing for example the nuclear research company ÚJV Řež, VUAB Pharma in Roztoky, the chemical enterprise Synthos Kralupy, and the oil refinery company Česká rafinérská in Kralupy nad Vltavou. Apart from industrial production, agriculture is also common in the area (Povodí Vltavy, 2007a,b).

2.2 Policy and stakeholder context

Institutional context

The legal concept of flood protection in the Czech Republic is set such that every citizen is responsible for protecting his own property and life from flood, as set in the Czech National Flood Protection Strategy (2000). The citizens cannot claim any flood damages from the government or other public entity. The properties that are subject to flood risks may be insured so that the owner does not have to bear the full costs of a possible inundation. Čamrová et Jílková (2006) state that with the increasing frequency of flood events experienced in the last years there is a growing tendency to insure the property located within floodplains. Whereas for 1997 insurance companies state that only 15.5% of the flood damages were covered by insurance, in 2002 the amount increased to 50%. However, the overall practice of the insurance companies is to cover only 1% (or a similar maximum fixed sum) of the insured amount, and many insurance companies do not cover flood risks in floodplains at all.

Nevertheless, flood protection planning is widely developed by the public sector, and accounts mainly for flood protection measures that affect larger areas in the river basins. Local administrations play a role in allowing development in floodplain areas (administratively defined areas that may be flooded in case of inundation), both by setting the territorial plan of the municipality, and by participation in the building-permit process. According to the Water Act (no. 254/2001; as amended by Act no. 150/2010), housing development (for other than water management purposes and necessary transport constructions) is forbidden in so called "active zones" of floodplain areas, which are the most vulnerable areas within floodplain zones. Flood protection management is assured by flood protection authorities (during the flood, these include a flood committee and integrated rescue system), which follow flood-event management plans.

Policy context

The key documents on the European level that deal with water management are the EU Water Framework Directive (2000/60/EC) and the EU Floods Directive (2007/60/EC). While the first aims at long-term sustainable water management, based on a high level of protection of the aquatic environment in all surface and groundwater bodies and at ensuring their sustainable use, the second directly focuses on reduction and management of flood risk. On the national level, these goals are transposed and embodied in the Water Act (no. 254/2001; as amended by Act no. 150/2010) and are also reflected in the main planning documents in the river basin districts; each of them contains a "Scheme of the measures" section, with descriptions of specific proposed adaptation measures. At present, also the "Flood risk management plans" that follow from the EU Floods Directive are being prepared. Together with the actualisation of Plans for the river basin districts, they will be finished by 22 December 2015.

To sum up, the main **regulations** affecting the settings of flood adaptation measures in the Czech Republic and in the study site area are the following:

- EU Water Framework Directive (2000/60/EC)
- EU Floods Directive (2007/60/EC)
- Water Act no. 254/2001 (as amended by Act no. 150/2010)
- Plan of main river basins of the Czech Republic (approved by Government Resolution no. 390/2004)
- Regulation 292/2002 on the river basin districts (as amended by Regulation 390/2004)
- Regulation 142/2005 on the planning in the field of water

The main **strategic and planning documents** are the following:

- Czech National Flood Protection Strategy (approved by Government Resolution no. 382 of 19 April 2000)
- Conception of settlement of the flood protection problematics in the Czech Republic with the use of technical and natural measures (approved by the government by Resolution no. 799 of 10 November 2010)
- Plan of the Upper Vltava river basin district (Povodí Vltavy, 2007a)

- Plan of the Lower Vltava river basin district (Povodí Vltavy, 2007b)
- Spatial development policy of the Czech Republic 2009
- General plan of surface water accumulation protected areas 2011
- Flood risk management plans (to be finished in 2015)
- National programme to abate the climate change impacts in the Czech Republic (approved by the government by Resolution no. 187 of 3 March 2004)

Concerning the links between the Czech planning documents and the Vltava cascade study site, the Czech National Flood Protection Strategy mentions the **Lower Vltava river basin in the stretch Štěchovice – Mělník** as one of the priority areas from the national point of view, and suggests a package of flood measures to address the flood protection in this area. More detailed description of the measures that are planned within the study site is found in Deliverable 6.2 of the project.

Stakeholders in the policy and regulatory domain

The Vltava cascade is located within two river basin districts, Upper Vltava and Lower Vltava, which are both managed by Povodí Vltavy, a state enterprise. Flood protection planning is carried out on state, regional and municipal level, At the state level the Ministry of Agriculture and the Ministry of the Environment of the Czech Republic play the most important role. At the regional level, the planning of flood protection measures on the Vltava river is affected by the decisions of the administrations of Jihočeský kraj, Středočeský kraj, Vysočina, Plzeňský kraj, Prague and Ústecký kraj (in the last mentioned region, only 46 km^2 of the river basin are located).

Planning on all levels is backed up with intensive research activities on climate scenarios, on the effects of water management schemes and of adaptation measures and with recommendations based on case studies. The main institutions that focus on research in this area are the Czech Hydrometeorological Institute (CHMI), the T. G. Masaryk Water Research Institute (TGM WRI), the Research Institute for Soil and Water Conservation (RISWC), the Institute of Hydrodynamics of the Academy of Sciences of the Czech Republic (IH AS CR), the Global Change Research Centre of Academy of Sciences of the Czech Republic (CzechGlobe) and the Faculty of matematics and physics at Charles University (FMP CU).

The variability of the functions of the Vltava cascade implies that different stakeholder groups are affected by the flood protection policy and measures. The main functions are the following:

- production of hydro energy (750 MW of installed capacity): Nine Hydroelectric power plants are operated by the largest Czech electricity producer, ČEZ, a.s.;

- water accumulation: water volume approximately of 1.4 10^9 m^3), including production of drinking and industrial water[2];
- flood protection: maintaining lower water levels;
- shipping[3]: the Labe-Vltava waterway is the only one in the Czech Republic that is employed for international transport; the navigable section of the Vltava in Slapy-Mělník is 92 km long;
- recreation, which varies largely in different reservoirs.

The trade-off is between the flood protection function and other functions such as production of hydro energy, navigability of the river, water withdrawal for industrial and drinking purposes, and recreation (especially use for water sports) in the reservoirs.

We have contacted and established cooperation with the following Czech stakeholders:

- Ministry of the Environment of the Czech Republic
  Department of Energy and Climate Protection
- Czech Environmental Information Agency
- Czech Hydrometeorological Institute
  Surface Water Department
- T. G. Masaryk Water Research Institute
  Department of Hydrology
- Research institute for soil and water conservation
  Department of Hydrology and Water Protection
- River Basin Managements (Povodí state enterprises)
  esp. Povodí Vtavy, state enerprise
- Municipalities
  esp. the Capital City of Prague
- ČEZ, a.s. electricity producer
  Hydroelectric power station

Financial sources for adaptation investments

Contrary to the legal principle of flood protection control in the Czech Republic, which states that every citizen is responsible for protecting his property (and life) from the flood primarily

[2] The management of drinking and industrial water production is responsibility of the municipalities, which usually own the water supply system on their cadastral areas, including the water treatment plants. Most of them lease the water and sewerage systems system to private companies that operate it, such as Veolia Voda Česká republika, a. s.

[3] The administrative body responsible for water level management of shipping and development of waterways is the Waterways Directorate of the Czech Republic.

by himself, most of the adaptation investments (mainly those that affect large areas or require notable investment are financed from the budget of the state, regions or municipalities. The subsidies from EU level also represent a substantial portion of resources for the realisation of adaptation measures in water management (at present, the measures are co-financed mainly by the European Regional Development Fund and by interregional integration programmes).

According to the Water Act (after incorporation of the EU Water Framework Directive), the flood protection measures that are set in the Plan of main river basins of the Czech Republic (the study site lies in the main river basin of Labe), are financed by the state. Flood protection measures defined in the plans of river basin districts (Upper Vltava, Lower Vltava) are financed by regions (defined by Eurostat as NUTS 3 administrations), sometimes with the contribution of the state.

There exists a developed scheme of subsidies on the EU and state level that support the realisation of projects aiming at flood control or flood damage removal. The main subsidies are listed in the following table.

Table 5 (also overleaf): Overview of main subsidy schemes concerning flood prevention that are applied in the Czech Republic. Source: OECD/EEA (2014), MoA (2013), MoF (2014).

Subsidy programme	***Programme no.***	***Source***	***Target group***	***Subsidy volume paid in year 2012 (millions CZK)***
Support of flood prevention II	129 120	Ministry of Agriculture	Povodí state enterprises, Lesy ČR s. e.	1,953
Support for renovation, sludge removal and reconstruction of ponds and water reservoirs	129 130	Ministry of Agriculture	Entrepreneurs in fishery	408
Support for enhancement of the function of hydraulic structures	129 170	Ministry of Agriculture	Povodí state enterprises (management of river basin districts)	0[1]
Removal of flood consequences from flood 2009 and 2010	229 116, 229 117	Ministry of Agriculture	Povodí state enterprises, Lesy ČR s. e., municipalities	1,820[2]

The Operational Environmental Programme - Priority axis 1: The improvement of water management infrastructure and reduction of flood risks - 1.3. Reduction of flood risk	-	EU + State Environmental Fund of the Czech Republic	Municipalities, regions, state enterprises	1,370
The Operational Environmental Programme - Priority axis 6: Improving the state of nature and the landscape - 6.4. Optimization of the water regime of the countryside	-	EU + State Environmental Fund of the Czech Republic	Municipalities, regions, state enterprises, physical entities etc.	768
Landscape natural function restoration programme - Climate change adaptation measures for water ecosystems	115 164	Ministry of Environment	Agency for Nature Conservation and Landscape Protection, National Parks	5.7

[1] *In 2012, projects subsidized in previous years were finalized, work was financed by the applicants.*
[2] *The number represents the total finance appropriated for both subsidies; not the real cost in 2012.*

After each large flood, a programme for removal of flood consequences is established. The programme “Support for flood prevention II” ends in 2014, after that, its successor “Support for flood prevention III” for years 2014-2019 will be applied.

Several important flood protection measures in cross-border NUTS 3 regions have been also implemented with the help of EU Cross-Border cooperation operational programmes (financed from ERDF).

Implementation of the measures

As illustrated above, the most important stakeholders implementing the measures in the Czech Republic are the following:

- Povodí state enterprises (management of the river basin districts)
- Lesy ČR, state enterprise (management of smaller creeks)
- Municipalities

However, the realization of specific measures is directly related to the previously adopted planning document, which is the result of a multilateral discussion between these stakeholders and the other agents that are involved in the planning process (see section 2.3).

In the study site Vltava cascade, the most important is Povodí Vltavy, state enterprise, and municipalities along the river.

Bottlenecks in stakeholder cooperation

The main problems in the Czech Republic concern the development in the flood-prone areas. The institutional settings of the Water Law allow the municipality to administratively define floodplain areas and active zones within these areas, where the development may be restricted (in floodplain areas) or forbidden (in case of active zones). Some municipality and town administrations however favour structural development and hinder the establishment of floodplain areas, which is counterproductive from the point of view of minimizing flood damage (Punčochář et al., 2012). The subsidization of flood protection measures from the state and EU sources, as opposed to relying on municipal and individual responsibility for the application of flood protection, also creates a “free rider”, and “moral hazard” problem, by which the number and value of assets in flood-prone areas may even increase in time. Langhammer (2007) also states that the reported increases of natural disaster damages in the Czech Republic are closely related to the increases in the value of assets that are exposed to risk.

As the areas suitable for the implementation of flood adaptation measures (such as areas designed for spilling flood water into the countryside) are very scarce in the river basin; Punčochář et al. (2012) suggest construction of dry polders that may retain part of the flood water and after the end of the main flood wave they may be gradually discharged. This type of flood adaptation measure is however in many cases hampered by difficult property rights situations. In the realization of other technical measures, problems with not well-defined property rights to the land in question also occur, but are of much lower scope due to the lower extent of land needed for these measures compared to dry polders. Further, dry polders are associated with not only primary investment costs, but have to be permanently maintained, which is associated with costs for the investor that are not in most cases accounted for in the subsidy schemes.

Another potential problem concerns the upstream-downstream coordination of the basin, and harmonizing the needs of different stakeholders in planning the adaptation measures: regional needs to manage the river basin as a whole versus local problems in particular municipalities within the catchment area; cooperation among the administrations of particular river basin that influence each other.

3 The Bilbao case study

3.1 Introduction and geo-socio-economic context

The Atlantic coast of the Basque Country is an area at high-risk, due to natural flood hazard (generated by high precipitation, strong slopes and steep valleys) but also to high exposure, with most of its low-lying areas densely urbanised (Ibisate et al., 2000). The region has suffered several flooding episodes in its recent history, which have caused significant damage. The most catastrophic flooding event occurred in August 1983. During this event, 37 people died and material damages rose up to to current €1,206 M. Bilbao (Fig. 6 and 7) was one of the most affected cities where flooding started due to extreme precipitation which added afterwards to the river flooding and high tide. The water level reached 6 m in the old part of Bilbao. In fact, Ibisate et al. (2000) consider Bilbao the most vulnerable area of the Atlantic Basque Country, as the city has suffered 39 catastrophic flood events in the last 600 years (Fernández Gómez, 1993).

As other old industrial cities, the urban development in Bilbao has been shaped by the requirements of the manufacturing industry accompanied by a fast growing population (Rodríguez et al., 2001). Most of this urban expansion during the mid-20th century occurred in flood prone areas along the estuary, which increased the vulnerability of the city.

After the dramatic floods in 1983, several infrastructure measures were implemented (see Fernández Gómez (1993) for further details), but the risk still remains. For example, in May 2008 the water reached its highest levels in 20 years and a new severe flood did not happen because this time high peak levels met a low tide (Diputación Foral de Bizkaia, 2008).

In 2012 a new urban development has been approved in a flood risk area within the estuary, an old industrial site located on the peninsula of Zorrotzaurre. The Zorrotzaurre project is currently being defined in depth by local managers. In a context of global climate change, with rising sea levels and increasing extreme events, this new development represents a perfect opportunity to analyse different adaptation measures that could be implemented in an urban context to reduce flood risk.

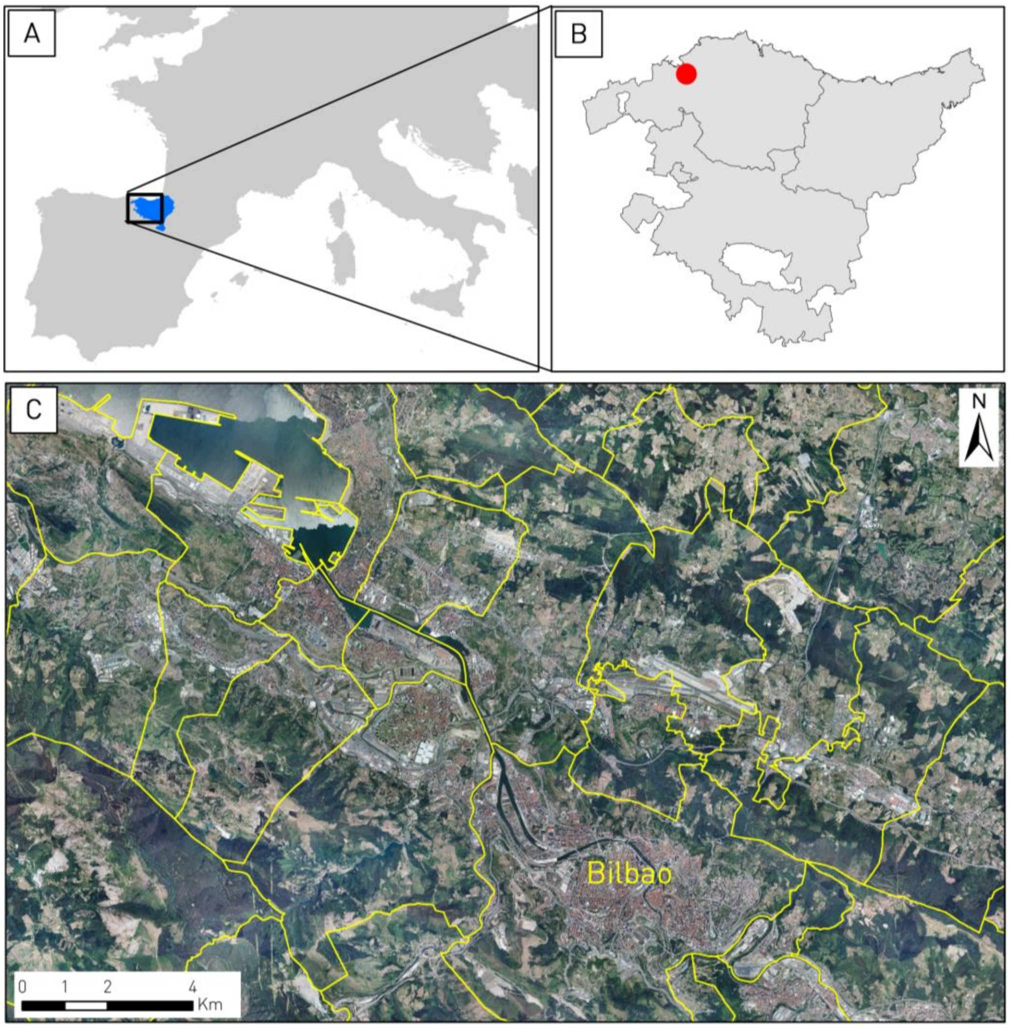

Figure 6. Location of Bilbao.

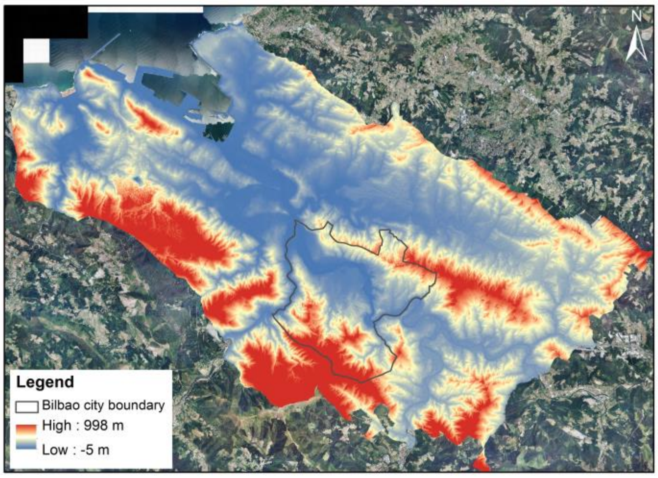

Figure 7. Topography of the Bilbao Metropolitan area. Heights in metres above the Alicante ordnance datum (Source: Basque Government Cartography, 2012[4]).

[4] Cartographic information developed by the Basque Government is public and available at the online Spatial Data Directory (http://www.geo.euskadi.net/s69-15375/es). In this case we have used LiDAR based Digital Terrain Model (DTM).

Goal and research objectives

The aim of this case study focuses on analysing, from an economic perspective and considering uncertainty, the adaptation measures that are already planned in Zorrotzaurre (Fig. 8), as well as others that could be envisioned within the ECONADAPT project.

The new urban development in Zorrotzaurre will need to consider mainly the risk of tidal and river flooding, but both impacts imply a great degree of uncertainty regarding their timing (when will it occur) and extent. In this context of high uncertainty, deterministic approaches to define adaptation options at the local level might have strong limitations (Dobes, 2008). For example, the construction of a sea wall as a response to sea-level rise could be too low or to high or its construction might happen too early or too late; and this situation could result in high social, environmental and economic costs.

Real options analysis has been extensively used in investment appraisal but it has only recently started to be applied to climate change adaptation. In fact, adaptation options are similar to any other investment decision under conditions of uncertainty.

In this case study a real options valuation technique will be applied to analyse a mix of different adaptation measures and strategies. Firstly, a methodological approach will be developed to assess the costs and benefits of potential impacts of sea-level rise in Bilbao, as well as those of the adaptation options that could be implemented to cope with such a threat. Secondly, the Real options analysis approach will be applied specifically to the new urban development in Zorrotzaurre considering sea-level rise together with the risk of river flooding.

Figure 8. Location of the Zorrotzaurre peninsula in Bilbao.

Geographic characteristics

The Basque Country is located on the northern edge of the Iberian Peninsula and Bilbao is the main city and its economic engine (Figure 6). The city has a population of nearly 350,000 but the area known as the “Gran Bilbao” that extends from Bilbao towards the sea along the estuary gathers 850,000 people, 40% of the population of the Basque Autonomous Community (Eustat, 2014a).

The Bilbao estuary, 15 km long and formed by the tidal part of the Ibaizabal River, was once the most extensive estuarine area along the Cantabrian coast (Hazera, 1968). During the last two centuries the estuary has been dramatically reshaped by the conversion of land to industrial and urban occupation,These activities have strongly polluted, and have degraded the environmental quality of the estuary (Leorri and Cearreta, 2004). In fact, the requirements of the steel industry and the manufacturing activity that grew around it during the second half of the nineteenth century have been the main drivers of the socio-economic and spatial development of the area (Rodríguez et al., 2001), until the industrial crisis occurred during the mid-1970s.

The Ibaizabal River flows SE-NW through the Bilbao urban area and it is limited by two ridges that run parallel to the watercourse. The ridges in the northeast reach 300 m, while those in the southwest rise up to 700 m, creating a narrow valley with dense urban areas where most of the population is concentrated (Acero et al., 2013).

With regards to the climate, Bilbao and its surrounding area have a humid oceanic climate with moderate temperatures. The proximity of the sea and the complex topography strongly influence atmosphere dynamics in the city, generating mild winters and summers. Average maximum temperatures during the winter are of ~13º C and minima of ~6º C. During summer, the average maximum temperature is about 26º C and the minimum temperature is ~16º C (see Table 6). However, higher temperatures (up to 40ºC) can be measured several times per year. Sea-surface temperature varies from ~14ºC in the winter to ~22º C during the summer. Precipitation is abundant (1100-2000 $mm \cdot yr^{-1}$) and more usual during spring and fall and overcast skies are common (Acero et al., 2013).

Table 6: Precipitation and temperature data series for Bilbao. Source: data for the Deusto station from Eustat (Eustat, 2014b).

Climate variables		***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Precipitation	Annual (mm)	934	1002	981	1115	803	1044	1317	1051	1152	787	820
	No. rainy days	182	156	172	156	144	166	185	160	165	142	168
Temperature	Average T_{max}	18.8	19.7	18.5	18.7	19.7	18.2	18.8	18.7	18	19.8	18.8
	Average T_{min}	12.2	12.6	11.8	11.6	12.5	11.7	11.5	11.8	11.5	12.8	11.9

Socio-economic characteristics

The Bilbao Metropolitan area has been shaped by the industrial activities that started during the late 19th century. A second wave of industrialization occurred during the 1950s and 1960s that turned Bilbao, together with Madrid and Barcelona, in an important economic zone in Spain. From 1950 to 1970 the population of the Great Bilbao area doubled, which forced a huge urban and industrial expansion along the Bilbao estuary (Rodríguez et al., 2001).

However, during the 1970s the crisis of the industrial sector that once had been the driver of socio-economic growth hit the population of the Great Bilbao. The unemployment rate grew from 2.6% in 1975 to 26% in 1986 (Rodríguez, 2012). A decade later unemployment rate was still 26%, but this changed during the late 1990s and in 2003 it was as low as 5.95% in Bilbao (Table 7), mainly due to the impulse of the regional Government in favour of a technology-based industrial policy (Gómez Uranga and Etxebarria, 2000)[5]. Since then, the unemployment trends in Bilbao and in the region have been largely in line with the crisis-driven trend of the country.

Table 7: Evolution of the unemployment from 2003 to 2013 in Bilbao, in relation to the province of Biscay and the Basque Autonomous Community. Source: Udalmap (2014) for Bilbao and Eustat (2014a) for Bizkaia and the Basque Autonomous Community.

Unemployment rate (%)	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***
Bilbao	5.95	5.71	6.64	5.95	5.90	7.76	9.82	11.11	12.03	13.73	13.80
Bizkaia	9.3	8.5	7.4	5	4	4.3	8.6	10	13.2	14.2	15.7
Basque Autonomous Community	8.6	7.8	5.7	4.1	3.3	3.8	8.1	9.1	10.8	11.8	14.3

The crisis during the 1970s also implied a redistribution of employment by sectors, with an important shift from the industrial sector to the service sector. If in 1975 46% of the population worked for the manufacturing sector in the Great Bilbao (Rodríguez et al., 2001), in 2010 only 15% did. Following an opposite evolution, the service sector gathered 42% of the active population in 1975 and this proportion rose to 75% in 2010 (Eustat, 2014a). And yet, Bilbao and the Basque Country have a higher GDP per capita than Spain and the European Union (28 countries).

[5] In 1990 the Basque Government defined the first Plan for Technological Strategy, which was followed by the Plan for Industrial Technology (1993-1996) and afterwards by the Plan for Science and Technology that has been updated since then every four years.

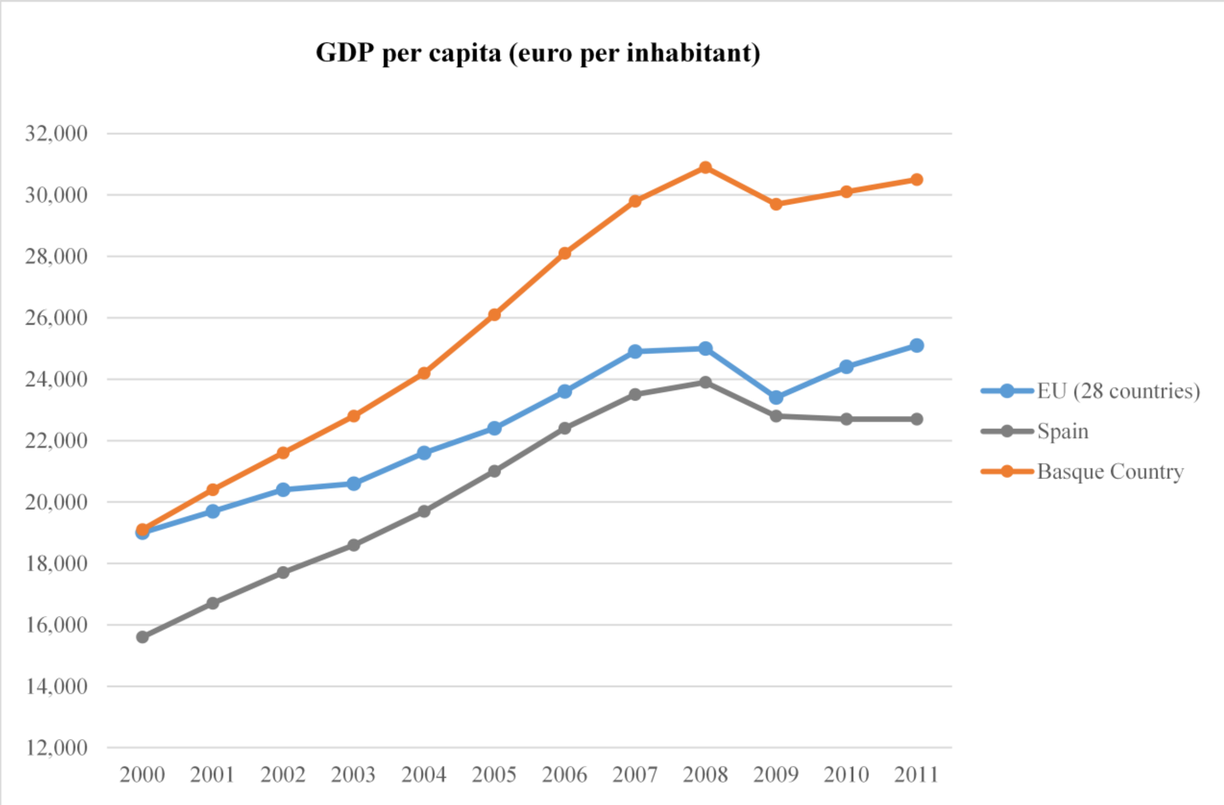

Figure 9. GDP per capita in euros per inhabitant for the Basque Country, Spain and the European Union (28 countries). Source: Eurostat[6].

From an urban perspective, the decline of the industry along the Bilbao estuary left a significant number of industrial ruins. According to the Department of Housing of the Basque Government, at the end of the 1990s two thirds of the industrial ruins in the Basque Autonomous Community were located in the Great Bilbao, with a surface above 330 ha (DOTVMA, 1998).

As a response to all the changes that occurred during the previous two decades, the Basque institutions defined several plans and initiatives during the 1990s with a clear objective: urban regeneration of Bilbao (Rodríguez, 2012). The restructuring of the Bilbao riverside area was one of the main objectives, with projects such as the Guggenheim museum, which is an example, perhaps the most iconic one, of the restructuration of Bilbao. Now, 20 years after the beginning of this recovery process the turn of the Zorrotzaurre district has come (Fig. 8).

The new urban development of Zorrotzaurre

Once an industrial area, the new plan for the peninsula of Zorrotzaurre will turn it into the newest urban development area of Bilbao. The restructuration project includes three types of actions:

1. The opening of the Deusto Channel which will turn this peninsula into an island. This measure was a requisite of the Basque Water Agency for flood security. It will have a

[6] http://ec.europa.eu/eurostat/web/regions/data/database, last accessed on January 2015.

cost of 12.1 M € but a recent study from Osés Eraso et al. (2012) estimated that this infrastructure could reduce losses by 67% for the 100 year return period flooding, from 241 M € to 79 M €.

2. The construction of two iconic buildings (IMQ Hospital and IDOM Engineering new head offices).
3. The restoration of existing household buildings, the restoration of the old paper industry building into a cultural centre and the creation of Bilbao ZWAP art and innovation area.

Figure 10. Zorrotzaurre in the 1970s (above) and the new urban development plan for the area (below). Source: Comisión Gestora de Zorrotzaurre (www.zorrotzaurre.com).

3.2 Policy and stakeholder context

Institutional context

The Autonomy Statute of the Basque Autonomous Community was approved by the Spanish Parliament in December 1979. The Statute established exclusive responsibilities to be assumed by the Basque Country, which included the fiscal system, education, health, urban and land planning and environmental policies. However, some of the responsibilities are not exclusive and others have not been transferred, so the Basque institutional landscape is, in practice, quite complex. The management of coastal areas is an example of this situation: the Spanish Coastal Act of 1988 holds back some responsibilities, and the authorization of the Spanish Ministry of Environment is required to carry out certain types of projects on coastal areas, even though this policy domain (coastal areas and in-shore waters) is exclusively the responsibility of the Basque Government. The urban transformation of Zorrotzaurre, because of its location on the Ibaizabil estuary, is affected by the concurrent responsibilities of the regional and central governments.

With regards to water management, including flood protection, the Basque Country is divided into three basin districts. Two of them are located in the northern part and its rivers flow into the Cantabrian Sea; the third is the Ebro basin, which runs through several other autonomous communities into the Mediterranean sea (Fig. 11). Only the Eastern Cantabric river basin district in the north is fully managed by the Basque Government, through its Water Agency, while the other two are under the control of the central government, although it shares some responsibilities with the Water Agency.

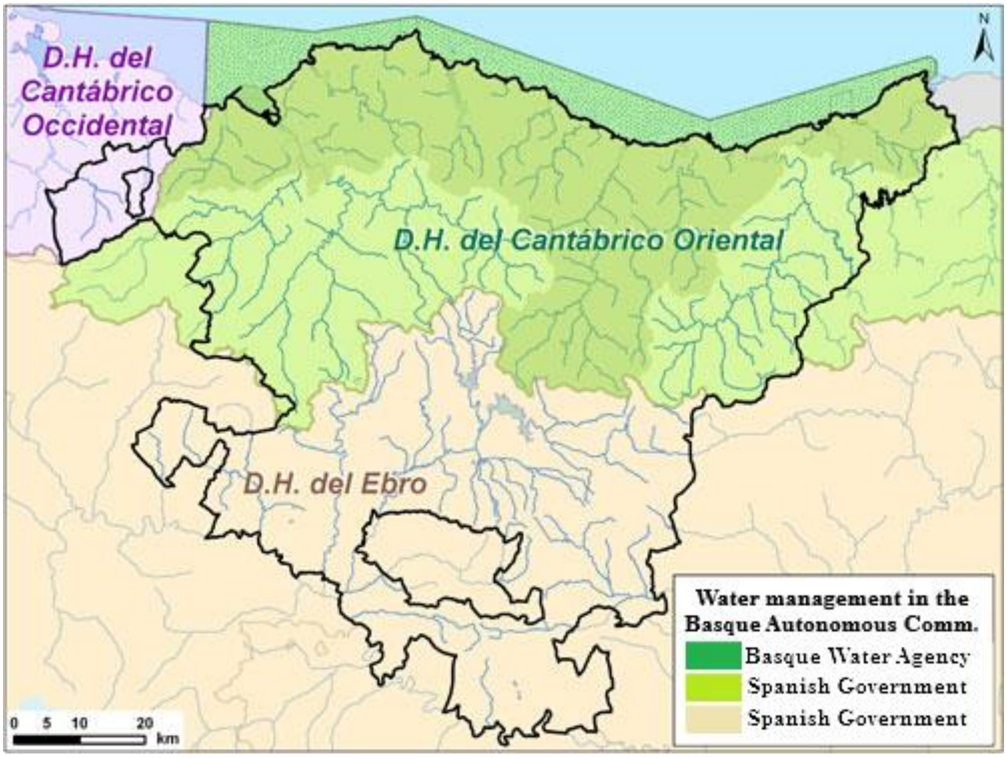

Figure 11. Competences on water management in the Basque Autonomous Community.

Responsibilities for land and urban planning are exclusive of Basque institutions, at different levels (regional, provincial and local). In the case of Zorrotzaurre, the Special Urban Development Plan to transform the area was finally approved by Bilbao City Council in 2012, after a long period of different administrative procedures.

Policy context: flood protection in the Basque Country

The general framework for water management in Europe is defined by the Water Framework Directive (2000/60/EC) and by the Floods Directive (2007/60/EC)[7]. The adaptation of Basque water policy to this framework implied a radical change of approach. Before the Water Framework Directive and with regards to flood prevention, the basic principles were based on reducing flood risk, generally by hard infrastructure and river channelling. The adaptation to the European regulations entailed the application of criteria to ensure the safety of new settlements and reduce the risk of existing ones, but also the introduction of precautionary policies and non-structural measures.

Water Policy in the Eastern Cantabric River Basin District is developed through Hydrologic Plans. There is a plan in force for the period 2009-2015 and the new plan for the period 2015-2021 is being processed. This new Hydrologic Plan contains a specific Management Plan for Flood Risk Prevention[8] that covers the whole Basque Country. This Management Plan includes the following policies and measures:

- Preliminary Assessment of Flood Risk
- Identification of all floodprone areas and the associated risk
- Definition of land use criteria
- Definition of river restoration measures
- Civil protection planning
- Measures of early warning systems

Stakeholder context in the policy areas of the case study

There are two main policy areas related to the Zorrotzaurre case study.

The first is related to flood risk prevention, for which the main stakeholder is the Basque Water Agency. Several meetings have already taken place with the key people in charge of flood risk management. The Agency has shown a great interest in the case study and is currently involved in the definition of flood risk scenarios under climate change.

The second policy area is at the local scale and deals with the urban design of Zorrotzaurre, in which several agents are involved. In 2001 a Management Commission for the Urban Development of Zorrotzaurre was created by several public institutions and private entities. The Management Commission deals with daily decisions regarding the urban development, while executive decisions are adopted by the Board of Directors, where high level

[7] In Spain, the Royal Decree 903/2010 of 9 July 2010 transposes the Floods Directive.
[8] All these documents are available for public consultation at the website of the Basque Water Agency: http://www.uragentzia.euskadi.net/u81-0003333/es/contenidos/informacion/2014_proyecto_plan_2015_2021/es_def/index.shtml

representatives of major property owners are represented (Table 8). The members of the Management Committee own 65% of the land in Zorrotzaurre (Zorrotzaurre Management Commission, 2014).

The implementation of the new urban area will be carried out in two phases. Phase 1 involves the development of the 1st Implementation Unit, which represents approximately two thirds of the new district (Fig. 12). It has a total area of 389,654 m^2 and contains 208 urban plots, property of 59 different institutions, private entities and owners. Eight of these major owners, who own 79% of the 1st Implementation Unit, are members of the Contracting Board: the Basque Government (through the Housing Public Company VISESA and the Employment and Social Affairs Department), Bilbao City Council, the Spanish Government and five private entities: Sociedad Promotora Inmobiliaria Margen Derecha S.A., Vicinay Cadenas S.A., FCC and other two not specified. The Contracting Board for the development of 1st Implementation Unit was created in October 2013.

Table 8: Members of the Board of Directors.

Position	***Member***	***Institution / Private entity***	***Character***
President	Bilbao Mayor	Bilbao City Council	Public
1st Vice-president	Minister of Employment and Social Affairs	Basque Government	Public
2nd Vice-president	Administrator	Sociedad Promotora Inmobiliaria Margen Derecha S.A.	Private
Member	President	Bilbao Port Authority	Public
Member	Vice-Minister of Employment and Social Affairs	Basque Government	Public
Member	Director of Housing	Basque Government	Public
Member	Town Planning councillor	Bilbao City Council	Public
Member	General Director of Visesa	Basque Government	Public
Member	Works and Services councillor	Bilbao City Council	Public
Member	Vice-Minister of Housing	Basque Government	Public
Member	Director of House Planning	Basque Government	Public
Member	President	Vicinay Cadenas S.A.	Private
Secretary	Technical team	Zorrotzaurre Management Committee	
Manager	Technical team	Zorrotzaurre Management Committee	

Several meetings have been carried out with the main stakeholders involved, i.e., the Bilbao City Council, the Basque Water Agency and the Zorrotzaurre Management Committee. All three stakeholders have committed to provide all the available information for performing the case study.

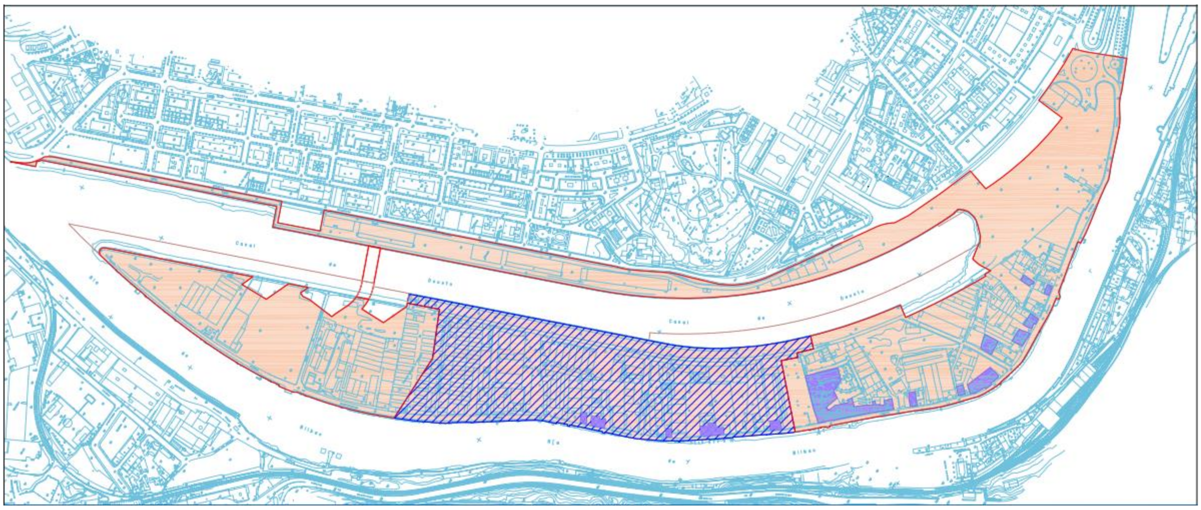

Figure 12. Zorrotzaurre 1st Implementation Unit in orange. Implementation Unit 2 is represented in blue lined.

4 References

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5 Annex I - Regulation and plans for the Vltava case study

Conception of settlement of the flood protection problematics in the Czech Republic with the use of technical and natural measures (approved by the government by Resolution no. 799 of 10 November 2010)

Council Decision 99/296/EC amending Council Decision 93/389/EEC for a Monitoring Mechanism of Community CO2 and other Greenhouse Gas Emissions

Czech National Flood Protection Strategy (approved by Government Resolution no. 382 of 19 April 2000)

EU Floods Directive (2007/60/EC)

EU Water Framework Directive (2000/60/EC)

Generel území chráněných pro akumulaci povrchových vod a základní zásady využití těchto území 2011 *(General plan of surface water accumulation protected areas 2011)*

Koncepce řešení problematiky ochrany před povodněmi v České republice s využitím technických a přírodě blízkých opatření (schválená usnesením vlády č. 799 10. listopadu 2010) *(Conception of settlement of the flood protection problematics in the Czech Republic with the use of technical and natural measures (approved by the government by Regulation 799, 10 November 2010))*

National program to abate the climate change impacts in the Czech Republic (approved by the government by Resolution no. 187 of 3 March 2004)

Obecně závazná vyhláška ze dne 12.12.2013, kterou se mění vyhláška č. 32/1998 Sb. hl. m. Prahy, o cenové mapě stavebních pozemků, ve znění pozdějších předpisů *(Generally binding regulation of 12-12-2013 that amends Regulation no. 32/1998 of the Capital City Prague on the price map of building sites)*.

Plán hlavních povodí České republiky, schválený nařízením vlády č. 562/2007 Sb. *(Plan of main river basins of the Czech Republic, approved by Government Resolution no. 390/2004)*

Politika územního rozvoje České republiky 2009 *(Spatial development policy of the Czech Republic 2009)*

Strategie ochrany před povodněmi na území ČR (schválená nařízením vlády č. 382 19. dubna 2000) *(Czech National Flood Protection Strategy, approved by Government Resolution no. 382 of 19 April 2000)*

Vyhláška č. 142/2005 Sb, o plánování v oblasti vod *(Regulation 142/2005 on the planning in the field of water)*

Vyhláška č. 292/2002 Sb., o oblastech povodí ve znění vyhlášky č. 390/2004 Sb. (*Regulation 292/2002 on the river basin districts (as amended by Regulation 390/2004))*

Zákon 254/2001 Sb., o vodách a o změně některých zákonů ve znění zákona č. 150/2010 Sb. *(Water Act no. 254/2001, as amended by Act no. 150/2010)*
Zákon č. 151/1997 Sb., o oceňování majetku a o změně některých zákonů *(Law on Property pricing no. 151/1997).*

6 Annex II - Regulation and plans for the Bilbao case study

Basque Water Act 1/2006, of 23 June 2006.
EU Floods Directive (2007/60/EC).
EU Water Framework Directive (2000/60/EC).
Hydrologic Plan of the Eastern Cantabric River Basin District 2009-2015. Royal Decree 400/2013, of 12 April 1996.
Hydrologic Plan of the Eastern Cantabric River Basin District 2015-2021. In process.
Management Plan for Flood Protection (2015-2021) for the Eastern Cantabric River Basin District.
Sectoral Land Plan for River Margins Protection of the Basque Autonomous Community. Decree 415/1998, of 22 November 1998.
Urbanisation Action Programme of the Zorrotzaurre Integrated Action 1.
Spanish Coastal Act 1988.
Special Urban Development Plan for Zorrotzaurre, finally approved on November 29 2012.