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FOR CLIMATE CHANGE
ADAPTATION DECISION-MAKING IN
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THE ITALIAN CASE

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ABSTRACT

This doctoral dissertation originally reports about interdisciplinary research in the area of climate change adaptation, moving between science and policy development in Italy. The study explores how European governments deal with three governance challenges that are crucial for climate change adaptation: enhancing cross-sectoral coordination of policies (horizontal integration), improving the multi-level governance response (vertical integration), and engaging society in the adaptation planning process (stakeholder involvement). Firstly, it provides the most updated review of the adaptation policy landscape at the European and national level, emphasizing the crucial dimensions of existing strategies for adaptation. Secondly, it measures the influence of the different political-administrative systems on the institutional capacity to tackle the challenges of horizontal and vertical integration within national adaptation strategies. Thirdly, it assesses the Italian situation with regard to observed and expected climate change impacts, vulnerabilities and adaptation responses in view of a future comprehensive strategy. And finally, it analyzes how the challenge of participation of non-governmental stakeholders is tackled in the context of the ongoing development of the Italian national adaptation strategy. As a conclusion, the dissertation provides policy-relevant recommendations for the continuation of the adaptation planning process in Italy. The four papers and the introduction and conclusions form a coherent package focused on national governance for adaptation that puts the Italian circumstances into a European context.

KEYWORDS

Climate change adaptation - Multi-level governance - Institutions - National adaptation strategies - Europe – Italy – Stakeholder involvement

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CHAPTER 1 - Introduction

RATIONALE

Over the past twenty years world governments have been intensifying their consideration of the threats posed by climate change by exploring the scientific basis of such changes and attempting to implement strategic action to tackle them. Scientific knowledge on climate change has greatly widened since the early nineties through the efforts of the Intergovernmental Panel on Climate Change (IPCC) and large international and national research programmes worldwide that inform decision-makers about the fundamentals of the climate system, observed and projected impacts, vulnerabilities and risks associated to climatic changes as well as possible policy options to face them. Since the First IPCC Assessment Report in 1990 to the upcoming Fifth Assessment Report expected in its complete version by 2014,¹ there has been a growing acknowledgment that two complementary strategies are required to manage the risks brought about by climate change (IPCC, 2007):

- 1) addressing the causes of climate change by mitigating (reducing) the anthropogenic greenhouse gas emissions that are responsible for it;
- 2) facing the consequences of unavoidable changes, regardless of future emissions trends, by adapting to new climatic conditions and climate variability.

Policy action has primarily focused on mitigation of climate change by the means of international instruments such as the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) setting binding reduction

¹ The Fifth Assessment Report (AR5) is being published in four parts between September 2013 and November 2014. The first volume ("*The Physical Science Basis*", by Working Group 1) has already been released.

targets to which most industrialized nations and the European Union (EU) have committed (UNFCCC, 1998). At the Doha Climate Change Conference in December 2012, the Kyoto Protocol, entered into force in 2005 and formally expiring by the end of 2012, was extended by a second commitment period that will maintain it alive until the end of 2020, although with a reduced number of signatories (UNFCCC, 2012). In parallel, a new agreement on cutting global emissions involving both developed and developing countries is being sought under the UNFCCC *ad hoc* Durban Platform for the period from 2020 onwards (UNFCCC, 2012b; C2ES, 2012). The EU has played a key role in the development and effective implementation of the UNFCCC mitigation provisions, by committing to dropping its emissions to 20% below 1990 levels by 2020 and encouraging other parties to raise their mitigation ambitions both in the medium and the longer term.²

However, the global policy response needs to be complemented with regional, national and local adaptation strategies that would address the numerous, varied and unavoidable impacts associated with climate change that will occur in spite of successful mitigation actions. Within the UNFCCC, industrialized countries are committed to support developing countries that are particularly vulnerable to climate change impacts and have limited capacities to cope with them. The UNFCCC requires, besides the obligation to cooperate in preparing to adapt to the impacts of the changing climate, that national and regional programmes containing measures for climate change adaptation be formulated and implemented.

From the initial concern for developing countries, adaptation has turned out to be a major issue for developed nations (Ford et al., 2011). Climate change is likely to affect Europe, North America and other developed countries at temperate latitudes with the same strength as in the developing world, or larger (IPCC, 2007). Although greatly exposed, high-income nations are assumed to have a relatively scarce vulnerability to climate change thanks to superior awareness, excellent research skills on impacts and adaptation, well-developed institutions as well as the

² EU reduction target could possibly be increased to 30% by 2020 whether other major emitting countries commit to undertake their “fair share” of a global emissions reduction effort. In the longer term, EU has the goal of reducing Europe's emissions by 80-95% compared to 1990 levels by 2050 as part of efforts by developed countries as a group to reduce their emissions by a similar degree. The European Commission has published a roadmap for building the low-carbon European economy that this will require.

technological and economic means to cope with the impacts. However, some deficits exist that would not allow such capacities to turn spontaneously into adaptation (Ford et al., 2011; Gagnon-Lebrun & Agrawala, 2007). Public intervention is therefore deemed necessary to overcome such shortfalls and help develop and coordinate adaptation strategies efficiently (Berkhout, 2005; Dumollard & Leseur, 2011).

Shortcomings in the adaptive capacity of developed nations are, among other things, associated to the institutional and political capacity (Ford et al., 2011). Governance challenges in the horizontal decision-making of adaptation (across domains) or in vertical policy processes (across levels of governance) may arise under the pressure of climate change as in the case of the 2003 European heat wave (Kovats & Ebi, 2006). Other issues may relate to developing adaptation policies to face impacts across national borders and multiple spatial-temporal scales.

Facing such challenges would call for the establishment of governance structures that explicitly address them, recognizing multiple interests and actors, across national domains of socio-economic and environmental relevance, and sub-national scales of administration. Increased participation of vulnerable people, integration of science in decision-making, as well as increased accountability and financial commitment have been acknowledged at the same time as barriers (or challenges) and success factors that contribute to effectively plan for adaptation policies.

The European Union and its Member States have widely engaged in action on adaptation and started to tackle these challenges through the establishment of adaptation strategies at all levels, since Finland adopted the first national adaptation strategy in 2005.

Some European countries, located in areas that are going to be extremely impacted by climate change and are characterized by relatively lower institutional or political capacity to deal with this compared to other countries, find themselves tackling new difficulties in policy planning while they are in the process of developing their own National Adaptation Strategy. This is particularly the case for Southern European States, like Italy.

There is a strong demand from European countries and EU institutions to deepen the understanding on ways to meet adaptation needs that arise from regions, sectors or communities by the means of a sound and coherent political response (EEA, 2013). The transferability of such knowledge across European countries is fundamental to facilitate countries at early stages of adaptation planning to swiftly and efficiently develop and finalize the policy process and implement concrete measures; however, this process requires particular care since the context dependency of adaptation may affect the actual transferability of adaptation knowledge. Besides data and information on climate change adaptation impacts and vulnerability specifically downscaled for the country, knowledge on national governance is key since political and institutional frameworks are believed to determine the kind of adaptation policies that are possible.

RESEARCH FRAMEWORK

The present doctoral research was carried out within the effort of coordinating adaptation research at various scales, from the national to the European and international.

At the national level, technical support has been provided to the Italian Ministry for Environment, Land and Sea on policy issues related to climate change adaptation and in particular, the scientific coordination of the project *SNAC - Elementi per una Strategia Nazionale di Adattamento ai Cambiamenti climatici* aimed at laying the foundation of a National Adaptation Strategy to climate change. The project, funded by the Italian Ministry for the Environment, Land and Sea, started in July 2012 and is to be finalized by mid 2014. Three main deliverables are to be accomplished:

- 1) a Report on the status of scientific knowledge with regards to climate change impacts, vulnerability and adaptation in Italy;
- 2) an Analysis of the EU Adaptation Strategy and of the national implementation of the *acquis communautaire* in the different sectors of the Italian National Adaptation Strategy;
- 3) a Strategic Document containing the National Adaptation Strategy for Italy.

My contribution was to manage the delivery of these reports and I was directly involved in the drafting as co-author. Furthermore, I helped maintain a dialogue between the two interim coordination bodies during the design phase of the Strategy: a technical board of about a hundred scientists and experts that elaborated the scientific and technical documentation; and an inter-ministerial board, led by the Ministry for Environment, Land and Sea, that steered the process and provided political guidance. Also, with the support of other colleagues at CMCC, I led a participatory process for stakeholders that took place along the various phases of the development of the National Adaptation Strategy. Such involvement allowed me to gain the most up-to-date information on the national situation regarding adaptation policy and practice.

Also, I took advantage of my participation to the EU FP7 ERA-Net project *CIRCLE-2 - Climate Impact Research and Response Coordination for a Larger Europe* that put me in contact with key players of European adaptation action. In parallel, other advisory activities carried out since 2009 were extremely significant for me to gain a privileged perspective on, and actual understanding of, the dynamics of climate change policy-planning at the European level, such as the active participation in the Working Group on Knowledge Base (WG-KB) aimed at supporting the EU Adaptation Steering Group (ASG) under the coordination of DG-CLIMA for the development of the EU Adaptation Strategy.

Finally, the knowledge of the international dimension of adaptation decision-making was achieved through my participation in the UNFCCC within the Italian Delegation since the Copenhagen Conference (COP15), with a focus on negotiations on adaptation and capacity-building matters.

SCOPE, OBJECTIVES AND OUTLINE OF THE STUDY

The present doctoral dissertation focuses on the governance of climate change adaptation, i.e. on the modalities in which adaptation policies and instruments are developed and implemented by governments at different scales. In particular, the research is focused on *national* adaptation governance. The scope of the dissertation encompasses Europe and European countries, intended as the thirty-two European Environment Agency (EEA) members.

The study explores how European governments deal with the following three governance challenges that are essential for climate change adaptation:

- a) Improving horizontal coordination of policies, namely the need to coordinate adaptation action across different socio-economic sectors that are remits of different ministerial or departmental bodies in order to exploit inter-linkages and avoid possible conflicts;
- b) Improving vertical coordination of policies, namely the multi-level governance response required for adaptation spanning various decision-making scales from international and European to national and sub-national administrations in order to provide adequate means to take action;
- c) Increase the engagement of stakeholders in adaptation planning, namely the involvement of society, non-governmental organizations and the scientific community in the preliminary phases of the NAS, or in its implementation and monitoring phases, in order to build a shared and more realistic strategy.

Italy is taken as the case study to assess how the challenge of participation of non-governmental stakeholders is tackled in the context of the ongoing development of a National Adaptation Strategy.

In particular, the present dissertation seeks to achieve the following specific research objectives:

- 1) Provide the most updated review of the adaptation policy landscape at the Union and national level across Europe, emphasizing the crucial dimensions of existing strategies for adaptation;
- 2) Measure the influence of political-administrative systems on the institutional settings for adaptation established to tackle the challenges of vertical and horizontal integration of adaptation in European countries' national strategies;
- 3) Assess the Italian situation with regard to observed and expected climate change impacts, vulnerabilities and related adaptation responses in view of a future national strategy for adaptation;

- 4) Analyze how the challenge of engaging the right stakeholders in the adaptation planning process is tackled in the ongoing development of the Italian National Adaptation Strategy.

The sequence of the dissertation follows the objectives set out above. Achieving the four objectives is sought through four individual peer-reviewed quality papers, in which key research questions are addressed, making use of different methodologies as appropriate. Results are reported and discussed at the end of each chapter.

The work of the doctoral dissertation is organized as follows.

In Chapter 2, the regional, sectoral and economic challenges brought by climate change in Europe are summarized. Subsequently, the status of adaptation policies in Europe is reviewed, including national progress and the European framework. In the section focused on national efforts, first an overview of the EEA Member Countries' national adaptation policies is provided, and then the "crucial dimensions" of the existing 16 National Adaptation Strategies are analyzed and compared, based on the publicly available information and personal communications with national focal points. Finally, the European framework for adaptation is analyzed including the content of the 2013 EU Adaptation Strategy, the provisions for monitoring and review as well as the guidance on developing national adaptation policies.

In Chapter 3, the focus is narrowed down to the 14 European countries that were selected as they satisfy the proposed definition of National Adaptation Strategy content-wise and form-wise. The countries are also categorized according to their political systems: unitary, administrative-federal and federal states. About 50 relevant institutional settings, put in place to coordinate adaptation horizontally and vertically in these countries, are collected and screened against a number of criteria to measure the national institutional capacity: number of institutions per country, degree of formalization, novelty, timing and scope of action, coordination mode and "transversality" of the institutions. The possible influence of the analyzed countries' different political systems on their institutional capacity is then statistically measured by originally applying the Principal Component Analysis (PCA) technique to the adaptation research domain.

In Chapter 4, the first comprehensive review of the Italian situation with regard to climate change impacts and vulnerabilities over 12 socio-economic sectors is provided, including economic costs of impacts, based on scientific studies of both national and global scope. Furthermore, the process leading to the future National Adaptation Strategy is analyzed and already existing adaptation initiatives outside a comprehensive national framework are then presented according to the identified sectors. This national assessment helps set the context for the case study illustrated in the next chapter.

In Chapter 5, the case study of the Italian adaptation planning process is addressed, analyzing in detail the challenge of engaging the right stakeholders in the development phases of the National Adaptation Strategy. In the context of the project *SNAC*, a broad public on-line questionnaire and subsequent more targeted interviews are designed and carried out in order to assess the perception of stakeholders about adaptation and contribute to identify national priorities. The results of these surveys are hereby presented and analyzed in the light of the future stages of the development of the National Adaptation Strategy in Italy.

In Chapter 6, a summary of the research conclusions across the four papers is provided. A reflection on the policy implications of this work from an Italian perspective is made at the end.

The dissertation also includes annexes containing complementary information, a complete bibliography and a glossary of basic terms.

CHAPTER 2 – A review of climate change challenges and adaptation responses of European countries and the EU

This chapter is based on: [Venturini, S.](#), Medri, S. & Castellari, S. (2012). Overview of key climate change impacts, vulnerabilities and adaptation action in Europe. CMCC Research Paper, July 2012.³

INTRODUCTION

The present paper summarizes the key knowledge on climate change impacts, vulnerability and adaptation needs across Europe and presents a critical desktop review of the public adaptation policy responses that have undergone major advancements in recent years.

Since the initial attention placed on mitigation strategies aimed at reducing emissions of greenhouse gases, the climate policy goals of the European Union (EU) and European countries have been progressively expanded to include adaptation over the past two decades. Before rising on the political agenda, the need for adaptation had been increasingly explored in the scientific literature that was collected in the various assessment reports of the Intergovernmental Panel on Climate Change (IPCC), now being further revised in its Fifth Assessment Report expected in its final form by 2014, the European Environment Agency (EEA) periodic reports and the final report of the Joint Research Center (JRC) *PESETA* project.

The IPCC set the science basis to frame adaptation and provided the most popular and complete definition of adaptation, adaptive capacity and vulnerability. Adaptation can be described as a process aimed at managing changes that are brought about by new climatic conditions, by limiting damages and taking advantage of favourable opportunities. Adaptation is meant to reduce the vulnerability and increase the adaptive capacity or resilience to

³ The original CMCC research paper was updated, reshaped and enlarged in order to be suitable for this dissertation. My contribution to this paper was the following: introduction; methodology; sections on impacts, national adaptation strategies and the European framework on adaptation; conclusions. Silvia Medri contributed to the collection of key findings on regional and sectoral challenges for adaptation. Sergio Castellari provided overall advice and review.

present and future impacts of climate change and climate variability (from the glossary in IPCC, 2007).

Indeed, a growing recognition of the already ongoing or expected climate change impacts and the associated vulnerabilities has contributed to raise understanding of adaptation practices and options (Adger et al., 2007). In particular, a better acknowledgement of the costs of climate change effects has most likely served as a driver for the political recognition of adaptation. Today we know some generic or Europe-wide figures from the Stern review, and the projects *ClimateCost* and *PESETA*, but these are often limited to a few sectors impacted by climate change (typically coastal protection and energy) and not available at the national level. Thus, considering only a small number of sectors, the minimum total annual cost of not adapting to climate change in Europe is likely to range between 100 billion Euros in 2020 to 250 billion Euros in 2050 (EC, 2013). Besides the economic costs, it is estimated that the social costs arising from the incidence of extreme events on the population would also be significant in the absence of adaptation measures. Supported by more solid science-based evidence, this shift in the European policy may have been ultimately pushed by contingent motivations (Patt et al., 2012). A succession of disasters of unprecedented severity in many regions of Europe, such as intense heat waves and flooding of vast proportions, has turned into a “window of opportunity” and raised a general concern about the need to define strategies and measures to make European regions, socio-economic sectors, ecosystems and populations less vulnerable and more resilient to climate change.

At the European scale, this issue was first taken into account in 2007 with the Green Paper on Adaptation that laid down possible directions for the EU to help Europe adapt and launched a consultation on a future Community policy action. This was followed by the release of a White Paper two years later that set the concrete path towards the planning of the EU Adaptation Strategy, which has eventually become reality in the spring of 2013.

At the EU scale, adaptation, given its beneficial push to sustainability and green economy objectives, also applies to support broader political and economic goals as identified in the Community’s growth strategy “*Europe 2020*” (EEA, 2013; EC, 2013).

At a lower governance tier, European countries have anticipated EU action and individually started to design their own adaptation strategies since 2005. Also, lots of practical measures that are beneficial to adaptation have been undertaken beyond the umbrella of formal adaptation policies at the national, regional and local levels all over Europe (EEA, 2013).

The EU as a whole is now equally committed to mitigation and adaptation that are recognized as complementary actions to, respectively, contain the causes of climate change and face its positive or negative consequences (Klein et al., 2007; Wilbanks et al., 2003). Despite their complementarities, the intrinsic “problem structure” greatly differs between adaptation and mitigation (Berkhout, 2005). Unlike mitigation, adaptation is characterized by short-term benefits experienced in a private or localized way; also, it requires multi-dimensional knowledge and its implementation is relevant horizontally, across different sectors, and vertically, at all governance levels (Swart et al., 2009; Smith et al., 2009; Paavola, 2008; Paavola & Adger, 2006; Berkhout, 2005). Therefore, adaptation must be addressed in an integrated fashion, where knowledge-base, governance issues and policy-support tools for implementation are bespoke to respond to specific demands (EEA, 2013; Venturini, Lourenço et al., forthcoming).

In the light of this, public policy and more specifically an *adaptation strategy* at the national level seem to be the most appropriate instrument to set up and coordinate adaptation of human and natural systems (Dumollard & Leseur, 2011; INTOSAI WGEA, 2010; Swart et al., 2009; Berkhout, 2005). European countries and EU institutions strongly encourage research managers to deepen the knowledge on the possibilities for a sound and coherent political response to adaptation needs that arise from regions, sectors or communities (EEA, 2013).

A growing interest on assessing national strategies of European countries can be observed over the years. However, comparative research on adaptation strategies is most often focused on different groupings of “European” countries (EUROSAI-WGEA 2012; Dumollard & Leseur, 2011; BMVBS, 2010; Massey, 2009) or included in a broader analyses of countries’ efforts on adaptation planning and action (Mullan et al., 2013; Aarjan et al., 2012; Bauer et al., 2012; Ford et al., 2011; Preston et al., 2011; Pfenninger et al., 2010; Keskitalo, 2010; Massey & Bergsma, 2008; Gagnon-Lebrun & Agrawala, 2006; Perkins et al., 2007). Studies that comprehensively cover all existing NASs (Biesbroek et al., 2010; Swart et al., 2009; Termeer et al., 2009) are now outdated due to the quick advancements of countries in adaptation policy planning. The EEA has recently released a wide-ranging overview of adaptation in Europe from a socio-economic perspective, including a concise section on the EU and national policy context offering information based on the European Climate Adaptation Platform [Climate-](#)

[ADAPT](#) (EEA, 2013).⁴ However, maintaining the database and analyzing its content reveals itself to be a complex exercise, as not all countries provide their feedback or regularly update their national pages in Climate-ADAPT. This challenge is being dealt with by the EEA, and new analyses based on Climate-ADAPT and countries' self-assessments will be released next year (Prutsch et al., 2013).

The primary goal of this paper is therefore to collect the most up-to-date and salient data and information on climate change challenges addressed by adaptation policies at different scales, which would help the scientific community take a snapshot of adaptation action in Europe. The added value with respect to the partly uneven information that can be found in Climate-ADAPT is the fact that insights on national policies have been complemented with direct instruction from country focal points as needed. Secondly, by reviewing the adaptation policy developments that have been occurring in particular at the national and European level, the paper aims at identifying policy gaps that could serve as a basis for further investigation to enhance public adaptation response.

Climate change challenges and adaptation responses are presented for the whole pan-European region. The scope of the policy stock-taking covers only planned adaptation action that results from top-down public intervention at the EU and national scale, leaving out planned or bottom-up action that is happening at the transnational, regional or municipal scale. In particular we consider the EU Adaptation Strategy and the National Adaptation Strategies (NAS) that have been created in a "larger Europe", namely across the thirty-two member countries of the European Environment Agency (EEA).⁵

The paper starts with a brief presentation of the method used to critically analyze the available information. Section 2 contains comprehensive background information on climate change impacts and vulnerabilities in Europe, divided into regional, sectoral and economic challenges. Section 3 presents an overview of NASs across European countries, which are discussed according to their key dimensions. Section 4 reviews the adaptation policy framework that has been established at the EU level. In the final section, conclusions on the

⁴ Climate-ADAPT is aimed at supporting stakeholders at all levels of governance, by sharing a large set of data and information on climate change risks, EU sectoral policies, practices of adaptation, national initiatives and decision support tools. This includes the main results of European research projects such as INTERREG and ESPON that have contributed to consolidate the understanding of adaptation in Europe. Created on the initiative of the European Commission in March 2012, it is currently managed by the EEA.

⁵ The 32 EEA member countries include the 27 European Union Member States together with Iceland, Liechtenstein, Norway, Switzerland and Turkey.

policy approaches taken by the EU and European countries are presented along with indications for future research efforts.

METHODOLOGY

This paper brings together three strands of evidence to provide a complete but concise overview of adaptation needs and policy in Europe.

Firstly, the background information on climate change impacts, vulnerability and adaptation needs was mainly gathered from the outcomes of large EU research projects such as ADAM - *ADaptation And Mitigation Strategies: supporting European climate policy*, ESPON *Climate - Climate Change and Territorial Effects on Regions and Local Economies in Europe*, ClimateCost - *Full Costs of Climate Change* and PESETA (1 and 2) - *Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis*, as well as IPCC and EEA findings on climate change challenges in Europe. Secondly, updated facts on national policies for adaptation were drawn from Climate-ADAPT as well as global and European assessment reports and scientific literature comparing countries' adaptation strategies. This knowledge was integrated with personal communications with national focal points. Thirdly, the analysis of the EU adaptation policy was based on a desk review of the main official documentation including DG CLIMA's background studies and impact assessment reports, the Commission's communications published since 2007, and relevant EEA analyses, in particular the 2013 "*Adaptation in Europe*" report.

With regard to the review of NASs, a further methodological step was necessary. Based on an initial meta-analysis of European countries' adaptation planning processes described in comparative literature, we found a great degree of overlap among the dimensions that were emphasized by scholars, which we interpret as implicit agreement on the importance of a number of areas for the assessment of country progress on adaptation policy design (see Tab.1). Building on this shared understanding, we identified the key components along which our critical overview of NASs was structured. These are the following: 1) the general policy framework in place and the overall approach adopted for addressing adaptation in the countries; 2) the generation of the knowledge-base for developing national adaptation strategies including the assessment of costs of action and costs of inaction; 3) the way society is involved in the design of the strategies; 4) which domains are prioritized by the countries and how cross-sectoral policies are foreseen within the strategies; 5) whether the strategies

contain provisions of such things as allocation of financial resources, or post-implementation schemes for monitoring and evaluation of the strategies. Another dimension is considered essential in the comparative literature: the horizontal and vertical governance of adaptation. However, this is not addressed in this review as it is treated in detail in Venturini, Capela Lourenço et al. (forthcoming) (Chapter 3 of this dissertation).

This initial overview also allowed to identify the dimensions that have been less explored in comparative analyses as they are not usually assigned a central position in the NASs. These are however important and will be addressed in this paper as crucial elements of a NAS additionally to the ones already identified. They are the following: 6) the transboundary issues that may affect neighbouring countries and international concerns that may become relevant in Europe; 7) the linkages that may exist between adaptation and mitigation at the national level.

Table 1. Essential dimensions of national adaptation strategies identified according to the key elements assessed in relevant comparative literature

References	Massey (2009)	Swart et al. (2009)	BMVBS (2010)	Termeer et al. (2009)	Dumollard & Leseur (2011)	Bauer et al. (2012)	EUROSAI-WGEA (2012)	Mullan et al. (2013)	EEA (2013)
NAS Dimensions									
1) Policy framework, overall approach and drivers	+	+	+	+	+	+	+	+	+
2) Knowledge generation and integration	+	+			+	+	+	+	+
3) Participation of society		+		+		+			+
4) Adaptation domains and their interface	+	+	+			+	+	+	+
5) Implementation provisions, monitoring and review		+	+	+	+		+	+	+
6) Trans- and international issues									+
7) Synergies between adaptation and mitigation					+				

WHAT EUROPE NEEDS TO ADAPT TO

Temperature warming has proved to be faster than the global average in Europe, where mean surface temperatures have increased by almost 1°C since pre-industrial times in the last one hundred years. According to the findings of the IPCC and EEA, the effects of climate change

have already been experienced in many socio-economic systems and ecosystems across European countries (EEA, 2012; EEA, 2010; EEA/JRC/WHO, 2008; IPCC, 2007). Projections of changes in average climate suggest that by the end of this century, temperatures, as estimated by different climate change scenarios, are projected to increase by 1.0 to 5.5°C in Europe, thus potentially implying higher warming compared to global average projections (IPCC, 2007). Besides average changes in climate, climate-related extremes are also projected to show some degree of alteration. It is believed that global temperature increases above 2°C will increase the risk of exceeding a number of so-called “tipping points”, such as the deglaciation of the West Antarctic ice sheet and Greenland ice sheet, which may generate sudden, large-scale, non-linear climatic events to which human systems and ecosystems would not be able to adjust without major disruptions. However, the understanding of these high-risk low-probability events is still limited (UNEP, 2009; Alison et al., 2009).

EXPECTED REGIONAL CHALLENGES

Scientific evidence shows that consequences of projected climate change will eventually impact all European regions, mainly in a negative way. However, such impacts will most likely be unevenly distributed, thus deepening the socio-economic imbalance across European regions and potentially endangering territorial cohesion (Greiving et al., 2011). Broadly speaking, a clear trend towards more negative potential effects in the South of Europe has been detected while in many Northern, central and Eastern European countries “*moderate levels of climate change*” are expected to produce a mix of negative and positive effects (IPCC, 2007). Europe regards its outermost regions as actual warnings of what the main land will be exposed to (EC, 2009).

A detailed territorial visualization of potential impacts, adaptive capacity and vulnerability to climate change over the pan-European area is provided by the project [ESPON Climate](#). Aggregated impacts analyses confirm that potential physical, environmental, economic, social as well as cultural impacts of climate change will vary considerably across Europe. Furthermore, the *ESPON Climate* mapping shows that Scandinavian and Western-European regions appear to be characterized by higher adaptive capacity while in the Mediterranean region and in South-East Europe such capacity is relatively lower. Drawn from the coupling of climate change exposure and adaptive capacity, a vulnerability mapping suggests an even more prominent disparity between the North of Europe, where high adaptive capacity could quite make up for any expected impacts, and the South, where little adaptive capacity does

not sufficiently compensate the larger negative impacts foreseen, thus resulting in medium to high levels of vulnerability (Greiving et al., 2011).

Consequently, the Mediterranean basin, North-Western Europe, Central-Eastern Europe and the Arctic are referred to as the most vulnerable bio-geographical regions to climate change in Europe. Within these regions, many coastal zones (characterized by high population density and high dependence on summer tourism), areas subject to river floods, mountain areas with high dependence on winter and summer tourism, as well as heavily populated conurbations have been identified as extremely vulnerable areas in Europe (EEA, 2012; Greiving et al., 2011; EEA, 2010; EEA, JRC & WHO, 2008; IPCC, 2007). In Tab.2 we have brought together a catalog of findings on observed impacts and key vulnerabilities that are likely to persist in the future, as classified by the EEA from a bio-geographical perspective.

Table 2. Key findings on observed impacts and bio-geographical vulnerabilities (Sources: EEA, JRC & WHO, 2008; EEA, 2010 and 2012)

Bio-geographical areas	Key impacts and vulnerabilities
Mountain areas (Alps, Apennines, Balkans-Rhodope Mountains, Carpathian, Fennoscandian, Pyrenees, Anatolian region, Dinaric Arc)	<ul style="list-style-type: none"> • High temperature increase • Substantial glacial retreat and expected disappearance of smaller Alpine ice-masses • Permafrost degradation • Reduced snow cover • Changing precipitation patterns • Potential water stress in summer • Increased risk of hazardous geomorphological processes such as floods and rock falls • Ecological impacts on biodiversity like altitudinal shift in vegetation zones and animal habitats, invasion of alien species • Various socio-economic impacts including reduced winter tourism; infrastructural problems; less energy supply from hydropower; reduced freshwater supply; consequences on river navigation; impacts on irrigation facilities
Coastal zones and European seas (especially the Baltic, Mediterranean and Black Seas)	<ul style="list-style-type: none"> • Aggravation of low-lying coasts submersion and quicker erosion of beaches from sea-level rise and storm-related floods • Possible local salinization • Higher water stress (scarcity and droughts) especially related to touristic peaks • Deterioration of coastal habitats and ecosystems • Changes in biodiversity due to northward shift of marine species and changes in the distribution of phytoplankton biomass • Increasing share of population living at risk of floods by the end of the century. The most affected countries are expected to be France, Latvia, the Netherlands and the UK
Cities and urban areas	<ul style="list-style-type: none"> • Higher vulnerability of urban areas mainly in relation to extreme weather events such as heat waves, floods and water scarcity • Increased length, frequency and/or intensity of warm spells or heat waves, of which impacts on human health are aggravated by modern cities' fabric and design (artificial surfaces increasing night-time temperatures) • Worse impacts of heat waves not expected exclusively in Southern countries, with increasing probability of "mega heat waves" over highly populated areas of Europe • Higher overall risk of flooding over European cities, including river floods (Western and Central-Eastern European areas), flash floods (Mediterranean and Alpine-Mediterranean to the Black Sea region), coastal floods (coasts in North-Western Europe, Northern Italy, and Rumania), urban drainage flooding (Western and Northern Europe), groundwater flooding • Water stress during summer expected to worsen and extend towards northern cities • Droughts coupled with heat waves can aggravate the risk of forest fires especially in proximity to cities • Beyond direct impacts (e.g. health impacts and emergency assistance issues, material damages to buildings and infrastructure, erosion and landslides due to flooding), possible adverse indirect socio-economic impacts are expected (e.g. lower productivity, failure of services, high energy demand for cooling, high water prices, loss of jobs and income sources)
Mediterranean basin (including Black Sea region)	<ul style="list-style-type: none"> • Exceptional decrease in annual mean precipitation especially in summer

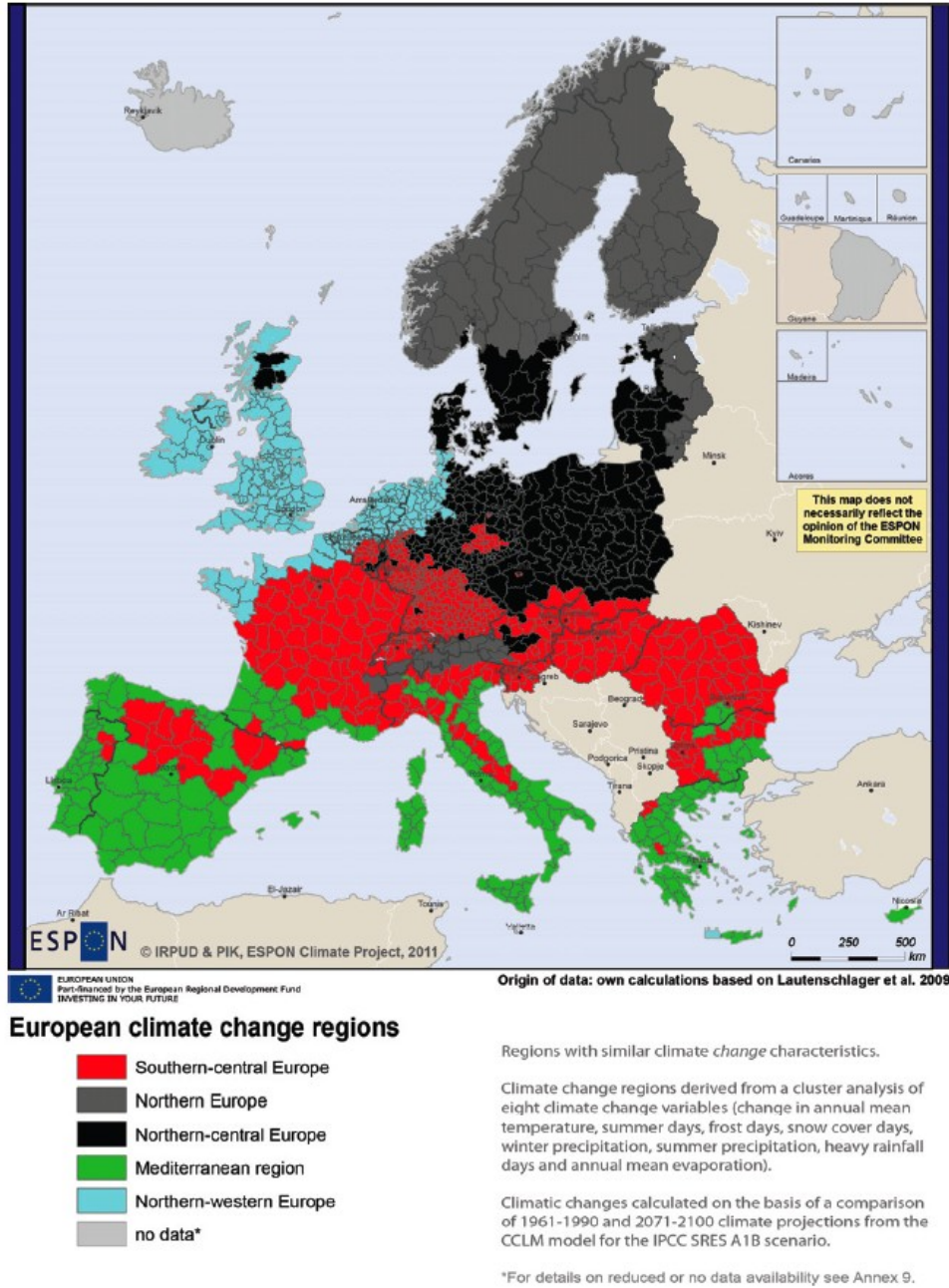
<p>North-Western Europe (Atlantic region)</p>	<ul style="list-style-type: none"> • High temperature increase • Water stress (decrease in water availability combined with increasing demand from agriculture and domestic sectors) • Higher risk of coastal floods due to sea level rise in combination with storm surges • Lower crop yields • Higher risk of biodiversity loss • Increasing risk of forest fires and decrease in forest growth • More likely heat waves, with an increased number of combined hot summer days and tropical nights • Higher risk of droughts and desertification • More vector-borne diseases • Socio-economic impacts (e.g. hydropower sector facing water shortage and augmented demand; summer tourism showing less favorable conditions; public health issues)
<p>Central and Eastern Europe</p>	<ul style="list-style-type: none"> • Increase in winter precipitation • Higher risk of flooding (coastal flooding; possible increasing frequency of winter and spring river flooding; further increase in urban drainage flooding) • Impacts on biodiversity due to northward movement of freshwater species
<p>Northern Europe (Boreal region)</p>	<ul style="list-style-type: none"> • More temperature extremes and more frequent and/or intense heat waves • Reduced summer precipitation • Increased risk of droughts • Possible higher frequency of river floods in winter and spring • Higher crop-yield variability • Increased occurrence of forest fires • Reduced snow, lake and river ice cover • Increased winter and spring river flows • More frequent and intense extreme weather events (winter storms) • Increased crop suitability and yields • Enhanced forest growth • Impacts on biodiversity due to northward movement of species • Some positive socio-economic impacts (e.g. more energy by hydropower, lower energy consumption for heating; possible increase in summer tourism)
<p>The Arctic</p>	<ul style="list-style-type: none"> • Decrease in summer sea ice cover • Greenland ice-sheet loss • Higher risk of biodiversity loss • Mixed socio-economic impacts (e.g. enhanced oil and gas exploration; opening of new shipping routes; infrastructural problems)

As an outcome of the *ESPON Climate* vulnerability assessment study, five types of regions that show similarities in terms of a number of biophysical impact-variables of climate change were determined (Greiving et al., 2011). This categorization slightly differs from the EEA biogeographical areas listed in Tab.2. Nevertheless, the study acknowledges that climate change impacts are often not limited by national borders or precise geographical regions. On the contrary, one country may be faced by various and diverse challenges belonging to other “climate change regions” (see Fig. 1).

Given the multiplicity of consequences that are expected across Europe, tackling climate change impacts effectively through adaptation will call for special consideration of socio-economic context and bio-geographical location issues (Greiving et al., 2011; Swart et al., 2009; Adger et al., 2007). Also, regions are interconnected in terms of adaptation responses that, applied in one location, may affect neighbouring territories (EEA, 2013).

Therefore, specific territorial characteristics and challenges as well as inter-regional issues should be given great emphasis in adaptation strategies to be tailored by European countries.

Figure 1. European “climate change regions” clustered according to projected impacts (Source: Greiving et al., 2011, p.12)



EXPECTED SECTORAL CHALLENGES

Climate change impacts and vulnerabilities in Europe can also be framed under a sectoral perspective. EEA assessment reports on adaptation identified a number of key vulnerable socio-economic and environmental sectors that will face several challenges with respect to the projected impacts of climate change (EEA, 2012 and 2010). Tab.3 summarizes the most significant findings on sectoral impacts and vulnerabilities across Europe.

Since all these sectors will require some adjustments to new climatic conditions, and all of them are interconnected, adaptation can be seen as a multi-sectoral (Burton et al., 2006) as well as a cross-sectoral issue (Klein et al., 2007). Successful adaptation is thus deemed to involve a cross-cutting approach to integrate adaptation considerations into existing sectoral policy mechanisms.

Table 3. Key findings on sectoral vulnerabilities and impacts (Sources: EEA, 2012 and 2010; EC, 2009a)

Sectors	Key impacts and vulnerabilities
Water	<ul style="list-style-type: none"> • Projected decrease in water availability in Southern and South-eastern Europe, as opposed to an increase in the Northern regions. The number of people living in water-stressed areas is expected to increase, especially in the Iberian Peninsula, Italy and large parts of central Europe by the end of the century; • More frequent river floods (fluvial floods including flash floods, as well as pluvial floods) due to the intensification of the hydrological cycle as a result of changes in temperature, precipitation, glacial and snow cover (coupled with unsustainable water management practices); • Water shortages due to glacial melt likely to change the seasonal timing of river discharge in a number of key river basins (Danube, Po, Rhine and Rhone) and lower precipitation, especially in summer; • Increased water demand, due to changes in demography, economy, technology and lifestyle linked to climate change; • Deterioration of water quality, both surface waters and groundwater resources due, inter alia, to higher temperatures and extreme events.
Biodiversity and ecosystems	<ul style="list-style-type: none"> • Increasing risk of ecosystem and biodiversity loss due to alterations to habitat conditions, especially for marine ecosystems and wetlands; • Northward and uphill distributional shifts of many European plant and animal species: main causes of vulnerability lies on the difficulties for many terrestrial species to move to new areas with suitable climate; • Changing phenology for marine and terrestrial plants and animals; • Higher risk of forest fires in Southern and continental Europe and related loss of habitats and species; • Projected decrease in sea ice coverage in Arctic ecosystems and related loss of habitat and species; • The share of species of Community Interest (breeding birds, reptiles and amphibians, butterflies and vascular plants) considered vulnerable to climate change is around 25% within the Natura 2000 network.
Agriculture	<ul style="list-style-type: none"> • Reduction of crop yields under drier conditions in Southern Europe and the Mediterranean area are expected, while increases are projected in Northern regions. All EU regions would experience yield improvements for low levels of temperature increases; • Changes in crop suitability, growing season and the timing of the agricultural crop cycle (agrophenology), especially endangering Central and Southern Europe productivity; • Increasing variability of crop yields in relation to more frequent and intense extreme weather events; • Increasing irrigation requirements for agricultural purposes and competition for water are projected to continue mainly in Southern and Southern and South-Eastern areas.
Forestry	<ul style="list-style-type: none"> • Northward shifts of vegetation distribution could lead to enlargement of forested areas in the North and their shrinking in the South; • Changes in distribution and timing of seasonal events; • Highly increasing risk of forest fires in Southern and Central European countries, with possible reduction in wood production and timber values; • Adverse consequences of increased frequency and intensity of heavy windstorms; • Possible negative impacts on logging and harvesting operations in the Boreal region.
Fisheries and aquaculture	<ul style="list-style-type: none"> • Difficult to distinguish climate change impacts from over-exploitation of fish stocks; • Geographical shifts in wild fish stocks distribution due to temperature changes and food availability; • Increased catch potential in the Arctic, and a decreased or constant catch potential in other European seas; • Possible new opportunities for aquaculture especially related to warm-water species.

Energy	<ul style="list-style-type: none"> • Expected mixed impacts across Europe, with significant seasonal patterns: rising domestic summer cooling demand in Southern regions and reduced winter heating needs in Northern Europe; • Production of both renewable and conventional electricity may be negatively impacted by changing temperatures, rainfall patterns and possible increases in storm severity and frequency; • Foreseen overall decline of hydropower potential for the whole of Europe, with strong regional variations between North (about +5%) and South (about -25%); • Possible adverse impacts on thermal power plant efficiency due to reduced availability of cooling water.
Transport and infrastructure	<ul style="list-style-type: none"> • Mixed impacts, depending on the transport mode, showing complex regional patterns, where the most relevant impacts are related to extreme weather events; • Negative consequences across all transport modes are projected, especially for Scandinavia, the British Isles, Central Europe/France, and Eastern Europe; • Road transport could be benefitted by reduced snow and ice cover, but damaged by increasing severity of extreme events; • Rail transport likely to have the highest cost increase from extreme events, • Aviation is expected to face negative impacts all over Europe.
Tourism and recreation	<ul style="list-style-type: none"> • The regions most favourable for general tourism are projected to shift northwards as a result of climate change, with positive consequences in Northern and Central Europe in most seasons; • Winter sport industry is expected to experience economic losses due to snow cover reduction in the Alpine region and Northern Europe. Regions close to the low elevation limit for winter sport are most vulnerable to the projected warming; • Artificial snow-making implies sustainability and environmental issues related to the use of water resources and energy; • Summer tourism is likely to shift in distribution and time due to decreased touristic suitability of the South-Eastern Mediterranean regions and improved comfort in the North and West European regions. Tourism flows may increase in the spring and fall.
Human health	<ul style="list-style-type: none"> • Human health may be affected by climate change in a number of ways through the alteration of weather patterns, changes in water, air, food quality and quantity, ecosystems, livelihoods and infrastructure; • The elderly, people with some diseases, young children, those on low income and ethnic minorities are considered the most vulnerable groups to the projected health-related effects of climate change; • A rise in the number of heat-related deaths can be expected, especially around urban areas where climate change is coupled with trends of increased urbanization and population ageing; • An increasing heat-related annual mortality occurring mainly in central and southern European regions is expected to substantially balance a decrease in annual cold-related mortality; • A higher number of potential casualties can result from more frequent and intense extreme weather-related events in some regions; • Expected changes in the spread of water-, food- and vector-borne diseases; • Possible changes in distribution in the environment and toxicity of some chemical pollutants.

EXPECTED ECONOMIC CHALLENGES

Although policy action on adaptation may have been triggered by considerations of an economic nature in the first place, assessing costs and potential profits of climate change impacts in Europe proved to be quite a complex exercise, since other factors of change mix with the share of impacts that may be attributable to climate change (EEA, JRC & WHO, 2008). Furthermore, costs and benefits of adapting to those impacts seem to have been poorly addressed in earlier economic assessment studies, where analyses were mostly focused on a few sectors or restricted to a subset of climate change effects (EEA, 2007; Agrawala & Fankhauser, 2008). In recent literature, more comprehensive cost estimates covering Europe have emerged, mainly drawing from the outcomes of seminal EU research projects such as [PESETA](#), [ClimateCost](#) and [ADAM](#). Despite their completeness, these EU studies are recognized

to be still limited by a number of methodological simplifications, which may have led to underestimation of total figures.

As to impact costs, the annual relative aggregate welfare loss is estimated between 0.2% and 1% for different scenarios of warming (Ciscar et al., 2011). Such aggregated economic impacts hide elevated variability across regions, sectors and climate scenarios in Europe. According to the findings of the *PESETA* study, Southern Europe is confirmed to be the area most severely affected by climate change also in economic terms, particularly due to losses in the agricultural sector and tourism. Central Europe would show mixed welfare impacts, mainly due to negative consequences of river floods and coastal damages, mitigated by increased profits from touristic flows. Northern Europe would be the only region with welfare improvements under all scenarios, largely driven by enhanced conditions for agricultural production and higher tourism revenues.

Focus on Italy

The major macro-economic study on the costs of climate change impacts and adaptation options for the Italian economy focuses on four key vulnerable areas: the Alps and glacier ecosystems; coastal zones; arid areas and areas threatened by desertification; areas prone to floods and landslides.

Aggregated losses induced by climate change would amount to 0.12%-0.16% GDP with an equivalent loss of about 20-30 bn Euros up to 2050, considering a temperature increase of 0.93°C. Larger losses in the range of 0.16%-0.20% GDP are expected for a +1.2°C temperature rise scenario (Carraro et al., 2008).

A coherent overall figure for adaptation costs in Europe is difficult to obtain from aggregated global or sectoral estimates. The review of about fifty sectoral assessments performed within the project *ClimateCost* summarized the available information on adaptation costing, highlighting large potential costs both in the short-term (in the order of billions of Euros per year) and the long-term (tens of billions of Euros) (ClimateCost, 2010). Tab.4 reports some important findings on costs of impacts and adaptation interventions in Europe.

From a national perspective, very few countries appear to have carried out cost assessments of adaptation options in some key sectors: this is especially the case of coastal zones and flood risk management in the Netherlands, UK, Sweden, Germany, France, Slovakia, Belgium (EEA, 2013, 2010 and 2007) and Italy (see focus box). It is reported that if findings of such national studies were scaled up to the European level, they would imply adaptation costs far higher

than the ones drawn from aggregated sectoral assessments or global studies (ClimateCost, 2010). However, no comprehensive national assessments seem to be available so far.

While the range of estimates varies widely across studies, it is commonly acknowledged that the cost of adapting today is lower than the cost of facing potentially larger climate change impacts tomorrow (Stern, 2007). Integrated sector studies, like the ones carried out within the project *PESETA*, concluded that some adaptation options entail economic benefits that would eventually exceed the investment in adaptation itself.

Decision-making under such uncertain estimation of costs and benefits of adaptation requires novel, iterative and flexible frameworks such as “adaptation pathways” (Jeuken & Reeder, 2011; Haasnoot et al., 2012) or “adaptation tipping/turning point” approaches (Kwadijk et al., 2010; Werners et al., 2012 and 2013). These are opposed to classical “what if” scenarios, and by outlining numerous alternative adaptation options and sequencing their implementation over time, they allow an adaptation strategy to be efficiently adjusted based on new knowledge and changing circumstances. They make policy objectives central, rather than potential climate impacts. In this context, the involvement of institutional and non-institutional stakeholders at different governmental levels is deemed crucial to correctly realize such adaptive management practices (EEA, 2013).

Table 4. Key findings on aggregated and sectoral cost estimates for impacts and adaptation in Europe

	Costs of climate change impacts	Costs of adaptation
Aggregated estimates	<ul style="list-style-type: none"> • EUR 20-65 bn/year of overall GDP loss in Europe by 2080 (PESETA: Ciscar et al., 2011) 	<ul style="list-style-type: none"> • EUR 2.5-16 bn/year by 2030 for interventions on infrastructure and coastal defence in Europe (UNFCCC, 2007) • EUR 4-60 bn/year for infrastructure (Stern, 2007) • EUR 4.1-29 bn/year in western Europe in 2020 (ADAM: Aaheim et al., 2010) • 0.64% of total output for Europe and 0.14% for Eastern Europe (de Bruin et al., 2009)
Sectoral estimates	<ul style="list-style-type: none"> • Studies on extreme events but difficult to assess climate change share 	<ul style="list-style-type: none"> • Coastal zones: EUR 0.25–1.7 bn/year in the period 2010–2040 and EUR 0.3–3.5 bn/year in the period 2070–2100 for structural interventions (PESETA: Richards & Nicholls, 2009; Hinkel et al., 2009, 2010) • River floods: EUR 1.7 bn/year in the period 2011-2040; EUR 3.4 bn/year in 2041-2070; EUR 7.9 bn/year in 2071-20100 for flood risk protection (EEA, 2013) • Energy: EUR 30 bn/year by 2050 to EUR 109 bn/year by 20100 as additional cooling costs (ClimateCost: Mima et al., 2011) • Health: EUR 10–215 million/year up to 2030 for interventions against diarrheal diseases (Ebi, 2008; Markandya & Chiabai, 2009)

NATIONAL POLICIES FOR CLIMATE CHANGE ADAPTATION IN EUROPEAN COUNTRIES

With respect to nationwide planned adaptation, European countries have been designing, developing and implementing adaptation policies at a very different pace. Almost all thirty-two EEA countries have filled their country page on the European Climate Adaptation Platform [Climate-ADAPT](#) with substantial information on their progress in adaptation policy planning. Nevertheless, for a few countries no facts are yet available on the Platform. Other sources besides Climate-ADAPT, as needed, were used to complete the country profiles in Tab.5 showing existing policies relevant for adaptation.

Such policies can take various forms, including climate change legislation or sectoral legislation, sectoral strategies or plans, as well as proper National Adaptation Strategies (NAS). Various researches have highlighted that public policy and in particular NASs seem to be the most efficient way to coordinate adaptation action at the country level (Dumollard & Leseur, 2011; INTOSAI WGEA, 2010; Swart et al., 2009; Berkhout, 2005).

Broadly speaking, NASs are intended as vision documents that reflect the direction of the government on how to tackle the consequences of climate change, while action plans detail the level of action and can come with a strategy or be developed at a different stage. However, these definitions are quite labile given the diversity in the legal status and degree of enforcement that these documents are assigned in different countries. A critical review of the various characterizations of a NAS found in literature and a screening of the national adaptation policies based on a proposed common definition of NAS is contained in Venturini, Capela Lourenço et al. (forthcoming) (Chapter 3 of this dissertation).⁶

This paper adopts the concept of a NAS as it is used in the Climate-ADAPT Platform based on countries' self-evaluation. Such definition of NAS is thus wide and ranges from climate change strategies with little focus on adaptation to specific adaptation documents.

Since 2005, when Finland adopted the first NAS, sixteen countries, including EU Member States and non-EU countries that are members of EEA, have declared that their governments have formally adopted a strategic document valid as a NAS (EEA, 2013). These are the following countries (highlighted in bold in Tab.5): Austria, Belgium, Denmark, Finland, France,

⁶ According to this analysis, Lithuania and Sweden do not fulfil the common criteria of a NAS shared by other countries.

Germany, Hungary, Ireland, Lithuania, Malta, the Netherlands, Portugal, Spain, Sweden, Switzerland and the UK. Half of them are achieving the goals of their NAS through one or more action plans that follow up the strategy providing overall guidance for implementing adaptation nationally or just focusing on some of the key sectors identified (e.g. water management in Denmark and the Netherlands). Finland and some of the more advanced are already at the stage of revising their NAS.

All the remaining countries are assessed to be at the stage of formulating or adopting their NAS, with the exception of Luxembourg, for which no information was available at the time of this research. Countries that can be considered particularly advanced in adaptation planning are Norway, Slovenia, Romania, Poland and the Czech Republic.

Norway launched a 5-year work programme titled *“Adaptation in Norway – The government efforts to adapt to climate change”*, focused on facilitating activities for adaptation at various

Focus on Italy

Italy is at the stage of formulating its national adaptation strategy. The process started in July 2012 and it is expected to be finalized by mid 2014 (project SNAC funded by the Italian Ministry for the Environment, Land and Sea). In 2007 the first National Conference on Climate Change had initiated prioritizing sustainable adaptation actions (APAT-MATTM, 2007).

sectoral and administrative levels, including through national vulnerability assessment, research and dissemination (Government of Norway, 2008). In June 2013 a White Paper on adaptation containing an overview of climate change impacts and risks in the country, as well as insights on general objectives of climate policy and on areas for research and policy development was presented to the Parliament. The White Paper mentions the development of national guidelines aimed at

mainstreaming adaptation into sectoral policies and providing overall coordination (Norwegian Ministry of the Environment, 2012).

Romania was expected to have finalized its NAS by 2008 as reported in various assessments (Termeer et al., 2009; EEA, JRC & WHO, 2008). In fact, the Romanian government adopted several documents in support of national adaptation policy: a first *“National Climate Change Strategy (2005-2007)”* containing a separate chapter on adaptation, and a 2008 *“National Guide on the Adaptation to Climate Change Effects”* providing recommendations on measures aimed at diminishing the risk of the adverse effects of climate change in thirteen key sectors (Romanian Ministry of Environment and Forests, 2005 and 2008). An updated *“National*

Climate Change Strategy (2012-2020)” is being completed and submitted for approval. It comprises a rich section on adaptation, meant to provide an action framework and guidelines to enable sectors to develop individual action plans, and was finalized in 2011 and subsequently opened to public debate (Romanian Ministry of Environment and Forests, 2011). In an analogous manner, Slovenia is in the phase of developing its adaptation policy. It has published a draft National Climate Strategy titled *“Strategy for the transition of Slovenia to a low carbon society by 2050”* that is expected to be the country’s broad climate change strategy on both mitigation and adaptation once it is formally adopted. A second draft version is currently under public consultation. Importantly, an adaptation strategy was officially adopted in 2008 followed by an action plan for years 2010 and 2011, but it only focused on two critical sectors: agriculture and forestry (Slovenian Ministry for Agriculture and the Environment, 2008).

Poland started the preparation of a *“Strategic Plan for Adaptation to sectors and areas vulnerable to climate change by 2020, with a view to 2030”* in 2009, with the aim to shape measures that would complement mitigation policy and to serve as the umbrella strategy for regional and sectoral development policies (Polish Ministry of the Environment, 2013). The NAS is currently under consideration for adoption by the relevant national authorities.

The Czech Republic adopted its climate change strategy *“National Programme to Abate the Climate Change Impacts in the Czech Republic”* (Czech Ministry of the Environment, 2004), that set priorities for adaptation measures in four interest areas, in 2004. In the following years a more detailed document has been formulated with focus on adaptation, which is being readied for government approval, expected by the beginning of 2014.

Other countries such as Latvia and Estonia were assessed to be at an advanced phase of adaptation planning in the past years (Massey, 2009; Swart et al., 2009; EEA, JRC & WHO, 2008). However, at the moment the information contained in Climate-ADAPT show that these countries have been prolonging the process of designing their NAS.

After the overview of all existing policies that are relevant for adaptation across European States, the following sub-sections focus on countries that are officially recognized to have adopted a NAS (as per Climate-ADAPT information accessed in July 2013), given the prominent importance of such a strategic approach for the coordination of adaptation and the relatively easier accessibility to data and information on the planning processes when a NAS is published.

Table 5. List of existing national adaptation policies in EEA Member Countries (Source: Mullan et al., 2013; Climate-ADAPT, accessed July 2013; national portals, publications and complementary information)

EEA Member Country	Status of NAS	Year	National responsibility	NAS or other adaptation-relevant policy	Language (English if available)	Plans for implementation
Austria	NAS adopted	2012	Federal Ministry of Agriculture, Forestry, Environment & Water Management	Austrian Strategy for Adaptation to Climate Change	EN	Austrian Strategy for Adaptation to Climate Change - Action Plan. Recommendations for the implementation** (2012)
Belgium	NAS adopted	2010	Belgian federal government and the regional governments of Flanders, Wallonia and Brussels	Belgian national climate change adaptation strategy	EN	<i>being developed</i>
Bulgaria	<i>Ongoing</i>	2012	Ministry of Environment and Water	Third National Action Plan on Climate Change 2013-2020	EN	
Czech Republic	<i>Ongoing</i>	2004	Ministry of the Environment	National Programme To Abate the Climate Change Impacts in the Czech Republic	EN	
Cyprus	<i>Ongoing</i>		Ministry of Agriculture, Natural Resources and Environment			
Denmark	NAS adopted	2008	Minister for Climate and Energy	Danish Strategy for adaptation to a changing climate	EN	How to manage cloudburst and rain water Action plan for a climate-proof Denmark (2012)
Estonia	<i>Ongoing</i>		Ministry of the Environment			
Finland	NAS adopted	2005	Ministry of Agriculture and Forestry	National Adaptation Strategy	EN	Adaptation to Climate Change in the Administrative Sector of the Ministry of the Environment Action Plan Update for 2011-2012 Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry 2011-2015 (2011)
France	NAS adopted	2007	Ministry for the Ecology, Sustainable Development and Energy	National strategy for adaptation to climate change**	FR	French National Climate Change Impact Adaptation Plan 2011 - 2015 (2011)

EEA Member Country	Status of NAS	Year	National responsibility	NAS or other adaptation-relevant policy	Language	Plans for implementation
Germany	NAS adopted	2008	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety	German Strategy for Adaptation to Climate Change	EN	Adaptation Action Plan the German Strategy for Adaptation to Climate Change (2011)
Greece	<i>Ongoing</i>	2003	Ministry of Environment, Energy and Climate Change	National Action Plan regarding Climate Change **	GR	
Hungary	NAS adopted	2008	Ministry of National Development, Department of Climate Policy	National Climate Change Strategy 2008-2025	EN	<i>being developed</i>
Iceland*	<i>Ongoing</i>	2007	Ministry of Environment	Iceland's Climate Change Strategy	EN	
Ireland	NAS adopted	2012	Department of the Environment, Community and Local Government	National Climate Change Adaptation Framework	EN	<i>being developed</i>
Italy	<i>Ongoing</i>		Ministry of the Environment, Land and Sea			
Latvia	<i>Ongoing</i>		Ministry of Environmental Protection and Regional Development			
Liechtenstein*	<i>Ongoing</i>	2007	Ministry of Construction and Environment	National Climate Change Strategy for the Liechtenstein Principality **	DE	
Lithuania	NAS adopted	2012	Ministry of Environment	Lithuanian climate change management policy and its implementation	LT EN summary	<i>being developed</i>
Luxembourg						
Malta	NAS adopted	2012	Ministry for Resources and Rural Affairs, Malta Resources Authority	National Climate Change Adaptation Strategy	EN	
Netherlands	NAS adopted	2007	Ministry of Infrastructure and Environment, Directorate for Spatial Development and Water Affairs	Make room for Climate	EN	Delta Programme (2011, 2012, 2013)
Norway*	<i>Ongoing</i>	2008	Ministry of Environment	Adaptation in Norway The government's efforts to adapt to climate change **	NO	

EEA Member Country	Status of NAS	Year	National responsibility	NAS or other adaptation-relevant policy	Language	Plans for implementation
Poland	<i>Ongoing</i>		Ministry of the Environment	Strategic Plan for Adaptation to sectors and areas vulnerable to climate change by 2020, with a view to 2030**	PL	
Portugal	NAS adopted	2010	Ministry of Agriculture, Sea and Spatial Planning	National strategy for adaptation to climate change**	PT	<i>being developed</i>
Romania	<i>Ongoing</i>	2011	Ministry of Environment and Forests	Adaptation component of the National Climate Change Strategy (2012-2020)**	RO	
Slovakia	<i>Ongoing</i>		Ministry of Environment			
Slovenia	<i>Ongoing</i>	2011	Ministry of Agriculture and the Environment	(Draft) National Climate Strategy – Strategy for the transition of Slovenia to a low carbon society by 2050	SI EN summary	
Spain	NAS adopted	2006	Ministry of Agriculture, Food and Environment	National plan for adaptation to climate change**	ES	National plan for adaptation to climate change – Work programme** (2006, 2009)
Sweden	NAS adopted	2009	Ministry of the Environment	Bill: An Integrated Climate and Energy Policy	SE EN summary	
Switzerland*	NAS adopted	2012	Federal Department of the Environment, Transport, Energy and Communications	Adaptation to Climate Change in Switzerland	EN	
Turkey*	<i>Ongoing</i>	2010	Ministry of Environment and Urbanization	National Climate Change Strategy 2010-2020	EN	
United Kingdom	NAS adopted	2008	Department for the Environment, Food and Rural Affairs	Climate Change Act	EN	England and UK reserved matters National Adaptation Programme (2013)

Note:

* non-EU Member State

**original title translated by the authors

POLICY FRAMEWORK, OVERALL APPROACH AND DRIVERS

All the existing NASs were formulated under the responsibility of the respective authority that deals with environmental matters in the country, typically the Ministry for the Environment along with some inter-ministerial coordination body (see Tab.5). One meaningful exception is Sweden, where no national agency has been appointed with overall responsibility for climate change adaptation, as the country chose a decentralized, county-based approach to adaptation planning (Swart et al., 2009; Termeer et al., 2009).⁷ In federal or devolved countries responsibility for adaptation is clearly split between the existing regions or countries that have in turn adopted, or are adopting, their adaptation strategies (e.g. in Belgium, the UK).

Often, environment agencies and other organizations are appointed to play a major role in the drafting of the strategy as in the case of Austria, Portugal and others. A complete list and analysis of the institutions, processes and mechanisms that have been established within the NASs to deal with the cross-sectoral (horizontal) and multi-level (vertical) coordination of adaptation is provided by Venturini, Capela Lourenço et al. (forthcoming) (Chapter 3 of this dissertation). Research institutions are also engaged in order to integrate adaptation knowledge, as in the case of the National Observatory for the Effects of Global Warming (ONERC) for France and UKCIP for the UK.

Across the countries considered in the comparative assessment by Swart et al. (2009) adaptation policy development seemed to be a joint result of top-down activities from the national government and bottom-up activities at the local level. Particularly vulnerable municipalities and sectors had often already started reducing their vulnerability before national strategies were being developed. In those cases, the strategy offered a framework for such activities, and an incentive to further implement and harmonize adaptation actions.

With reference to the driving forces behind a national adaptation strategy, no clear correlation can be observed between the promptness of developing a governmental

⁷ In fact, Sweden does not prove to have a dedicated NAS (see Chapter 3 of this dissertation).

response to climate change and the degree of exposure or vulnerability. For instance, despite being one of the most vulnerable areas in Europe, only four countries belonging to the Mediterranean region have formalized their adaptation action in a comprehensive policy. More likely the pace of the response has to do with the adaptive capacity in the country. The degree of awareness is one component of the adaptive capacity and can explain why among the first to adopt an adaptation strategy there were countries from the North of Europe. The financial, economic, cultural and political components of the adaptive capacity are also likely to play a significant role. The severe global financial crisis and the economic recession are acknowledged to have particularly affected South-Eastern European countries since 2008, which therefore suffer from a lack of current resources to earmark for adaptation research and action. The limited financial and human resources and the lack of political will and commitment have been identified among the main barriers for adaptation in countries such as Greece and Italy. In fact, due to the economic situation sometimes accompanied by political instability, these countries also may have a tendency to plan policies with a shorter-term horizon and await external inputs. For instance, the push from EU institutions towards enhanced action on adaptation and the resources made available through European grants and funds for adaptation were among the main drivers of many countries to start undertaking the development of the NAS, as in the case of Portugal and Cyprus.

Successful experiences of adaptation in other countries that are close in terms of geography, impacts or administrative systems are also a strong motivation for Mediterranean and, in general, for all European countries to take action.

Other important drivers are known to contribute to the formulation of a NAS, including: first of all, the occurrence of major extreme weather-related events as a push and “window of opportunity”; the fulfillment of the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) and the role within the international community; the latest findings from national and international research studies on impacts and adaptation; the growing understanding of economic costs of inaction and the recognition of beneficial opportunities linked with climate change (Swart et al., 2009).

PARTICIPATION OF SOCIETY

According to the experience of the countries that have adopted a NAS, engaging society and the adaptation stakeholder seems to play an extremely important role to the success of adaptation planning for a variety of reasons, not least, the need to build ownership and create consensus around the NAS. The key elements in ensuring effective participatory processes are, among others, identifying and engaging the right stakeholders, selecting a proper format for consultations that allows integration of different perspectives of stakeholders, and ensuring an open consultation process to support trust-building.

Depending on the goals of the participation, different typologies of stakeholders have been identified and involved to varying degrees in the various phases of the NAS (development, implementation, monitoring and evaluation). Typical stakeholder groups include representatives of governmental authorities at the national and sub-national levels, interest groups (e.g. farmers associations and environmental or social NGOs), academia, businesses and common citizens.

The modalities in which the stakeholders have been involved reflect progressive approaches towards “real” participation (for a complete ranking of participation categories see Arnstein, 1969; and Green & Hunton-Clarke, 2003). These include: creation of dedicated adaptation portals, newsletters, reports, awareness-raising campaigns through media, informative and technical workshops, on-line surveys, consultation on policy drafts, participation in advisory bodies, partnerships and negotiations. Although not all the countries report clear information on the participatory mechanisms surrounding the NAS, based on the available information the processes adopted to engage stakeholders are acknowledged to be quite varied in terms of combination of modalities and inclusiveness. A preliminary overview is presented in Tab.6. Some examples are worth mentioning.

While in participatory processes the general public is usually kept informed and asked to contribute to varying degrees to the development or implementation of the NAS, the final decisions are made by a restricted group of actors, including, for instance, national and local governmental stakeholders and the private sectors. Austria designed a broad and inclusive process in support of the NAS formulation,

coordinated by the Austrian Environmental Agency. The whole process lasted about three years (2008-2011) and was targeted at identifying adaptation options to be included in the strategy. Representatives of federal and provincial authorities, interest groups and relevant NGOs were involved through a series of workshops and meetings, where they had the opportunity to improve understanding of the issues at stake. The topics discussed included responsibilities for implementation, financial resources, knowledge gaps and open research questions. All the outcomes of such process had been considered in the final formulation of the NAS.

In France the involvement of society was considered of high importance and took place in various forms, including a ten-month process in 2011 to support the elaboration of the implementation plan following the NAS (Beriot & Jouzel, 2011). This was organized along the structure of the Grenelle Environment Forum gathering elected representatives and local authorities, the state, employers, employee unions and non-profit associations. The main goals were to increase awareness of a broad range of stakeholders and make adaptation perceived as high as mitigation in the policy agenda. Secondly, it aimed at collecting opinions and recommendations for defining the “*National Climate Change Adaptation Plan*” (French Ministry of Ecology, 2011).

In Spain, a specific series of sectoral workshops, framed under the NAS in coordination with the National Centre for Environmental Education, was established to engage and inform stakeholders about the projected impacts of climate change on a variety of socio-economic sectors and ecological systems. So far, three workshops have been organized in the course of the NAS development and implementation. They discussed ideas and adaptation options on biodiversity and forests, and presented regional climate change scenarios.

Although the involved non-governmental stakeholders possibly had the chance to influence decision-making through their consulting role, it is difficult to determine whether “real” participation had been achieved in these and other national situations, due to the outsider perspective.

Table 6. Participation of society in national adaptation strategies (Source: Climate-ADAPT, accessed July 2013; national publications and complementary information)

EEA Member Countries	Participatory approach	Short description
AT	√	Type: broad consultative process NAS Phase: development Objectives: consultation, exchange, partnership, empowerment
BE	-	-
CH	√	Type: consultative process (focus on national governmental stakeholders) NAS Phase: development, implementation, preparation to monitoring and evaluation Objectives: information exchange, active involvement, partnership, empowerment
DE	√	Type: broad consultative process NAS Phase: development, implementation, monitoring and evaluation Objectives: consultation, information exchange, partnership
DK	√	Type: broad informative process NAS Phase: development Objectives: information exchange, consultation
ES	√	Type: broad informative process NAS Phase: development, implementation, monitoring and evaluation Objectives: information exchange, address specific tasks and projects
FI	√	Type: broad informative process NAS Phase: development, implementation, monitoring and evaluation Objectives: information exchange, consultation
FR	√	Type: broad consultative process NAS Phase: development, implementation, monitoring and evaluation Objectives: consultation, information exchange
HU	√	Type: broad informative process NAS Phase: development Objectives: consultation, information exchange
IE	√	Type: broad informative process NAS Phase: development Objectives: information exchange, consultation
LT	-	-
MT	√	Type: broad informative process NAS Phase: development Objectives: Information exchange, consultation
NL	√	Type: broad consultative process NAS Phase: development, implementation, monitoring and evaluation Objectives: empowerment, partnerships, consultation
PT	√	Type: broad consultative process NAS Phase: development, implementation Objectives: consultation, active involvement
SE	√	Type: limited consultative process (focus on scientific community) NAS Phase: development Objectives: consultation
UK	√	Type: n.a. NAS Phase: development, implementation, monitoring and evaluation Objectives: n.a.

Furthermore, in general the scientific community has been actively involved mainly in the development phase, to contribute to the identification of adaptation options, and in the monitoring and evaluation phase, to develop methodologies. For instance, in Sweden the only participatory moment, according to the available information,

was the inclusion of about 150 expert stakeholders in the development of the risk and vulnerability assessment.

Interestingly, Malta reports in its NAS the reasons why the public consultation process on the adaptation policy draft, held between November 2010 and June 2011, did not meet the expectations with respect to the previous similar process on the mitigation strategy (Maltese Ministry for Resources and Rural Affairs, 2012). First, according to the authorities, the concepts of risks and vulnerability appeared more difficult to understand to a general audience than the negative effects of greenhouse gas emissions, thus turning off the public's attention. Secondly, the use of conventional media (not animated) did not attract proper interest as they failed in illustrating the evolution of impacts which are not immediately visible. Finally, the extremely technical nature of the document under consultation seemed to have engaged specialists and expert stakeholders and proved to be less interesting to the general public. These lessons contributed to generate an improved communication strategy outlined in the NAS.

In the case of Belgium, there was no national participatory process for the development of the NAS, however a various range of stakeholders were involved in the formulation of the Flemish Adaptation Plan.

KNOWLEDGE GENERATION AND INTEGRATION

Almost the totality of the NASs considered prove to be grounded on national risk and vulnerability assessments (see Tab.7). These are of, at least, qualitative nature, which simply implies the review of existing regional and sectoral studies that are relevant to the national case. Some have developed a sound methodology and are based on downscaled global climate scenarios (e.g. Denmark, Ireland, Spain, Belgium-Flemish government), while others make use of ad hoc regional / high-resolution scenarios that provide specific information for the national territory (e.g. Belgium - federal government and Brussels and Walloon governments, Netherlands, Germany, Switzerland and the UK). Regional scenarios are at the basis of new-generation vulnerability studies that enable a more effective allocation of priority action on adaptation within the NAS.

These studies generally assess climate change impacts and vulnerability nationally and cross-sectorally, and often are also applied to sub-national levels (e.g. Austria, Belgium, Denmark, France, Germany, Netherlands, Portugal, Switzerland, the UK). Sector-based assessments are usually led by the relevant ministries and the appointed research institutions, however specialists or groups of interest from the private sector may be in charge of the studies in specific sectors (e.g. in Belgium, Netherlands, Sweden).

Rarely, risk and vulnerability assessments include some cost estimates of the impacts as well as consideration of costs and benefits of possible adaptation options. The lack of comprehensive information about costs at the national level is acknowledged to be one of the main shortcomings of the European NASs so far. The NASs tend to refer to general economic findings on adaptation e.g. the Stern Review (Stern, 2007) or to initial estimates based on sectoral or regional studies. Significantly, the UK 2013 “*National Adaptation Programme*” is accompanied by a technical annex titled “*Economics of the NAP*” that provides insights into the potential costs and benefits of adaptation in a number of policy areas and the impacts of climate change on economic activity, although recognizing the surrounding uncertainties and the impossibility of calculating a comprehensive macro-economic estimate yet (HMG, 2013a).

To refine the accuracy of vulnerability assessments, information on costs of inaction and costs of action is very much needed in the context of adaptation planning. As considerable uncertainties and information gaps remain in the area, costs and benefit assessments are part of on-going research programmes in many countries.

Importantly, risk and vulnerability assessments need to be regularly updated to keep up with the latest climate and socio-economic projections; such provision is explicitly present in a few NASs (e.g. the UK, Netherlands) while in other countries this has not been decided yet. As an example, in the UK the revision of the impacts and vulnerability assessment to be carried out every five years is mandatory under the 2008 “*Climate Change Act*”.

Table 7. National risk and vulnerability assessments that support national adaptation strategies (Source: Climate-ADAPT, accessed July 2013; national publications and complementary information)

EEA Member Countries	Risk and vulnerability assessments	Economic assessment	Updating provisions
AT	√	-	Next NAS update
BE	√	Only for one region (Flanders)	Every 7 years (Flemish government)
CH	√	-	
DE	√	-	
DK	√	-	
ES	√	-	
FI	√	Only for some sectors	Next NAS update 2013-2014
FR	√	Only costs of impacts	
HU	√	-	
IE	√	-	
LT	√	-	
MT	√	-	
NL	√	-	
PT	√	-	
SE	√	Only for some sectors	
UK	√	Only for some sectors	Every 5 years

Note:

AT = Austria; BE = Belgium; CH = Switzerland; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; HU = Hungary; IE = Ireland; LT = Lithuania; MT = Malta; NL = Netherlands; PT = Portugal; SE = Sweden; UK = United Kingdom

The integration of knowledge is also sought through the establishment of national web portals dedicated to adaptation that help policy-makers, businesses and society to find and understand the information they need, such as facts regarding future climate impacts or sectoral guidance on adaptation options.

So far, almost all the countries with a NAS have reported national and sub-national adaptation platforms, with, however, a very different degree of coverage of adaptation issues: [Austria](#), Belgium ([Flanders](#), [Wallonie](#)), [Denmark](#), [Finland](#), [France](#), [Germany](#), [Hungary](#), [Netherlands](#), [Portugal](#), [Spain](#), [Sweden](#), [Switzerland](#), and [the UK](#) ([Scotland](#), [Northern Ireland](#), [Wales](#)).

Besides the challenge of promoting and coordinating knowledge, this instrument is also useful to attract society's attention to adaptation-related processes and thus improve stakeholder participation.

ADAPTATION DOMAINS AND THEIR INTERFACE

The assessed NASs typically address adaptation through a sectoral approach. According to our review (Tab.8), the sectors that are considered by the large majority of the countries in their NAS are the following:

- Water resources management;
- Agriculture and food production;
- Public health;
- Forests and forestry;
- Biodiversity and ecosystems;
- Spatial planning and development;
- Energy production and consumption;
- Fishery and aquaculture.

In the second place, the most commonly addressed sectors include:

- Industry and economy;
- Infrastructure and built environment;
- Tourism and recreation;
- Civil protection and safety preparedness;
- Transport services and infrastructure;
- Insurance and financial services;
- Coastal areas management.

Furthermore, other specific national vulnerabilities are addressed by a minority of countries reflecting their environmental conditions or economies (e.g. desertification in Spain; reindeer husbandry in Sweden and Finland; mountain areas in France and Spain).

It is worth noticing that the grouping of sectors can vary between countries. For example, Natural resources and biodiversity and Fisheries are considered as a single sector in Ireland, while in the majority of other countries these issues are treated separately. Furthermore, the same identified sectors may encompass diverse issues: for instance, some countries have chosen to put an emphasis exclusively on the Tourism sector, while others see Industry, economy, business and services as a

whole thus including the tourism industry. Also, economic issues that are typical of the private sector, such as Insurance and financial services, are explicitly considered by only five countries (Germany, Spain, France, Finland and Malta). This may explain why these three sector categories have been identified by a small number of countries compared to other sectors.

Finally, the choice of sectors between national and sub-national strategies may differ: for instance, the autonomous Regions of Belgium and the devolved administrations of the UK that have developed a NAS have utilized their own list or categorization of sectors with respect to the NAS adopted by the central government.

Focus on Italy

Italy identified a number of key vulnerable sectors and sub-sectors for the development of the NAS, as follows:

- *Water resources;*
- *Areas at risk of desertification, drought and soil degradation;*
- *Areas at risk of floods and landslides;*
- *Biodiversity and ecosystems (marine, terrestrial and inland water ecosystems);*
- *Health;*
- *Forestry;*
- *Agriculture, fisheries and aquaculture;*
- *Energy;*
- *Coastal zones;*
- *Tourism;*
- *Urban areas;*
- *Critical infrastructure (cultural heritage; transport infrastructure);*
- *Special case studies (Alps and Apennines; Hydrographical Basin of the Po River).*

In summary, the assessed NASs seem to concentrate on the same key public sectors, following the traditional subdivision of EU and national policy areas. Interestingly, economic issues are quite neglected and possibly addressed within the various sectors, which may be partly due to the lack of knowledge about potential adaptation options or current measures being taken by the private sector (except for the insurance industry and water and energy utilities).

However, the definition of similar vulnerable sectors does not imply that the countries are exposed to climate change in the same way or have equal capacity to cope with it. Indeed, significant differences in vulnerability can be better distinguished at a more detailed scale,

when looking at the options that are prioritized and the adaptation measures customized to specific bio-geographical, socio-economic and also political-administrative circumstances (BMVBS, 2010; Massey & Bergsma, 2009). Besides the primary identification of sectors, the prioritization process is thus deemed essential in this sense.

Several adaptation strategies explicitly address cross-sectoral characters of adaptation when addressing the various sectors or separately in a different section of the policy document. The clearest example is the Swiss NAS, that has a dedicated chapter on interfaces between sectors providing a brief description of the interface relevant to adaptation and the identification of the authority primarily responsible for dealing with the interface, as well as reference to other sectors in which a field of action is affected by the interface.

Elements such as research, education, communication and public awareness are discussed by many, or at least their importance is recognized as crosscutting within the NAS, while only few consider regional development issues (e.g. Hungary), governance (e.g. France, Ireland, Finland) or international and European cooperation (see next sub-section).

Table 8. Key domains addressed in the existing national adaptation strategies (Source: national publications and complementary information)

Key policy adaptation domains	Countries																	TOT
	AT	BE	CH	DE	DK	ES	FI	FR	HU	IE	LT	MT	NL	PT	SE	UK		
Water resources management	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15	
Agriculture and food production	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	15	
Forests and forestry	+		+	+	+	+	+	+	+	+		+		+	+	+	13	
Public health	+	+	+	+	+	+	+	+	+			+		+	+	+	13	
Natural resources and biodiversity conservation / Biodiversity and ecosystem services / Nature		+	+	+	+	+	+	+	+	+	+			+	+	+	13	
Spatial, urban planning and development / Land use	+	+	+	+	+	+	+	+			+		+	+			11	
Energy production and consumption	+	+	+	+	+	+	+	+			+	+	+				11	
Fishery and aquaculture				+	+	+	+	+		+	+			+	+		9	
Industry and trade / economy / business and services		+		+		+	+	+			+			+		+	8	
Infrastructure and built environment / Building					+	+	+		+	+					+	+	7	
Tourism and recreation	+		+	+		+	+					+		+			7	
Civil protection /safety preparedness / rescue services/Natural hazards prevention	+		+	+	+			+					+	+			7	
Transport services and infrastructure		+		+		+	+	+									5	
Insurance / Financial services industry				+		+	+	+				+					5	
Coastal areas / coastal management					+	+	+	+						+			4	
Hunting /Reindeer husbandry						+	+								+		3	
Soil/ Desertification				+		+											2	
Mountain areas						+		+									2	
Marine and aquatic ecosystems						+									+		2	
Waste management									+		+						2	
Wildlife management							+										1	

Note:

+ = key sector in the NAS

Sectors identified in the different NAS were grouped by general categories when analogous;

Countries that have addressed two or more sectors jointly (e.g. natural resources, biodiversity and fisheries as a single sector in Ireland) are assigned a “+” in all the distinct sectors in this table

AT = Austria; BE = Belgium; CH = Switzerland; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; HU = Hungary; IE = Ireland; LT = Lithuania; MT = Malta; NL = Netherlands; PT = Portugal; SE = Sweden; UK = United Kingdom

TRANSNATIONAL AND INTERNATIONAL ADAPTATION ISSUES

Although transnational cooperation i.e. cooperation that happens in neighbouring countries is considered as an important element in the adaptation policy process, cross-border adaptation issues are not significantly addressed in the NASs or NAPs, with a few exceptions (see Tab.9). The Belgian NAS refers to existing projects on conservation of biodiversity and ecosystems of transboundary rivers, as well as on river flooding management with the Netherlands. The Irish NAS presents opportunities to make use of existing cooperation between the North and South of the island of Ireland to jointly develop adaptation measures. Others discuss cooperation across Europe in general. For instance, the Dutch NAS focuses on cooperation on river flood risk management through the International River Commissions; the German NAS mentions the cooperation for marine protection; the Swiss NAS emphasizes collaborations on the fight against the spread of diseases and alien species; and the French one recalls the work of the Conference of peripheral and maritime regions of Europe, besides the need to support transnational research programmes in Europe.

In fact, adaptation is most often part of the European cooperation initiatives that the countries regularly undertake outside the framework of an adaptation strategy. These are often highlighted in the NASs, including the following: the Alpine Convention; the Arctic Council and the Barents Euro-Arctic Council; international projects, such as *ASTRA*, *BaltCICA*; various EU INTERREG projects, such as *AdaptAlp*, *CLISP*, *C3-Alps*, *GRaBS*; LIFE+ projects such as *ACT*; and EU FP7 projects such as *CIRCLE-2*.

Furthermore, climate change is generating international concerns that may become relevant in Europe. For instance, conflicts arising in areas suffering from water shortage and migration due to environmental degradation in developing countries may be reflected in European countries as security issues, or the interruption of the international supply chain of certain commodities and services due to adverse weather-related conditions may have grave repercussions on global trade.

Table 9. Consideration of transnational and international issues in the existing national adaptation strategies (Source: national publications and complementary information)

EEA Member Countries	Transnational issues explicitly mentioned in the NAS	Issues addressed in the NAS or in cooperation initiatives relevant for Europe	Interrelationships between global impacts and national adaptation explicitly mentioned in the NAS
AT	-	Alps and mountain areas Water, flood risk management	
BE	√	Scheldt basin Meuse basin Smart cities in Northwest Europe	√
CH	√	Alps and mountain areas Natural hazard management Spread of harmful organisms, diseases, and alien species	
DE	√	Trade and industry Marine protection Wadden Sea region	√
DK	-	Natural hazard management Water	
ES	-	Biodiversity in the Iberian Peninsula Pyrenees region	
FI	-	Transboundary rivers Baltic Sea region Arctic area	√
FR	√	Maritime issues Mountain areas	
HU	-	n.a.	
IE	√	River basin management Marine and coastal management	
LT	-	Baltic Sea region	
MT	-	n.a.	
NL	√	Transboundary rivers, flood risk management	
PT	-	Transboundary rivers Biodiversity in the Iberian Peninsula	
SE	-	Baltic Sea region	
UK	-	n.a.	√ (NAP)

Note:

AT = Austria; BE = Belgium; CH = Switzerland; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; HU = Hungary; IE = Ireland; LT = Lithuania; MT = Malta; NL = Netherlands; PT = Portugal; SE = Sweden; UK = United Kingdom

International cooperation on adaptation is therefore crucial to tackle such issues. In fact, eleven of the NASs consider international issues to varying degrees: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Malta, Netherlands, Portugal and the UK. However, besides a general recognition of the importance of international cooperation to help developing countries advance on adaptation, with a special attention to overseas territories, the assessed NASs hardly ever elaborate further.

Only in few cases they discuss the interrelationships between the global impacts and the adaptation to climate change in the interested country.

In particular, international supply issues are mentioned by Belgium, Finland, Germany and the UK.

The Finnish NAS contains some preliminary estimates relating to the impacts that changes taking place in other parts of the world will have on the country's economic sectors. These also include emerging opportunities such as increased demand for national food products and tourists' preferences shift from the Mediterranean and the Alps to Finland.

The German NAS, on one hand, stresses the potential international risks with respect to weather-induced disruption of procurement and sales paths including transport routes. On the other hand, it highlights new opportunities to export innovative environmental technologies and make use of them also for international cooperation.

The UK "*National Adaptation Programme 2013*" looks attentively at the outcomes of research commissioned to Price Waterhouse Coopers on the threats and opportunities associated with climate change internationally for sectors of national interest (PWC, 2013). The most remarkable finding of the report is the fact that international hazards can impact on the UK economy far more than domestic risks, especially for business (trade and investment), and food (imports). In addition, the report says that while in the short-term the main impacts would show in a lower availability of import material, higher volatility of import commodity prices, interruptions of transport and damages to UK assets abroad, in the longer term more insidious changes to trade in food and other goods (e.g. energy) with unpredictable effects in other areas such as health, conflict and global governance may occur. Finally, the report states that such international threats not only concern the relationships with developing countries, but are also a reality in the connections with more industrialized countries that are exposed to certain climate change impacts (e.g. droughts in American South-West).

SYNERGIES BETWEEN ADAPTATION AND MITIGATION

The adaptation and mitigation synergies (and trade-offs) are acknowledged to exist in several sectors (IPCC, 2007). In particular, the largest potential exists in the agriculture, forestry and land use sectors; and in the second place, in the energy, infrastructure planning and building, transportation, insurance and waste management sectors. Unveiling and promoting such synergies can serve as an important factor in building the necessary knowledge base, institutional capacity and cross-sectoral cooperation in the context of a comprehensive climate strategy leading at the same time to low-carbon and resilient societies.

For countries that have opted for an integrated climate change strategy (the UK, Hungary, Lithuania, Sweden) these synergies seem more evident and easy to grasp, thus are likely to be

considered in the adaptation planning process. Conversely, only in few cases of dedicated adaptation strategies are aspects that are potentially relevant to mitigation explicitly taken into account, especially in some sectors such as energy, construction, transport, sustainable soil management, and tourism (e.g. Austria, Belgium-Flanders).

In most cases, the complementarity between adaptation and mitigation is recognized in the NAS as a founding principle but not elaborated further. Existing and upcoming climate and energy legislation and sectoral road maps for low carbon, sustainable economies, have established or strengthen these linkages, or are expected to do so in the near future (e.g. in France, Switzerland, Ireland, Finland). Also, prospects of harnessing adaptation and mitigation exist whenever the NAS is dealt with by institutions that have the responsibility for both policies. In this respect, it is worth mentioning that the importance of linking mitigation and adaptation policies is clearly recognized in the Maltese NAS, in particular as far as the institutional and legal frameworks are concerned.

In general, a better link is needed between adaptation and mitigation in the European NASs so to exploit win-win solutions and avoid mal-adaptation in a number of sectors.

IMPLEMENTATION PROVISIONS

ALLOCATION OF RESOURCES

Operationalization of adaptation is intended as the allocation of roles, financial and human resources to implement the measures indicated in the strategic document. This seems to be among the main weaknesses of adaptation strategies in Europe. Some assessments have indicated a lack of coordination and clarity in the responsibilities for executing adaptation strategies, plans and programmes (EUROSAI-WGEA, 2012). Others have pointed out that concrete advice on how to integrate the proposed “no-regret” measures into planning practice is completely missing from the strategies analyzed (BMVBS, 2010). Generally, the adaptation measures identified are expected to be financed through multiple channels, such as public support (e.g. budget allocation of policy departments or autonomous regions, subsidies, taxes), project-based public financing, public-private partnerships and insurance mechanisms.

Typically detailed implementation provisions are touched upon separately in the context of national adaptation plans of action that often are adopted at later stages (even many years after the adoption of the strategy).

NATIONAL MONITORING, REPORTING, EVALUATION AND REVIEW

The monitoring, reporting and evaluation of a NAS are needed to enable a measurement of the progress achieved in implementing it and the consequences of the adaptation measures undertaken on society and the economy. Effective monitoring and evaluation systems are at the basis of effective periodic reviews of the NAS that would lead to a continuously improving strategy. In most countries such provisions are not mentioned in the strategic documents, with little exception, especially concerning those countries that have adopted climate change legislation. Some examples are provided below.

The UK "*Climate Change Act*" sets a requirement for monitoring and evaluation of the adaptation policy process to be undertaken by the Adaptation Sub-Committee, aimed at evaluating progress on the implementation of the NAP and reporting to the Parliament. Similarly, the Lithuanian NAS foresees a mandatory provision with criteria for the government to report on the strategy's implementation to the Parliament every two years. The Hungarian climate legislation also requires that a monitoring system based on indicators be developed and the National Climate Change Programmes be updated every two years.

Switzerland identifies the monitoring of the progress in adaptation as one of the general principles in the NAS. In order to further develop the adaptation strategy, Switzerland is developing a monitoring system which assesses the strategic as well as the operational level of the NAS. As to reporting, the "*CO2-ordinance*" (Article 15, 3) says that the Cantons need to inform the Federal Office for the Environment regularly on their measures taken.

So far, only a few countries have reported the actual establishment of sound methodologies for tracking progress in implementing adaptation: while Germany and UK have developed a quantitative method (including the use of indicators), Finland and Spain have chosen a more qualitative approach for monitoring and evaluating their strategy (periodic reports, self-assessment like). France, Switzerland, Austria and several others have initiated developing methodologies for a monitoring and evaluation system or a reporting system but are at a very initial phase of such exercise (see EEA 2013; BMVBS, 2010).

INTERNATIONAL REPORTING

Often the NASs refer to the UNFCCC National Communications for further insights on country's adaptation action, where the countries report on a variety of components of their initiatives. However, in such broad documents, the information on adaptation reported may

be fragmented and inconsistent due to different reporting approaches adopted by countries. Given the need for a more structured reporting on adaptation at the EU level, the Commission has proposed amending the *Monitoring Mechanism Decision on greenhouse gas emissions and the implementation of the Kyoto Protocol* to include requirements to report on climate change impacts, costs, vulnerability and measures being taken on adaptation. The enhanced Monitoring Mechanism was adopted in May 2013, and includes specific obligation for the EU Member States to report on adaptation action by 15 March 2015, and every four years thereafter, aligned with the timings for reporting to the UNFCCC (Official Journal of the EU, 2013).⁸ Coherent collection and elaboration of such data and information across European countries would help to compare and evaluate the status of adaptation processes with the aim of further supporting the provision and dissemination of best practices on adaptation (Herold et al., 2011).

Countries are also responsible for updating their national pages on the European Climate Adaptation Platform Climate-ADAPT. Reinforced reporting requirements will eventually provide more regular and coherent key information and data that will be input into Climate-ADAPT and thus become widely available.

THE EUROPEAN FRAMEWORK ON ADAPTATION

Actual political action on climate change adaptation by the EU institutions has developed over the last six years. The 2007 Green Paper *“Adapting to Climate Change in Europe: Options for EU action”* released by the European Commission opened the way to a more attentive concern for adaptation in Europe (EC, 2007). The following 2009 White Paper *“Adapting to climate change: Towards a European Framework for action”* provided insights on adaptation measures and policies to reduce the EU’s vulnerability to the impacts of climate change by outlining more than thirty sectoral policy options for the EU (EC, 2009). Importantly, with this document the Commission set out the fundamental concept on which a European strategy for adaptation is centred: the allocation of responsibility for adaptation action to national, regional and local tiers of governance. This approach is supported by the scientific evidence that various regions of Europe will be affected by the impacts of climate change in a

⁸ Art.15: “(..) Member States shall report to the Commission information on their national adaptation planning and strategies, outlining their implemented or planned actions to facilitate adaptation to climate change. That information shall include the main objectives and the climate- change impact category addressed, such as flooding, sea level rise, extreme temperatures, droughts, and other extreme weather events” (Cf. Official Journal of the EU, 2013).

differentiated manner, against unevenly distributed adaptive capacity of populations, and socio-economic and natural systems. The added value of a European strategy therefore lies in the possibility for Member States to receive support for their specific adaptation initiatives through better coordination, greater sharing of information and the integration of adaptation into relevant Community policies. In this way, the EU would guarantee that adaptation is addressed in a consistent manner between national and European legislation.

In the White Paper the design of a European adaptation strategy is illustrated along four key action lines or “pillars” (EC, 2009):

1. Develop and improve the knowledge base on climate change impacts, vulnerability mapping, and the costs and benefits of adaptation measures;
2. Integrating adaptation into EU key policies (“mainstreaming”);
3. Use a combination of political and economic instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation;
4. Support international cooperation for adaptation jointly with Member States to integrate adaptation into EU foreign policy.

The Commission has sought to attain these goals through an approach that would ensure: consistency, by avoiding contradictions between policies; flexibility, by using methods that are appropriate to each context; and participation, by drawing inspiration from a variety of stakeholders (EEA, 2013).

With a view to the adoption of the strategy in 2013, a preparatory phase of approximately four years (2009-2012) saw the involvement of a broad range of actors under the guidance of the European Commission, and in particular the recently established Directorate General for Climate Action. Some aspects of the strategy were discussed through workshops with Member States, experts and stakeholders from the private sector, while a broader on-line consultation⁹ was launched to the public. Various technical working groups and institutions have been designated to support the Strategy. In order to assist improving the sharing of information a “Working Group on Knowledge Base on Climate Change Impacts, Vulnerability and Adaptation” composed of country representatives and technical experts was established. An “Adaptation Steering Group” consisting of high-level national delegates and representatives of

⁹ Through the platform “Your Voice in Europe” a consultation on the preparation of the EU adaptation strategy was open to the public from 21 May to 20 August 2012.

environmental organizations and business companies contributed to engaging with the private sector and working in partnerships with the Member States (McCallum et al., 2013a).

According to background studies for the EU adaptation strategy, most of the thirty-three actions for adaptation in the White Paper have already been implemented or are about to complete (EC, 2013b).

Indeed, one of the most significant milestones achieved following the publication of the White Paper is the realization of the European Climate Adaptation Platform Climate-ADAPT, already mentioned in this paper as an important source of information.

Mainstreaming adaptation in EU sectoral policies has been focused on the most vulnerable areas in Europe. This has been carried out through a variety of policy initiatives on nine key Community sectors: water management, marine and fisheries, coastal areas, agriculture and forestry, biodiversity, infrastructure, financial, disaster risk reduction and health (EEA, 2013). A complete mapping of EU current and forthcoming initiatives through these sectors can be found in the EEA 2013 Adaptation Report (EEA, 2013).

In 2011 the Commission proposed to mainstream the issues related to low-carbon economy and resilience building in the next Multiannual Financial Framework (MFF) 2014-2020 which would facilitate the flow of contributions for adaptation.¹⁰ The proposal includes earmarking of 20% for climate related expenditure and the integration of climate change considerations in all EU funds in their financial allocation decisions (EC, 2013b).

Regarding the implementation of adaptation, the Commission promoted several studies aimed at identifying policy instruments suited for delivering adaptation and at elaborating guidelines for specific areas (e.g. Common Agricultural Policy (CAP) and Economic and Social Cohesion Policy). Also, consultations have been held with private companies on technical issues, such as standards and insurance (McCallum et al., 2013a).

For strengthening the international cooperation on adaptation, a number of policy processes have been taken into account which are eligible to integrate climate change and adaptation needs. These include the review of EU Environment Integration Strategy, the Mid-Term Review of EC cooperation strategies, the European Neighbourhood Policy dialogue and the

¹⁰ The MFF regulates the EU annual budget for a period of seven years. Contained in a unanimously adopted Council Regulation, it sets the maximum amount of spending in the EU budget each year for broad policy areas, and an overall annual ceiling on payments and commitment appropriations.

UNFCCC negotiations. Furthermore, early warning systems and existing tools, such as conflict prevention mechanisms and security sector reform, were deemed to be appropriate instruments to mainstream adaptation into international policies (McCallum et al., 2013).

THE 2013 EU ADAPTATION STRATEGY

The adoption of the official European Adaptation Strategy by the European Commission took place on the 16th of April 2013 with a public event in Brussels. The Strategy consists of a package of thirteen documents: the main paper is the Commission's Communication *"An EU Strategy for adaptation to climate change"* that describes the objectives and a number of concrete actions to be taken by the Commission in three priority areas in order to forge a more resilient Europe (EC, 2013). The accompanying preparatory technical Impact Assessment sets the context for the Strategy and presents possible enforcement options ranging from non-binding measures to regulations (EC, 2013b; 2013c). Furthermore, guidelines are provided for the preparation of Member States' national adaptation strategies (EC, 2013a), as well as for mainstreaming adaptation into cohesion policy and rural development. A Green Paper on the insurance of natural or man-made disasters was also issued, launching a consultative process open to stakeholders (EC, 2013d). Other Commission staff working documents in the package explore the issue of adaptation in specific sectors and policy areas of interest to the Strategy, such as coastal and marine issues, health, infrastructure, environmental degradation and migration. The European Adaptation Strategy package has been endorsed by the Council of the EU that calls upon the Commission and Member States to advance action on adaptation at their own governance level (Council of the EU, 2013).

In order to reach the overall goal of the European Adaptation Strategy and contribute to a more climate resilient Europe, three main objectives have been put forward by the Commission (EC, 2013):

1. Encourage and support adaptation action by the Member States;
2. Ensure informed adaptation decision-making processes;
3. "Climate proof" EU action and promote adaptation in sectors that are particularly vulnerable.

Whilst it reflects the basic structure outlined in the White Paper, the 2013 Strategy leaves out the international aspects of adaptation as a priority area of action, since these were thought to

be adequately addressed in the context of development cooperation and through the UNFCCC (EC, 2013b). Greater emphasis is put on transboundary issues and sectors that are closely integrated at EU level through common policies.

With regard to the first objective, the Commission encourages all Member States to develop adaptation strategies that are consistent with national plans for managing the risk of natural disasters and are inclusive of cross-border issues. EU financial support will be provided to help countries improve their ability to adapt, especially by funding projects that touch upon cross-cutting issues, cross-border and cross-sectoral adaptation through the European funding scheme “LIFE”. The Commission will contribute to the exchange of information and good practices between adaptation at various levels. It will also support the efforts of European cities towards the preparation of adaptation strategies, inviting them to make a commitment on the model of the [Covenant of Mayors](#).

As to the second objective, the Commission will seek to fill the knowledge gaps on adaptation through a future funding programme dedicated to research and innovation, “Horizon 2020”. In addition, greater impetus will be given to Climate-ADAPT with better access to information and greater interaction with other platforms.

With respect to the third goal, the Commission will continue its work to integrate adaptation into EU policies. In particular, it will ensure that this is done for the CAP, the Cohesion Policy and the Common Fisheries Policy for which specific dedicated guidance has been prepared. In addition, the Commission will ensure that Europe can rely on more resilient infrastructure through a review of the standards in the fields of energy, transport and construction. Finally, the use of insurance to protect against disasters and other financial products for risk management and reduction in the European market will be promoted.

The Strategy envisages the coordination of actions through the current “Climate Change Committee” representing the Member States within the EU. In addition, each country is encouraged to appoint a national contact point to coordinate communication between the State and the Commission. The Commission will maintain an open dialogue with stakeholders to ensure proper and timely implementation of the Strategy. The Communication containing the Strategy is addressed to the other European institutions for their feedback.

MONITORING AND REVIEW

The Strategy foresees one particular process for monitoring progress. The Commission intends to set up an “*adaptation preparedness scoreboard*” by 2014 to assess the degree of awareness and action of countries towards adaptation through a number of key indicators that will help determine whether the quality and coverage of national adaptation strategies is sufficient (EC, 2013, p.6). The evaluation will be carried out by 2017, based on this scoreboard and the national reports on adaptation action provided under the enhanced Monitoring Mechanism Regulation. If the Member States’ progress in terms of effective adaptation is regarded as unsatisfactory, the Commission will consider the proposal of a legally binding instrument for enforcing adaptation policies in the countries (such as an Adaptation Directive). However, it is reported from the preliminary consultative process that some Member States would oppose an EU legislative instrument as a means to promote the adoption of national adaptation strategies (EC, 2013b).

In addition to the expected evaluation of national advancements, the Commission will report to the European Parliament and the European Council on the state of implementation of the Strategy itself and will present a revision if necessary by 2018.

EU GUIDANCE ON DEVELOPING NATIONAL ADAPTATION POLICIES

Although acknowledging that there is no “one-size-fits-all” framework for adaptation, the Commission offers guidance on defining and implementing adaptation.

Ten guiding principles are identified in support of planners and decision-makers dealing with adaptation processes (Prutsch et al., 2010). Further, with the 2013 EU Adaptation Strategy, the Commission presented a methodology addressed to Member States to assist them in developing, implementing and reviewing their national strategies and plans (EC, 2013a).

The methodology consists of a policy cycle of five iterative and closely interlinked steps, opening with an introductory phase that can be summarized as follows:

0. Preparing the ground for adaptation with a number of institutional set-ups and early activities;
1. Assessing risks and vulnerabilities to climate change;
2. Identifying adaptation options;

3. Assessing adaptation options, including the cost-benefits assessment of adaptation options, and the development and political adoption of a national strategy;
4. Implementing adaptation, including through the development of an action plan and/or a sectoral plan with the allocation of roles and responsibilities, that secures human and financial resources in the long term;
5. Monitoring and evaluating the implementation of the strategy.

This guidance is acknowledged to mirror the so-called [Adaptation Support Tool](#) in the Climate-ADAPT Platform that was in turn inspired by the UKCIP [Adaptation Wizard Tool](#).

All these steps are supported by the EU institutions through a variety of policies, resources, tools and instruments, such as: Instruments of Pre-Accession Assistance (IPA); Neighbourhood policy (ENPI); the Commission's service contracts for climate proofing for various sectors; European Research Framework Programmes; awareness-raising campaigns; mainstreaming frameworks (e.g. MFF 2014-2020, Horizon 2020, Cohesion Policy 2014-2020, Common Agricultural Policy reform, Water Framework Directive; Floods Directive; Trans-European Networks for Transport and Energy); frameworks for developing indicators for measuring progress on adaptation action and policy efficiency; as well as all the other information and methodological tools contained in Climate-ADAPT.

CONCLUSIONS

This paper has offered the state-of-the-art knowledge on adaptation challenges and responses across Europe.

In the first place, we learnt that climate change impacts are distributed very differently across European countries, however some "climate change regions" showing common patterns of change can be identified cutting across the political boundaries. Southern Europe and specific locations such as coasts, mountains, river plains and cities are expected to be highly exposed and unable to adapt swiftly. Also, many sectors of socio-economic relevance are going to be affected by climate change in an intertwined way. Uncertainties in the cost and benefits of adaptation are still a major issue in decision-making. In the light of this, it is acknowledged that strategies to cope with climate change should be tailored to specific bio-geographical and socio-economic circumstances, and adopt flexible adaptation pathways capable to evolve over time and new circumstances to be effective.

With respect to the existing responses, we found that half of the assessed European countries have an adaptation strategy in place to respond to the risks and vulnerabilities posed by climate change, for a total of sixteen reported strategies. Eight of those are implementing adaptation through a specific plan of action following the NAS. Nevertheless, it does not seem possible to identify a clear correspondence between the degree of impacts and exposure and the speediness in adopting a NAS. The level of adaptive capacity of the countries and other driving forces may be the main motivation for governments to start developing a NAS. National strategies depend on the adaptive capacity and at the same time play an important role in building it by raising knowledge and awareness to identify key vulnerabilities and agree on priority adaptation actions, in the first place. Strategies can also foster adaptive capacity when it comes to design and coordination of the adaptation actions, or promoting technological development.

Adaptation planning, in almost all cases analyzed, is supported by two factors that are greatly interrelated: participation of society and scientific knowledge. The first is pursued through attempts to engage the right stakeholders, including researchers and scientists, and build a comprehensive and shared NAS. The latter implies the conduct of risk and vulnerability assessments (at least qualitative) that inform the NAS. Improving the methodology to estimate adaptation costs and benefits would be of great relevance to make these assessments more accurate and thus entail robust adaptation decisions.

We could observe large differences between NASs in terms of objectives, scope and spatial focus but they appear to have a similar sectoral approach as the sectors identified are the traditional public policy areas, such as water management, agriculture, forestry, health, and so on.

This paper confirmed that there are precise shortcomings in the European NASs that need to be fixed with future studies within the EU and national research frameworks.

While cross-sectoral issues, such as the need for education and research to foster adaptation, are addressed in many of the national strategies, cross-border issues between neighbouring countries are regularly neglected. In fact, it is mainly through European funding that transnational issues are tackled, but these are not explicitly addressed in the NASs. Furthermore, although cooperation with developing countries for adaptation is mentioned in most NASs, the emerging international threats and vast opportunities associated with climate

change affecting European countries' national economic interests are not significantly considered, except by Finland, Germany and the UK.

It was stressed that, although the complementarity of adaptation and mitigation may be one of the principles underlying the strategies, the synergies (or conflicts) between the two policies generally play a minor role in the NASs assessed.

Finally, the operationalization aspects are generally missing from national strategies. They may just contain preliminary prospects of the future allocation of resources and facilities necessary to implement action to increase adaptive capacity. To draw up a well-considered NAS, or to enable a measurement of its progress and effects on society and the economy, tools need to be developed that can be utilized at the implementation and evaluation stage, such as indicators and criteria for monitoring and evaluation.

In the coming years the European Commission's activities to implement the EU Adaptation Strategy will include methodological guidance and financial support to Member States, in particular to formulate and strengthen their NASs and address transnational issues.

CHAPTER 3 – Differences and similarities in institutional settings that support national adaptation strategies across Europe

This chapter is based on: Venturini, S., Capela Lourenço, T., Avelar, D., Castellari, S., Leitner, M., & Prutsch, A. (forthcoming). Do political systems matter? Differences and similarities in institutional settings that support national adaptation strategies across European states. Under preparation for submission to *Climate Policy*.¹¹

INTRODUCTION

This paper addresses the issue of adaptation policy response under the perspective of the institutions that support it and the way countries are governed.

Adaptation, as an adjustment in natural or human systems, seeks to respond to actual or expected climatic stimuli and their effects (IPCC, 2007).

For several years, European countries have undertaken proactive adaptation activities by developing policies for climate change adaptation based on current and future climate change risks. In 2005 Finland became the first European country to officially adopt a National Adaptation Strategy (NAS) (Finnish Ministry of Agriculture and Forestry, 2005) and since 2008, when only eight countries had a NAS in place (Swart et al., 2009), the development of this type of national policy had doubled across Europe by 2012 (see Chapter 2 of this dissertation). The NASs mostly mark the first attempt to coordinate the issue of adaptation (Bauer et al., 2012). Most of the existing strategies include only little information on implementation (e.g. financing of adaptation action) and, therefore, some countries have recently published additional national action plans (NAPs).

The progress on planning and implementing adaptation in European countries has been previously assessed, to varying degrees and scopes. The European Environment Agency (EEA)

¹¹ My contribution to this paper was the following: overall coordination, outline, data collection and validation, drafting of introduction, definitions, methodology, results, discussion, and conclusions. Tiago Capela Lourenço contributed to frame the idea and the methodology. David Avelar performed the Principal Component Analysis and contributed to the interpretation of results. Sergio Castellari, Markus Leitner and Andrea Prutsch provided advice and review.

has lately published a summary of adaptation action in Europe showcasing examples of practical adaptation measures, recent policy developments and relevant agenda-setting issues in the context of socio-economic growth (EEA, 2013). Further EEA analyses aim to gain a deeper understanding of the current state of countries' adaptation policy processes regarding the lessons learned. These reports are expected to be released by EEA in the upcoming years (Prutsch et al., 2013).

Other specific regional studies or broader analyses of developed countries' efforts on adaptation include consideration of adaptive processes and strategies in Europe, both in grey literature (Mullan et al., 2013; EUROSAT-WGEA 2012; Dumollard & Leseur, 2011; BMVBS, 2010; Keskitalo, 2010; Pfenninger et al., 2010; Massey, 2009; Swart et al., 2009; Termeer et al., 2009; Massey & Bergsma, 2008; Gagnon-Lebrun & Agrawala, 2006; Perkins et al., 2007) and scientific peer-reviewed analyses (Bauer et al., 2012; Ford et al., 2011; Preston et al., 2011; Biesbroek et al., 2010). Despite differences in scope and purpose, these assessments are mainly descriptive and illustrate the status of development of the NASs at the time of the study. They highlight procedures that have led to that current stage of planning, the policy contents of national adaptation frameworks and the general approach taken in the past to implement it. Some provide inductive frameworks to assess adaptation efforts (Dumollard & Leseur, 2011; Biesbroek et al., 2010; Pfenninger et al., 2010; Swart et al., 2009) while others offer more standardized means of categorizing and evaluating the progress of policy developments along its contents and shortcomings (EUROSAT-WGEA 2012; Preston et al., 2011; Massey & Bergsma, 2008). Only a few studies attempt to systematically assess institutional aspects of NASs (Aarjan et al., 2012; Bauer et al., 2012; Termeer et al., 2010).

Bauer et al. (2012) address the issue of "governance challenges" in adaptation policy-making, namely distinctive attributes of adaptation that make traditional ways of planning and implementing policies more complex, which requires some institutional innovations to be overcome. The study covers ten country members of the Organisation for Economic Co-operation and Development (OECD) considered the most active ones in adaptation planning and from whose side information was accessible, including several European countries, namely: Austria, Denmark, Finland, Germany, Norway, Spain, the Netherlands and the UK.

The first governance challenge relates to the need to coordinate adaptation action across different socio-economic sectors that are remits of different ministerial or departmental bodies but present inter-linkages and possible conflicts (horizontal integration or "mainstreaming") (EEA, 2013; Bauer et al., 2012; Klein et al., 2007). Reflecting this challenge,

European countries have identified a wide range of priority policy sectors in their adaptation strategies. These generally include the main vulnerable sectors such as water management, forestry, agriculture, biodiversity, public health, and others (EEA, 2013, p.75; Venturini, Medri et al., forthcoming) (Chapter 2 of this dissertation). The second challenge concerns the multi-level governance response required for adaptation, a response spanning various decision-making scales from international and European to national and sub-national administrations in order to provide adequate means to take action: from guidance at a higher level, to the actual implementation at local level (vertical integration) (EEA, 2013; Bauer et al., 2012; Klein et al., 2007). The third challenge relates to integration of knowledge in decision-making needed to manage scientific uncertainties. The fourth challenge is about participation of stakeholders in the governance of adaptation.

Although the amount of literature recently published on the assessment of NASs in Europe is considerable and increasing, a number of key research gaps still persist in this field.

First of all, the above-cited wide range of assessments provide useful insights into the European landscape, but due to the fast evolution of policy processes the information contained in them can quickly become obsolete (Swart et al., 2009). This fact was, indeed, one of the initial reasons for the establishment of the European Climate Adaptation Platform [Climate-ADAPT](#). It was called for in the 2009 White Paper on Adaptation to Climate Change (EC, 2009) and was launched in 2012 by the European Commission (hereafter: the Commission) being currently maintained by the EEA. Updated country data on all EEA Members' national adaptation strategies are now publicly available at Climate-ADAPT, which has served as a stepping stone to the work described in this paper. However, keeping up-to-date the analysis of the content of such a database represents quite a challenge.

Another major gap relates to the governance of adaptation and specifically to the understanding of how adaptation policy frameworks are established and enforced by governments in their broader contexts of national policy developments. Multi-level climate change governance is a relatively new field gaining attention from academia (Mickwitz et al., 2009). Nevertheless, *adaptation governance* has not been satisfactorily investigated, according to many scholars, despite being a critical area since the identification, implementation and evaluation of adaptation responses is expected to primarily occur through the brokerage of institutions (Bauer et al., 2012; Gupta et al., 2010; Meadowcroft, 2009; Schipper & Burton, 2009; Termeer et al., 2009; Paavola, 2008; IPCC, 2007; Jordan &

O’Riordan, 1997). Furthermore, the discrepancy of adaptation frameworks across countries is deemed to echo the differences in political-administrative national systems (Mullan et al., 2013; EEA, 2013; Bauer et al., 2012; Dumollard & Leseur, 2011; Juhola et al., 2011; BMVBS, 2010; Keskitalo, 2010), potentially affecting both the development and the effectiveness of these strategies.

For these reasons, there is a clear demand from key public actors in Europe to assess in depth the information continuously input in Climate-ADAPT, and evaluate the role of the administrative and planning systems in the setting up of adaptation policies (EEA, 2013). The outcomes of such investigations would shed light on similarities needed among European countries to possibly consider transferability of knowledge and good practices.

This paper attempts to fill these research gaps. Building on the work of Bauer et al. (2012) and the available assessments that touch upon country-wide adaptation planning processes in Europe, it focuses on the institutional settings put in place by the European countries that have addressed the challenges of horizontal and vertical integration of adaptation within their national strategies, and enriches the previous research with a quantitative analysis of institutions across federal and unitary states (see definition in Section 1), aimed at assessing the role that the political-administrative systems play in defining the governance of adaptation.

The primary goal of this study is to formally analyze the influence of the different political-administrative systems of those countries on their adaptation policy processes and institutions. In order to achieve the main research objective, the study: 1) applies a proposed definition of “national adaptation strategy” critically against existing strategies across Europe; 2) classifies the countries according to their political-administrative systems; and 3) provides an overview of the institutional settings for adaptation across the countries fitting the definition of NAS, with a focus on the horizontal and vertical coordination challenges of adaptation.

Ultimately the study has the ambition to offer a helpful perspective for decision-makers of governments at early stages of developing or implementing their NAS. Providing insights about the influence of political systems on adaptation policy frameworks is aimed to allow decision-makers to learn from other countries having similar political-administrative circumstances to their own.

With this exercise, we do not attempt to assess the capacity of countries or institutions to adapt to climate change nor their success in implementing adaptation (an extensive review on the evaluation of institutional capacities for adaptation can be found in Gupta et al., 2010).

The structure of this paper is as follows. Section 1 illustrates operational definitions that are noteworthy for this study, namely “national adaptation strategy”, “institutional settings for adaptation” and “political-administrative systems”. Section 2 details the methodology used and key considerations applied. In Section 3 results are presented according to the main research objectives, including: the initial screening of countries’ national adaptation strategies, a cataloguing of the national political-administrative systems, an overview of the horizontal and vertical governance settings that support adaptation strategies. Section 4 presents the results of the statistical analysis applied to the countries’ political and institutional capacity. Section 5 answers key questions posed, namely: (a) is there a common approach that can be drawn from the experience of European countries for defining a NAS? (b) can the characteristics of adaptation governance be statistically associated to the countries’ political system? (c) what are the main differences and similarities in institutional settings of NASs across federal and unitary states? The paper concludes with a consideration on the transferability of good practices across European countries and possible gaps to fill in future research.

OPERATIONAL DEFINITIONS

A first clarification that is critical for this study relates to the concept of “National Adaptation Strategy” (NAS). Yet the definition of a NAS cannot take a univocal shape due to the diversity of policy approaches to adaptation existing across Europe and beyond.

The OECD characterization of NAS refers concisely to “*countries’ initial planning or framework document*” that sets out the government’s approach to adaptation and communicate priority actions (Mullan et al., 2013, p.16).

The United Nations Development Programme (UNDP) defines a NAS as a “*general plan of action*” to reduce countries’ vulnerability to the impacts of climate change, including weather extremes, that would embrace “*a mix of policies and measures*” and that could be “*comprehensive at a national level, addressing adaptation across sectors, regions and vulnerable populations, or (..) more limited, focusing on just one or two sectors or regions*” (Niang-Diop and Bosch, 2004, also cited in Biesbroek et al., 2010; Swart et al., 2009). Hence, according to

UNDP, a strategy is a broad plan of action that is implemented through policies, typically referring to public instruments (such as economic mechanisms) and measures, namely specific actions (such as planting different crops) (Ebi et al., 2004).

The EUROSAT-WGEA (2012) report highlights that a NAS generally puts forward objectives for adaptation measures in a long-term perspective, by prioritizing actions that address identified key vulnerabilities. The strategy is typically adopted by the government and should assign some kinds of responsibilities. A NAS can then result in an implementation plan, including time frames and allocation of resources, which is more often adopted by the entity that is in charge of the implementation, involving entities with shared responsibilities when appropriate.

The EEA (2013) recognizes four main non-mutually exclusive modes to regulate adaptation policy that are up to governments. One of these modalities is a national strategy focused on adaptation, others include sectoral strategies, specific climate change legislation, and sectoral legislation in each policy area. According to the EEA, a NAS is a framework that can “*support the implementation of measures by (sometimes sector-specific) action plans, vulnerability assessments, research programmes, funding opportunities and information services*” and can be accompanied by individual sectoral strategies or plans (EEA, 2013, p.73).

In providing guidance to the EU Member States in the context of the EU Strategy on adaptation to climate change launched in April 2013 (EC, 2013), the Commission identifies adaptation strategies as an “*umbrella term for adaptation policies (including strategies, action plan and potentially sectoral plan)*” (EC, 2013a, p.5). The Commission’s guidelines offer Member States a 5-step cycle to develop such strategies at the national level, mirroring the so-called [Adaptation Support Tool](#) in the Climate-ADAPT Platform.¹² By this logic, the Commission envisages the adoption of a NAS as just one part of the full adaptation policy cycle, and assumes that it is followed by a specific plan of implementation with budget provisions.

As illustrated by the above-mentioned definitions of NAS, some discrepancy remains on the extent of the term “strategy”, ranging from a single policy document (Mullan et al., 2013;

¹² The cycle includes: 1. Assessing risks and vulnerabilities to climate change; 2. Identifying adaptation options; 3. Assessing adaptation options (including the cost-benefits assessment of adaptation options, and the development and political adoption of a strategy); 4. Implementation (including the development of an action plan and/or a sectoral plan with the allocation of roles and responsibilities that secure human and financial resources in the long term); 5. Monitoring and evaluation.

Niang-Diop and Bosch, 2004) to a step in the overall policy process that entails a variety of complementary activities as well as full implementation (EEA, 2013; EC, 2013).

For the purpose of this article, the definition of a NAS will be limited to its minimum size: a policy document formally adopted by the national government that provides general information and indications in facing climate change impacts, in order to reduce vulnerability, use positive synergies and allow successful adaptation. Action plans or sectoral plans are not considered as integral elements of a NAS, but separate instruments for its implementation.

Another definition that is relevant to this study pertains to “institutional settings for adaptation”. In social sciences the concept of institutions has been widely explored and structured around the notions of rules and procedures characterized by some degree of permanency and re-negotiability (IDGEC, 1999; Jordan & O’Riordan, 1997) that can eventually take the form of organizations (Newman, 2004; Sen, 2002; Jordan & O’Riordan, 1997). Gupta et al. (2010, p.460-461) notice that there is ambiguous use of the concept of institutions in the recent literature on adaptation to climate change because some scholars tend to use it in a stringent way while others open up the definition to imply physical organizations (Agrawal et al., 2009; Agrawal et al., 2008; Yohe & Tol, 2002). The Intergovernmental Panel on Climate Change (IPCC) acknowledges “*institutional requirements for adaptation*” as a key precondition to allow efficient processes and promote effective adaptation policy-making (Adger et al., 2007, p.731; Klein et al., 2007, p.747). According to Smith et al. (2009), institutional organization is one of the components that should not be missed in an architecture put together to empower governments to act for the purposes of adaptation. Some think that new institutions exclusively devoted to adaptation are not essential, which could in fact weaken the idea of mainstreaming (Smith et al., 2009). Instead, institutional innovations, such as new mandates for existing institutions, may be necessary to face the two governance challenges of horizontal and vertical coordination posed by adaptation policy (Bauer et al., 2012). Within their research framework, Bauer et al. (2012) look for governance arrangements, namely institutions, policy-making processes, mechanisms and tools, that governments utilize to assist the development, implementation and reviewing of policy instruments aimed at accomplishing the overall objectives of a national adaptation policy.

Similarly, in this document “institutions” (or “institutional settings”) is used as an inclusive term referring to organizations, structures and processes, new or pre-existing that have been innovated, established permanently or temporarily in the public sector to develop, implement

and review climate change adaptation at the national or sub-national level within the framework of a NAS.

A third working definition refers to national “political-administrative systems”, which is the set of formal rules that constitute the dominant form of government in one country. According to the quantitative framework proposed by Inman (2007), governments of the world can be classified into federal, administrative-federal and unitary. A state can be considered federal when it has independently elected constituent governments with substantial policy responsibilities, and representation of those sub-national governments to the central government is guaranteed by the constitution. Unitary states are often characterized by the allocation of policy competences within a single, centralized level of government. However, in unitary systems some “provincial” (regional or local) governments can be recognized and obtain self-governance for minor or local issues. In such cases, where lower-tier governments are assigned with a major role in the implementation of central policies but they are not allowed independent policy power or representation in the central government (and independence may be unilaterally revoked without changing the constitution), formal unitary states can be described as administratively federal governments.

This categorization helps us in our analysis to verify whether adaptation policy processes can be hindered or supported by a variety of institutional contexts at different levels of governance, whose structure and functions depend to a large extent on the country’s political-administrative system.

METHOD

First, and in order to produce an updated mapping of NASs in Europe, we screened the current status of adaptation policy-making in European countries. The taking stock of the information officially displayed on Climate-ADAPT and cross-checking it against the definition of NAS applied in this paper was carried out in June/July 2013. The scope of Climate-ADAPT is the EEA thirty-two member countries.¹³ It draws on a wide range of information about national adaptation processes (including the presence of documentation such as strategies or plans, impact and vulnerability assessments, research programmes, climate services provision, web portals, monitoring and review mechanisms, and National Communications to

¹³ The 32 EEA member countries include the 27 European Union Member States together with Iceland, Liechtenstein, Norway, Switzerland and Turkey.

the United Nations Framework Convention on Climate Change (UNFCCC)) submitted by countries to the EEA. Because there is a great heterogeneity on the definitions used by each country to assess their own progress in terms of adaptation planning, open criteria such as the one applied in this EU platform allows for a substantial degree of misinterpretation about whether, in practice, a country has a NAS. From our continuous interactions with adaptation policy-makers across these countries in the context of the European FP7 project *CIRCLE-2*¹⁴, it has become clear that the description of a country's status of adaptation activities is not a straightforward task and, as such, even in the absence of a policy document that bears such a name, often countries label their status as having an adaptation strategy. Thus, we applied the following criteria to cross-check national information as reported in Climate-ADAPT to verify if the country can be considered having an actual NAS:

- *Form-wise*: the country government's executive body must have adopted a policy document or a piece of legislation on climate change and adaptation;
- *Content-wise*: the document must contain a vision focusing solely or substantially on adaptation at the national level, putting forward priority adaptation options, based on the country's available knowledge on impacts and vulnerabilities to climate change, aimed at strengthening national capacity to respond to consequences of such changes.

Secondly, and for all countries selected for the analysis, an assessment of their political-administrative system was performed on the basis of the classification proposed above: federal, administrative-federal and unitary states. From an initial review of the autonomy assigned to territories within European states, we realized that some peculiar case-studies were excluded from the list of administrative-federal countries contained in Inman (2007) despite the presence of territories with a certain degree of independence, due to specific quantitative constraints employed in his analysis. Inman used locally collected revenues to measure decentralization of powers, assuming that own revenues reflect a larger degree of provincial autonomy, and then ranked the countries according to their performance. The UK presents circumstances of devolved powers to its four constituent states; Portugal shows two autonomous provinces. In Inman's analysis the UK and Portugal are considered unitary countries although they present more than one "province", because they rank in lower quartiles of the statistical measurement of the degree of policy authority assigned to lower

¹⁴ A number of workshops and other activities were held within the CIRCLE-2 consortium with a focus on national adaptation strategies since 2009: <http://www.circle-era.eu/np4/CARAadaptationstrategiesongoingactivities.html>

administration tiers compared to other world's governments. Since our analysis is restricted to Europe, and the category of administrative-federal states helps in dealing with the diversity of country cases found in this context, the definition was applied in a slightly broader logic encompassing the low levels of decentralization so to include the relevant cases of the UK and Portugal in such a category.

Thirdly, and in accordance with the previous selection method, we analyzed the institutional settings that support adaptation policy in all the countries that were considered to have a NAS. These institutional settings comprise horizontal and vertical coordination arrangements, but leave out both the institutions referred to as science-policy interfaces (e.g. UKCIP) and participatory approaches as such. In particular, with respect to horizontal integration of adaptation we screened the selected NASs for inter-ministerial coordination bodies and processes such as public consultations, workshop series etc. Similarly, for vertical integration we sought for inter-governmental coordination bodies, multi-level governance processes, networks and partnerships, and monitoring and reporting schemes. The resulting data matrix is shown in Tab.14 in the Results section.

Finally, we performed a correlation test of the horizontal and vertical institutional settings identified, and evaluated them against the countries' political-administrative structure. The method used to assess the relationship between the various dimensions was the Principal Components Analysis (PCA). The PCA is a data reduction technique that creates a small number of components (factors) from relatively large series of data that can thus be meaningfully interpreted without much loss of information. The PCA enables one to identify patterns in data, and express them in a way to highlight their similarities and differences. A clear advantage of the PCA is the possibility to obtain a graphical representation of the (possibly few) components that eventually result most significant in the analysis.

As a preliminary step to the PCA, a number of criteria (variables) were selected to cover the main dimensions of the investigation. The number of existing institutions, their degree of formalization and novelty, the timing and the focus of institutional action with respect to the NAS, the mode of institutional coordination as well as the "transversality" of the challenge addressed by the institutions, were considered proxies of the overall institutional capacity for adaptation (see Tab.10 for the detailed description of criteria). Additionally, the political dimension was taken into account with the national political-administrative structure as a separate criteria to run the analysis. Each criterion was then further specified with classes for

the purposes of the analysis (e.g. the criterion “novelty” was defined according to the “pre-existing” or “new” nature of the institutions assessed). Finally, these criteria were applied to the identified catalogue of institutional settings in order to obtain a standardized matrix of basic data (Tab.14 in the Result section).

In the next phase, we interpreted the initial matrix of data containing all the information on institutional settings to obtain single values for each of the selected countries in a secondary matrix (Tab.17). To do so, we assigned a score to the classes, yet this did not imply any value judgment (good or bad) on the characteristics or performance of the institutions or systems categorized in such a way. Since we considered the entire set of institutions found in each country as a single data, we needed to create a new progressive set of classes to grasp the meaning of the aggregated information (e.g. Country X shows two institutions, of which one is new, and the other one is pre-existing; this situation would be measured as “an equal combination” of novelty, and scored “2”).

The values for each criteria input in the secondary matrix were thus scores associated to the whole of the institutions per country (see last column in Tab.10), and only these were used to run the PCA software.

The whole study drew on available literature and a long standing personal involvement with national and regional adaptation policy-makers in Europe to collect and verify the necessary information. Main references were Climate-ADAPT Platform, EEA Reports, EC documentation, the relevant ongoing work of the EEA’s [European Topic Centre on Climate Change Adaptation](#) (ETC/CCA), assessment reports with European scope, and other information available on national portals accessible in English. Personal contacts with national focal points of all countries involved were taken through *CIRCLE-2* consortium and ETC/CCA consortium in order to validate the basic data and find agreement on country-relevant statements (see Annex 1).

Table 10. Framework for the analysis of institutions

Dimensions	Criteria	Description	Classes for single institutions analysis	Classes and scores for aggregated institutions analysis (per country)
Institutional capacity	Number of institutions	The amount of existing specific institutions, mechanisms, procedures that address horizontal/vertical challenges in the framework of a NAS	---	<i>Actual number of institutions = x</i>
	Formalization	The degree of formalization of the institutional settings within a NAS	<i>Temporary Institutionalized</i>	<i>Mostly temporary = 1 An equal combination = 2 Mostly institutionalized = 3</i>
	Novelty	The degree of novelty of institutions according to the time of their establishment with respect to the development of the NAS	<i>Pre-existing New</i>	<i>Mostly pre-existing = 1 An equal combination = 2 Mostly new = 3</i>
	Timing of action	The time when the institutions initiated their action with respect to the various phases of a NAS, either pre- (ad hoc for developing the NAS) or post-NAS (for NAS implementation)	<i>Pre-NAS Whole process Post-NAS</i>	<i>Mostly Pre-NAS = 1 During the whole process / all phases covered = 2 Whole process and Post-NAS = 3 Mostly Post-NAS = 4</i>
	Scope of action	The main scope of the institutional action within a NAS	<i>Sectoral policy Adaptation Climate change Broader policy</i>	<i>Sectoral policy = 1 Adaptation only = 2 Equal mix of adaptation and climate change = 3 Climate change = 4 Broader policy fields = 5</i>
	Coordination mode	The modality of institutional coordination, from voluntary-networking-negotiation modes (e.g. informal workshops, fora, committees) to mandatory requirements (e.g. binding reporting schemes, establishment of committees mandated by law) within a NAS	<i>Voluntary Mandatory</i>	<i>Voluntary = 1 Mostly voluntary (with some mandatory) = 2 Mostly or completely mandatory = 3</i>
	Transversality	The overall level of integration or separation of horizontal and vertical governance challenges addressed by the institutions within a NAS	<i>Horizontal Vertical Horizontal+Vertical</i>	<i>Mostly separated = 1 Partially integrated, equal combination = 2 Mostly Integrated = 3</i>
Political dimension	National structure	The type of political-administrative system characterizing the country	---	<i>Unitary = 1 Administrative-federal = 2 Federal = 3</i>

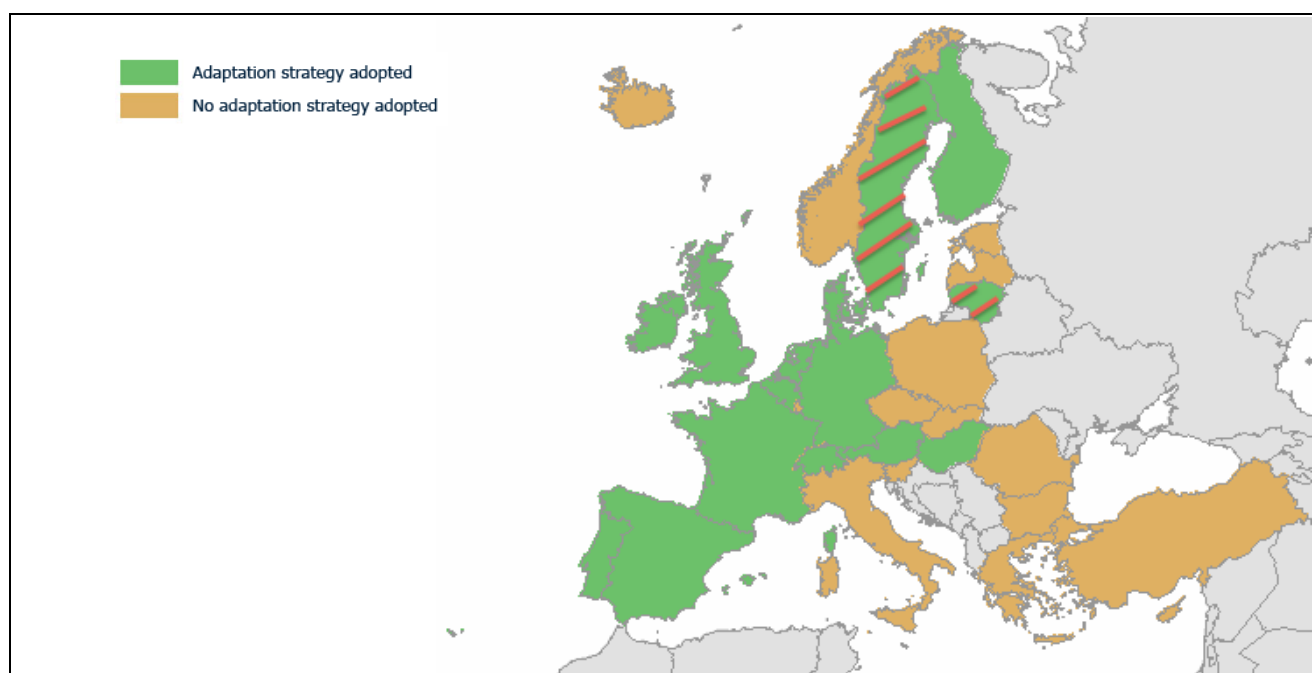
RESULTS

SCREENING OF NATIONAL ADAPTATION STRATEGIES ACROSS EUROPE

By cross-checking information submitted by countries to the EEA with the definition of a NAS applied in this paper, outcomes slightly differ from what is reported in Climate-ADAPT.

Of the sixteen countries that stated to have adopted a NAS, most of them are confirmed to have a piece of official documentation or legislation providing strategic guidance to build resilience to climate change impacts and reduce the vulnerability of the countries (see Tab.11). Only two countries listed in green as having a NAS in the Climate-ADAPT mapping of countries (see Fig.2), Lithuania and Sweden, were left out from our analysis since they do not fulfill the criteria proposed above related to the form and content of a NAS.

Figure 2. Illustration of countries' status across Europe: Sweden and Lithuania are not considered in our analysis (Source: elaborated from Climate-ADAPT, accessed July 2013)



Sweden represents a peculiar case in Climate-ADAPT records since it is one of the few countries that did not provide any information on the status of national adaptation planning, except for a link on the Swedish national portal on adaptation where information can be retrieved, but not in English.

Swart et al. (2009) report that Sweden has already accomplished comprehensive preparatory stages to develop a national adaptation strategy. In 2007 the Commission on Climate and Vulnerability, appointed by the government and chaired by the Ministry of Environment,

delivered an extensive report titled *“Sweden facing climate change – threats and opportunities”* that outlined the specific climate change impacts and challenges, as well as concrete options to reduce vulnerability sector by sector (Swedish Ministry of the Environment, 2007). Since the information contained was thought to be a sound and suitable basis to initiate an adaptation process in Sweden, the Commission on Climate and Vulnerability proposed that the coordination of climate adaptation would be assigned to the county administrations. As such, an adaptation strategy at the national scale is judged not necessary in Sweden, as long as the regional and local administrations are provided with sufficient and precise information (Termeer et al., 2009). The recommendations contained in the national Commission’s report were included in the bill *“An Integrated Climate and Energy Policy”*, adopted in 2008 and now considered the official piece of legislation in support of adaptation, although it is mostly focused on mitigation and energy efficiency targets. The bill states that adaptation policy is being developed along a number of directions, such as improving the knowledge base and the database for risk assessment, inclusive of allocation of budget and responsibilities (Swedish Ministry of the Environment & Ministry of Enterprise, Energy and Communications, 2009). Hence, it is incorrect to state that Sweden has adopted a legislation focusing on adaptation or has developed a comprehensive national vision aimed at adaptation (see also Mullan et al., 2013), but rather it is willing to continue with a more decentralized bottom-up approach to adapt to climate change.

Lithuania reported that a document titled *“Lithuanian climate change management policy and its implementation”* was endorsed by the Parliament in November 2012 and it is considered to be the country’s strategy to tackle climate change. This appears to be an integrated strategy covering both adaptation and mitigation issues, and addressing implementation considerations for the period 2013-2050 (Lithuanian Ministry of Environment, 2012). A plan of measures for implementation is under development based on this strategic document. In the past, *“The National Strategy for the Implementation of the UNFCCC until 2012”* and its action programme putting forward mitigation and adaptation measures were endorsed by the national government (Government of the Republic of Lithuania, 2008). Both documents identify strategic goals for adaptation and mitigation in the country and define deadlines and responsible authorities for implementation. Although the more recent strategy document is available in English as a leaflet only, it is possible to assess that the actual adaptation issues are dealt with in a very limited and generic way compared to the extent of mitigation sections. The strategic goal of reducing vulnerability to climate change in the most vulnerable sectors is

structured around four broad directions for its realization that, in fact, closely resemble general principles for preparing for adaptation: they point out the need for an integrated approach, the synergies of adaptation and mitigation, the contribution of country-level research and the importance of a knowledge base on adaptation (Lithuanian Ministry of Environment, 2012). Furthermore, Lithuania reported to have adopted a “*Law on Financial Instruments for Climate Change Management*” in 2009. However, in this piece of legislation reference to adaptation is not existing (Republic of Lithuania, 2009). In the light of the available information, the Lithuanian strategy does not seem focused enough on adaptation to be called NAS.

On the other hand, other countries choose to adopt an integrated climate change strategy rather than a single-focused adaptation document, but were included in the analysis. Hungary reports to hold a “*National Climate Change Strategy*” approved by a Parliament decree in 2008, as mandated by the 2007 Climate Change Act for the implementation of the UNFCCC framework. The national strategy’s content spans across provisions on both mitigation and adaptation and identifies key objectives and actions to be implemented in the period 2008-2025 (NES, 2008). However, despite the broad scope, the Hungarian document gives substantial attention to adaptation, presenting knowledge of climate change impacts across sectors and a list of related measures and options to tackle them. In order to implement the strategy the Hungarian government is required by law to adopt biannual National Climate Change Programmes, of which a second edition (2011-2012) has already been released. More updates of the NAS are expected in the coming months. Thus, contrary to the Lithuanian one, the Hungarian climate change strategy was considered focused enough on adaptation to be taken into account in our analysis.

Also the UK has initially chosen a broad approach to adaptation with the 2008 “*Climate Change Act*” encompassing both mitigation and adaptation issues (HMG, 2008), which has been recently complemented with the first mandated “*National Adaptation Programme*” (HMG, 2013) released in July 2013, addressing adaptation actions for government, business and society. In addition, non-binding adaptation frameworks have been previously created by the UK central government (HMG, 2010; HMG & DEFRA, 2008) and the devolved administrations of Wales and Scotland have adopted their own adaptation strategies and plans (Welsh Assembly Government, 2010; Scottish Government, 2008). Together, these form a comprehensive set of policies to carry out adaptation in the whole UK. Therefore, the long-

standing and extensive recognition of adaptation matters within the country is unquestionable. However, for the scope of this paper, only the adaptation strategy of the UK central government will be analyzed in detail.

Table 11. List of national strategies relevant for climate change adaptation as reported in Climate-ADAPT against the proposed definition of NAS

EEA Member Country	NAS reported in Climate-ADAPT	Year	Title of NAS or climate change strategy	Language (English if available)	Adopted by the government (Form-wise)	Adaptation-focused (Content-wise)	NAS according to defined analysis criteria
Austria	√	2012	Austrian Strategy for Adaptation to Climate Change	EN	√	√	√
Belgium	√	2010	Belgian national climate change adaptation strategy	EN	√	√	√
Bulgaria		2012	Third National Action Plan on Climate Change 2013-2020	EN	√	Plan focuses on mitigation	No
Czech Republic		2004	National Programme To Abate the Climate Change Impacts in the Czech Republic	EN	√	Programme focuses on mitigation	No
Cyprus							
Denmark	√	2008	Danish Strategy for adaptation to a changing climate	EN	√	√	√
Estonia							
Finland	√	2005	National Adaptation Strategy	EN	√	√	√
France	√	2007	National strategy for adaptation to climate change**	FR	√	√	√
Germany	√	2008	German Strategy for Adaptation to Climate Change	EN	√	√	√
Greece		2003	National Action Plan regarding Climate Change**	GR	√	Plan focuses on mitigation	No
Hungary	√	2008	National Climate Change Strategy 2008-2025	EN	√	Strategy is on both adaptation and mitigation – Comprehensive adaptation section	√

EEA Member Country	NAS reported in Climate-ADAPT	Year	Title of NAS or climate change strategy	Language	Adopted by the government (Form-wise)	Adaptation-focused (Content-wise)	NAS according to defined analysis criteria
Iceland*		2007	Iceland's Climate Change Strategy	EN	√	Strategy focuses on mitigation	No
Ireland	√	2012	National Climate Change Adaptation Framework	EN	√	√	√
Italy							
Latvia							
Liechtenstein*		2007	National Climate Change Strategy for the Liechtenstein Principality	DE	√	Strategy focuses on mitigation	No
Lithuania	√	2012	Lithuanian climate change management policy and its implementation	LT EN summary	√	Strategy focuses on mitigation	No
Luxembourg							
Malta	√	2012	National Climate Change Adaptation Strategy	EN	√	√	√
Netherlands	√	2007	Make room for Climate	EN	√	√	√
Norway*		2008	Adaptation in Norway The government's efforts to adapt to climate change**	NO	√	Workprogramme on adaptation – not a comprehensive strategy	No
Poland		2013	Strategic Plan for Adaptation to sectors and areas vulnerable to climate change by 2020, with a view to 2030**	PL	Strategy document NOT yet adopted	√	No
Portugal	√	2010	National strategy for adaptation to climate change**	PT		√	√
Romania		2011	Adaptation component of the National Climate Change Strategy (2012-2020)**	RO	Strategy document NOT yet adopted	Strategy is on both adaptation and mitigation – comprehensive adaptation section	No

EEA Member Country	NAS reported in Climate-ADAPT	Year	Title of NAS or climate change strategy	Language	Adopted by the government (Form-wise)	Adaptation-focused (Content-wise)	NAS according to defined analysis criteria
Slovakia							
Slovenia		2011	(Draft) National Climate Strategy – Strategy for the transition of Slovenia to a low carbon society by 2050	SI EN summary	Strategy document NOT yet adopted	Strategy focuses on mitigation	No
		2008	National adaptation strategy for forestry and agriculture	SI	√	Sectoral strategy - not comprehensive	No
Spain	√	2006	National plan for adaptation to climate change**	SP	√	√	√
Sweden	√	2009	Bill: An Integrated Climate and Energy Policy	SE EN summary	√	Bill focuses on mitigation - country opted for integrated and coordinated cooperation for adaptation	No
Switzerland*	√	2012	Adaptation to Climate Change in Switzerland	EN	√	√	√
Turkey*		2010	National Climate Change Strategy 2010-2020	EN	√	Strategy focuses on mitigation	No
		2010	Turkey's National Climate Change Adaptation Strategy and Action Plan (Draft)	EN	Strategy document NOT yet adopted	√	No
United Kingdom	√	2008	Climate Change Act	EN	√	√	√

Note:

* Non-EU countries.

** Title of NAS translated from the original to English by the authors.

Besides Lithuania and Sweden that were clearly out of the scope of this study, other situations were considered to be challenging in terms of matching the criteria of our analysis. Almost all European countries can be considered at the phase of formulating or adopting their national adaptation policy (Venturini, Medri et al., forthcoming) (Chapter 2 of this dissertation), but only a part of these have provided official documentation to the EEA to prove their commitment to adaptation so far (EEA, 2013).¹⁵ Those are not listed among the countries with a NAS on Climate-ADAPT as shown in Tab.11. We considered such special cases and briefly present them hereunder.

Similarly to Lithuania, the Czech Republic, Bulgaria, Greece, Iceland, Liechtenstein and Turkey adopted climate change strategies that cannot be included in the analysis since they address mitigation almost exclusively. In the case of the Czech Republic, the strategic document approved by the government is the *“National Programme to Abate the Climate Change Impacts in the Czech Republic”* (Czech Ministry of the Environment, 2004). It puts forward the strategy to tackle climate change and contains mitigation policy goals and measures, as well as a short overview of adaptation measures in four key sectors. As this is not recognized as a NAS, a comprehensive adaptation strategy is reported to be under preparation, and will embrace an impact assessment, a list of adaptation measures, as well as analysis of regulation and cost-benefit assessments. The same applies to Greece, whose national action plan regarding climate change only focuses on mitigation to comply with the UNFCCC Kyoto Protocol (Greek National Gazette, 2003), while the process of setting up a NAS is under way. Bulgaria has recently adopted the *“Third National Action Plan on Climate Change”*, that is aimed at mitigation although it defines a small number of adaptation measures in the agriculture and forestry sectors (Bulgarian Ministry of Environment and Water, 2012). Iceland’s *“Climate Change Strategy”* is clearly focused on mitigation but it identifies the need to develop a central strategy for adaptation as well as develop methodologies for risk assessment, disaster management and preventive actions (Icelandic Ministry for the Environment, 2007). Liechtenstein has adopted a national climate strategy but it does not include provisions for adaptation (Government of Liechtenstein Principality, 2007). Turkey did not provide information to Climate-ADAPT, however Mullan et al. (2013) report that a Turkish *“National Climate Change Strategy 2010-2020”* exists (Republic of Turkey, 2010), and although adaptation is referred to within the UNFCCC framework, the document is almost entirely

¹⁵ Including Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Italy, Latvia, Norway, Poland, Romania, Slovakia and Slovenia.

dedicated to mitigation. Yet the process towards adopting a NAS seems to have started, as a draft publication, “Turkey’s National Climate Change Adaptation Strategy and Action Plan”, was released in 2010 (Turkish Ministry of Environment and Urbanization, 2010). However this document cannot be considered in this analysis as it has not been adopted.

Other countries seem quite advanced in the development of their adaptation policy but are not eligible for this research. Despite the considerable amount and width of policy effort, comparable to other countries considered more active in the field of adaptation, Norway, Poland, Romania and Slovenia do not appear in the list of countries with a NAS in Climate-ADAPT since a full national climate change strategy has been formulated but not formally adopted yet (Venturini, Medri et al., forthcoming) (Chapter 2 of this dissertation). In the case of Slovenia, a sectoral NAS was also adopted, but its scope was considered too narrow to fulfill the criteria of content-wise comprehensiveness.

Table 12. Summary of special country cases analyzed and considered or excluded in the subsequent analysis

Special circumstances analyzed	Considered	Excluded
Broader climate change strategy	Hungary, UK	Lithuania, Sweden, Bulgaria, Czech Rep., Greece, Iceland, Liechtenstein, Turkey
Incomplete strategy	--	Norway, Romania, Slovenia, Poland, Turkey

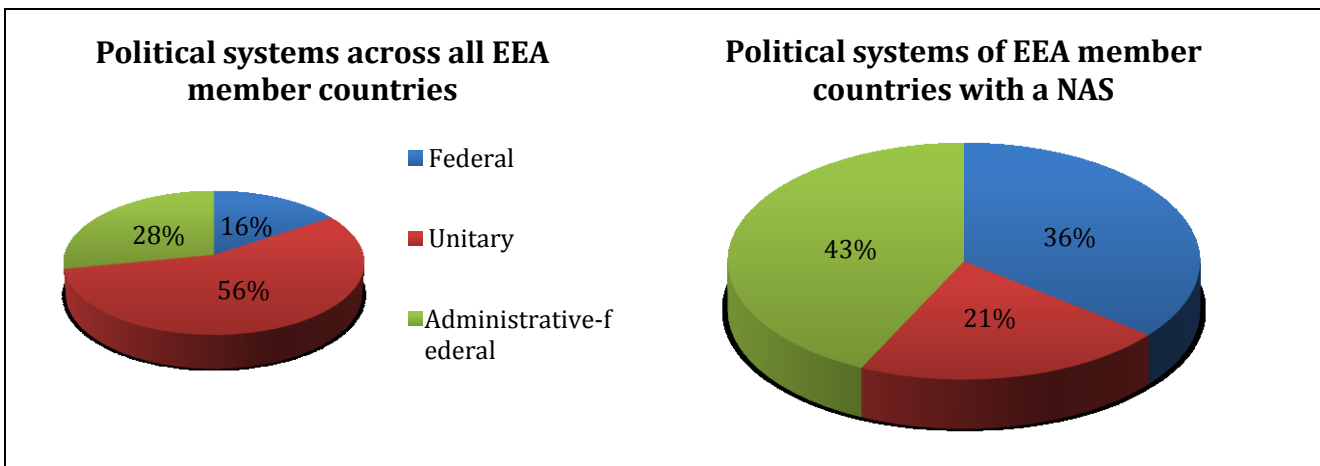
Following the screening of existing NASs in Europe, the next sub-sections highlight the governance arrangements that have been put in place in order to support them.

OVERVIEW OF POLITICAL SYSTEMS IN PLACE

According to the proposed classification of political systems, we were able to verify that twenty-seven out of the thirty-two European countries considered fall within the class of unitary states (84%). This figure incorporates nine countries that are classified as administratively federal (28%) as, per definition, they allow a greater degree of autonomy to lower government levels or existing “provinces”, if any, but remain constitutionally unitary. These countries include: Denmark, Finland, France, Italy, the Netherlands, Norway, Portugal, Sweden and the UK. Only five countries (16%) can be listed as federal countries, being federations of constituent states with almost equal authority. These are Austria, Belgium, Germany, Switzerland, or federal *de facto* since the autonomous regions are recognized by the constitution as in the case of Spain.

When applying this categorization to the fourteen countries that have adopted a NAS, the presence of the three political systems appears relatively different (see Fig.3). Although the majority of the countries with a NAS are characterized by a unitary form of government reflecting the general dominance of this type of category in Europe, the percentage decreases to 64%. Nevertheless, if we split the subcategories within unitary systems we can appreciate the diversity of national political situations. Purely centralized states that have adopted a NAS are now a minority (12%) being only three countries (Hungary, Ireland and Malta), while administratively federal states reach the highest percentage (43%) since all administrative-federal countries, except Norway and Italy, have finalized a NAS. Also, all five identified federal countries have adopted a NAS and represent the second largest category of administrative systems (36%) in this analysis.

Figure 3. Representation of different political systems across 32 EEA member countries (on the left), and across those countries that have adopted a national adaptation strategy (on the right)



Tab.13 presents the cataloguing of the fourteen countries where a NAS is in place, showing their political systems, the number of existing independent national or sub-national constituents or “provinces”, the potential representation in the central government and the allocation of overall policy responsibilities to those constituents. In this table, the ranking of countries resulting from Inman’s analysis are represented with the sign “+”, as a general indication of the autonomy assigned to lower administrative tiers or federal states, based on the amount of locally collected revenues as a proxy measure of the decentralization of powers (Inman, 2007). The last column of the table shows the presence of adaptation policies (strategies or plans) in the constituent regions or countries.

On the basis of such an overview, it can be confirmed that, on one side, unitary countries like Ireland (and Hungary and Malta) do not decentralize powers to local administrations. On the

other side, it can be observed that, although maintaining a fully centralized system, Denmark, Finland (++++) and, to a slightly lesser extent, France (+++), seem to have allowed a large responsibility for the implementation of national policies to regional or local administrations.

Focus on Italy

Italy is considered an administrative-federal country according to Inman (2007). It is structured in twenty regions, of which five are constitutionally assigned a broader amount of autonomy granted by special statutes. Each region (except for the Aosta Valley) is divided into provinces. One of these special autonomy regions (Trentino-Alto Adige) has two autonomous provinces that are given powers equivalent to the ones of the regions.

Some French overseas communities have a specific competency regarding environmental policy (e.g. French Polynesia, New Caledonia), thus adaptation policy falls under their local decision making process. However, overseas territories or special municipalities outside Europe are not taken into account in this analysis as they go beyond our scope.

In other cases like the UK, Portugal and the Netherlands, countries have established a number of self-governing states or regions that, despite a certain degree of independence

and policy authority, do not have constitutionally protected representation in the central government. The Netherlands, culturally used to decentralization, is divided into twelve provinces with an elevated degree of autonomy (+++). In Portugal the autonomous regions of Madeira and the Azores have their own regional political and administrative statutes and self-governing institutions (++) . These two regions have full autonomy when it comes to environmental matters and they have developed their own climate change legislation.

The UK, as a central government in charge of the so-called reserved matters, namely those with a UK-wide or international impact, has devolved various powers (++) to its constituent countries. This case is worth mentioning since Northern Ireland, Scotland and Wales are relatively large countries that can legislate on the sectoral policies mostly concerned with the mainstreaming of adaptation (e.g. agriculture, forestry and fisheries, education and training, environment, health and social services, housing, local government, tourism and economic development, transport). In fact, as mentioned above, Scotland and Wales have already adopted their autonomous NASs and adaptation plans.

Federal countries usually rank very high in the amount of responsibility allowed to their federated territories, which can then autonomously legislate within the limits given by the constitution, which includes the possibility to develop their own climate adaptation policies.

The nine *Länder* (federal states) in Austria and the sixteen *Länder* in Germany as well as the twenty-six *Cantons* in Switzerland seem to have a great degree of policy accountability (++++). Almost all German federal states have adopted adaptation strategies and measures, and the remaining ones are currently drawing them up. In Switzerland, several Cantons have developed basic documents for adaptation at the regional level and more action is expected after the publication of the NAS.

A relatively lower degree of overall policy accountability (++) seems to be granted to the three administrative Regions (*Gewesten* or *Régions*) of Belgium and the seventeen Autonomous Communities (*Comunidades Autónomas*) of Spain. However, for what concerns climate policy, most of the Spanish Autonomous Communities have developed their own adaptation plans or strategies, either as individual strategies or within general climate change programmes. In Belgium, after the adoption of the NAS, the three Regions and the Federal government are developing their own adaptation plans which will form the basis for the national adaptation plan of action. The Flemish Adaptation Plan is the only one in Belgium that has been finalized and adopted.

Table 13. Classification of countries by political systems (Source: based on Inman, 2007).

EEA Member Country (year of NAS adoption)	Type of political system	Nr. of independent constituents*	Political representation of constituents in central government	Allocation of overall responsibility to lower-tier governments or federal states	Adaptation policy developed in sub-national constituents
Austria (2012)	Federal	9	Yes	++++	
Belgium (2010)	Federal	3	Yes	++	√
Denmark (2008)	Adm. federal	-	No	++++	
Finland (2005)	Adm. federal	-	No	++++	
France (2007)	Adm. federal	-	No	+++	
Germany (2008)	Federal	16	Yes	++++	√
Hungary (2008)	Unitary	-	No	n.a.	
Ireland (2012)	Unitary	-	No	++	
Malta (2012)	Unitary	-	No	n.a.	
Netherlands (2007)	Adm. federal	12	No	+++	
Portugal (2010)	Adm. federal	2	No	++	√
Spain (2006)	Federal	17	Yes	++	√
Switzerland* (2012)	Federal	26	Yes	++++	√
United Kingdom (2008)	Adm. federal	4	No	++	√

Note:

*Special autonomous territories that politically are not part of the EU (overseas territories of France and the Netherlands, and Greenland for Denmark), or small independent islands (Åland Islands in Finland, Faroe Islands in Denmark) are not reported in the analysis as independent provinces.

INSTITUTIONAL SETTINGS IN SUPPORT OF NATIONAL ADAPTATION STRATEGIES:
HORIZONTAL AND VERTICAL GOVERNANCE

Forty-eight institutional arrangements and processes specifically tackling the challenge of horizontal and vertical integration of adaptation have been found to support NASs across the fourteen countries selected. The identified list of governance settings is illustrated in Tab.14, according to the agreed institutional capacity criteria.

Figure 4. Analysis of the institutional capacity across all countries with a national adaptation strategy

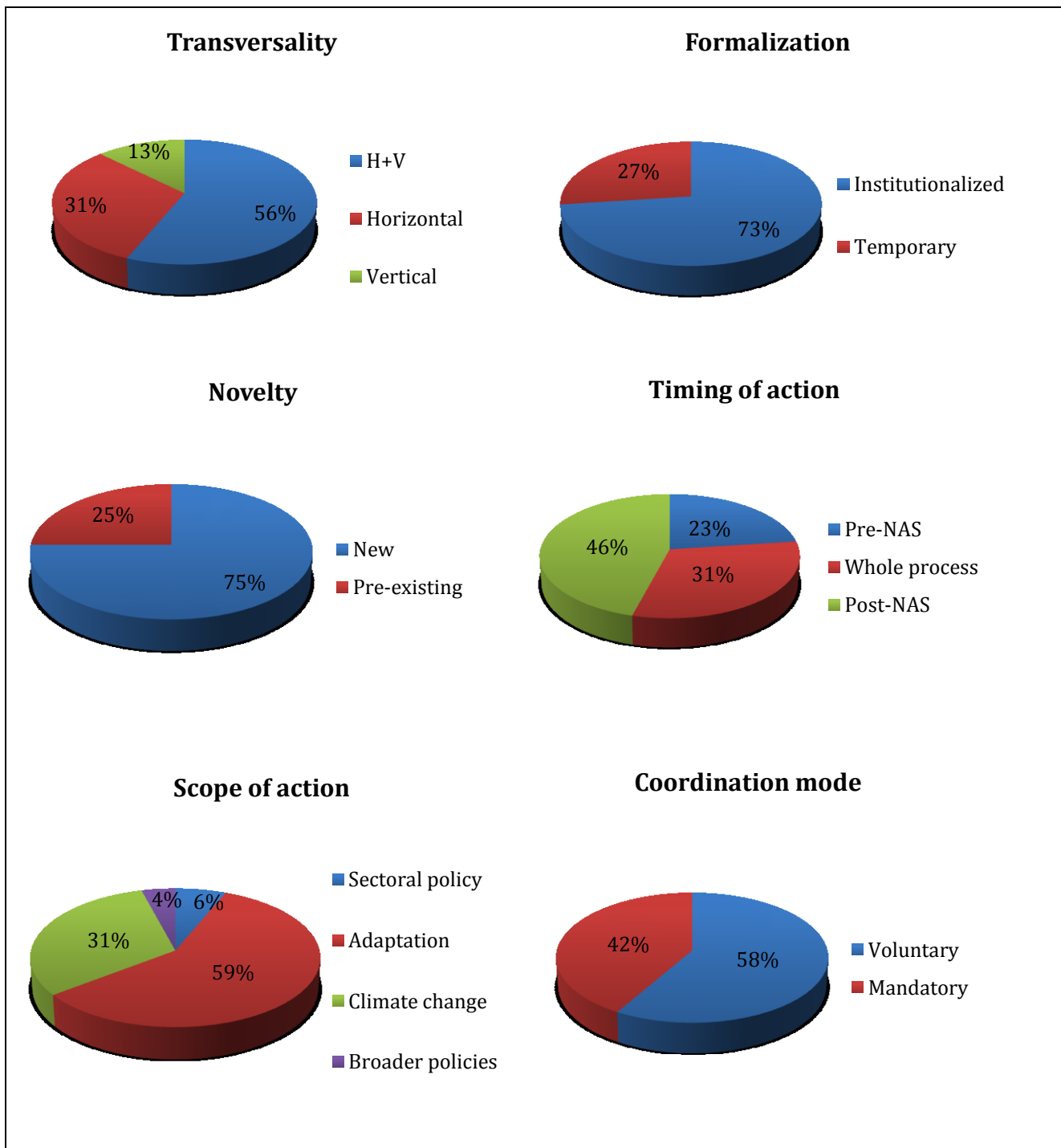


Fig.4 offers the visual analysis of the identified institutions and processes not aggregated per countries. At first glance, it can be noted that more than half of the institutional settings in Europe are established to address the challenges of horizontal and vertical coordination of adaptation jointly showing high “transversality” (56%); while those that address a single challenge are more concerned with cross-sectoral integration (31%) than multi-level integration (13%). The large majority of the identified governance settings are newly established in the context of the NAS (75%) and have a more permanent nature (73%). On the other hand, many relevant temporary consultation processes are designed to involve a broader public, thus addressing the participation challenge often seems their main goal rather than dealing with horizontal and vertical coordination.

Regarding the timing of action, generally countries seem to have a preference for institutional settings that deal with the NAS once it is adopted and has to be put into effect (43%). However, about one third of the institutions follow the NAS from the development to the implementation phase (31%). It has to be acknowledged that ad hoc institutions or processes established in the initial stages pre-NAS (23%) may disappear once they have fulfilled their role within the NAS (e.g. preliminary consultation, drafting of the document).

Not surprisingly a big share of the identified institutions focus only on adaptation (59%) as they are operating in the framework of a NAS. However, quite a number are devoted to both adaptation and mitigation (31%) as the NAS is structured under the national climate change policy agenda. Few institutional settings deal with broader policies such as energy and air quality besides climate change, as in the case of the France (4%). A narrower focus on water-related effects of climate change instead is covered by most Dutch institutions (6%), as the implementation plan restricted the sectoral scope of the first NAS (further detailed in the Discussion section).

A slightly more frequent coordination mode among existing institutional settings is voluntary networking (58%), which implies variously organized dialogue and interaction between “equal” actors, as opposed to hierarchical mode or mandatory actions that may be required by law. Countries that show mandatory provisions for adaptation usually complement these with voluntary approaches. For instance some countries have legally binding regulation, such as the “*Climate Change Act*” in Hungary and the UK, and the “*CO2 Act*” in Switzerland, as a foundation for the review of the NAS or the creation of reporting schemes. Others have legal

bases that support the establishment and enable the legal force of the institutions, or that mandate the participation of specific institutions in the NAS development and implementation. This is the case of the Grenelle Environment Forum in France (based on *"First Grenelle Act"*), the Delta Commissioner in the Netherlands (*"Delta Act"*) and various inter-ministerial bodies in Belgium, Germany, Ireland, Portugal and Switzerland.

A special situation has emerged with regard to Ireland. Here the Department of the Environment, Community and Local Government (and the Cabinet Committee system) that coordinated the development of the NAS has also been implicitly assigned with the task of integrating adaptation horizontally and vertically. No other specific institutional innovations seem to exist for this purpose. According to Aarjian et al. (2012), current institutions could provide a good basis to set up effective coordination, however, an adaptation high-level national group should be mandated in the context of the NAS to enhance institutional capacity in Ireland. It is anticipated that under the proposed *"Climate Action and Low carbon development Bill"* of 2013 this issue will be addressed, therefore the future institutional arrangements have been included in this analysis for completeness (Desmond, 2013; personal communication).

Table 14. Institutional settings addressing horizontal and vertical coordination of adaptation within European national adaptation strategies

Country with NAS	Institutions	Transversality	Formalization	Novelty	Timing of action	Scope of action	Coordination mode
	Special coordination bodies, mechanisms, processes within the NAS	Horizontal/ Vertical/ H+V	Temporary/ Institutionalized	Pre-existing/ New	Pre-NAS/ Whole process/ Post- NAS	Sectoral policy/ Adaptation / Climate Change / Broader policies	Voluntary/ Mandatory
Austria	Series of informal workshops	H+V	Temporary	New	Pre-NAS	Adaptation	Voluntary
	Consultation process (workshops with public adm. and non-gov actors)	H+V	Temporary	New	Pre-NAS	Adaptation	Voluntary
	Austrian Kyoto Forum	H+V	Institutionalized	Pre-existing	Pre-NAS	Climate change	Voluntary
	Inter-ministerial committee on climate change (IMC Climate)	H+V	Institutionalized	Pre-existing	Whole process	Climate change	Voluntary
Belgium	National Climate Commission (NCC)	H+V	Institutionalized	Pre-existing	Whole process	Climate change	Mandatory
	Working Group on Adaptation (CABAO)	H+V	Institutionalized	Pre-existing	Whole process	Adaptation	Mandatory
Denmark	Task Force on Climate Change Adaptation	H+V	Institutionalized	New	Whole process	Adaptation	Voluntary
Finland	Series of seminars during NAS development	H+V	Temporary	New	Pre-NAS	Adaptation	Voluntary
	Finnish Coordination Group for Adaptation to Climate Change	H+V	Institutionalized	New	Whole process	Adaptation	Voluntary
	Monitoring and review of the NAS	H	Temporary	New	Post-NAS	Adaptation	Voluntary
France	Consultation process based on Grenelle Environment Forum structure	H+V	Temporary	New	Post-NAS	Adaptation	Voluntary
	Grenelle Environment Forum (moved into the National committee for ecologic transition)	H+V	Institutionalized	New	Post-NAS	Broader policies	Mandatory
	General directorate for energy and climate within ONERC	H+V	Institutionalized	Pre-existing	Post-NAS	Broader policies	Mandatory

Country with NAS	Institutions	Transversality	Formalization	Novelty	Timing of action	Scope of action	Coordination mode
Germany	Preliminary Inter-ministerial Working Group	H	Temporary	New	Pre-NAS	Adaptation	Voluntary
	Inter-ministerial Working Group on adaptation	H	Institutionalized	New	Post-NAS	Adaptation	Mandatory
	Consultation procedures in specific sectors	V+H	Temporary	New	Whole process	Adaptation	Voluntary
	Standing commission on adaptation of the federal conference of the environment ministers (AFK)	V+H	Institutionalized	New	Post-NAS	Adaptation	Mandatory
	“Bund-Länder” Committee on Climate Impacts	V	Institutionalized	Pre-existing	Whole process	Adaptation	Voluntary
Hungary	Climate Change Commission	H	Institutionalized	Pre-existing	Post-NAS	Climate change	Voluntary
	Hungarian Working Group on Climate Change	H	Institutionalized	New	Post-NAS	Climate change	Voluntary
	Review of the NAS under climate change law	H+V	Institutionalized	New	Post-NAS	Climate change	Mandatory
Ireland	Institutional arrangements proposed under the Climate Action and Low carbon development Bill 2013	H+V	Institutionalized	New	Post-NAS	Climate change	Mandatory
Malta	Climate Change Committee for Adaptation (CCCA)	H	Institutionalized	New	Pre-NAS	Adaptation	Voluntary
	Public consultation process	V	Temporary	New	Pre-NAS	Adaptation	Voluntary
Netherlands	Steering committee and programme team of the National Programme for Spatial Adaptation to Climate Change (ARK)	H+V	Temporary	New	Pre-NAS	Adaptation	Voluntary
	Delta Commissioner	H+V	Institutionalized	New	Post-NAS	Sectoral policy	Mandatory
	Ministerial Steering group of the Deltaprogramme	H	Institutionalized	New	Post-NAS	Sectoral policy	Voluntary
	Steering committees of area-based Delta sub-programmes	V+H	Institutionalized	New	Post-NAS	Sectoral policy	Voluntary
	Ministerial drafting group of the 2013 Climate Roadmap	H	Temporary	New	Pre-NAS	Climate change	Voluntary

Country with NAS	Institutions	Transversality	Formalization	Novelty	Timing of action	Scope of action	Coordination mode
Portugal	Adaptation and Monitoring division within Portuguese Environment Agency (APA) Climate Department (following integration of Climate Change Commission into APA)	H	Institutionalized	New	Post-NAS	Climate change	Mandatory
	Inter-ministerial Coordination Group for the NAS	H+V	Institutionalized	New	Post-NAS	Adaptation	Mandatory
	2 Regional Working Groups for the autonomous regions	H+V	Institutionalized	New	Post-NAS	Climate change	Mandatory
Spain	Inter-ministerial Commission on Climate Change	H	Institutionalized	Pre-existing	Whole process	Climate change	Voluntary
	Spanish Coordination Commission of Climate Change Policies (CCPCC)	H+V	Institutionalized	Pre-existing	Whole process	Climate change	Mandatory
	CCPCC Working Group on Impacts and Adaptation	H+V	Institutionalized	New	Whole process	Adaptation	Mandatory
	National Climate Council	H+V	Institutionalized	Pre-existing	Whole process	Climate change	Voluntary
	Public consultation process	H+V	Temporary	New	Pre-NAS	Adaptation	Voluntary
Switzerland	Interdepartmental Committee on Climate (IDA Climate)	H	Institutionalized	Pre-existing	Whole process	Climate change	Mandatory
	IDA Climate Working Group 2 on adaptation	H	Institutionalized	Pre-existing	Whole process	Adaptation	Mandatory
	Monitoring	H	Institutionalized	New	Post-NAS	Adaptation	Voluntary
	Reporting scheme under CO2 Act	H+V	Institutionalized	New	Post-NAS	Adaptation	Mandatory
United Kingdom	Cross-UK Government Climate Adaptation Board	H	Institutionalized	New	Whole process	Adaptation	Voluntary
	Consultation on framework	V	Temporary	New	Pre-NAS	Adaptation	Voluntary
	Local Adaptation Advisory Panel (LAAP) (since 2011, used to be Local and Regional Adaptation Partnership Board)	V	Institutionalized	New	Whole process	Adaptation	Voluntary
	Climate UK network of Regional Climate Change Partnerships	V	Temporary	New	Post-NAS	Climate change	Voluntary
	Adaptation Reporting Power under the Climate Change Act 2008	H	Institutionalized	New	Post-NAS	Adaptation	Mandatory
	Monitoring and reporting scheme (Indicator "NI 188")	V	Institutionalized	New	Post-NAS	Adaptation	Mandatory
	Review of the national adaptation programme	H+V	Institutionalized	New	Post-NAS	Adaptation	Mandatory

OUTCOMES OF THE ANALYSIS

In this section we illustrate the results of the statistical analysis performed with the PCA method, based on the aggregated data shown in the secondary matrix in Tab.17.

The PCA produced a number of useful outcomes to explain the patterns in the data provided, and thus contributed to verify if any notable correlation exists between the political dimension and the institutional capacity of the countries with reference to their NASs.

The starting point of the PCA is the correlation matrix (Tab.15). All factor analysis techniques try to clump subgroups of variables together based upon their correlations, and often it is possible to get an idea of what the most significant factors are going to be just by looking at the correlation matrix and identifying clusters of high correlations between groups of variables. Although the aim of the PCA is to reduce the number of variables, in this case it is not possible.

In fact, the very first observation is that there are correlations between variables but all of them have unique characteristics and need to be explored independently. This is shown by the fact that in Tab.15 there are no correlations higher than 0.9 in absolute value (threshold at which it is advised to merge variables). In other words, all the chosen variables are shown to be significant for our analysis!

Table 15. Correlation matrix (Pearson (n)) from the PCA

Variables	Nr Instit.	Formalization	Novelty	Timing of action	Scope of action	Coordination mode	Transversality	Political system
Nr Institutions	1							
Formalization	0.127	1						
Novelty	-0.086	-0.119	1					
Timing of action	0.227	0.585	0.448	1				
Scope of action	-0.277	0.262	-0.162	0.266	1			
Coordination mode	-0.050	0.420	-0.151	0.623	0.452	1		
Transversality	-0.352	-0.108	-0.234	-0.095	0.303	0.143	1	
Political system	0.420	0.093	-0.679	-0.318	-0.147	0.093	0.143	1

Note:

Values in bold are different from 0 with a significance level $\alpha=0.05$

Secondly, the key finding in Tab.15 is that a clear and strong negative correlation can be seen between the variables “Political Systems” and the “Novelty” (-0.679). This robust relation between the variables suggests that the more federal a country is, the more it will use pre-

existing institutions to coordinate adaptation within a NAS. It is therefore possible to preliminarily infer that in federal countries the institutions involved in the NAS are mostly pre-existing, while in the unitary or administrative-federal countries the institutions are for the most part newly established within a NAS.

Other strong correlations exist between the “Timing of action” and the “Coordination mode” (0.623) and “Timing of action” and “Formalization” (0.585). This may mean that the institutions that initiated their action earlier in the planning process with respect to the various phases of a NAS tend to have more voluntary networking-negotiation modes (e.g. in Austria, Malta, Denmark) and their degree of formalization is lower as the institutional settings are mostly temporary (e.g. in Finland, Austria and Malta).

Besides merely looking at the correlation matrix between variables, which can already provide some useful initial insights, the next step is to extract factors, or groupings of correlated variables, that help explain the variations in the data in more detail and with some level of statistical rigor.

Firstly, we obtained eight factors of which the first three are the most meaningful since together they model most of the data variability (76%) (see cumulative variability in Tab.16). Since the sum of Factor 1 (F1), Factor 2 (F2) and Factor 3 (F3) allows to explain to reasonable extent how all the eight variables behave, we focused on these factors in the following steps of the analysis. Tab.16 shows the factor loadings calculated by the PCA, representing the correlation between a specific observed variable and a specific factor.

Table 16. Factor loadings resulting from the PCA and the amount of data variability explained by the three factors. The values are the correlation coefficients between the variables and factors. Loadings should be 0.7 or higher to confirm that independent variables identified a priori are represented by a particular factor, on the rationale that the 0.7 level corresponds to about half of the variance in the indicator being explained by the factor.

Variables	F1	F2	F3
Nr. institutions	-0.049	-0.182	0.855
Formalization	0.689	-0.264	0.317
Novelty	0.220	0.897	0.050
Timing of action	0.895	0.211	0.286
Scope of action	0.589	-0.269	-0.494
Coordination mode	0.778	-0.361	-0.039
Transversality	0.040	-0.391	-0.670
Political system	-0.292	-0.830	0.330
Variability %	29.558	24.966	21.483
Cumulative variability %	29.558	54.523	76.007

What the factor loadings tell us is in agreement with the correlation matrix and offers some additional information, as follows:

- F1 (explaining 29.5% of total data variability): the variables “Timing of action”, “Formalization”, “Coordination mode” and “Scope of action” are all positively correlated and mostly represented by Factor 1. This confirms what we have guessed previously based on the correlation matrix and adds the variable “Scope of action” to the picture: the earlier the countries initiate their action (Timing of action), the most temporary (Formalization), voluntary (Coordination mode) and with a narrow policy focus (Scope of action) the process within a NAS is, and vice-versa.
- F2 (explaining 24.9% of total data variability): the variables “Political system” and “Novelty” are negatively correlated and mostly represented by Factor 2. This supports the most statistically significant relation between variables found in the correlation matrix, and suggests that federal countries are inclined to assimilate pre-existing institutions in NAS processes while unitary countries have a tendency to create new ones.
- F3 (explaining 21.4% of total data variability): the variables “Nr. of Institutions” and “Transversality” are negatively correlated and mostly represented by Factor 3. This is a strong correlation that did not appear earlier in the correlation matrix because less statistically significant. It implies that countries that have more institutions involved in the NAS process tend to show a higher degree of separation between horizontal and vertical governance challenges, and vice-versa.

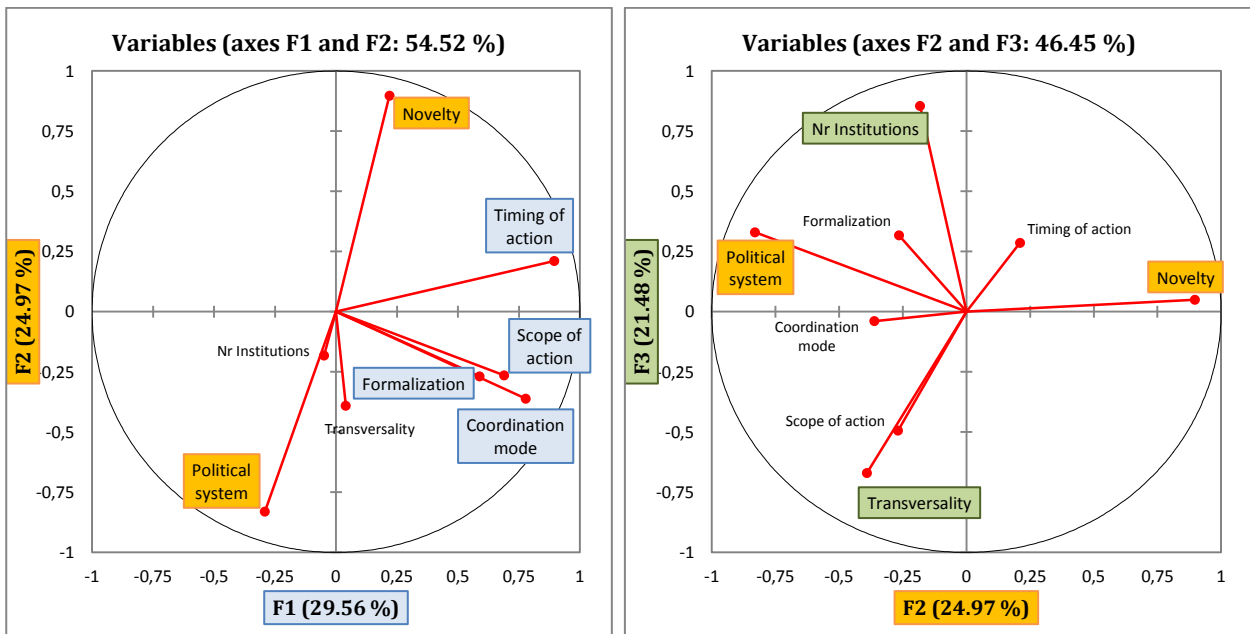
With this information we can already state that the political dimension seems to significantly affect the differences in the institutional capacity of the analyzed countries, especially with respect to the character of the novelty, since it belongs to a factor that determines quite a share of the data variability.

Based on this sample, we can obtain graphical representation that provides further clarification on the correlations existing between our main research interest, the political dimension variable, and the other institutional capacity variables.

From Fig.5, showing the combined plot of F1&F2 and F2&F3, it is possible to spot the vector “Political system” represented in both graphs as it belongs to F2, and other variables’ vectors belonging to F1 and F3 in the respective graphs. A positive correlation can be seen between

“Political system” and “Transversality”, “Nr. of Institutions” (from F2&F3 biplot) and, less significant, with “Coordination mode”, “Formalization”, “Scope of action” (from F1&F2 biplot). Besides the already assessed strong negative relationship with “Novelty”, “Political system” shows a less significant negative correlation with “Timing of action”.

Figure 5. Correlation between variables and factors (biplot of F1&F2 (on the left) and F2&F3 (on the right) explaining 76% of the data variability). When analyzing, special attention should be given to the variables more related to each factor, signalled in each graphic with a correspondent box colour (e.g. F2 axis and the related variables “Political system” and “Novelty” are highlighted in orange). Vectors in the same quadrant and with the same length are highly positively correlated (e.g. “Formalization”, “Scope of action” and “Coordination mode”). Vectors in opposite quadrants are highly negatively correlated (e.g. “Political system” and “Novelty”)



In other words, federal systems (as opposed to unitary systems) may tend to:

- i) Involve a higher number of institutions, mechanisms, procedures within a NAS for the coordination of adaptation;
- ii) Assign a higher degree of formalization to such arrangements;
- iii) Involve mainly pre-existing institutions in the NAS process;
- iv) Engage the institutions in earlier phases of the NAS development;
- v) Utilise institutions that deal not only with adaptation;
- vi) Set up most institutions with mandatory requirements or based on climate laws;
- vii) Have relatively more integration of horizontal and vertical coordination of adaptation in their institutions.

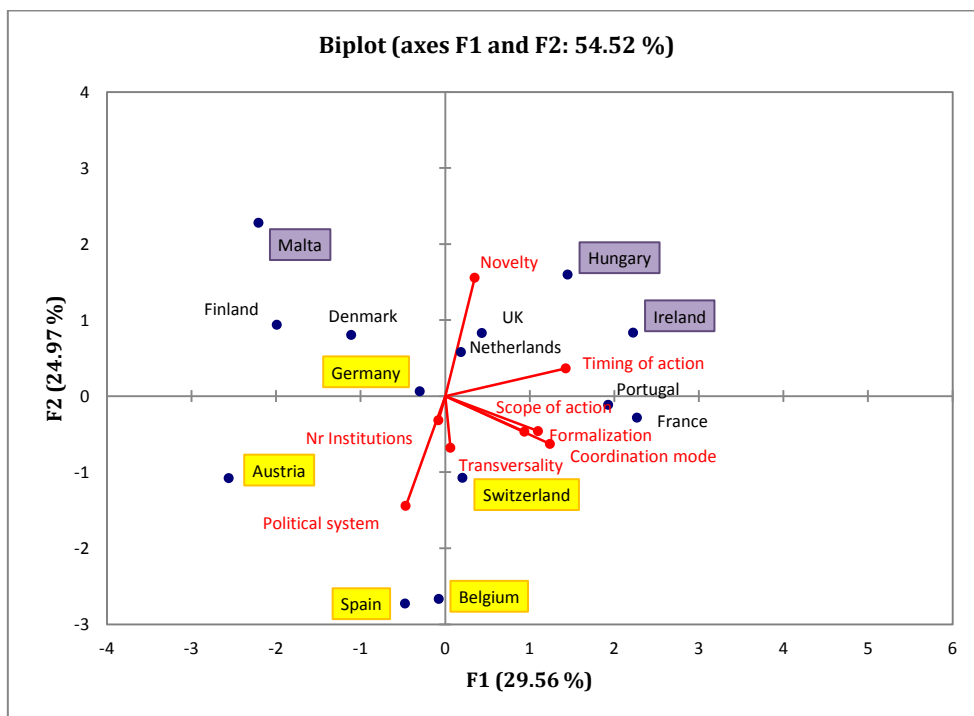
It is important to stress that these statements are general and further interpretation needs to be done to duly consider the peculiar behaviours of variables based on the initial country data (e.g. by double-checking the average scores, and minimum and maximum values).

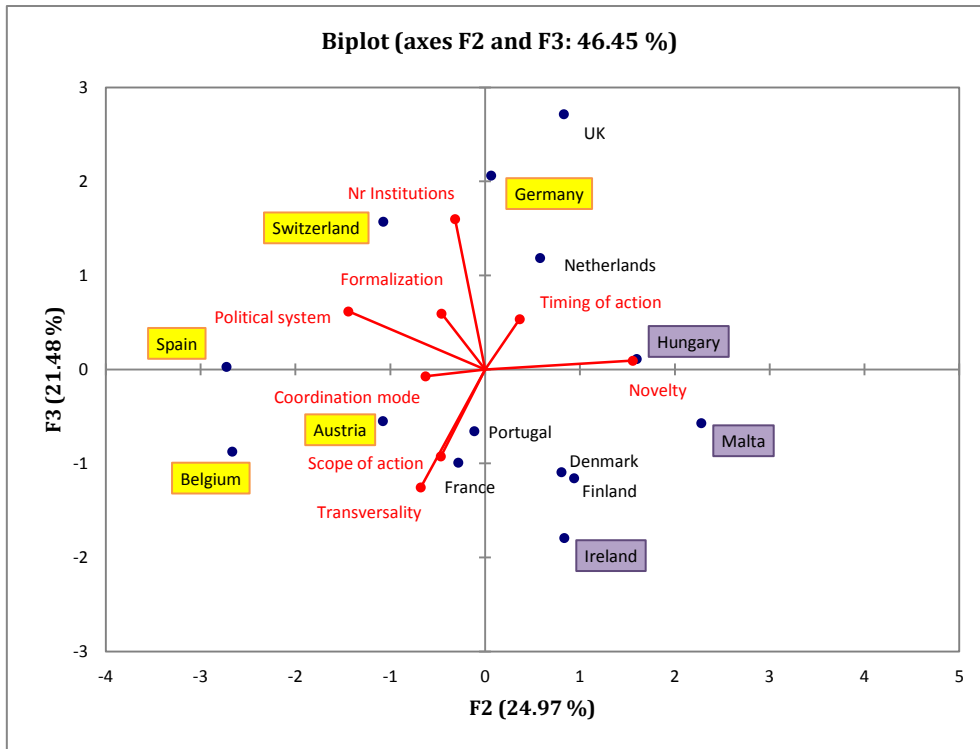
An extra analysis of the influence of political systems on the institutional capacity can be made with a focus on countries, with the support of PCA graphic outcomes.

Taking into account F1, F2 and F3 that proved statistically relevant in this analysis, we can look at the scores of these factors for each country and compare them. This allows us to verify how the countries cluster around the variables representing the institutional capacity, and if they follow any pattern in relation to their political system.

As expected from the initial results, similarities across countries with regard to certain aspects of adaptation policy planning do not match perfectly the similarities in political-administrative structures. In fact, from Fig.6, it is evident that federal countries (highlighted in yellow) do not follow a univocal pattern although it is possible to observe a general tendency. The same goes for the unitary political systems (highlighted in purple) and, less clearly, for the administrative-federal countries (not highlighted).

Figure 6. Correlation among variables, country scores and factors (biplot of F1&F2 (upper box) and F2&F3 (lower box) explaining 76% of the data variability). In purple, the unitary countries and in yellow, the federal countries. Countries in the same variable quadrant are highly positively correlated with the characteristic (e.g. Hungary with “Novelty”: the country mostly uses new institutions), while in opposite quadrants are highly negatively correlated (e.g. Spain with “Novelty”: the country mostly uses pre-existing institutions)





By graphically emphasizing the countries with respect to their scores across the relevant factors, four main clusters of countries then become visible in Fig.7, regardless of their political system. The logic behind such clusters is also proved by verifying the single country scores in the aggregated matrix (Tab.17).

- Cluster 1: Portugal and France – These countries seem to show the most marked similarities because they share exactly the same score in all the characteristics of institutional capacity assessed, with a slight exception on the “Scope of action”, as Portuguese institutions focus on climate change whilst French ones on broader policy fields.
- Cluster 2: Denmark and Finland – Both countries present the same level of “Novelty”, “Timing of action”, “Scope of action” and “Transversality” in their institutional settings.
- Cluster 3: UK, Netherlands and Germany – These countries share the high “Nr. of institutions”, and the degree of “Formalization” and “Novelty” as well as similar “Timing of action”, “Scope of action” and “Coordination mode” of their institutions.
- Cluster 4: Spain and Belgium – These two countries look similar in terms of “Formalization”, “Novelty”, “Timing of action” and “Transversality” of their institutional arrangements.

It also interesting to notice that purely unitary countries neither cluster between themselves nor with other countries. However, a sample of only three is likely to be too limited to obtain meaningful results for this category of countries.

Figure 7. Correlation between country scores and factors (biplot of F1&F2 (upper box) and F2&F3 (lower box) explaining 76% of the data variability). The circles cluster countries with higher similarities in terms of institutional capacity

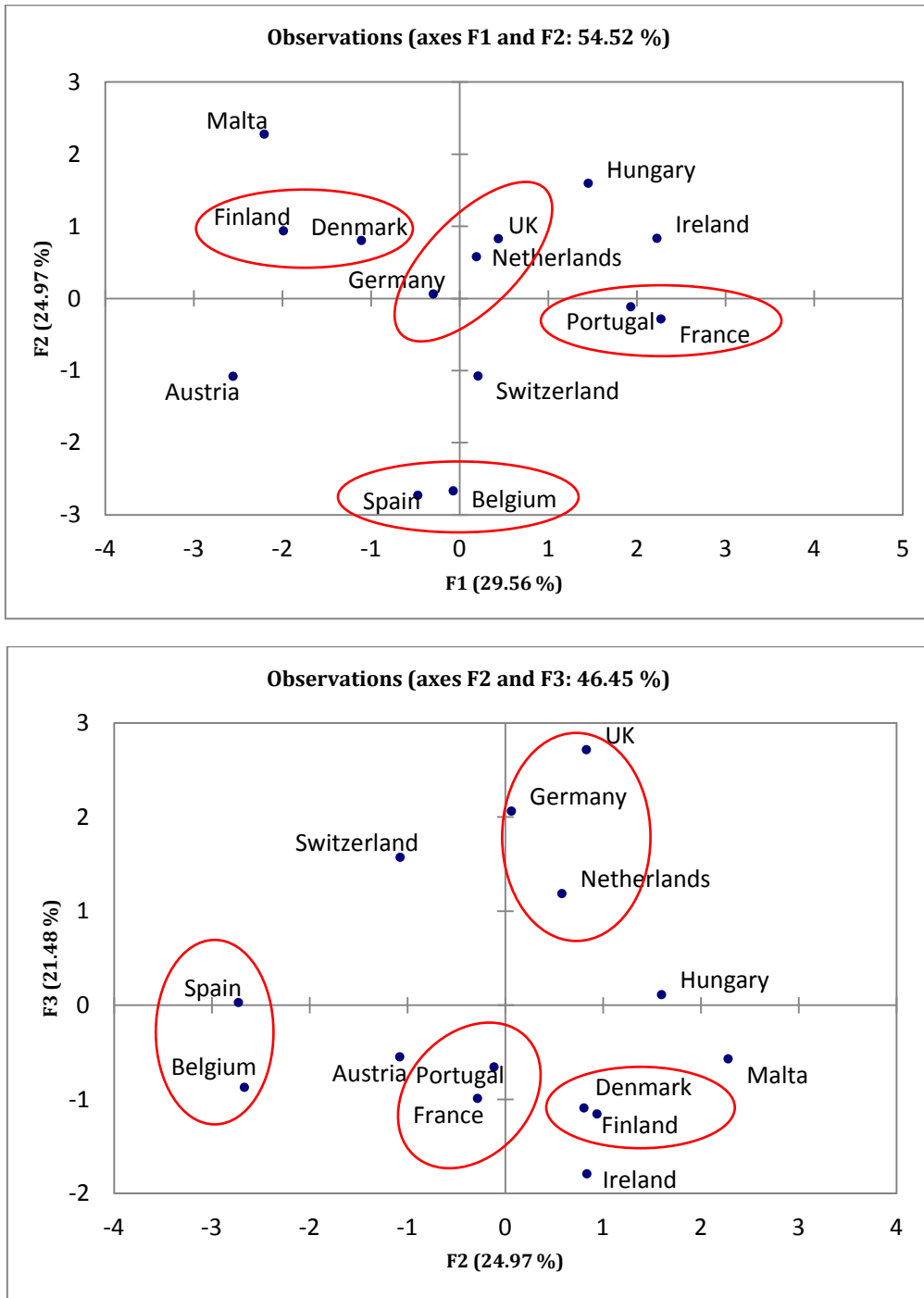


Table 17. Secondary matrix with aggregated data used in the PCA

Country with NAS	Nr. institutions	Formalization	Novelty	Timing of action	Scope of action	Coordination mode	Transversality	Political system
Austria	4	Equal combination	Equal combination	Pre-NAS	Adaptation + Climate Change (equal mix)	Voluntary	Integration	Federal
Belgium	2	Institutionalized	Pre-existing	Whole process (single institutions)	Adaptation + Climate Change (equal mix)	Mandatory	Integration	Federal
Denmark	1	Institutionalized	New	Whole process (single institutions)	Adaptation	Voluntary	Integration	Adm-Fed
Finland	3	Temporary	New	All phases covered (different institutions)	Adaptation	Mostly voluntary	Integration	Adm-Fed
France	3	Institutionalized	New	Post-NAS	Broader policies	Mandatory	Integration	Adm-Fed
Germany	5	Institutionalized	New	All phases covered (different institutions)	Adaptation	Mostly voluntary	Separation	Federal
Hungary	3	Institutionalized	New	Post-NAS	Climate change	Mostly voluntary	Separation	Unitary
Ireland	1	Institutionalized	New	Post-NAS	Climate Change	Mandatory	Integration	Unitary
Malta	2	Equal combination	New	Pre-NAS	Adaptation	Voluntary	Separation	Unitary
Netherlands	5	Institutionalized	New	Post-NAS	Sectoral policy	Mostly voluntary	Integration	Adm-Fed
Portugal	3	Institutionalized	New	Post-NAS	Climate change	Mandatory	Integration	Adm-Fed
Spain	5	Institutionalized	Pre-existing	Whole process (single institutions)	Climate change	Mostly voluntary	Integration	Federal
Switzerland	4	Institutionalized	Equal combination	Whole process and post-NAS	Adaptation	Mostly mandatory	Separation	Federal
UK	7	Institutionalized	New	Post-NAS	Adaptation	Mostly voluntary	Separation	Adm-Fed

DISCUSSION OF RESULTS

This section provides answers to the main questions of this analysis based on the previous results.

Is there a common approach that can be drawn from the experience of European countries for defining a “national adaptation strategy”?

Looking at the overview of NASs across European states, two main intentions of an adaptation strategy in terms of its content stand out: 1) an adaptation-focused approach and 2) a broader climate change approach. While the first is followed by the majority of countries that have developed or are in the process of developing their adaptation policy through a dedicated framework, others (Bulgaria, Hungary, Lithuania, Greece, the Czech Republic, Iceland, Liechtenstein, Sweden, Turkey) rely on the latter to tackle adaptation matters, through a UNFCCC-like configuration which yet includes the predominant consideration of mitigation issues in almost all cases. The UK government is a special case since a broad climate change act was the legal basis for an adaptation-focused implementation plan, complemented by devolved countries' adaptation strategies and plan. In the light of the equal importance that adaptation and mitigation now assume in climate change policy planning at the European and international level, both approaches seem acceptable, provided that substantial examination of adaptation knowledge and options to deal with observed and expected impacts and vulnerabilities is achieved to support a national vision on adaptation.

The fourteen NASs acknowledged in this analysis are the ones that focus only or substantially (in the case of Hungary) on adaptation. However, within the set of analyzed NASs, a number of differences can be found about the content (Venturini, Medri et al., forthcoming) (Chapter 2 of this dissertation). Significantly, most NASs do not include explicit prioritization of options based on cost-benefit analyses for all fields of action, nor specific implementation provisions. The issues of monitoring adaptation action, reporting on the progress and reviewing the strategy are tackled through institutional settings in few countries, particularly those with a that adopted a climate change strategy. It can be noted that where a climate change act is in place, either serving as the NAS or complementing it (e.g. in Hungary and the UK, and

Switzerland) those arrangements are institutionalized and of mandatory nature as opposed to *ad hoc* and voluntary (Finland). In fact, a Climate Act in Finland is being set up: it will include adaptation elements and is expected, among other things, to enforce monitoring and reporting activities.

This links to the second aspect of our discussion. With regard to the form of a NAS, all countries refer to it as a single policy document or legal act that sets strategic priorities, separated from an eventual action or sectoral plan of implementation that is, in a few cases, mandated by the NAS (e.g. the UK 2008 2013 “*National Adaptation Programme*” mandated by the “*Climate Change Act*”).

As such, NASs do not necessarily imply the prompt or regular completion of the whole adaptation policy process as described in the Climate-ADAPT Adaptation Tool. Countries may adopt a NAS and then interrupt or amend the process due to purely political reasons, as in the emblematic case of the Netherlands. The original Dutch 2007 NAS had a broad scope and was supported by the Ministry of Housing, Spatial Planning and the Environment, however the implementation process hardly got a start before the next political decision in 2010. Based on a sense of urgency, the Dutch Government chose to narrow down the focus on water related issues such as water safety (coast and rivers) and water quality. The original NAS was abandoned and replaced by a yearly action plan, the “*Deltaprogramme*” under the new Ministry of Infrastructure and Environment that formulated new priorities. In November 2012 the Dutch Court of Audit criticized the narrow scope of the Dutch adaptation policy and warned on risks about sectoral themes not covered by the Deltaprogramme. In response the Dutch Cabinet launched a so called “*Climate Roadmap*” in October 2013, focusing on both adaptation and mitigation. With such a Climate Roadmap a trajectory has started on the way to a more comprehensive NAS to be realized by 2017 (Schoonman, 2013; personal communication).

Having learnt the approaches, the inconsistency of definitions found in the European documentation taken into account in this analysis is likely to have implications on the future national and European policy. Specifically, in the context of the recently launched EU Adaptation Strategy, the Commission advanced the proposal of a system to evaluate countries’ adaptation policy, a so-called “*adaptation preparedness*

scoreboard” (EC, 2013, p.6) that would measure the level of readiness of countries through a number of key indicators. Based on this scoreboard and the national report on adaptation action provided under the enhanced Monitoring Mechanism¹⁶ Regulation (EC, 2011), the Commission intends to assess the adequacy of “*the coverage and quality of the national strategies*” that have been put in place by Member States by 2017 (EC, 2013, p.6). If countries’ achievements in adapting to climate change are judged unsatisfactory in these terms, the Commission is determined to propose a legally binding instrument, such as an Adaptation Directive, that will oblige them to comply with certain requirements.

Can the characteristics of adaptation governance be statistically associated to the countries’ political system?

A convergent line of thought towards the possibility that adaptation policy responses to climate change are affected by political-administrative structures has already been emerging among scholars who based their inductive reasoning on general evidence (Mullan et al., 2013; Dumollard & Leseur, 2011).

Dumollard & Leseur (2011), analyzing a restricted number of European countries (Germany, Spain, France, the Netherlands, the UK), noted that the role of regional and local governments has been emphasized to varying extents, especially in decentralized systems, at the stage of drawing up and/or implementing adaptation policies. A broader study on OECD members by Mullan et al. (2013, p.24) provides general statements on the likely overall influence of the political systems on the scope and characteristics of national adaptation planning based on some examples: for instance, it reports that France’s comparatively centralized governance system is reflected in its inclusive NAS, while federal Austria’s strategy emphasizes more the responsibility of local administrations.

Bauer et al. (2012, p.298) confirm this idea through a qualitative analysis of governance challenges, stating that the characteristics of vertical coordination of adaptation especially depend on national political systems, as federal countries

¹⁶ Mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

appear to involve regional and local governmental tiers more than unitary countries, particularly in the early phases of developing a NAS.

We can preliminarily support this theory taking a look at our overview of the NASs and the countries' respective political systems. An immediate association between the tendency towards federalism and the promptness of the countries in adopting a NAS comes out.

In fact, all the federal and administrative-federal countries in Europe have been more pro-active in adaptation planning compared to the centralized states. Only three unitary countries out of eighteen (Hungary, Ireland and Malta) have adopted a NAS. This diversity in the pace of policy planning may be due to the fact that, in some cases, federal countries have experienced a ferment of adaptation at the local levels in recent years that has been the driver for national policies. For instance, in Switzerland, the Uri Canton was the first to provide a comprehensive climate strategy in 2011, covering both mitigation and adaptation, before the Swiss NAS was finalized. Also, pre-existing regional partnerships and networks of cities largely contributed to the adaptation landscape in Germany and Spain.

However, other reasons besides the political structure may better explain this dynamic, such as the general availability of resources in the country and the arrangement of economic incentives/subsidies, cultural values, societal expectations, and different political opportunities.

Through our study we wanted to *quantitatively* verify if the organization of powers determines the institutional process followed to outline and implement the adaptation policy.

From the results of the statistical analysis performed it can be confirmed that there is a significant correlation between the political dimension and the institutional capacity of NAS.

Such correlation exists between the political system variable and all the seven criteria concerning the institutional settings, although it is valid to differing degrees, as follows:

- Novelty (*negative correlation; robust confidence*);
- Nr. Institutions (*positive correlation; medium confidence*);
- Timing of action (*negative correlation; medium confidence*);
- Coordination mode (*positive correlation; weak confidence*);
- Formalization (*positive correlation; weak confidence*);
- Transversality (*positive correlation; weak confidence*);
- Scope of action (*no significant correlation; weak confidence*).

The confidence on the correlation between the political dimension and the institutional capacity variables is measured by the coherence of the relationship between the variables' signal (+/-) under each of the factors that better explain the variables (in Tab.16): when the relationship between the signals is respected in both factors *and* the values are similar in their magnitude the correlation is considered robust; when only the relationship between the signals is respected across the factors that explain the variables, the correlation is of medium strength; when the relationship between signals is incoherent across the factors the correlation is weaker. Furthermore, such correlations imply general statements that need to be interpreted in order to provide coherent conclusions.

For instance, in the case of the "Scope of action", what Tab.16 and the graphs tell us is that it is positively correlated with "Political system" under F2 and negatively under F1 (and F3). Looking at that, and supported by the evidence of the basic data where no clear pattern can be identified across countries, what we can conclude is that there is in fact no significant statistical correlation with the "Political system". As the political dimension seems to have no influence on the scope of institutions involved in the NAS compared to other factors, there must be other internal (within the very institutional capacity) or external explanations. For instance, the "Coordination mode" is highly statistically correlated to the "Scope of action". Countries with broader scope (climate change or environment) in their NAS arrangements, tend to have mandatory institutions, while countries with focus on

adaptation or sectoral policy fields tend to have mostly voluntary institutions in the process.

The meaning of the correlations is specified in the next answer.

What are the main differences and similarities in institutional settings of NASs across federal and unitary states?

According to the results obtained in the PCA, federal, administrative-federal and unitary countries do not follow a univocal pattern of adaptation governance although a general trend can be noticed. Our interpretation of the correlations resulting from the factor analysis is also based on the general overview of the institutional settings and the aggregated data per country.

The following conclusions stand out:

- Novelty: while all unitary and administrative-federal countries tend to establish new institutions within a NAS, federal countries tend to use pre-existing institutions, perhaps already in place to meet the needs and give voice to lower governmental tiers and existing “provinces”.
- Number of institutions: federal (average score = 4) and administrative-federal countries (average score = 3.7) tend to involve a higher amount of institutions to deal with the NAS while unitary countries tend to have less (average score = 2). These additional institutions are often public consultation processes and boards of regional/local representatives that are necessary to integrate adaptation across governance scales and thus may serve the purposes of vertical integration jointly with cross-sectoral coordination.
- Timing of action: federal countries seem to engage the institutions from the earlier phases of the NAS (average score = 2.2), covering the whole process from the development to the implementation (with the same or different institutions), while unitary countries mostly wait for the later stages to set up appropriate institutional mechanisms (average score = 3). Generally speaking, pre-NAS institutions or ad hoc processes may disappear once they have fulfilled their task (e.g. preliminary consultation, drafting) while post-

NAS arrangements are longer-term provisions (e.g. monitoring and review, committees for implementation).

- Coordination mode: federal states (average score = 2.2) tend to have mandatory requirements for their institutional arrangements based on NASs and climate laws, while unitary states (average score = 2) can have more voluntary modes. However, here the difference is very subtle and this conclusion has to be taken with caution. More mandatory-like coordination modes (e.g. monitoring and reporting schemes) are likely to appear only once the NAS is adopted with the aim of enforcing its provisions.
- Formalization: federal countries tend to assign a high degree of institutionalization to the arrangements for the NAS (average score = 2.8) compared to unitary countries. However, administrative-federal unitary countries also do (average scores = 2.7), although to a slightly lesser proportion. Like in the previous conclusions with low confidence, given the available information we cannot distinguish clearly the categories of countries based on the level of formalization. There is, indeed, a general tendency of all governments to have more permanent institutions as opposed to temporary processes. Administrative-federal Finland represents the only exception in this case.
- Transversality: federal countries (average = 2.2) tend to have more integration between horizontal and vertical challenges in their institutional settings when compared to unitary states (average = 1.7), but the administrative-federal countries (average = 2.7) are the ones that promote transversality more. Besides the overall trend to address the two adaptation challenges jointly, this is a delicate characteristic to assess across countries' categories. One reason may be that having already existing institutions in place that are suitable, federal countries tend to optimize by integrating the challenges there, while in unitary countries new institutions are mostly created to respond to single challenges.
- Scope of action: this seems the most complex issue to assess per country categories in this exercise, given the low confidence on this correlation and the unclear pattern in the raw data. Federal countries (average score = 2.8) and unitary countries (average score = 3.3) seem to oscillate between the

preference for institutions with focus on adaptation and those with focus on climate change. Within the overall (expected) tendency towards adaptation-focused institutions, the only extreme values are represented by two administrative-federal states: France and the Netherlands showing respectively preference for broader and narrower policy focus.

CONCLUSIONS

This paper has introduced the definitions of “national adaptation strategy”, “institutional settings for adaptation” and “political systems” in order to make use of them in a quantitative analysis. It has proved the existence of fourteen NASs across Europe that match the proposed definition content-wise and form-wise. These NASs are characterized by a variety of governance approaches (48 institutional settings) established to tackle the challenges of horizontal and vertical integration of adaptation. Three typologies of political systems have been assessed in Europe according to the degree of policy responsibility assigned to sub-national administrations. The data collected from literature and country reporting were elaborated and originally employed to run a factor analysis aimed at identifying the correlation between the political dimension and the institutional capacity of the selected countries. The PCA is used in many disciplines, including social sciences, to meaningfully interpret observations of reality. To our knowledge, this method was used for the first time in the research domain of adaptation by the present paper.

A number of scientific uncertainties around the method applied must be acknowledged. The major uncertainty is associated with the basic data. Despite the relatively high confidence about the information on NASs and political systems collected, defining the institutional settings was not a straightforward exercise. Some of the chosen criteria were reasonably easy to assess (e.g. the number of institutions), but it was sometimes problematic to identify the nature of institutions (e.g. the exact timing of their action or the way they coordinate) with a high degree of certainty, since the available information was incomplete or unclear. To overcome this issue, the data were validated by the chosen national adaptation focal points who provided clarification and determined the final data matrix. Nevertheless, this validation was based on the individual scrutiny of the interviewed person and

remains at least partly subjective. Furthermore, the fact that the countries' sample was composed of only fourteen elements, of which only three were representatives of the category "unitary countries", could have been a bias to the PCA, in that it is usually applied to a larger sample. Despite the underlying uncertainty on the data collected, which is a common problem of statistical analyses, the PCA is considered a sound methodology. In fact, we were able to explain all the eight variables in the first three factors identified by the PCA that together accounted for the 76% of the total data variability (extremely good statistical-wise). The variables proved all independent and not redundant. Given the small series of data and the importance of analyzing all the variables, no data reduction was then needed. The conclusions that were drawn from the PCA are therefore solid, although they naturally needed further interpretation to ensure coherence with single cases.

As a result, we found that across Europe there are two main different perspectives on what a NAS is. Countries are split into two groups: the majority of those that have adopted or are preparing a NAS see it as a vision document focused on adaptation, while others intend it as a broader climate change strategy that pays equal attention to adaptation and mitigation, setting broad directions for countrywide action endorsed by the government. These definitions seem, however, to have the same implications on the delivery of adaptation, except for the provisions of monitoring of adaptation action and reporting, and for the review of the strategy.

While monitoring and reporting schemes tend to be mandatory under strategies that involve climate change legislation, in both approaches the allocation of resources and responsibilities for implementing the strategy are generally postponed to a later stage. Delaying the realization of a NAS may be due to different motivations including the need for further consultation and planning among ministries, or the failure to identify available human and financial resources. Significantly, we have learnt that political priorities that are not strictly related to climate change agenda may arise and modify the process of the implementation of the NAS, as in the case of the Netherlands.

The difference in definitions is likely to become politically relevant for the countries once their degree of adaptation preparedness and the value of their NAS have been

assessed by the Commission. Whether the Commission's scoreboard will check the accomplishment of the 5-steps adaptation policy cycle or just the existence of a NAS paper (or a climate change legislation) in a country, is not clear yet. Which will make a huge difference for many EU Member States that would be subject to possible obligations on adaptation from the EU if they fail to demonstrate good progress.

As per initial hypothesis, we acknowledged that the pattern of response of any nation to climate change will be conditioned by the configuration of political systems, on the basis of previous literature. This study presented some empirical evidence in the promptness of federal countries in adopting a NAS as opposed to a late reaction by the majority of unitary countries that have started to develop their policy only recently. Only three out of eighteen unitary countries have a strategy, while almost all administrative-federal and all the federal countries have finalized the NAS document.

Through the PCA, a significant statistical correlation could be found between the political dimension and the institutional capacity, particularly for what concerns the degree of novelty of institutions dedicated to a NAS that seem to be strongly positively influenced by the type of political-administrative structure (federal countries tend to use pre-existing institutions, mechanisms and processes, while unitary tend to create new institutions). Ultimately, although the correlation is found to be meaningful, we can state that political systems only explain a limited part of the countries' choices in terms of adaptation governance settings, and other external or internal variables may have a stronger influence.

Venturini, Medri et al. (forthcoming) (Chapter 2 of this dissertation) draw attention to the fact that although they are the most vulnerable to climate change, only four Mediterranean countries, Spain (federal), France, Portugal (administrative-federal) and Malta (unitary), have adopted a NAS. This implies that different factors could possibly affect national policy processes besides the political dimension and the participatory nature of the government, open to receiving policy inputs from lower administrative levels and society, as in the case of some federal states. The financial and economic circumstances (availability of national resources), different political conditions (how strategies are perceived within different governments and the role

with respect to other environmental / development issues), cultural values (inclination towards long-term or short-term planning), as well as societal expectations (increased awareness due to the existence of similar strategies in neighboring countries and the push from the EU) are all drivers that need to be

Focus on Italy

According to the project ESPON, Italy is split in three main climatic areas that fit into different climate change regions (Greiving et al., 2011). The Alps belong to the Northern European region; the North of Italy and the Apennines are more similar to the Southern-central Europe region; while coastal zones, most of Southern Italy and the islands are definitely Mediterranean regions.

considered in future analyses.

A parallel between federal countries and the EU helps to understand the function that the Commission has in fostering national adaptation action, by filling knowledge and funding gaps through the EU Adaptation Strategy as the central governments do with their “provinces”.

On one hand, the transferability of knowledge and good practices across regions and countries is deemed essential to achieve progress on adaptation in Europe. Since climate change impacts often cross political borders of European countries, NASs need to be tailor-made and address trans-national issues consistently with the neighbouring policies. On the other hand, the context-dependency of adaptation may affect the value of transferability.

One “best practice” of adaptation governance to follow is therefore not possible to identify in principle, and in practice the aim of this paper is not to provide a ranking of the institutional performances of countries based on their political system.

Instead, the outcomes of this research suggest that lessons on adaptation planning should be continuously exchanged between countries that are closer in terms of governance. In the course of the statistical test, four clusters of countries emerged, as they are linked by certain similarities in the institutional capacity for adaptation: 1) France and Portugal; 2) Denmark and Finland; 3) UK, Netherlands and Germany; 4) Spain and Belgium. These governments, that are now putting their NAS into operation with diverse speed and modalities, are encouraged to establish cooperation, dialogue and exchange of good practices on the aspects that have

determined the success (or failure) of the institutional settings involved in the NAS implementation, in order for others at earlier stages of implementation to adjust the future phases of the process as necessary.

Countries that are still developing their NAS, as Italy, Norway and all the remaining European unitary states are, should first of all establish cooperation with countries belonging to the same “climate change regions” (Greiving et al., 2011) to learn how to face similar and transnational expected climate change impacts through their future NAS. Finally these countries, especially those of which less is known on the governance of adaptation, as the complexity in collecting data and information in the absence of a NAS has been a barrier to research, are advised to further promote this line of investigation and deepen the knowledge of the role that their national administrative and socio-economic systems can play in the development and implementation of adaptation strategies. In particular, the present research could be extended in scope to adaptation-relevant institutions existing in countries without a NAS, in order to better assess common approaches and identify aspects of knowledge transferability and potential cooperation between more advanced and less advanced countries in terms of adaptation planning.

CHAPTER 4 – Climate change impacts and vulnerabilities in Italy: what are the adaptation responses?

This chapter is based on: Medri, S., Venturini, S., Castellari, S. (2013). Overview of climate change impacts, vulnerabilities and adaptation action in Italy. CMCC Research Paper, August 2013.¹⁷

INTRODUCTION

The Mediterranean region is expected to face particularly negative climate change impacts over the next decades, which, combined with the effects of anthropogenic stress on natural resources and low adaptive capacity, make this region one of the most vulnerable areas in Europe. Italy, as a Mediterranean country, is exposed to a number of impacts that increase the vulnerability of its human and natural systems. Yet the Italian government has not adopted a national adaptation strategy to climate change (NAS), a national adaptation plan (NAP) or any specific action plan to face climate change consequences and build capacity to overcome them. Only recently has a process towards the establishment of an Italian NAS been initiated and it is currently ongoing. Despite the lack of comprehensive economic assessments and a coherent framework for action on adaptation, a variety of climate change adaptation initiatives have already become reality, especially at the regional and local scale.

Only few countrywide assessment studies that take stock of the current Italian situation with regard to climate change challenges and adaptation responses exist, however for the most part they are limited in scope and often available only in Italian.

¹⁷ The original CMCC research paper was reshaped and enlarged in order to be suitable for this dissertation. My contribution to the new paper was the following: introduction, section on national adaptation response, analysis and conclusions. Silvia Medri had the responsibility for the overall coordination in the original working paper and contributed to the data collection. Sergio Castellari provided advice and review.

This paper presents an extensive desk review of the available knowledge on climate change impacts and vulnerability in Italy and illustrates the state of the art of the adaptation policy and practice in the country, including available information on costs of impacts and costs of adapting to climate change. In the first place, it aims to provide complete and accessible facts on the Italian approach to facing climate change consequences, that could be used to display the existing national adaptation efforts in the European and international arena, for instance, in the context of the EU Adaptation Strategy process for monitoring and reviewing countries' progress on adaptation (EC, 2013) and the National Communications to the United Nations Framework Convention on Climate Change (UNFCCC). In the second place, it identifies relevant gaps in the adaptation planning and practice that should be addressed in the future NAS to ensure that national vulnerabilities are addressed in a comprehensive approach.

The paper is structured as follows. Section 1 introduces the expected climate change challenges relevant for the Italian case for each of the twelve sectors of key national socio-economic and environmental interest. Section 2 describes the range of sectoral adaptation initiatives that have already been implemented in Italy despite the lack of a NAS, including legal frameworks and practical measures. The paper concludes with a summary of the key findings on the Italian situation and insights on the future National Adaptation Strategy.

OVERVIEW OF EXPECTED CLIMATE CHANGE IMPACTS AND VULNERABILITIES IN ITALY

This section provides an overview of the expected climate change impacts and vulnerabilities in Italy, covering the following twelve key sectors: water and hydro-geological system, biodiversity and ecosystems, coastal zones, fisheries and aquaculture, soils, agriculture and food production, forests and forestry, human health, tourism, urban areas, energy and infrastructure. The sectors were chosen for two sets of reasons. First, these are the most vulnerable sectors identified through relevant findings in overall scientific assessments on the Mediterranean region and Southern Europe (Navarra & Tubiana, 2013 and 2013a; EEA, 2012, 2012a, 2010 and 2007; EEA, JRC & WHO, 2008; IPCC, 2007). And second, they include the priority sectors identified by the research community in Italy throughout various national

studies (Castellari & Artale, 2009; Carraro, 2008; Menne & Wolf, 2007; Antonioli et al., 2007). Insights on the monetary costs of climate change are provided at the end of the section, based on the few available economic assessments with a focus on Italy.

Located in the South of Europe, Italy is composed of a peninsula and a number of islands including Sicily, Sardinia and about seventy smaller ones. The environmental features of the Italian territory are similar to the ones of other Mediterranean countries in Europe (Spain, Portugal and Greece), with a dry and hot Mediterranean climate in summer, North-South variations in soil characteristics, as well as vegetation quality and cover predominantly influenced by elevation (EEA, 2010 – on-line country assessments). The Mediterranean area where Italy is situated is characterized by a dry climate and natural resources affected by anthropogenic stresses. The whole region is expected to be particularly exposed to negative climate change impacts over the next decades. Such impacts are mainly related to possible exceptional temperature rise, especially in summer, increased frequency of extreme weather events (heat waves, droughts and severe rainfalls) and reduced annual precipitation and river flow (a complete assessment of climate change in the Mediterranean region is contained in Navarra & Tubiana, 2013 and 2013a). As a result of high exposure and low capacity to cope with the consequences, the Mediterranean region is considered one of the most vulnerable areas in Europe (IPCC, 2007).

In this context, Italy expects a range of impacts and vulnerabilities associated with climate change that would critically affect the following national circumstances:

- water resources and areas at risk of desertification;
- coastal areas prone to erosion and flooding and susceptible to alterations of marine ecosystems;
- Alpine regions and mountain ecosystems experiencing glacial loss and snow cover loss;
- areas prone to flood and landslide risk (including the risk of flash floods, flash mud/debris flows, rock falls and other mass movements related to soil and land management) and, in particular, the hydrographical basin of the Po River, as well as the Alpine and Apennine regions.

As stated by the Intergovernmental Panel on Climate Change (IPCC), climate change is likely to magnify the regional differences in terms of quality and availability of natural resources and ecosystems at the European level. Such a dynamic could hold true also for Italy.

WATER AND HYDRO-GEOLOGICAL SYSTEM

Water resources (in terms of annual precipitation and river discharge) are projected to decrease over Southern Europe, and this regional pattern could intensify in the last decades of this century. Population growth and climate change could lead to an increase in the number of people living in river basins characterized by water shortage located in various European areas, including Italy (EEA, 2010).

The existing conditions of high stress on water resources and hydro-geologic disturbance in some Italian regions could be exacerbated by the projected climatic changes, through the following processes (Portoghese et al., 2009):

- reduced water availability and quality;
- increases in frequency and intensity of droughts, especially in summer;
- increases in frequency and severity of reductions of summer river flows, and annual river flow decline;
- limited groundwater recharge.

Such conditions could compromise the ability to moderate the effects of extreme weather events and to regenerate the water reservoirs.

WATER QUANTITY AND QUALITY

The quantity and quality of water resources in Italy could be subject to the following adverse situations (Portoghese et al., 2009; EEA, JRC & WHO, 2008; Funari et al., 2007):

- reduced water availability, especially in summer;
- increased water stress by 25% in the present century;
- severe negative impacts in the South, where vegetation and territory have already been experiencing a marginal water supply regime (safe water supply is becoming a social and economic emergency);

- increased seasonal water deficit due to significant pressures of summer tourism peaks on already scarce water resources, especially in small Mediterranean islands;
- potential increased conflicts among multiple users of water resources.

HYDRO-GEOLOGICAL SYSTEM

A 2006 mapping of the flood and landslide risks in Italy shows that 5.2% of the Italian territory is exposed to the risk of landslides, the areas at risk of flooding correspond to 4.1% of the national territory, and 0.5% of the country is prone to avalanches (Bigano & Pauli, 2007). According to a more recent assessment of the hydro-geological instability of the Italian territory carried out in 2008, such risks affect 9.8% of the national territory (conditions of “high” and “very high” risk and hazard), of which 6.8% involves built-up areas with exposed properties such as urban centres, infrastructure, and industrial areas (MATTM, 2008).

Climate change impacts on the Italian hydro-geological system might include the following (EEA, 2012; Portoghese et al., 2009; EEA, JRC & WHO, 2008; MATTM, 2008):

- variations in the hydrologic regime related to:
 - progressive melting of the glaciers and reduction of seasonal snow cover in Alpine catchments, due to rising temperatures and changing precipitation patterns;
 - increase in the aridity of soils and in the frequency of drought events in the plain areas;
 - changes in groundwater related to increased saltwater intrusion in coastal aquifers, due to sea level rise and lower capacity of beach nourishment associated with both anthropogenic interventions and climate-related processes;
- increased risk of inland flooding, due to more frequent river flood heights in relation to heavy precipitation events, with possible consequent onset of regional “hot spots” for impacts on physical structures;

- increased winter run-off by 90% and decreased summer run-off by 45% in central Europe's Alpine rivers, with consequent greater risk of flooding and drought in the respective seasons (Beninston, 2006);
- significant changes in the hydrologic balance and water quality of some assessed river basins (Rio Mulargia, Sardinia and Alento river, Campania) (Lo Porto et al., 2007), with an estimated reduction in annual discharge and nutrients and sediments transport in the next decades (Greiving et al., 2011);
- increased risk of flash mud/debris flows, due to the potential increase of extreme weather events;
- increased risk of avalanches in the Alps, due to ice melting; generalized risk of rock falls in the Apennine region, because of possible more frequent and sudden freeze-thaw cycles, especially in winter; risk of flash floods in both areas, due to severe precipitation events.

The areas most exposed to the risk of flood and landslide include: the hydrographical basin of the Po River, subject to increased flood risk; and the Alpine and Apennine areas, subject to increased flash flood risk.

BIODIVERSITY AND ECOSYSTEMS

Italy is characterized by one of the most significant natural heritages of animal and plant species in Europe, in terms of both the total number of specimens and the high rate of endemism.¹⁸ Furthermore, fifty sites in the country have been recognized as internationally important wetlands in the Ramsar Convention's list.¹⁹

Current major threats to Italian biodiversity for species and habitats are also associated with climate change, especially for mountain environments (MATTM, 2010). Since ecosystems are expected to move north and towards higher elevations as a consequence of climate change (about 100 km northwards and 150 metres upwards per 1°C rise in yearly average temperature), possible risks to Italian ecosystems can be foreseen due to the country's orography limiting the possibility for ecosystems to actually shift, and the fast pace of climate change exceeding the

¹⁸ Compared to the total in Europe, over 30% of animal species and almost 50% of plant species live in Italy, on a surface of about 1/30 of the continent (Cf. MATTM Website: "[Biodiversità](#)").

¹⁹ Cf. MATTM Website: "[Zone umide di importanza internazionale](#)".

time span necessary for the ecosystems to relocate (Menne et al., 2009). Thus, Italy is expected to face an extremely high risk of biodiversity and natural systems loss.

AQUATIC ECOSYSTEMS

The anthropization of the Mediterranean shores in the last century has already led to a progressive decline of marine biodiversity, magnified by the semi-closed basin features of the Mediterranean Sea with slow recharge waters. Mediterranean marine organisms, communities and ecosystems might be altered by climate change, including with the spreading of invasive marine species due to water warming, which would imply a general decline of marine biodiversity (EEA, JRC & WHO, 2008). In particular, during summer, the conditions of high temperatures and low food availability in the Mediterranean Sea lead to reduced seasonal activity in many benthic suspension feeders. Under these circumstances many biological processes are expected to be negatively affected by projected climate change, which could imply mass mortality of invertebrates among other consequences. Simulation of the effects of these conditions reveal a biomass loss higher than 35% (Coma et al., 2009). The increasing development of marine mucilage in the Mediterranean waters during the last twenty years can be considered a sign of altered environmental conditions for such aquatic systems. This phenomenon, which is linked to sea surface temperature increase, might favour the spreading of pathogenic bacteria (Danovaro et al., 2009).

Freshwater ecosystems are also expected to undergo major negative changes such as loss of habitats, decline in biotic components and related processes, with the extent of specific impacts depending on the typology of ecosystems. A warmer climate could induce a reduction in species richness in freshwater ecosystems, especially in the Alps (Cecchi et al., 2007). Higher temperatures affecting water thermal stratification might increase the risk of excessive growth of algae and cyanobacteria and eventually eutrophication processes in lake ecosystems, especially in late summer (Menne & Wolf, 2007). Furthermore, the loss of wetlands would cause severe imbalances in the related biotic communities. The variety of reptiles and amphibians is likely to be reduced in some regions of Italy due to their low ability to spread around and the great fragmentation of habitats (Aràujo et al., 2006).

TERRESTRIAL ECOSYSTEMS

Mediterranean-type terrestrial ecosystems are likely to be especially affected by new climatic conditions. They might experience the following changes (IPCC, 2007):

- increased risk of extinction for several terrestrial species, changes in the structure of the biological community and biodiversity loss;
- potential contraction of forests and biodiversity loss especially in the South and in the mountains;
- advancing trends in plant phenology;
- loss of wetland ecosystems;
- changes in spatial distribution of fauna.

Across Europe, all mountain ecosystems could face a number of negative consequences. Italian mountains (Alps and Apennines) are considered very fragile environments, hence are especially vulnerable to climate change (MATTM, 2010). Among the expected impacts there are the following (Castellari, 2008; IPCC, 2007):

- significant changes in the structure of mountain plant communities, induced by a 1-2°C temperature increase;
- shift of plant and animal species towards higher elevations, with changes in the composition and structure of Alpine and nival communities (Cecchi et al., 2007) generally putting mountain flora and fauna at high risk of extinction;
- alteration of the hydrological cycle, with consequences on both the water balance of rain-collecting basins and the stability of mountain slopes, resulting in higher risk of soil erosion and rock falls;
- glacial retreat and permafrost reduction, with small Alpine glaciers expected to disappear and larger ones projected to suffer a volume reduction between 30% and 70% by 2050; potential for glacial lake outburst floods, as large Alpine lakes might be formed from glacial retreat;
- significant reductions in snow mass in the Italian Alps (Soncini & Bocchiola, 2011), with duration of snow cover expected to decrease by several weeks for each degree of temperature increase at middle elevations.

COASTAL ZONES

With a total length of more than 7.500 km, the Italian shoreline constitutes a main national asset for its environmental, social, economic and cultural resources (Aucelli et al., 2006). More than half of the Italian coastal zones (3.952 km) are classified as low and sandy coasts, of which about 42% (1.681 km) have already been suffering from widespread erosion (Antonioli & Silenzi, 2007). Many Italian coastal plains are areas of high natural and scenic value as well as locations of production activities of national importance. The strong anthropization process is negatively affecting these coastal environments with an ever-growing pressure from urbanization, tourism and industrial activities (Aucelli et al., 2006).

The expected increase in the frequency and intensity of extreme weather-related events (floods, storms, etc.) and sea level rise (SLR) may contribute to accelerate the existing erosion processes eventually leading to the degradation or loss of coastal land, ecosystems, infrastructures and economic assets (Antonioli & Silenzi, 2007). For these reasons, Italian coastal zones are considered particularly vulnerable to projected climate change, with potential increasing flood risk and coastal instability and erosion (MATTM, 2009). Specifically, about 4.500 km² of Italian coastal areas are at risk of sea flooding from SLR by the next century. Most of the endangered areas are located in the North Adriatic Sea, and some Tyrrhenian and Ionian coasts may be at risk too (Antonioli & Silenzi, 2007). The Northern Adriatic coast, characterized by the Po River delta and the Venice lagoon, is considered particularly at risk, as this area lies below sea level (due to subsidence) and hosts many residential settlements, cultural heritage sites as well as industrial establishments (PRC, 2009).

In general, climate change impacts on coastal zones might include (IPCC, 2007):

- coastal erosion and instability, with risk of shoreline regression;
- loss of coastal land and hence of economic activities, infrastructures, urban settlements, recreational areas and natural heritage sites, mainly where climate change combines with natural and/or anthropogenic subsidence;

- reduction or loss of biodiversity and ecosystems (especially wetlands), and decrease of marine life caused by the combined effect of climate change and anthropogenic stress;
- damage to the coastal rural economy, due to salt water intrusion into coastal fresh-water beds;
- negative impacts on tourism and possible displacement of tourism flows from the coasts in summer;
- possible threat to human health posed by flood events.

FISHERIES AND AQUACULTURE

MARINE FISHERIES

The overexploitation of European fishery resources, exceeding in many cases the ability of fish populations to remain stable over time in terms of numbers and biomass, is considered the main reason for the current critical status of exploited fish stocks (EC, 2009b). Moreover, such overexploitation may affect the overall resilience of fish to climate change.

In the Mediterranean Sea, the following negative impacts associated with climate change can be expected for fisheries in the next decades (FAO, 2008; EEA, JRC & WHO, 2008):

- fish stock movements, inducing changes in the composition of biological communities in a given area, also affecting the economic activities related to fishery;
- transboundary aquatic infections, with potential increase and expansion of aquatic diseases in aquaculture and spreading of exotic pest species;
- exceeding of resilience of many water ecosystems due to anthropogenic stress (e.g. from overfishing, pollution, tourism, fragmentation and loss of habitat) combined with climate change effects on temperature, salinity and density of water, with potential impact on ecosystems' physiology, biology and ecology;
- effects from expected reduction of sea water pH, and anoxia or hypoxia events during summer heat waves on bivalve and gastropod molluscs,

shellfish, and like calcified species (Cebrian et al., 2011; Vaquer-Sunyer & Duarte, 2011), which would put at particular risk all the economic activities based on the collection of these organisms;

- possible general reduction of the productivity of the fished species (Cheung et al., 2012 and 2010).

With specific reference to Italy, some studies (Albouy et al., 2012) suggest that by mid-century, coastal fish populations could shift their distribution area by an average of 70 km to the north and/or deeper areas. In the northern and central Adriatic the number of fish species could increase compared with the past (with about 15% of them coming from other sub-areas), while in most other northern Italian coasts, faunal richness would tend to decrease and the processes of species replacement could be less conspicuous. In particular, the coastal areas close to the mouths of the Po River and other large rivers could undergo a net reduction in primary and secondary productivity, due to the projected decrease in precipitation.

FRESHWATER FISHERIES

It is very likely that over the short term there could be negative effects on the physiology of freshwater fish communities due to local temperature increase. This could result in adverse changes in the distribution and abundance of freshwater species, with significant impacts on aquaculture. Italian aquaculture could be particularly affected in North-Adriatic coastal wetlands and lagoon areas, due to possible warming and acidification of water, extreme weather conditions, increasing incidence of diseases and SLR.

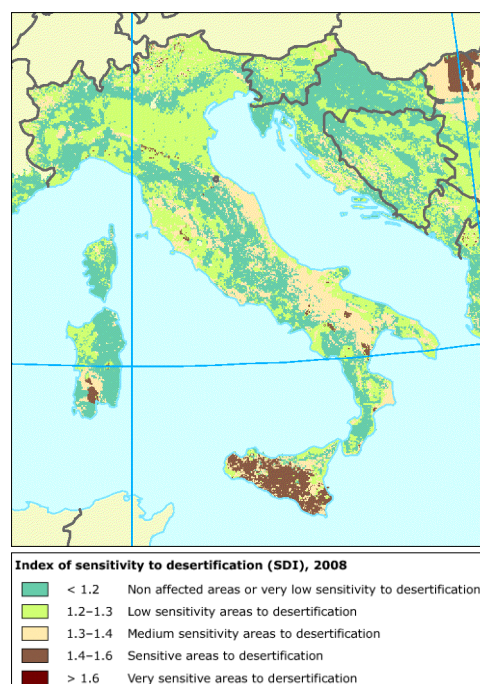
SOILS

Climate change impacts and vulnerability of soils are mainly associated with drought, land degradation and desertification. A significant part of the Italian territory (about 30%) can be considered at risk of desertification, with key vulnerabilities localized in the South of the country.²⁰ Overall, about 1/3 of the country is vulnerable to varying degrees to the processes of land degradation (Perini et al., 2008).

²⁰ Cf. MATTM Website "[Desertificazione](#)".

A classification of the vulnerability of the Italian territory to land degradation and desertification, based on the Environmentally Sensitive Area Index (ESAI), shows that in 2000 Sicily was affected by a medium-high degree of environmental vulnerability where sensitive areas represented about 70% of the regional territory, followed by Molise (58%), Apulia (57%) and Basilicata (55%). Six regions (Sardinia, Marche, Emilia-Romagna, Umbria, Abruzzo and Campania) shared similar severe conditions (30% to 50% of sensitive territory); for other regions, desertification was still an issue but smaller (10%-25% in Calabria, Tuscany, Friuli-Venezia-Giulia, Lazio, Lombardy, Veneto and Piedmont) or minor (2%-6% in Liguria, Aosta Valley and Trentino-Alto Adige) (Perini et al., 2008).

Figure 8. Sensitivity to desertification and drought of Italy (Source: EEA Website "[Sensitivity to desertification index map](#)", 2009)



More recent studies carried out within the project *DISMED - Desertification Information System for the Mediterranean* provide the mapping of sensitivity to desertification and drought in Italy (Fig.8), as defined by the Sensitivity to Desertification Index (SDI) based on soil quality, climate and vegetation parameters. The most sensitive regions to desertification are confirmed to be Sicily, Sardinia, Basilicata, Apulia, Molise, Abruzzo, Marche, Tuscany and Lazio. Within those regions and across the whole Italian territory, the areas that can be considered especially vulnerable to desertification include: farmlands with intensive and marginal

production; areas at risk of accelerated erosion; areas damaged by contamination, pollution and fires; fallow and abandoned lands (CIPE, 1999).

Broadly speaking, a trend towards a gradual worsening of the existing conditions of soil vulnerability has been detected all over the country, observed in widespread degradation processes. Land degradation and desertification, particularly prominent in the coastal zones, can be partly attributed to the changes in climate leading to the expansion of arid and semi-arid areas; partly, they are deemed to be a consequence of increasing human pressure and land use change along with processes of agricultural intensification and soil salinization (Perini et al., 2008). Climate change might indeed exacerbate the already observed trends, by worsening the actions of erosion, salinization, loss of organic matter and drying up of soils (Carraro & Sgobbi, 2008).

Furthermore, land degradation and desertification processes may imply serious indirect socio-economic impacts (Sciortino et al., 2009), including:

- decline in agriculture and tourism productivity;
- growing unemployment in rural areas with consequent migration;
- conflicts over water uses;
- harm to properties and people, due to increased frequency of fires;
- overall biodiversity loss.

AGRICULTURE AND FOOD PRODUCTION

In Italy, as in many areas bordering the Mediterranean basin, crop yields are considered at risk in relation to climate change. The following conditions can be expected in the agricultural sector:

- increasing yield variability and declining average yield, due to higher temperatures and scarcer water availability, increase in the frequency of extreme weather-related events (such as heat waves, heavy rainfalls and droughts periods) and varying spread of plant diseases and pests (Cecchi et al., 2007);

- reduced crop yields, especially in summer for spring sown crops (e.g. maize, sunflower and soybeans), due to more frequent extreme weather events and reduced water availability (Cecchi et al., 2007);
- possible amplification of the competition for water between different sectors and uses, and potential rise of the costs related to the irrigation practice, due to increasing water demand in agriculture for irrigation purposes (EEA, 2012; Miglietta et al., 2009);
- possible increase in the use of pesticides to cope with any climate change related variation in the geographic distribution of pests (Cecchi et al., 2007).

However, the impacts are expected to be highly diversified for different crops and geographical areas. In general, water shortages during specific crop development stages may reduce the productivity of most crops (e.g. corn, soybeans and wheat). On one side, the decline in agricultural productivity could especially concern wheat yield and fruit and vegetable production, as a consequence of water scarcity and soil degradation (Miglietta et al., 2009). On the other hand, olive, citrus, vine and durum wheat cultivation could become possible in the North of Italy. Wine production, an activity of particular economic relevance in Italy, could undergo major changes too. The suitability of cultivation areas for specific crops might modify, which could lead to displacements of agricultural productions (Miglietta et al., 2009).

FORESTS AND FORESTRY

Forests cover about 1/3 of the Italian territory (MIPAAF-CRA, 2005). Despite the lack of comprehensive analyses, existing studies indicate that climate change could induce overall changes in the composition of species and habitats of Italian forests, resulting in local losses of biodiversity (Valentini et al., 2009; Petriccione et al., 2009; EEA, JRC & WHO, 2008). Possible effects of climate change include:

- northwards and altitudinal shift of the range of climatic and environmental conditions typical of the Mediterranean area;
- reduction of growth and productivity rates in central-Southern Italy, where about 1/3 of the woodland could be threatened by reduced water supply and extended drought periods;

- changes in the distribution of main tree forest species in central Italy, mostly located in the central Apennines over 1.500 m, by 2080;
- higher soil aridity, droughts and risk of forest fires, with possible extension of fire areas, more ignition events and longer fire seasons, in the most critical areas of the Alps and Calabria, Campania, Sicily and Sardinia regions;
- some potential positive impacts, such as an increase in forest productivity in the Alps in relation to the expansion of the growing season.

The actual possibilities for the forest ecosystems to shift are scarce, because climate change rate far exceeds the rate of colonization of new areas and the potential corridors are often obstructed by human-induced territorial fragmentation. Hence, a progressive disruption of forest ecosystems could be expected (Valentini et al., 2009).

Results of a study on scenarios for the spreading of forest species in response to climate change with a special reference to the Alps show a possible reduction of about 50% of the habitats at the national level, with a progressive decline of mountain habitats for high altitude conifers (red fir, larch, Swiss pine) in favour of beech, chestnut and deciduous oaks (Valentini et al., 2009; Valentini & Santini, 2008).

HUMAN HEALTH

New risk scenarios influenced by weather and climate-related determinants are acknowledged in Italy. In addition to the more frequent adverse consequences of extreme weather events, other risks must be considered in relation to the impacts of climate change on ecosystems, biodiversity, soils, drinking and bathing waters, outdoor and indoor air quality. Expected effects of climate change on human health in Italy might include the following (Menne & Wolf, 2007):

- increased heat-related mortality and morbidity, associated with summer heat waves (Michelozzi et al., 2007);
- slight reduction of cold-related mortality, associated with expected milder winter temperatures (but the extent is not known) (Michelozzi et al., 2007);

- increased risk of injuries, morbidity (e.g. enteric infections, post-traumatic stress disorder and vector-borne diseases) and fatalities, from expected increasing floods, heavy precipitation and fires events (Funari et al., 2007);
- increased respiratory diseases and allergic disorders, as a result of the effects of changes in air pollution concentrations that may be aggravated by climate change (Forestiere, 2007);
- adverse consequences of potentially more frequent and prolonged extreme ozone events and increasing toxicity of pollutants, particularly in summertime (Menne et al., 2009);
- possible increase in the incidence of West Nile fever and leishmaniasis, risks of malaria and dengue fever and the spreading of vector-borne diseases (Majori, 2007).

Such impacts are likely to be perceived more across specific vulnerable groups such as the elderly, children, people suffering from different diseases and marginalized people.

TOURISM

Direct impacts on tourism are expected to be diversified for the various Italian regions, including possible reduced summer tourism flows due to high temperatures and water scarcity, more expensive and/or reduced winter tourism due to the reduction of natural snow cover, but improved conditions for spring and autumn tourism. Overall, the most affected regions could be: Sicily, Lazio, Tuscany and Umbria, Trentino-Alto Adige and to a lesser extent Friuli-Venezia Giulia and Aosta Valley (Bigano & Bosello, 2007).

URBAN AREAS

Urban areas may be subject to damages to settlements and disruption of socio-economic activities. This is mainly due to extreme events, like floods and storms, with an increasing risk especially for northern Italian coastal cities due to SLR combined with storm surges. In the second place, increased frequency and length of heat waves and droughts are expected to affect urban areas. In some Alpine areas, human settlements could be affected by the melting of permafrost reducing soil

stability. Also, water availability and quality, and air quality may be reduced, thus affecting urban population (EEA, 2012; EEA, JRC & WHO, 2008).

ENERGY

Regarding energy consumption, in southern European countries, due to the increase in maximum temperatures, higher than the minimum, and the lower efficiency of cooling than heating, the energy demand for cooling will increase more than the energy demand for heating will reduce (Mima et al., 2011), and also the increase in costs for cooling will far outweigh the savings for heating. Summer cooling needs might increase up to 50% Italy by 2080 (Cecchi et al., 2007).

Regarding energy production, the capacity of thermo-electric power plants could be adversely affected by some phenomena related to climate change, such as floods, reductions in the availability of cooling water and its increase in temperature and, ultimately, increase the frequency and intensity of extreme events in temperature.

The changes in weather and climate have led and will lead to a reduction in water availability for hydroelectric production and greater difficulties in water resource management (Gaudioso & Masullo, 2009). For other renewable sources (wind, biomass, photovoltaic), minor impacts are expected, which will occur, however, with longer life expectancy of the plant.

INFRASTRUCTURE

An assessment of the infrastructural capacity to adapt to climate change impacts (as a combination of indicators on the road network density, hospital beds and sustainable water use) carried out by the *ESPON CLIMATE* project for the Italian case study shows how such capacity varies in the country depending on region, spanning from the “lowest capacity” mainly in insular and some south-eastern regions, to the “highest capacity” mainly in north-western regions (EEA, 2012; Greiving et al., 2011).

Pressures on urban and rural infrastructures and built-up areas, and damage or loss of property may take place, mainly due to extreme events, such as flooding (EEA, JRC

& WHO, 2008). In this overview, critical infrastructure includes transport system and cultural heritage.

TRANSPORT

Climate change might negatively affect a number of elements of the Italian transport system, leading to a possible overall deterioration of the transport network. These include: stability of roads, rails and ports, due to higher temperatures, higher frequency of extreme precipitation events and SLR; endurance of road asphalts and railroad tracks, due to temperature increase; accessibility of roads, railways and ports in relation to damages and temporary disruption of infrastructure, due to higher frequency of extreme precipitation events and SLR; navigation in maritime and inland waterways, due to ice melting; shifts in the preferences of transport modalities, due to temperature increase (Caserini & Pignatelli, 2009).

CULTURAL HERITAGE

A risk mapping developed within the (1992-1995) national project *The risk map of cultural heritage* coordinated by the Institute for Conservation and Restoration (Istituto Superiore per la Conservazione e il Restauro - ISCR) under the former Ministry for Cultural Heritage and Environment, covering architectural, archaeological, historical and artistic assets, considers climate and risk of flood and landslide among the main environmental risk factors that may harm cultural heritage.

ECONOMIC IMPACTS OF CLIMATE CHANGE

This sub-section provides examples of the few studies assessing the sector- or site-specific economic impacts of climate change currently existing for Italy. However, it has to be noted that as scenarios, approaches and methodologies used in these studies are different, the resulting cost estimates present a great variability and are generally not comparable between them.

WATER AND HYDRO-GEOLOGICAL SYSTEM

Compared with other European regions, river flooding costs related to climate change are expected to be higher in Italy (EEA, 2012). Indeed, in the past such costs

were huge.²¹ An early attempt to assess the expected costs of climate change impacts on the hydro-geological system in Italy estimated the direct costs of increased hydro-geologic risks (floods and landslides) for three Italian regions (Lombardy, Calabria and Lazio) to be about 103 million Euros as of the value of the land at risk of floods and around 187 million Euros as of the value of the land at risk of landslides (Carraro & Sgobbi, 2008).

According to the assessment carried out within the DG ENV *ClimWatAdapt* study, the expected direct costs of floods for Italy in 2050 under the IPCC A1B scenario could be around 1.6 billion Euros. The related impact on the national GDP would amount to 457 million Euros by 2050 (Flörke et al., 2011).

COASTAL ZONES

Existing studies on the expected costs of climate change for the coastal areas were carried out by Foundation Eni Enrico Mattei (FEEM) and Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA). These are, however, mainly limited to a few vulnerable areas (such as the Fondi Plains, the Sangro River basin, and Grado and Marano Plains) for which the direct costs of climate change were calculated in terms of land loss (Carraro, 2008; Breil et al., 2007). In the case of the Sangro River basin, for example, the estimated costs are about 14 million Euros for the 2100 reference scenario;²² considering higher hydro-geological vulnerability besides SLR, the estimated costs would increase to about 73 million Euros (Carraro, 2008).

The EU FP6 project, *CIRCE - Climate Change Impact Research: The Mediterranean Environment*, estimated that the loss of coastal areas in Italy by 2050 under the IPCC A1B scenario could be around 0.7% of the national territory. The indirect economic impact on the Italian GDP resulting from the loss of coastal infrastructures and agricultural productive land was assessed at - 0.18% (Navarra & Tubiana, 2013a).

²¹ 28 major floods, occurring in the country between 1939 and 2004, caused damages of USD 32.7 ml; and 13 main landslides, occurring between 1991 and 2003, generated a material damage of around USD 1.2 bn (Carraro & Sgobbi, 2008).

²² The used reference scenario is representative of the state of the environmental, economic and social system at the local level as of 2007.

Some studies addressing climate change impacts on coastal tourism, highlighted that while extremely hot summers could reduce tourism inflow to Italian regions on average by 1.22%, they would possibly slightly increase tourism inflow towards Italian coastal zones (Galeotti et al., 2004; Gambarelli & Gorla, 2004).

SOILS

As to the economic impacts of climate change related to desertification and drought, the costs of the process of desertification in the Italian territory were estimated as a first approximation at 60-412 million US dollars/year, considering 16.500 km² of land at risk (Carraro, 2008; Carraro & Sgobbi, 2008).

AGRICULTURE AND FOOD PRODUCTION

The DG CLIMA *EUAdaptStrat* study provides an estimate of the potential economic impacts on the Italian GDP due to loss of productivity of agricultural soils. The average yield reduction evaluated is 9.3% for a +2°C and 23% for a +4°C temperature rise scenario by 2050. The value of lost production is estimated in the range of 13-30 billion Euros/year in 2050, with a negative impact on the GDP of around 0.1% (courtesy of F. Bosello, CMCC-FEEM, 2013). Based on another analysis, the economic impacts of climate change on the Italian agricultural sector in terms of decrease in the value of agricultural land was estimated between 87 and 162 billion Euros by 2100 under the IPCC A2 scenario (Van Passel et al., 2012).

FISHERIES AND AQUACULTURE

Concerning the economic assessment of climate change impacts on fisheries and aquaculture, some site-specific studies on Sacca di Goro Lagoon (one of the major European sites of aquaculture for the production of Philippine clams) studied the consequences of reduced rainfall and the incidence of certain seaweed. It concluded that such impacts could induce a reduction in clam production corresponding to an annual monetary loss in the range of 10.4-16.5 million Euros on average (Viaroli et al., 2007).

The EU FP6 project *SESAME - Southern European Seas: Assessing and Modelling Ecosystem Changes* estimated the loss of aggregated productivity of fish stocks for Italy at about 8% by 2030 under the IPCC A1B scenario. This would negatively

impact Italy's GDP by 0.04% in 2030, equivalent to a loss of 25 million Euros/year in the period 2001-2030, considering only the potential impact of the reduced fish availability on the ability to produce goods and services in the future. The fishing industry would suffer a loss of production of around 4% by 2030 (courtesy of F. Bosello CMCC-FEEM, 2013).

HUMAN HEALTH

Two examples of economic assessment of climate change impacts on public health can be provided, that can be helpful to gain an initial picture of the total costs:

- the costs of heat waves in the absence of any adaptation strategy are estimated around 281 million Euros in the city of Rome alone by 2020 (Alberini & Chiabai, 2007);
- the damages caused by floods in the Mediterranean Europe in the last decade are estimated at 12.3 billion Euros, of which 96% are considered attributable to events that took place in Italy (Sinisi, 2009).

TOURISM

The *SESAME* project estimated that the reduction of touristic demand for Italy due to the potential loss of attractiveness resulting from the possible deterioration of marine ecosystems could be of 1.65% by 2030 under the IPCC A1B scenario (courtesy of F. Bosello, 2013).

The reduction of tourism inflows for Italy potentially induced by increasing temperature was estimated by the *CIRCE* project at about 15% in 2050 in the IPCC A1B scenario; this could be partially offset by an increased domestic tourism demand, with a net negative impact on the sector of around 8.9%. The consequent potential reduction of the country's GDP would be of 0.25% by 2050 (Bosello et al., 2010).

The DG CLIMA EUAdaptStrat study estimated the direct impacts on tourism at - 6.6% and - 8.9% by 2050 for a 2°C and a 4°C temperature rise scenario respectively, based on the variations of international arrivals, domestic tourism and tourism expenditure resulting from changes in climate attractiveness. The induced GDP loss

by 2050 would be 0.25% and 1.05% respectively (courtesy of F. Bosello, CMCC-FEEM, 2013).

MACRO-ECONOMIC IMPACTS OF CLIMATE CHANGE IN ITALY

The only available study assessing the aggregated costs of climate change impacts for the Italian economy was carried out by FEEM in collaboration with the Institute for Environmental Protection and Research (ISPRA) and the Euro-Mediterranean Center on Climate Change (CMCC) (Carraro, 2008). The study focuses on four key vulnerable areas: the Alps and glacial ecosystems; coastal zones; arid areas and areas threatened by desertification; areas prone to floods and landslides. Given its limited scope, this study is not intended to be a comprehensive national assessment. However, it provides useful information on the economic impacts at the national level²³. Some of this information is highlighted hereby:

- Italy could experience aggregated GDP losses induced by climate change of 0.12%-0.16% in the period 2001-2050 with an equivalent loss of about 20-30 billion Euros, considering a temperature increase of 0.93°C; larger losses in the range of 0.16%-0.20% GDP could be expected for a +1.2°C temperature rise scenario (Carraro et al., 2008) (see Tab.18);
- some economic sectors such as tourism and the economy of Alpine regions could suffer significant damages;
- higher economic impacts could be expected in the second half of the century;
- huge North-South differences could emerge in Italy in terms of economic impacts of climate change.

²³ The analysis is based on a general equilibrium model of the world economy and two warming scenarios for the years 2001-2050, considering a temperature increase of 0.93°C and of 1.2°C in line with IPCC scenarios B1 and A2 respectively. The study examines the adjustments induced by several climate change effects (e.g. sea level rise, desertification, energy demand) on the directly affected sectors, as well as on the global trade structure and its feedback mechanisms. A macroeconomic estimate captures all the interactions of national and international climate change impacts on different sectors and the associated redistribution effect. The model, however, does not take into account non-market costs (like ecosystems and biodiversity loss) nor damage to artistic and architectural heritage (Carraro, 2008).

Table 18. Macro-economic impacts of climate change in Italy (Source: Carraro, 2008)

Increase in temperature by 2050	Economic sector most affected	GDP variation by 2050
Scenario B1 (+0.93 °C by 2050)	Services (from -0.71% to -0.87%) Energy (Oil -1.88%, Gas: -3.72%, Electricity: + 1.8%) Cereals (-1.45%)	-0.12% to -0.16% equal to an equivalent variation loss of EUR 20-30 bn
Scenario A2 (+1.2 °C by 2050)	n.a.	-0.16% to -0.20%

Also, sectoral cost assessments carried out under national and European research projects that are relevant for the Italian circumstances exist e.g. Alberini and Chiabai (2007) for costing health impacts, Giupponi and Shechterto (2003) for the costs of desertification and drought. These and others are considered in Carraro (2008). However, as the scenarios, approaches and methodologies used in these studies are different, the associated cost estimates have a great variability and are generally not comparable between them.

STATE OF THE ART OF CLIMATE CHANGE ADAPTATION IN ITALY

This section presents the current situation with respect to adaptation initiatives designed and undertaken at the national, regional and local scale across Italy. In the following sub-sections the existing frameworks and implemented measures that are relevant for adaptation are illustrated by sector. Research initiatives on adaptation and information on costs of adapting to climate change are presented subsequently.

To date, Italy has not adopted a national adaptation strategy (NAS), a national adaptation plan (NAP) or any other action plan to frame and implement adaptation in the country. A process to design a NAS has been initiated recently and it is currently ongoing. The Italian Ministry for Environment, Land and Sea (MATTM) has the main responsibility for the preparation and establishment of a strategy and a plan of action for adaptation of national scope. While the MATTM deals with the integration (mainstreaming) of adaptation into the sectoral policies, the Regional Governments would be entrusted with the implementation of an eventual NAP.

Attention to climate and adaptation dates back to 2002, when the Interministerial Committee for Economic Planning (CIPE) adopted the *“National strategy for*

sustainable development” highlighting the need to adapt to climate change.²⁴ More specific preparatory activities towards a NAS started in 2007 in the framework of the National Conference on Climate Change (Rome, 12-13 September 2007). In this context the existing countrywide climate change vulnerabilities were analyzed from a scientific and socio-economic point of view and a number of policy sectors were identified for high-priority adaptation action (see Tab.19). Importantly, the first thirteen priority actions for sustainable adaptation to be carried out by the Ministry for Environment and other Ministries were put forward (Tab.19), with the agreement of the whole scientific community. In fact, the outcome of the Conference took the form of a “Manifesto for Climate” intended as a “*new deal for sustainable adaptation and environmental security*” (APAT-MATTM, 2007).

The Conference raised the awareness that only through the development and implementation of a NAS would it be possible to respond to climate change in an integrated and long-term proactive way, which is the only approach widely acknowledged as being successful and cost-effective. Furthermore, the importance for the Italian NAS to be consistent with international recommendations and complementary to national, European and international mitigation strategies was highlighted.

The conclusions of the Conference recommended that the NAS should be preparatory to the implementation of a NAP, involving the Government as a whole, the local and regional administrations and the civil society, thus allowing a more effective horizontal and vertical coordination among the relevant policies and actors. According to the Conference, the NAP should be inter-linked with the *National Strategy for Biodiversity* and with the *National Action Plan to Combat Drought and Desertification* (see next sub-sections for further information on these).

²⁴ Cf. MATTM Website “[Strategia d'azione ambientale per lo Sviluppo Sostenibile in Italia](#)”.

Table 19. Outcome of the National Conference on Climate Change: top priority sectors and 13 actions for adaptation (Source: based on APAT-MATTM, 2007)

Outcome of the National Conference on Climate Change (Rome, 12-13 September 2007)	
Top priority policy sectors for adaptation	
	<ul style="list-style-type: none"> • Water resources management • Agriculture and rural development • Marine and terrestrial ecosystems and biodiversity protection • Soil and coastal management • Health protection • Industry and energy • Tourism
Priority actions for adaptation	
	<ol style="list-style-type: none"> 1. Enhanced research: Improve research on critical issues related to climate change impacts; engage in monitoring of climate change and its effects and provide annual reporting; widely involve the research community and university; 2. Energy efficiency: Confirm and expand the system of incentives for energy-saving in the residential sector; initiate a programme of support for green building by defining standards that enable its development; 3. Sustainable consumption: Engage in fostering new forms of consumption compatible with climate adaptation needs, starting with promoting “water labelling” of goods and products; 4. Efficient water management: Adjust the management of water resources to climate change; initiate voluntary actions of water-saving agriculture through a pact with agricultural organizations; avoid exploitation of groundwater in the vicinity of wetlands of high natural value; promote water conservation and efficient water distribution; 5. Innovative agriculture: Respond to the impact of climate change on agriculture; defend typical Italian products by supporting quality agriculture and organic farming, encouraging traditional drought-resistant crops, supporting the cultivation of forests and the maintenance of the territory; 6. Integrated coastal zone management: Secure the Italian coasts; adapt the planning rules on the coastline; reshape port infrastructure, transport networks, the location of energy production plants in relation to the change of the coastline; restore the dunes and coastal wetlands; 7. Enhanced preparedness to weather extremes: Respond to the expected increase in the frequency and severity of extreme events by adjusting and securing areas at greatest risk; apply safety standards for construction in the areas of river expansion and in areas at risk of landslide and avalanche; reforest areas with low vegetation cover; 8. Sustainable fisheries: Provide action for sustainable management of marine resources; initiate mechanisms for the development of sustainable river fisheries by developing a recovery plan of the river resources, coordinating the actions of ecosystem preservation and management of water resources; 9. Sustainable management of mountain areas: Promote the mountains’ natural heritage and a tourism less based on ski-related activities; aim at the rehabilitation of ski areas and make the construction of new infrastructure subject to feasibility and cost-effectiveness assessments; 10. New health strategies: Consider climate-related risks (e.g. increasing frequency of summer heat waves) in the development of health strategies; 11. Early warnings: Set up a more efficient early warning system in the areas at greatest risk of floods and landslides; 12. Enhanced stakeholder participation: Improve participation of citizens both in adaptation and mitigation policies; launch awareness-raising campaigns with the creation of a Climate Day; 13. Environmental incentives for business: Create forms of environmental incentives for companies, also in relation to the new standards of environmental accounting.

Furthermore, in order to mainstream adaptation into environmental policies, the NAP should be strongly embedded in spatial planning and consistent with, and complementary to, the mitigation strategies and the research programmes on climate change at the national, European and international level. In addition, the full implementation of the following legal frameworks is considered essential to support a comprehensive NAS and NAP: the Water Framework Directive 2000/60 (water resources), the Habitat Directive 92/43/EEC and the Birds Directive 79/409/EEC (biodiversity), the International Convention for the Protection of Alps (Alps), and the National System on Environmental Accounting (proxy law).

Despite such a good premise, the process to develop a NAS was interrupted due to changes in government administrations that brought about different priorities and did not allow the necessary institutional mandate to proceed.

Concrete follow-up activities took place in July 2012, when a new government resumed the process to develop a NAS. The MATTM assigned the scientific coordination to CMCC, and set the conditions for the establishment of a scientific committee of experts (*"Tavolo Tecnico"*) and an Inter-ministerial Advisory Group (*"Tavolo Istituzionale"*). On the basis of the previous work done for the 2007 National Conference on Climate Change and more recent research, the scientific committee pointed out an enlarged list of key sectors to be addressed in the NAS. Besides the top policy sectors previously identified, the committee agreed that the NAS should also include priority guidance on forestry; urban areas; critical infrastructure; and the risk of floods and landslides. The Alps and Apennines, and the hydrographical basin of the River Po are taken as case studies within the NAS due to their strategic importance in the national economy and their high vulnerability to climate change impacts.

Table 20. Sectors addressed by the Italian National Adaptation Strategy

Outline of the National Adaptation Strategy (2012)	
Priority sectors	Sub-themes
<ul style="list-style-type: none"> • Water resources 	
<ul style="list-style-type: none"> • Areas at risk of desertification, drought and soil degradation 	
<ul style="list-style-type: none"> • Areas at risk of floods and landslides 	
<ul style="list-style-type: none"> • Biodiversity and ecosystems 	<ul style="list-style-type: none"> • Marine ecosystems • Terrestrial ecosystems • Inland water ecosystems
<ul style="list-style-type: none"> • Health 	
<ul style="list-style-type: none"> • Forestry 	
<ul style="list-style-type: none"> • Agriculture, fisheries and aquaculture 	<ul style="list-style-type: none"> • Agriculture and food production • Maritime fisheries • Aquaculture
<ul style="list-style-type: none"> • Energy 	
<ul style="list-style-type: none"> • Coastal zones 	
<ul style="list-style-type: none"> • Tourism 	
<ul style="list-style-type: none"> • Urban areas 	
<ul style="list-style-type: none"> • Critical infrastructure 	<ul style="list-style-type: none"> • Cultural heritage • Transport infrastructure
<ul style="list-style-type: none"> • <i>Special case studies</i> 	<ul style="list-style-type: none"> • Alps and Apennines • Hydrographical Basin of the River Po

In support of the preparation of the Italian NAS, a participatory process was designed involving stakeholders and citizens through an ex-ante survey on the perception of adaptation in the country and public consultation on the draft strategy document (to be held between October 2013 and January 2014).

At about the same time the comprehensive 2013 EU Adaptation Strategy was being developed and the available guidance from the EU Commission (EC, 2013a; Prutsch et al., 2010) has been taken into account to develop the Italian NAS in a consistent fashion.

In December 2012, the MATTM put forward a preliminary document containing “*Strategic guidelines for adaptation to climate change, sustainable management and safety of the national territory*”. The identified priority actions focus on coping with flood and landslide risk through a national strategy, complemented by urgent safety measures (MATTM, 2013). The guidelines have to be discussed by CIPE in consultation with the Ministry of Agricultural, Food and Forestry Policies (MiPAAF), the Ministry of Infrastructure and Transport (MIT), and the Ministry of Economy and Finance.

The only existing reference for countrywide adaptation cost-benefit assessment is the above-cited FEEM-ISPRA-CMCC study (Carraro, 2008), covering adaptation measures explored and undertaken in four key vulnerable areas.

Despite the current lack of a NAS or a NAP, or comprehensive economic assessments, some adaptation initiatives have already been implemented in the context of the existing policies for environment protection, natural hazards prevention, sustainable management of natural resources and health protection.

The most relevant efforts at the national level are acknowledged to be in the domains of human health, agriculture, water resources, coastal areas management, and the fight against desertification. These include specific legislation and other non-binding frameworks (such as the *White Paper on rural development*, the *National Biodiversity Strategy* and the *National Action Plan to combat drought and desertification*), as well as monitoring and surveillance systems for heat-waves, vector-borne diseases and other infections, and a number of other local practical measures.

At the sub-national level, a range of remarkable initiatives has been designed and implemented by Regions, Provinces, Cities and Municipalities.

Italy is also active in several international cooperation initiatives on climate change related topics, including transnational cooperation efforts (e.g. in the context of the Alpine Convention) and capacity building activities in developing countries, funded by the Italian Ministry of Foreign Affairs and MATTM.

WATER AND HYDRO-GEOLOGICAL SYSTEM

Adaptation efforts in the water sector in Italy mainly concern water scarcity and drought, and the risks associated with floods, landslides and other mass movements.

WATER SCARCITY AND DROUGHT

The projected increase of drought frequency and water scarcity, especially localized in the South of the country, are very high on the policy agenda. Such issues are driving the development of suitable responses in combination with the other components of European water regulation (EEA, 2007a).

IMPLEMENTED ADAPTATION ACTIONS AND MEASURES

- According to the 2000 EU Water Framework Directive (WFD), water emergency regulations were issued to address water crises, providing both technical and financial support for emergency measures;²⁵
- the Council of Ministers approved “*Practical guidelines to deal with possible water crises*” in 2007 that provide indications for all the institutions involved in water management for undertaking monitoring and appropriate enforcement activities (Gaudioso & Masullo, 2009);
- ad hoc organizations for crisis management were established in order to regulate the use of water and take the necessary measures to prevent water crises;²⁶
- a number of national structural funds include irrigation networks as well as drinking-water distribution networks, not only for water emergencies;
- in terms of cohesion funds, Italy runs a water programme that is useful in providing necessary information for water crisis prevention.

In addition, several initiatives in other sectors also serve the purpose of water resources conservation, like the *National Plan for irrigation in support to the agricultural sector* and the *National Action Programme and Local Action Programmes to combat drought and desertification*, and these will be discussed in further detail under the respective sub-sections.

Local initiatives exist at the river catchment level:

- the River Basin Management Plan of the Po River catchment adopted in 2010 and approved in 2013 aims, among other objectives, at the identification of shared strategies for water management and adaptation to climate change (Autorità di bacino del fiume Po, 2010);
- the Watershed Authority of the Arno River Basin took into account climate change impacts in mapping flood hazard and risk in support of river Basin planning (pursuant to Directive 2007/60/EC on flood risks assessment and management).

²⁵ Cf. MATTM Website, “[Attuazione della Direttiva Quadro sulle Acque \(2000/60/CE\)](#)”.

²⁶ Like a “Drought control room” for drought events in the Po River basin, and a “Coordination Unit for the management of water resources” shared between Puglia and Basilicata Regions.

RISK OF FLOOD AND LANDSLIDE

LEGAL FRAMEWORKS

National legislation that set the context for the protection from the risk of landslides and river floods, include the following:

- Law 267/1998, also known as *Legge Sarno*, the main legal mechanism involving the implementation of protection from the risks of flood and landslide, in line with the WFD requiring the authorities responsible for hydrological basins management to detect risk areas, sets up prevention plans and establishes regulations to avoid additional risk due to anthropogenic factors; it is also the legal basis for identification and funding of urgent preventive measures;
- 2004 *Prime Minister Directive*²⁷ providing operational guidelines for the organizational and functional management of the national and regional warning system for the hydro-geological and hydraulic risks for the purpose of civil protection; it requires the establishment of an integrated warning system at the national and regional level, based on the activities of Functional Centres devoted to the collection, processing and assimilation of climate-related, hydrological, geological and geo-morphological data.²⁸

IMPLEMENTED ADAPTATION ACTIONS AND MEASURES

The main activities coping with the risks of flood and landslide are implemented at the national level by the Department of Civil Protection, including:

- monitoring of hydro-pluviometric data and water availability, in order to anticipate possible future critical situations, in collaboration with Regional and Watershed Authorities;
- establishment (in January 2007) of a technical-scientific group of the main national experts in seasonal weather forecasting and climatology, with the aim to update the scenarios for the next three-month period;

²⁷ Cf. Protezione Civile Website, "[Direttiva 27 febbraio 2004: indirizzi operativi per la gestione del sistema di allertamento nazionale per il rischio idrogeologico e idraulico](#)".

²⁸ Cf. Protezione Civile Website, "[Hydro-meteorological and hydraulic risk](#)".

- managing, in accordance with the Regional governments, the network of functional centres, regional structures and competence centres for the collection, monitoring, and sharing of weather, hydro-geological and hydraulic data (the National System for early warning and monitoring), a key support tool for decision-making for civil protection and warning for hydro-geological and hydrological risks;
- promotion, financing and coordination of technical and scientific initiatives aimed at widening the knowledge base on extreme weather events and their application to the development of early warning, evaluation and real-time monitoring tools;
- implementation of a national *Radar Plan* for nowcasting.

BIODIVERSITY AND ECOSYSTEMS

CONSERVATION AND MANAGEMENT OF FAUNA AND FLORA

At the international level, the MATTM Directorate for the protection of nature and the sea (DPNM) takes part in several initiatives for the protection of species and habitats and pursues the goal of protecting biodiversity through the implementation of a variety of International Conventions, Agreements and Protocols, first of all the Convention on Biological Diversity (CBD).²⁹

At the national level, conservation and management actions are addressed by the DPNM by promoting the establishment of nature reserves and national parks (currently covering about 1.300.000 ha) and the definition of relative management

²⁹ International Conventions, Agreements and Protocols joined by Italy:

- Convention on Biological Diversity - CBD (Protocol of Cartagena, Protocol Nagoya);
- Ramsar Convention on Wetlands;
- Convention on migratory species of wild animals – CMS/Bonn Convention) (ACCOBAMS, AEW, EUROBATS);
- Convention on international trade of species of wild fauna and flora threatened with extinction (CITES – Convention of Washington);
- Convention for the conservation of European wildlife and natural habitats - Berne Convention (European Diploma of protected areas);
- Convention for the Alps (for a global policy for Alps protection and preservation, including consideration of climate change), Convention for the protection of the Mediterranean (Barcelona Convention) (Protocol concerning Specially Protected Areas and biodiversity in Mediterranean – ASP Protocol);
- International agreement on the International marine mammal sanctuary, also known as Cetacean Sanctuary;
- Nature 2000 Network.

criteria, as well as by developing national action plans, guidelines and guidance documents for the conservation of species and habitats, and by producing publications and databases on natural heritage. The variety of initiatives implemented on terrestrial and marine protected areas, national parks (24), landscape protection, terrestrial fauna and flora, and actions for limiting the impacts of alien invasive species can be considered beneficial also for adapting to climate change.

ITALIAN NATIONAL BIODIVERSITY STRATEGY

In order to ensure the integration of the preservation of the priceless national biodiversity heritage in the development strategy of the country, in 2010 MATTM launched the *Italian National Biodiversity Strategy* to be implemented in the period 2011-2020. The Strategy is built on three pillars: 1) biodiversity and ecosystem services, 2) biodiversity and climate change, 3) biodiversity and economic policies.

The Strategy provides indications on priorities for action based on intervention tools for the different working areas, either directly or implicitly linked to climate change adaptation. With respect to biodiversity and climate change, the Strategy explicitly aims at reducing substantially the impact of climate change on biodiversity by 2020, by defining appropriate measures of adaptation and mitigation, also targeted at increasing the resilience of natural and semi-natural ecosystems to climate change. Such identified adaptation actions are aimed, for instance, at maintaining the range and variability of ecological habitats and species; facilitating the spread of species into new favourable habitats; maintaining the existing ecological networks; controlling the spread of invasive species.

Furthermore, the Strategy underlines the importance of increasing the understanding of the impacts of climate change on biodiversity by analyzing the effects of climate change on species, habitats and ecosystems, in support of implementing adaptation (and mitigation) measures. However, the Strategy also points out that the speed and scale of climate change require immediate action despite the existence of knowledge gaps, and suggests to “plan for the future with the information available today”.

This initiative preceded the launch of the EU 2020 Biodiversity Strategy (EC, 2011), that took place in 2011, to protect and improve the state of biodiversity in Europe in the following decade and the subsequent Environment Council conclusions endorsing the implementation of the Strategy, stressing the need to “integrate biodiversity concerns into all EU and national sectoral policies, in order to reverse the continuing trends of biodiversity loss and ecosystem degradation” (Council of the EU, 2011).

COASTAL ZONES

The main competences and responsibilities for organising and managing coastal defence passed recently (2001) from the Italian national government to the fifteen coastal regions. The government, through MATTM and ISPRA, is responsible for the provision of policy guidance and financial support, beside a legal framework for environment protection that also cover the coastal zones. The Regions are entrusted with coastal planning, protection and management, including independently organizing the related sharing of responsibilities with Provinces and Municipalities (PRC, 2009).

INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

At the national level, Italy is required by various international agreements to prepare a strategy on Integrated Coastal Zone Management (ICZM), the current European tool for the governance of marine-coastal zones, which includes prevention and/or reduction of the effects of natural hazards and of climate change. MATTM has already started an overall institutional coordination, through the involvement of regional and local authorities dealing with planning and management of coastal areas, with a view to define the required ICZM Strategy and to prepare the relevant Plans/Programmes or Guidelines. In this process, appropriate consultation of economic as well as social stakeholders is envisaged, to ensure proper input and consideration of all relevant interests. The most recent status of activities is reported in the 2011 report on national progresses on ICZM in the period 2006-2010 (MATTM-DGPN, 2011).

At the regional level, some Italian regional governments have started approaching the ICZM to different extents, e.g. Emilia-Romagna and Marche (2005) and Liguria

(2002), with the adoption of instruments having reference to the ICZM, and Tuscany, Lazio, Abruzzo, Sardinia and Apulia, with preliminary testing of the ICZM approach or plans for land protection and spatial planning. Basilicata and Sicily have just started preparatory activities for their regional coastal plans.

IMPLEMENTED ADAPTATION ACTIONS AND MEASURES

Over the years, regional action has focused on interventions and provisions aimed at stabilizing and fixing the coastline to protect coastal zones from increased erosion and flooding, mainly in the framework of regional coastal plans. Even if these initiatives were designed and planned without explicit consideration of climate change, the implementation of several of them is also beneficial for adapting to climate change. They include the following (PRC, 2009; Carraro & Sgobbi, 2008):

- traditional coastal defence measures, such as artificial reefs (rock mound structures, flood walls), near-shore breakwaters, bulkheads, artificial channelling and drainage and, more recently, beach nourishment, generally in high-profit touristic areas, and dune restoration (e.g. Campania, Lazio, Emilia-Romagna, Tuscany);
- a cutting-edge system of mobile barriers against exceptionally high tides (Veneto);
- a real-time wave monitoring network in support of civil protection decisions during extreme weather events (Campania) and/or other monitoring systems (Emilia-Romagna);
- political decisions, such as land use planning;
- managerial interventions, such as changing agricultural practices in areas prone to floods;
- behavioural strategies, such as changing location of recreational facilities.

Two cases are emblematic for advanced coastal protection: Venice MO.S.E. and Emilia-Romagna Coastal Plans (PRC, 2009). These are illustrated below.

Venice (Veneto region): following a 1984 national law, the Venice Water Authority, through the Consorzio Venezia Nuova, has been implementing a General Plan of Interventions financed by the government, to achieve protection measures to

safeguard the city and its lagoon from sea tides. In addition, a specific project called [*MO.S.E. - MOdulo Sperimentale Elettromeccanico*](#), was designed to temporarily divide the sea from the lagoon during high tides. For this purpose, a system of mobile barriers was built at three lagoon inlets to be activated during exceptionally high tides. The defence structure, whose construction started in 2003, is designed to cope with an increase of up to 60 cm in sea level. This is the only region taking into account a climate scenario indicator (SLR) in the planning and implementation of coastal protection measures.

Emilia-Romagna is the first Italian region to have implemented beach nourishment (a “soft” kind of intervention) as an alternative to the environmentally unsustainable “hard” protection works in 1983. Later, in 2002 and 2007, two major beach nourishment interventions were carried out using off-shore submerged sand deposits. In 1983 the region also approved its first Coastal Plan and established a subsidence monitoring network for the coastal territory and shoreline movements. The second Coastal Plan was issued in 1995 which was followed by two Coastal Status Reports in 2000 and 2007. The latest Coastal Plan, including a ten-year Management Plan (2010-2019), contains some considerations on climate change. Since 2000 a GIS-based Coastal Information System has been developed in support of coastal studies, monitoring and planning. In 2002 the region started experimenting a pilot video monitoring system of the littoral processes in support of ICZM through the development of video-derived Coastal State Indicators (CSI). Furthermore, the region is the only one, according to the available information, to have developed and adopted Guidelines for an ICZM, in 2005.

SOILS

FIGHT AGAINST DROUGHT AND DESERTIFICATION

NATIONAL ACTION PROGRAMME TO COMBAT DROUGHT AND DESERTIFICATION

As requested by the United Nations Convention on Combating Desertification (UNCCD), Italy developed and approved the *National Action Programme (NAP) to Combat Drought and Desertification* in 1999 (CIPE, 1999), aimed at reducing losses of soil productivity caused by climatic changes and human activities, in the context of sustainable development, following the ad hoc guidelines elaborated by the

National Committee to Combat Desertification (CNLSD). The NAP, which calls for the creation of links and synergies with other global conventions on climate, biodiversity and the protection of international waters, provides a coherent set of indications that are beneficial also to adapting to climate change.

The NAP top priorities are: 1) soil protection, sustainable management of water resources, reduction of the environmental impact from productive activities and land restoration; 2) information, training and research, and programmes and measures to combat drought and desertification in vulnerable areas within Italy and in developing countries, according to development cooperation priorities. Most of the proposed actions and measures identified for the top priority sectors are indirectly beneficial for adapting to climate change.

LOCAL ACTION PROGRAMMES TO COMBAT DROUGHT AND DESERTIFICATION

In order to achieve its goals, the NAP entrusted the Regional Governments and Watershed Authorities with the responsibility to accordingly develop Local Action Programmes (LAPs) to Combat Drought and Desertification. LAPs are tools that: 1) identify specific regional areas sensitive and/or at risk of desertification through the application of a methodology supported by an appropriate set of indicators at the regional scale; 2) define specific action plans for the prevention, mitigation and adaptation to drought and desertification; and 3) provide guidance for quantification of the financial needs and the identification of funding sources.

Currently, 10 Italian Regional Governments adopted their own LAP: Campania (2010), Liguria (2010), Tuscany (2010), Emilia-Romagna (2009), Apulia (2008), Sardinia (2008), Calabria (2008), Abruzzo (2007), Basilicata (2007) and Sicily (2007).

PILOT PROJECTS AND OTHER INITIATIVES

With the guidance of the CNLSD, MATTM promoted a number of pilot projects to combat desertification that go beyond the LAPs. In fact they also make use of experimental techniques and methods for actions aimed at improving knowledge (e.g. environmental monitoring, maps and boundaries of sensitive areas/at risk of desertification) and directly intervening in the territory. To date, six Italian Regional

Governments carried out such pilot projects: Abruzzo (2010), Piedmont (2010), Sardinia (2009), Sicily (2009), Calabria (2009) and Apulia (2008).

Further initiatives aimed at protecting soil and restoring its stability are included in the 2007-2013 *Rural Development Plans* (RDPs), such as: improving soil quality and reducing the organic content loss (Apulia); restoring dry stone walls and relative works to support steep slopes (Liguria); renewable energy production plants from biomass and other renewable sources (Sardinia, Basilicata and Apulia); water resources management and water saving technologies (Sardinia, Basilicata, Apulia and Calabria).

Moreover, in 2009, the report: *“Good practices for combating desertification”* (Seddaiu et al., 2009) was published by the MATTM in collaboration with the Research Nucleus on desertification of Sassari University, providing a methodological and operational tool for the identification of good practices for combating desertification.

AGRICULTURE AND FOOD PRODUCTION

RURAL DEVELOPMENT

WHITE PAPER ON RURAL DEVELOPMENT AND CLIMATE CHANGE

In September 2011 MiPAAF published the White Paper on rural development and climate change titled *“Challenges and opportunities of rural development for mitigation and adaptation to climate change”* (MiPAAF, 2011). The White Paper aims at increasing the resilience of the agricultural sector to climate change as well as improving the investments in a low-carbon economy through the development and diffusion of renewable energy and green products.

Besides general recommendations (e.g. exchange of and free access to climate data; maintaining monitoring networks; realizing an Italian Atlas of climate change; building a database of figures related to future climate; establishing a National Council on climate change), the White Paper identifies specific types of adaptation actions to be implemented in the agriculture sector at different levels in four main areas: technology development; adoption of technologies; government programmes and insurance services; financial management of farms.

LEGAL FRAMEWORKS

Further to a *National plan for water use* approved by the CIPE in 2005, Italy implemented a *National Plan for irrigation in support to the agricultural sector (2007-2010)* and allocated specific funds to alleviate the effects of extreme events, including droughts (EEA, 2007a).

Furthermore, specific adaptation actions are financially supported by the 21 regional *Rural Development Programmes (RDPs) 2007-2013* mainly through the implementation of water management measures (including activities targeted at improving the efficiency of irrigation infrastructures, enhancing the capacity to store water and coping with extreme weather events) and secondly through forestry measures (reducing the consequences of forest fires and preventing soil deterioration).

RISK MANAGEMENT

Concerning risk management and the economic and structural tools for anticipatory adaptation actions, Italy has established specific support for the costs of insurance premiums covering the risks of climate change on crop production, animal diseases in livestock, diseases and pest infestations of plants since 2010. For this purpose, a single system was created collecting all the relevant funds, including the *CMO Wine funds* providing contributions to insurance for wine grape crops, and the *National Solidarity Fund* for natural disasters in agriculture. The latter promotes preventive measures to cope with the damages to agricultural production and livestock, farm structures, production facilities and rural infrastructures in areas affected by natural disasters or exceptional events, through measures encouraging the stipulation of insurance contracts and compensatory actions.

FISHERIES AND AQUACULTURE

SUSTAINABLE MANAGEMENT OF FISHERIES

Existing adaptation strategies for the fishery sector focus mainly on the sustainable management of fisheries at national and international level and on the enhancement of complementary activities such as aquaculture.

IMPLEMENTED ADAPTATION ACTIONS AND MEASURES

Concerning the initiatives implemented at the national level, it is worth mentioning the *Operational Programme for the Italian fisheries sector* for the period 2007-2013, approved by the European Commission, covering the whole Italian territory. The Programme is run under the responsibility of the MiPAAF and is built on five priority lines that entail measures involving some degree of adaptation and sustainability (e.g. interventions directed to the protection of the marine ecosystem and the competitiveness of national fisheries). As another example, the eight *National Plans for trawling management* covering the Italian seas, adopted by the MiPAAF in 2011, include measures to further limit the national fishing efforts, both in terms of allowed annual number of fishing days and fishing areas.

FORESTS AND FORESTRY

WILD FIRES PREVENTION

Adaptation in the forest sector in Italy is mainly related to the protection of forests from wild fires. MATTM, through the DPNM, developed the following initiatives for the protection of forests from fires:

- “Framework law on forest fires” (2000);
- Guidelines for sustainable forest management in State natural parks and reserves (2005);
- Schemes for plans against forest fires for State natural protected areas (2002/2009);
- Specific plans for State natural reserves;
- Provision of scientific and technical support on planning the detection of wild fire in State protected natural areas and national parks of priority intervention areas (including on-line GIS-bases cartography).

Awareness-raising campaigns were also carried out and the organization of the national and regional fire prevention systems was improved (Cecchi et al., 2007).

Furthermore, the Ministerial Decree on “*Minimum criteria concerning good forestry practices*”, issued on 21 January 2010 by the MiPAAF for the purposes of the “forest

payments”, is intended to compensate voluntary commitments for the mitigation of climate change, among others.

HUMAN HEALTH

PROTECTION FROM HEAT-WAVES

Efforts undertaken in the national health sector that are beneficial also for adapting to climate change are most developed in the field of protection from the effects of heat waves, implemented mainly under the direction of the Department for Civil Protection and the Italian Ministry of Health.

After the heat wave of summer 2003, which had serious impacts on the elderly population in different regions and municipalities, the health agencies took a number of actions to respond to the effects of heat waves. In order to provide a framework for the implementation of prevention plans at the local level, the Ministry of Health launched the *National Programme for the prevention of effects of heat waves on health*, with the technical support from the Department for Civil Protection. The main objective of this initiative is the implementation of warning systems and the national system of rapid detection of daily mortality.

IMPLEMENTED ADAPTATION ACTIONS AND MEASURES

- *National network of city-based Heat-Health Watch/Warning Systems (HHWWSs)*, covering 34 cities (in February 2012), including:
 - daily mortality surveillance system;
 - vulnerability registry;
 - local action plans;
 - national working group of experts for the preparation of local surveillance and response plans and the vulnerability registry;
- *National Operational Plan* for the prevention of the effects of heat on health, extending the city-specific forecasting systems, defining the mortality surveillance system and the local response plan and identifying the categories at risk (for the Vulnerability registry) and the reference centres (Italian Ministry of Health, 2005);

- 2006 “*Guidelines for preparing monitoring and response plans for the health effects of heat waves*”;
- Regional initiatives against heat waves, including specific programs of active surveillance for co-infection HIV/leishmania by Campania, Sicily and Liguria Regions, and measures concerning heat waves, depletion of the stratospheric ozone layer, vector-borne diseases, water and food quality, and pollen species by Emilia-Romagna Region.

AWARENESS-RAISING INITIATIVES

- Ministry of Health [HEAT LAB Website](#) (2004), providing an overview of practical local experiences to facilitate the exchange of knowledge between stakeholders;
- Ministry of Health *Social Guardians Service* (2004-2006) experimental project in 4 large cities, to verify the effectiveness of the assistance model of the “social guardian”;
- “*For a safe summer*” initiative, disseminating information and recommendations to the citizens (including a National Call Centre Service, booklets for advice and special TV programmes).

TOURISM

Among the implemented adaptation measures in the tourism sector, it is worth mentioning the ones existing for winter tourism. Artificial snowmaking systems are still the most applied response of the Italian winter tourism industry to the decrease in the snow-reliable ski zones. About 77% of Italian ski areas are already covered with artificial snow, reaching 100% in Friuli-Venezia Giulia and Alto Adige regions. However, this kind of intervention has high costs and it is not considered a sustainable option (due to energy consumption, water resource use, installation and maintenance). New and promising business models, including both snow-related and non-snow-related offers (health tourism, congress tourism, other sports and popular activities, etc.) have been developed to some extent, leading to the diversification of winter tourism revenue.

URBAN AREAS

As to the urban areas, some Provinces, Cities and Municipalities started addressing adaptation to climate change mainly through the implementation of urban adaptation planning initiatives, the development of guidelines for climate change adaptation for urban systems and the drafting of their adaptation plans and strategies, such as the following ones, that are reported as good practices.

LOCAL ADAPTATION PLAN OF ANCONA MUNICIPALITY

In the framework of the EC LIFE project *ACT - Adapting to climate Change in Time*, the Municipality of Ancona applied a participatory model for the development of its Local Adaptation Plan (LAP) to climate change. The LAP was defined by the Municipality in close collaboration with the Local Adaptation Board (LAB), consisting of key stakeholders from the most vulnerable areas, as identified by the local climate change impacts assessment carried out within the project. The methodology at the basis of the development of the LAP was defined by ISPRA and was designed in such a way that it can also be transferred to other European cities. The peer review evaluation of the project results is currently underway, in order to define guidelines that could be used by other local authorities interested in developing a plan for local adaptation.

ADAPTATION ACTION PLAN OF THE GENOVA PROVINCE

The Genova Province (Liguria region) implemented a series of initiatives on climate change adaptation under the INTERREG project *GRaBS - GReen and Blue Space adaptation for urban areas and eco towns*. Within this framework advanced methods of planning for new urban settlements, both residential and public, were developed based on the principles and methods of environmental protection. Also, best practices on urban green spaces were defined and a tool for climate change risks and vulnerability assessment of the territory (as a planning support tool to adapt to climate change) was produced. The involvement of local stakeholders and citizens was a core pillar of the project. In particular, the city of Genova developed an Adaptation Action Plan for its Province (EEA, 2012). The plan aims inter alia at addressing in practice the natural vulnerability of the territory, which might be worsened by climate change, through planning strategies which increase the land's

natural defences. This includes innovating the design criteria for the urban space in order to harmonize the development needs of the region with the principles of environmental sustainability in the context of adaptation to climate change (e.g. by promoting “green and blue” infrastructures, i.e. the water and vegetation components, as primary elements of thermoregulation and ecological continuity).

BIO-NEIGHBOURHOOD INCENTIVE PROGRAMME FOR DEVELOPERS OF FAENZA MUNICIPALITY

In order to respond to current high temperatures as well as to prepare for coping with future possible increasing temperatures related to climate change, the Municipality of Faenza implemented an “incentive programme for developers”, embedded in the urban planning regulations (Kazmierczak & Carter, 2010). The aim of the initiative is to deploy synergic measures for climate change adaptation and mitigation, improving the quality of life and attractiveness of the town while pursuing development needs. For this purpose, the incentive programme authorizes possible additional building capacity with respect to the approved standards for buildings having distinctive features of environmental sustainability. The flexible building development conditions are agreed upon by the town authorities with the developers on a case-by-case basis, thus considerably accelerating the traditional process of releasing building permissions.

“SUSTAINABLE CITIES” AND AGENDA 21 GUIDELINES FOR LOCAL ADAPTATION ACTION PLANS OF URBAN SYSTEMS

In 2011 the “Sustainable Cities” Working Group, in collaboration with the Coordination of Italian Local Agenda 21, developed draft guidelines for “local adaptation action plans of urban systems to climate change”. The document aims at facilitating the integration of mitigation and adaptation actions in local planning for resilient cities and territories in Italy. The indicated areas of intervention include: spatial planning (land use and territorial government); prediction, reduction and management of land vulnerability (hydro-geological assets); adapting urban planning, settlements and buildings; water cycle (conservation of resources and quality); multifunctional urban green spaces and health and social services and civil protection. The document was also prepared based on the outcomes of two National workshops related to adaptation to climate change for the urban environment,

organized by the above mentioned network. A national survey of best practices in Italian urban and regional planning was also launched, with the aim to support the process of adapting the territories and cities to climate change.

ENERGY

In Italy the criteria applied in the construction of new buildings have achieved a good degree of power efficiency as regards the use of heating, while the same criteria lead to weak disadvantages in the use of cooling systems. Newly designed buildings lead, in general, to substantial energy savings in the use of heating, whether it be produced by electricity or by other sources, and moderate increases in electricity demand in the use of cooling (Madonna, 2012). Given the expected increase in the need for cooling during summer due to higher temperatures, this may thus be considered a case of mal-adaptation.

As for the thermoelectric production of energy at the national level, there are no long-term strategies designed to respond to the impacts of climate change. In the ordinary, the priority is the need to comply with legal obligations.

However, during the water crisis in summer 2003 that affected the whole basin of the Po River, to prevent the occurrence of further emergency situations, the Department of Civil Protection promoted a memorandum of understanding signed by the Basin Authority, Regions Aosta Valley, Piedmont, Lombardy, Veneto, Emilia-Romagna, the Interregional Agency for the Po River (AIPO), the National Transmission Grid Operator, Consortia regulators of the lakes, the National Association of reclamation, irrigation and land improvements (ANBI), and companies producing electricity in the basin. In 2007, based on the recommendations of a technical-scientific group set up by the Department of Civil Protection, the *“Practical Guidelines to face possible water crises”* have been issued by the President of the Council of Ministers, which led all the relevant structures in the management of water resources at various regional levels to carry out the necessary monitoring and appropriate actions to reduce the severity of the impacts.

The promotion of solar energy as a viable alternative energy source started in Italy in February 2007 (Gaudioso & Masullo, 2009).

INFRASTRUCTURE

TRANSPORT

As a practical example of adaptation in the transport sector, it is reported that the motorway authority of the “Milano Serravalle” infrastructure network, serving the territory of Milan and Lombardy region with more than 180 km of highways, is considering climate change related flood risks in revising the design criteria for the crossing of watercourses (ETC/CCA, 2013).

CULTURAL HERITAGE

The ISCR has worked, since the 1980s, both in terms of scientific research and on operating procedures to be adopted for restoration, on the theme of the harmful effects of pollution and climate change on the historical and artistic heritage. Campaigns and interventions were designed to address the issue of restoration of the major Roman archaeological monuments, the preservation of the great masterpieces such as The Last Supper by Leonardo da Vinci in Milan, the Giotto's fresco cycle with Stories of the Virgin and Christ in Padua, the conservation of the mural paintings of Basilica of San Clemente in Rome, and the problems related to the use of spaces of cultural heritage properties, such as the Domus Aurea in Rome.

RESEARCH INITIATIVES

Italy is involved in several applied research efforts on climate change adaptation at international, European as well as national level. A number of projects aimed at identifying adaptation measures have been funded, mainly focusing on agriculture, biodiversity, coastal zones, desertification, health, water and cities. While national financing seems mainly dedicated to support the investigation of adaptation in the agricultural sector, most adaptation research and applied projects undertaken in the country are funded by the European Union through FP7, INTERREG and LIFE funding schemes. Numerous transboundary research initiatives have also been undertaken in the context of the Alpine Convention.

In addition, several bilateral and multilateral initiatives (projects and programmes) were funded for climate change research on impacts, adaptation and mitigation, including capacity-building activities in developing countries, through the financial

resources provided by the Italian Ministry of Foreign Affairs and MATTM. The objectives of these initiatives are various and ambitious. They include, among others: efficient use of energy, implementation of innovative financial mechanisms, efficient water management, carbon sequestration, professional training and exchange of know-how, promotion of eco-efficient technologies, and aerosol monitoring.

A comprehensive list of adaptation-relevant research projects is provided in the summary table in the conclusive section.

FEASIBILITY STUDY FOR THE ABRUZZO REGION

At the regional level, the Abruzzo Regional Government and ENEA set up a joint project aimed at providing the information necessary to identify the most vulnerable environmental and socio-economic sectors for the Abruzzo Region to expected climate change in support of adaptation planning, titled: *“Feasibility study for the assessment of climate change impacts and vulnerabilities for the Abruzzo region and possible adaptation actions”* (ENEA, 2011).

This collaborative effort led to an evaluation of critical situations in the various sectors and to the formulation of possible working hypotheses regarding regional adaptation actions, with a focus on four themes, based on the available climate change knowledge and on the geo-morphological, meteo-climatic and economic features of the Abruzzo region: 1) coastal marine environment, 2) coastal zone, 3) mountain area and 4) production activities.

This feasibility study can be considered a cutting-edge action in Italy as it aimed at identifying technical, scientific, methodological, procedural and public elements needed to tailor the methodologies and procedures put forward by the United Nations (IPCC and UNEP) to the Italian context for the identification of adaptation options. The ultimate goal includes building a field-tested prototype that could be taken up as a reference method for analysis of climate change adaptation at the national level.

COST OF ADAPTING TO CLIMATE CHANGE

With respect to measuring the potential cost of adapting to climate change at the national scale, only the already mentioned early joint effort by FEEM-CMCC-ISPRA can be reported (Carraro, 2008). This study covers just a few specific adaptation measures that have been explored or undertaken in four vulnerable areas: the Alps and glacial ecosystems, coastal zones, arid areas and areas threatened by desertification, and zones prone to floods and landslides. Some of the main conclusions of this study are reported hereunder.

ALPS AND GLACIER ECOSYSTEMS

Despite a lack of comprehensive economic evaluations over the Italian Alpine zones, some estimates for adjusting the tourism industry to climate change were performed. The most common adaptation strategy regards artificial snowmaking for winter tourism; however, this kind of intervention implies high costs linked to energy consumption, water resources use, installation and maintenance and it is therefore not considered a sustainable adaptation option.

COASTAL ZONES

Economic assessments of coastal adaptation measures do not exist in Italy, with the exception of very specific issues (e.g. MO.S.E. project in the Venice lagoon). According to the estimates by the project *PESETA - Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis*, damages due to sea level rise could amount to 9 - 42 billion Euros/year, depending on the sea level scenario. In addition, adaptation could reduce the costs of adverse climate change impacts in the possible range of 7% - 50% in the medium run and up to 70% in the long period.

AREAS THREATENED BY DESERTIFICATION

At present, there are no available estimates for Italy concerning the adaptation costs in the sector of drought and desertification. The main reasons involve the lack of scientific literature as well as some specific features of the phenomenon, which hamper the identification of measures to combat desertification and their economic assessment.

ZONES PRONE TO FLOODS AND LANDSLIDES

Urgent measures financed by Italy until 2006 for the risk of flood and landslide amounted to 447.36 million Euros for flood risk and 667.88 million Euros for landslide risk. These figures could give an idea of the costs needed for the defence of the Italian territory from disasters associated with floods, landslides and other mass movements. Nevertheless, they do not represent at all the cost of protection in the light of the increased risk associated with climate change.

DISCUSSION AND CONCLUSIONS

This paper provided an extensive review of the information on climate change impacts, vulnerabilities and current adaptation action, gathered from the few available national studies and broader analyses on the Mediterranean and Europe.

Italy expects a number of impacts from the changing climate, which, coupled with low adaptive capacity that characterizes Southern Europe, will increase the country's vulnerability to climate change. A summary of impacts and vulnerabilities is shown in Tab.21.

Table 21. Summary of key climate change impacts and vulnerabilities in Italy

Sector	Key climate change impacts and vulnerabilities
Water and hydro-geological system	Water availability and quality: higher stress on water resources which could lead to reduced water availability and quality, especially in summer, in southern regions and small islands. Hydro-geological system: alterations of the hydro-geological regime could increase the risk of landslides, flash mud/debris flows, rock falls and flash floods; areas most exposed to the risk of flood and landslide include the hydrographical basin of the Po River (increased flood risk) and the Alpine and Apennine areas (flash flood risk).
Biodiversity and ecosystems	Possible higher risk of biodiversity and natural ecosystems loss , especially in Alpine areas and mountain ecosystems.
Coastal zones	Potential increased risk of flood and erosion of coastal zones from increased occurrence of extreme weather events and sea level rise (especially where coupled with both natural and human-induced subsidence).
Soils	Potential soil degradation and higher risk of soil erosion and desertification , with a significant share of the South of the country at risk of desertification and specific areas in some northern regions showing some critical conditions.
Agriculture and food production	Possible reduction of agriculture productivity especially for wheat, and also for fruit and vegetable crops; olive, citrus, vine and durum wheat production could become possible in the North; corn cultivation could suffer in the South.
Fisheries and aquaculture	Potential overall decline in productivity of fished species due to fish stock movements, aquatic infections, effects of warming temperature on bivalve and gastropod molluscs or shellfish. Possible reduction in aquaculture output in North-Adriatic coastal wetlands and lagoon areas.
Forests and forestry	Possible higher risk of forest fires and droughts threatening Italian forests , with the most critical areas being the Alpine zone, Southern regions and the Sicily and Sardinia regions.
Human health	Possible effects on human health , particularly affecting the most vulnerable parts of population, including increased heat-related mortality and morbidity, cardio-respiratory diseases from air pollution, more injuries, deaths and illnesses due to flood and fire events, allergic disorders, as well as changes in the spreading and occurrence of vector-, water- and food-borne diseases.
Tourism	Potential damages to winter and summer tourism , due to more expensive or reduced winter tourism as well as reduced summer tourist flows in relation to less comfortable conditions, but potential for improved spring and autumn tourism.
Energy	Reduced hydropower production potential; minor impacts on renewable sources; energy demand for cooling higher than the reduction of energy demand for heating
Infrastructure	Pressures to urban and rural infrastructures with possible inaccessibility or disruption of transport network, human settlements and socio-economic activity. Potential negative impacts on the cultural heritage.

A first macro-economic assessment of climate change impacts for Italy, performed by FEEM, ISPRA and CMCC, indicates that the country could experience an aggregated GDP loss of 0.12%-0.16% in the period 2001-2050 equal to a total loss of 20-30 billion Euros, considering a temperature increase of 0.93°C. Losses could be larger, of about 0.16%-0.20% GDP, for a +1.2°C temperature rise scenario. In

particular, some economic sectors, such as tourism and the economy of the Alpine regions, could experience significant damages. More relevant impacts could be expected at the end of this century, with GDP losses potentially six times larger than those predicted by 2050. Huge differences in terms of economic impacts of climate change could also emerge between northern and southern Italy. This study also provides an early attempt to assess costs and benefits of adapting to climate change in Italy. However, it is limited to adaptation measures explored or undertaken in four vulnerable areas: the Alps and glacier ecosystems, coastal zones, arid areas and areas threatened by desertification, and zones prone to floods and landslides.

To face the adverse consequence of climate change in a number of vulnerable areas, Italy as a whole is making a huge effort, despite the lack of a coherent framework of action such as a NAS or a NAP. While the development of a NAS is in progress, other countrywide initiatives have been undertaken that are beneficial to adaptation, such as legislation, non-binding frameworks, monitoring and early-warning systems as well as practical measures (see Tab.22). In particular, three important national frameworks make specific reference to climate change: the White Paper *“Challenges and opportunities of rural development in mitigating and adapting to climate change”*, aimed inter alia at increasing the resilience of the agricultural sector to climate change; the *National Biodiversity Strategy*, with one of its three pillars on “biodiversity & climate change” and including action on adaptation to climate change as a priority; the *National Action Plan to combat drought and desertification* and related ten *Local Action Programmes*, calling for the creation of links and synergies with climate change issues.

Furthermore, Regions, Provinces and Municipalities have designed and implemented a variety of actions that are relevant for adaptation. The four following urban initiatives are reported as good practice case studies: *Ancona Municipality Local Adaptation Plan*, developed in close collaboration with local stakeholders based on a methodology designed by ISPRA with the aim to be applied also in other European cities; *Genova Province Adaptation Action Plan*, developed to cope with the territorial vulnerabilities that might be worsened by climate change and through planning strategies that would increase the environment’s natural defences (e.g. “green” and “blue” infrastructures); *Faenza Municipality Bio-neighbourhood incentive*

programme for developers, implemented within the urban planning regulations to cope with rising temperatures related to climate change, with a focus on enhancing synergies between climate change adaptation and mitigation, quality of life and development; *Sustainable Cities* network and *Coordination of Italian Local Agenda 21* guidelines for local adaptation of urban systems.

Table 22. Summary of adaptation initiatives in Italy

Vulnerable area	Vulnerability	Reported implemented adaptation initiatives
	Water scarcity and increased drought frequency, also inducing competition for available resources	<p>Management of water emergencies/crises</p> <ul style="list-style-type: none"> • <i>National water emergencies regulations</i> providing technical & financial support for addressing water crises • <i>Ad hoc organizations for crisis management</i>, e.g. <ul style="list-style-type: none"> – Drought control room for drought events in the Po River basin – Coordination Unit for the management of water resources shared between the Apulia and Basilicata regions. <p>Water management</p> <ul style="list-style-type: none"> • <i>Irrigation and drinking water networks</i> (structural funds) • <i>Water programme</i> (cohesion funds) • National plan for irrigation (agriculture) • <i>Specific funds for droughts, National Action Plan (NAP) and 10 Local Action Plans (LAPs) to combat drought and desertification</i> (drought) • <i>River Basin Management Plan</i> of the Po River catchment • <i>Arno River Basin Authority mapping of flood hazard and risk</i> in support to river Basin planning.
	Increased flood and landslide risk	<p>Management of risk of flood and landslide</p> <ul style="list-style-type: none"> • National legislation <ul style="list-style-type: none"> – <i>Legge Sarno</i> (Law 267/1998), for the implementation of protection from floods and landslides – <i>Government directive</i> (27 Feb. 2004), for the prediction and prevention activities, and the establishment of an integrated warning system at the national and regional level. • Civil protection activities <ul style="list-style-type: none"> – Monitoring of hydro-pluviometric data and water availability – Monthly updating of scenarios for the next three-month period by a technical-scientific group – Network of Functional Centres for data assimilation, and processing – Widening knowledge base on extreme weather events and its application to early warning an monitoring tools – National Radar Plan for nowcasting.

	Floods, droughts, water scarcity and cross-sectoral vulnerabilities. Reduction of quality and quantity of groundwater resources	<p>International scientific research</p> <ul style="list-style-type: none"> • CLIMWATADAPT - Climate Adaptation – Modelling water scenarios and sectoral impacts project (2010-2011) • TRUST- Tool for regional scale assessment of groundwater storage improvement in adaptation to climate change project (2009-2011).
Biodiversity and ecosystems	Overall biodiversity reduction	<p>National Biodiversity Strategy 2011-2020, for biodiversity protection by and beyond 2010, including adaptation to climate change.</p> <ul style="list-style-type: none"> • Strategic aim: reducing substantially the impact of climate change on biodiversity by 2020, by defining appropriate measures of adaptation and mitigation, as well as by increasing the resilience to climate change of natural and semi-natural ecosystems. • Adaptation measures to be implemented: actions aimed specifically at keeping the range and variability of ecological habitats and species, favouring the spread of species into new favourable habitats, maintaining the existing ecological networks, and controlling the spread of invasive species.
	Conservation and management of fauna and flora	<p>Initiatives for the protection of species and habitats:</p> <ul style="list-style-type: none"> • International Conventions, Agreements and Protocols • national initiatives (legal frameworks, Action Plans and Guidelines, publications and databases) concerning terrestrial and marine protected areas, national parks, landscape, terrestrial fauna and flora, and actions for limiting the impacts of alien invasive species • <i>Nature 2000</i> Network of protected terrestrial and marine sites • <i>LIFE+ programme</i> (14 specific new projects for biodiversity protection in 2008).
	Natural hazards and overall climate change vulnerability of the Alpine space	<p>Scientific research</p> <ul style="list-style-type: none"> • AdaptAlp - Adaptation to climate change in the Alpine Space project (2007-2013) • ClimChAlp - Climate change, impacts and adaptation strategies in the Alpine Space project (2006-2008) • STRADA - Climate change adaptation strategies for the management of natural hazards in the transboundary areas project (2010-2013).
Coastal zones	Flooding from sea level rise and extreme events, coupled with coastal erosion and subsidence, anthropogenic pressures and fragmentation of institutional competences, saltwater intrusion in the coastal aquifer waters	<ul style="list-style-type: none"> • Implemented measures: traditionally coastal defence measures, behavioural strategies, managerial interventions, political decisions • National level: on-going institutional coordination by IMELS towards the development of a National Strategy on Integrated Coastal Zone Management (ICZM) and relative Plans, Programmes or Guidelines. • Regional level: some Italian Regional Governments have already started approaching the ICZM (e.g. Emilia-Romagna and Marche (2005) and Liguria (2002), with the adoption of instruments having reference to the ICZM; Tuscany, Lazio, Abruzzo and Sardinia with testing

		activities of the ICZM approach or plans for land protection and spatial planning).
	Coastal erosion, alteration of marine and coastal ecosystems	Scientific research <ul style="list-style-type: none"> • INTERREG IIIC Beachmed-e MedPlan subproject (2005-2008) • MEDCOAST network • COASTANCE - regional Common Action Strategy Against Coastal Erosion and climate change effects for a sustainable coastal planning in the Mediterranean basin project (2009-2012) • MedLab - Mediterranean Living Lab for Territorial Innovation project (2009-2011) • EMMA - Environmental Management through Monitoring and Modelling of Anoxia project (2004-2007) • SHAPE - Shaping an Holistic Approach to Protect the Adriatic Environment between coast and sea project (2011-2014) • CAMP - Coastal Area Management Programme Italia project (2009) • VECTOR - VulnErability of the Italian coastal area and marine Ecosystems to Climatic changes and Their rOle in the Mediterranean caRbon cycles project (2006-2009).
Soils	Prolonged periods of drought, run-off erosion (due to increased intense precipitations and floods), erosion caused by dryness, salinization and nutrient loss (due to decreasing precipitation and increasing droughts), increased fire frequency and severity	Fight against drought and desertification <ul style="list-style-type: none"> • <i>National Committee to combat drought and desertification (1997)</i> • National Action Plan (NAP) to combat drought and desertification (1999) • 10 Local Action Plans (LAPs) to combat drought and desertification: Campania (2010), Liguria (2010), Tuscany (2010), Emilia-Romagna (2009), Apulia (2008), Sardinia (2008), Calabria (2008), Abruzzo (2007), Basilicata (2007), Sicilia (2007) • 6 Regional Pilot Projects to combat drought and desertification: Abruzzo (2010), Piedmont (2010), Sardinia (2009), Sicily (2009), Calabria (2009), Apulia (2008) • Methodological and operational report: MATTM (2009) “<i>Good practices for combating desertification</i>”, for the identification of good practices for combating desertification.
	Soil degradation and instability	<ul style="list-style-type: none"> • Rural Development Programmes (RDPs) 2007-2013, including actions aimed at protecting soil and restoring its stability.
	Desertification	Scientific research <ul style="list-style-type: none"> • MEDALUS - Mediterranean Desertification and Land Use project (1991-1999) • DISMED - Desertification Information System for the Mediterranean project (2000-2003) • DesertWatch project (2004-2006).
Agriculture and food production	Water scarcity leading to crop yield reduction	<ul style="list-style-type: none"> • National Plan for irrigation in support of the agricultural sector • MiPAAF (2011) White Paper on rural development and climate change, aimed at increasing the resilience of the agricultural sector to climate change

	<p>Extreme weather events, pest damage, forest loss, forest fires leading to sudden loss of crops, water scarcity causing yield decline</p>	<ul style="list-style-type: none"> • National Strategic Plan for Rural Development and 21 regional Rural Development Programmes (RDPs) 2007-2013, with activities targeted at water management efficiency improvements in irrigation infrastructures and enhancement in the capacity to store water, conservation of plant and animal species and preventive actions against extreme weather events • A single funding system since 2010, supporting: <ul style="list-style-type: none"> – the costs of insurance premiums covering the risks of climate change on crop production, animal diseases in livestock, diseases and pest infestations of plants – the costs of insurance for wine grapes crops • preventive measures to cope with the damage to agricultural production and livestock, farm structures, production facilities and rural infrastructures in areas affected by natural disasters or exceptional events.
	<p>Overall climate change vulnerability of the agriculture sector; water-issues</p>	<p>Scientific research</p> <ul style="list-style-type: none"> • AgroScenari - Adaptation scenarios of Italian agriculture to climate change Programme (2008-2012) • CLIMESCO - Evolution of cropping systems as affected by climate change project (2006-2010) • SOILSINK - Climate change and agricultural and forestry systems: impact on the carbon reservoirs and on the soil microbic diversity project (2006-2010) • Climagri - Climate change and agriculture project (2001-2004) • Icarus - IWRM for Climate Change Adaptation in Rural Social Ecosystems in Southern Europe international project (2010-2012).
Fisheries and aquaculture	<p>Combination of climate change and anthropic pressure on fisheries</p>	<p>MiPAAF (2007) Operational Programme for the Italian fisheries sector for the period 2007-2013, on sustainable management of fisheries.</p>
Forests and forestry	<p>Risk of forest fires and related biodiversity loss</p>	<p>Protection of forests from wild fires</p> <ul style="list-style-type: none"> • (2000) Plan for the State natural parks and reserves • (2002) Scheme for plans against forest fires for the State natural protected areas • (2006) Specific plan for the State natural reserves • Technical-scientific support to the forests managers.
	<p>Wild fire management</p>	<p>Scientific research</p> <ul style="list-style-type: none"> • FUME - Forest fires under climate, social and economic changes in Europe, the Mediterranean and other fire-affected areas of the world project (2010-2013)

Human health	Summer heat waves	<p>Prevention of and response to heat health effects from heat waves</p> <ul style="list-style-type: none"> • National network of city based Heat-Health Watch/Warning Systems (HHWWSs) covering 34 cities in Feb. 2012, with <ul style="list-style-type: none"> – Daily mortality surveillance system – Vulnerability registry – Local Action Plans – National working group of experts for the preparation of local surveillance and response plans and of the Vulnerability registry • Heat Health Prevention National Operative Plan • Regional initiatives against heat waves. <p>Dissemination of information</p> <ul style="list-style-type: none"> • HEAT LAB website • Social Guardians Service project • For a safe summer communication initiative. <p>Scientific research</p> <ul style="list-style-type: none"> • Epidemiologic studies • cCASHh - Climate Change and Adaptation Strategies for Human Health in Europe project (2001-2004).
	Risk of spreading of vector-, water- and food-borne diseases	<p>Regional initiatives</p> <ul style="list-style-type: none"> • Specific programs of active surveillance for co-infection HIV/leishmania (e.g. Campania, Sicily and Liguria) • Surveillance and monitoring of the increase of pathogenic agents in water, of a possible alteration of water and food quality, of the increase of the vectors of some diseases and monitoring of various pollen species (e.g. Emilia-Romagna).
	Depletion and delayed recovery of the ozone layer	<p>Regional Initiatives: monitoring of the increase in concentrations of air pollutants, including ozone (e.g. Emilia-Romagna).</p>
Tourism	Snow-cover reduction and decreasing length of winter touristic season	<p>Winter tourism adaptation</p> <p>Artificial snow making systems (covering 77% of Italian ski areas); Diversification of tourism supply.</p>
Urban areas	Urban environment vulnerabilities worsened by climate change	<p>Implemented initiatives</p> <ul style="list-style-type: none"> • Municipality of Ancona <i>Local Adaptation Plan</i> • Genova Province <i>Adaptation Action Plan</i> • Faenza Municipality “<i>Bio-neighborhood incentive programme for developers</i>” • “Sustainable Cities” and Coordination of Italian Local Agenda 21 guidelines for <i>Local adaptation action plans of urban systems to climate change</i>

		<ul style="list-style-type: none"> • Emilia Romagna and Veneto Regions <i>strategies to mitigate, adapt to, prevent and manage the risks related to the urban heat island phenomenon</i> (under development). <p>Scientific research</p> <ul style="list-style-type: none"> • ACT - Adapting to Climate change in Time project (2010-2012) • UHI - Urban Heat Island project (2011-2014) • CHAMP - Local Climate Change Response project (2009-2012) • EU Cities Adapt - Adaptation Strategies for European Cities project (2012-2013).
Energy	Increased cooling and heating needs	<p>Implemented initiatives</p> <ul style="list-style-type: none"> • Energy-saving building codes (mal-adaptation?).
	Reduced hydropower potential affecting thermo-electrical production	<ul style="list-style-type: none"> • <i>Practical Guidelines to face possible water crises</i> about monitoring and action.
Infrastructure	Flood risk on the transport network	<ul style="list-style-type: none"> • Revision of the design criteria for the crossing of watercourses along Milano-Serravalle highway.
	Impacts of climate change and pollution on cultural heritage	<ul style="list-style-type: none"> • Interventions on monuments, great masterpieces, and heritage properties for their restoration and conservation.

With regard to applied research initiatives aimed at identifying adaptation measures, Italy is involved in several research projects framed both at international and national level. Projects are mainly focusing on coastal zones and related ecosystems, agriculture, urban areas, biodiversity and hazards in the mountain areas, desertification processes, water resources, and health, including transboundary issues to a minor extent (e.g. for the Alps). It can be noted that the range of the project topics covers almost all the top vulnerabilities observed over the Italian territory. The majority of the projects are supported by the EU (FP7, INTERREG, LIFE schemes), while national funds appear to be primarily directed towards adaptation-relevant research in the agricultural sector. One outstanding research initiative at the regional level is the joint Abruzzo Region-ENEA feasibility study aimed at assessing climate change impacts and vulnerabilities in Abruzzo and defining adaptation actions.

This review identified twelve key sectors: water and hydro-geological system, biodiversity and ecosystems, coastal zones, soils, agriculture and food production, fisheries and aquaculture, forests and forestry, human health, tourism, urban areas, energy and infrastructure. Such categorization of sectors based on scientific assessments provides an overall verification that the list of key policy sectors identified by the 2012 NAS outline is coherent and succeeds in addressing the main climate risks run by Italy. A slight discrepancy of sectors between this review and the 2012 NAS list is purely artificial since the same sectors may be considered together or separately due to diverse reasons. For instance, while here the hydro-geological system is associated with water resources for their technical affinity, the NAS addresses it as a single aspect due to the political relevance that the matter of flood and landslide risks (hydro-geological hazards) has taken on in the recent years. Similarly, the NAS considers agriculture, fisheries and aquaculture as one sector because they are linked to the food production function, while here they are separate following the distinction of European policies. Furthermore the NAS is expected to tackle two special case studies that were not singled out in general assessments on the Mediterranean, but have particular strategic importance in the economy of the country: the Alps and Apennines and the hydrographical basin of the River Po. Despite these minor methodological differences in the categorization, all

the key sectors that have been found particularly vulnerable in the scientific assessments considered for this review are addressed by the 2012 NAS outline, which thus can be judged satisfactory in terms of coverage.

The 2007 National Conference on Climate Change only considered seven priority sectors, which, however, already included the most serious vulnerabilities identified in this review: the management of water resources, coastal areas, soils and the protection of biodiversity, among others. In the outline of the future NAS the focus of adaptation appears enlarged to emphasize the need to intervene on some other vulnerabilities, such as, in the first place, the areas at risk of floods and landslides, areas at risk of desertification, as well as the mountain regions. With respect to the 2007 list of sectors, the NAS will have a more targeted approach to some sectors, and provide specific guidance also on forestry, urban areas, and critical infrastructure including transport and national cultural heritage.

For what concerns the thirteen early actions on sustainable adaptation put forward at the National Conference on Climate Change, this assessment can confirm that those are still needed, although much of what they suggest has been done in the absence of a NAS. Enhancing research, improving the involvement of society and engaging the private sector are three cross-cutting themes that remain valid as success factors behind adaptation planning, and are expected to be dealt with by the future NAS. At the current stage of formulation, the issue of sustainable consumption as such does not seem to be touched upon by the NAS, however it is a theme that was very much stressed by the stakeholders who participated in the first public national consultation on adaptation as the need to “change personal behaviours” (Venturini, Giannini et al., forthcoming) (Chapter 5 of this dissertation). Also, the synergies and conflicts between adaptation and mitigation, although they are considered in few sectors, do not play a prominent role throughout the NAS. Decision-makers may have to consider whether to include them in the future priority actions. The NAS is likely to assign priority to disaster risk prevention and land management actions aimed at reducing the risk of floods and landslides in the most hazardous areas, according to the preliminary ministerial guidelines for future economic planning.

As a conclusion, while at the policy level the finalization of a NAS would provide a coherent umbrella for the action that is already happening at the sub-national level, one of the most urgent research gaps to be filled concerns the lack of comprehensive national and sectoral economic assessments. More accurate figures on impacts of climate change and tailored cost-benefit analyses on the options for adapting to new conditions in Italy, would in fact support decision-makers to choose the most appropriate adaptation strategies.

CHAPTER 5 - Starting a participatory approach for a future governance of the National Adaptation Strategy in Italy

This chapter is based on: [Venturini, S.](#), Giannini, V., Davide, M., Castellari, S. (forthcoming). A national adaptation strategy to climate change in Italy: can the right stakeholders be engaged? Under preparation for publication.³⁰

INTRODUCTION

Despite an eventual accomplishment of the international community's effort in seeking a 2015 global agreement to significantly reduce emissions of greenhouse gases (C2ES, 2012), numerous and mostly negative impacts resulting from increased temperatures and other changes in the climate system would be unavoidable (IPCC, 2007). In Europe, Mediterranean regions are among the most vulnerable areas, together with mountain and coastal regions, cities, river flood prone areas and islands (EEA, 2012). The countries in the Mediterranean basin are particularly facing climate change risks. Expected negative impacts in the Mediterranean are primarily associated with a rise in average and maximum temperatures, particularly in summer, above the European average, an augmented frequency and intensity of extreme meteorological events, and the reduction of annual average precipitation. Adapting to such changes, by increasing the adaptive capacity, reducing overall vulnerability and building resilience of socio-economic systems and ecosystems, is crucial, complementary to mitigation, in order to tackle climate change (EEA, 2013).

³⁰ Cooperation led authors to exchange ideas and discuss the goals of the first and second questionnaire, their design and their analysis. My contribution to this paper was the following: framework and guidance, introduction, literature review, methodology, discussion of results, conclusions. Valentina Giannini designed the two questionnaires and elaborated the answers of the second questionnaire. Marinella Davide elaborated the answers of the first questionnaire. Sergio Castellari provided overall advice and review.

Italy, as a Mediterranean country, has already become familiar with the consequences of climate change that are posing new and augmented threats. This is especially true in some regions where climate change is amplifying existing environmental processes. The most critical hot-spots identified in the country include: areas with scarce water resources advancing towards desertification; coastal areas subject to erosion and flooding; areas susceptible to alterations in marine ecosystems; the Alpine region and other mountain ecosystems experiencing loss of glaciers and snow cover; areas prone to the risks of flash floods, landslides, flash mud/debris flows and other mass movements related to soil and land management, among which are the Po River basin, the Alps and the Apennines regions (Medri, Venturini et al., 2013) (Chapter 4 of this dissertation).

To deal with the worsening of such impacts, national and sub-national action has been undertaken in the broader context of existing policies related to: the safeguarding of biodiversity; prevention of natural disasters; integrated management of coastal zones; the fight against desertification; sustainable management of water resources; agriculture and food security; and the protection of health against heat waves and new water-, vector- and food-borne diseases. An extensive review on adaptation initiatives carried out in Italy can be found in Medri, Venturini et al. (2013).

As shown by the experience of other European countries that have adopted a national adaptation strategy (NAS), successfully tackling negative effects of climate change requires a strategic approach to ensure that adaptation measures are taken promptly, are effective and consistent across different sectors and levels of governance (EEA, 2013; Swart et al., 2009). Nevertheless, in Italy the absence of a central framework for adaptation at the national scale has not prevented regional and local actors to pursue adaptation, thanks to the large autonomy of Italian regions (Juhola et al., 2009).

The European Commission (EC) launched a European Strategy on adaptation to climate change in April 2013 to top-up Member States' adaptation efforts with support for transnational coordination and possibilities of funding adaptation measures and research (EC, 2013). In encouraging action by Member States, the EC

provides guidance to the countries to further design and implement adaptation strategies (EC, 2013a) with a view to monitor and evaluate them and eventually strengthen European legislation on adaptation towards more binding provisions affecting national processes (EC, 2013).

The Italian Ministry for the Environment, Land and Sea (MATTM) began to develop a structured and collective thinking around adaptation during the process of the National Climate Change Conference held in 2007, where plans to formulate and implement a NAS were put forward and the earliest “thirteen actions for sustainable adaptation” were identified (APAT-MATTM, 2007). The Conference was not followed-up with more focused work on adaptation until recently, due to political barriers associated with changes of government administrations.

Motivated by a growing number of driving forces, including the impulse by the European Commission, the MATTM formally initiated the preparation of a NAS in July 2012. Given the intersectoral nature of adaptation policy itself as well as its complexity, the process for the preparation of the strategy was envisaged to have an appropriate involvement of relevant institutions and key stakeholders from the very beginning.

As a first step, the MATTM tasked the Euro-Mediterranean Center on Climate Change (CMCC) with the technical and scientific coordination of the process to acquire the knowledge-base needed to develop the Strategy. The coordination was carried out through the establishment of a committee of experts, or Technical Board (*“Tavolo Tecnico”*), composed of about one hundred scientists from various disciplines, who collected and summarized the scientific data and information on impacts, vulnerability and adaptation available at the national level. The Technical Board mainly carried out its work through a virtual platform for exchanging information, with *ad hoc* technical meetings organized by CMCC. In addition, an Inter-ministerial Advisory Group was set up (*“Tavolo Istituzionale”*), composed of representatives of the ministries and other institutional bodies relevant to the elaboration of the NAS, chaired by the MATTM. The Inter-ministerial Advisory Group had provided input to the process by steering the work of the Technical Board, through a number of

physical meetings and other virtual interactions, thus substantially contributing to the preparation of the strategy.

As a next step, the participatory process with national stakeholders has been carried out along the initial planning phases of the NAS. The process is still ongoing and various consultation rounds on the NAS are expected, to conclude with the adoption of the strategy.

In line with the findings of other scholars (Bauer et al., 2012; Preston et al., 2011; Smith et al., 2009), we argue that adequate stakeholder participation is a key challenge that governments face when developing and later implementing adaptation policies. The involvement of non-governmental stakeholders in the governance of adaptation - that is, in fact, how adaptation action is developed and coordinated - is not only a matter of democracy or “social justice” (Paavola, 2008), but also it helps to guarantee support and commitment to decisions that potentially affect stakeholders’ interests at the local level (Beierle & Cayford, 2002). Stakeholders may also enrich the process with relevant “indigenous” knowledge and experience in particular sectors (Reed, 2008).

The overall objective of this article is therefore to analyze how the very significant challenges of participation have been faced in the Italian National Adaptation Strategy at its origin and deepen the understanding of the involved stakeholders’ opinion with regards to the objectives of the Strategy and its possible priority actions. Results of the initial participatory steps are intended to inform the following phases of the development of the Italian Strategy, as well as to ultimately improve the exchange of practices between countries in the framework of adaptation policy planning within Europe.

Section 1 sets the context by presenting a literature review of the challenge of participation. Section 2 illustrates the methodology used to design and analyze two surveys carried out within the participatory process of strategy development. In Section 3 the outcomes of the surveys are discussed. Finally, conclusions are drawn from this exercise and recommendations for further work formulated.

THE CHALLENGE OF PARTICIPATION

Participation of stakeholders in adaptation planning processes is considered both a challenge (Bauer et al., 2012) and a typical success factor (EEA, 2013; Preston et al., 2009; Smith et al., 2009). According to Ebi et al. (2004, p.37) stakeholders are “*those who have interests in a particular decision, either as individuals or as representatives of a group*”, which encompasses both influencers and those affected by the final result of such a decision.

There are, indeed, multiple ways to realize participation within a given system, ranging from soft to harder forms of interaction between the relevant authority and the groups of interest.

Arnstein (1969) categorizes eight levels of participation that are depicted as a ladder, where each rung corresponds to the extent of citizens’ power in determining the outcomes of the process. At the bottom there are forms of “non-participation” called (1) *Manipulation* and (2) *Therapy*, where the real objectives are to educate and “cure” the stakeholders through illusory involvement. The next two rungs are called (3) *Informing* and (4) *Consultation* and are considered forms of “tokenism” as they are ways in which citizens can make their voice heard and get informed; however, their input in the end does not need to be taken up by the authorities, thus creating a false sense of inclusiveness. A further rung up is (5) *Placation* which still amounts to tokenism since stakeholders are allowed to advise but the decision-making power is not in their hands yet. Real participation or “citizen power” is reached in the three upper rungs of the ladder. While (6) *Partnership* allows stakeholders to negotiate with policy-makers as peers, with (7) *Delegated Power* and (8) *Citizen Control*, stakeholders obtain the majority of decision-making seats, or full managerial power.

Along the same lines, Green & Hunton-Clarke (2003) seem to leave out the lowest and topmost steps of Arnstein’s ladder and simplify the idea of participatory processes as a growing involvement from *Informative participation* (equivalent to rung 3 from Arnstein) to *Consultative participation* (rung 4-5) to *Decisional participation* (rung 6-7). While the goal of informative participation is to raise awareness and knowledge of the participants and at the same time ensure

transparency, the other two modalities imply a deeper involvement and a more substantial contribution to the issue at stake. For instance, in the context of adaptation planning, informative participation may happen through public meetings, awareness-raising campaigns, establishment of adaptation portals and publication of reports. Although they both allow a practical dialogue between the parties, leading to commitment and capacity-building, consultative participation differs from the decisional mode, because in the latter an actual input from stakeholders must be heeded in the political decision-making. Consultative events could include workshops with specific groups, roundtables and dialogue platforms where an exchange of views is possible. Partnerships for joint planning, committees for the establishment of a NAS including both governmental and non-governmental stakeholders instead would be examples of decisional participation.

A unanimous positive sentiment is expressed by scholars with respect to the use of approaches for engaging the broader society by governments when planning for adaptation strategies (de Bruin et al., 2009; Preston et al., 2009; Smith et al., 2009; Swart et al., 2009). International and European institutions are encouraging the decision-makers more and more to establish a specific stage within the adaptation planning cycle (EC, 2013a; Prutsch et al., 2010) to identify and cooperate with relevant groups from civil society, scientific community and private sector, in order to obtain sound policies that are responsive to the preferences of stakeholders (World Bank, 1996). The main reasons that make participation so valuable include:

- decisions under high uncertainty, as for climate change and adaptation, and scarce resources, can be more effective when recognizing multiple interests and community-based knowledge in addition to traditional science (de Bruin et al., 2009; Brunner et al., 2005);
- a shared adaptation strategy contains more realistic options and early consideration of possible barriers and conflicts, which may result in a more straightforward implementation phase (de Bruin et al., 2009);
- participation often brings intangible improvements in democracy and social justice that help build the social capital in a country (Paavola, 2008).

METHODOLOGY

For the purpose of having a shared vision on adaptation, the work programme for the development of the NAS involved engaging various non-governmental stakeholders in three distinct moments of the process. In a preliminary phase, a questionnaire was designed and disseminated on-line to gather the views of the stakeholders and initiate a structured dialogue with the society and the scientific community, in order to identify specific needs and obstacles to the implementation of any adaptation actions and measures. In a more advanced phase, a public consultation should take place through an on-line review platform between October 2013 and January 2014, to obtain feedback on the elements of the draft Strategy document. A third round of open consultation is envisaged before the end of the planning process, through a public event, with the aim of gaining endorsement of the final strategy from society and all relevant institutions.

In this context, CMCC had played the role of a “boundary organization” (Swart et al., 2009) by coordinating the work of the Technical Board, maintaining a dialogue with the MATTM and the Inter-ministerial Advisory Group and managing the participation of the broader public in order to successfully develop a shared and scientifically sound NAS in Italy.

This article builds on the work done by CMCC in involving non-governmental stakeholders throughout the first stage of the process of drafting the Strategy.

Based on the outcomes of the preliminary questionnaire developed by the authors, the research was further expanded by designing a survey targeted at a specific sample of respondents. The aim was to clarify some elements of interest that emerged from the initial consultation, related to the peculiar representation of sectors in the participatory process itself, to a convergence on a shared vision for adaptation in the context of a broader goal of sustainable management of the environment, as well as to the sometimes seemingly incoherent perception of adaptation versus mitigation by the respondents.

In this section two steps of the initial participatory process to build an adaptation strategy in Italy are illustrated in detail: the preliminary on-line questionnaire (Q1) and the subsequent interviews (Q2).

The Q1 was designed following recent examples of consultative processes regarding climate change policies, such as:

- Consultation on the preparation of the EU Adaptation Strategy;
- Consultation by the Municipality of Ferrara on citizen knowledge of climate change adaptation;
- Interview guide for regions without climate change adaptation policy document in the frame of the [C3-Alps](#) project;
- Public Consultation on the EU environment policy priorities for 2020;
- Survey on preparing for climate change in cities across Europe, part of the EC project Adaptation Strategies for European Cities [EU Cities Adapt](#);
- Survey on practical examples to develop a National Adaptation Strategy in Europe;
- Trends In American Public Opinion On Global Warming Policies Between 2010 and 2012 (Krosnick & MacInnis, 2012).

Other documents of national relevance were also taken into account, such as:

- Study of climate change and its impacts by the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA);
- Climate, global climate changes and their impact on the national territory by the National Research Council (ISAC-CNR);
- Overview of key climate change impacts, vulnerabilities and adaptation action in Europe by CMCC (Medri, Venturini et al., 2013).

The information drawn from these led to the identification of topics to be elicited in the consultation, which included:

1. *Perceptions about climate change risks, vulnerability and adaptation;*
2. *Objectives and contents of a national adaptation strategy;*
3. *Sectoral approaches for adaptation (focus on sustainable land use and urban areas);*
4. *Needs and priorities for the implementation of a national adaptation strategy;*
5. *Opportunities and barriers to the implementation.*

The questionnaire was divided into five sections related to each topic, and questions were then designed to address the topics, breaking them down into single issues for a total of 23 queries (see Annex 3). While using multiple-choice, scale of liking, and open-ended questions, we gave preference to closed questions, assuming that they facilitate the respondents' judgment among different opinions or alternatives presented. A smaller number of open questions enabled free expression of thought, thus capturing stakeholders' opinions more comprehensively than possible with multiple choice or scale of liking questions. A pop-up glossary was also integrated into the questions in order to allow non-expert respondents to grasp the basics of adaptation terminology (e.g. adaptive capacity, risk) before making their choice.

The questionnaire was then launched online using a web platform that was advertised on the MATTM and CMCC websites. It was left open to the public for one and a half months (1st October - 15th November 2012). Although the questionnaire was accessible by any interested citizen, a list of selected stakeholders received an invitation from the MATTM to encourage their specific contribution. The "preferred stakeholders" were individuals or group representatives chosen if they matched at least one of the following criteria:

- professional affiliation to one of the sectors of reference considered within the work of the Technical Board;³¹
- belonging to a civil society organization (NGO, trade union, professional association, private foundation) working on climate change adaptation;
- belonging to a firm that is expected to develop its own adaptation strategy to climate change.

Existing national associations and businesses were screened against these criteria through web searches and authors' personal knowledge, to compile a comprehensive directory of the most influential stakeholders for a variety of key sectors in the country (see Annex 2). Furthermore, participation from the scientific community was especially promoted by CMCC through e-mail invitations.

³¹ The key vulnerable sectors and sub-sectors identified for the development of the Italian National Adaptation Strategy include: Water resources; Areas at risk of desertification, drought and soil degradation; Areas at risk of floods and landslides; Biodiversity and ecosystems (marine, terrestrial and inland waters); Health; Forestry; Agriculture, fisheries and aquaculture; Energy; Coastal zones; Tourism; Urban areas; Critical infrastructure (Cultural heritage; Transport infrastructure); Mountain areas; Hydrographical Basin of the River Po.

In summary, several efforts were made to involve the target audience within society, which was meant to be an expert audience. Invitations were sent and these included the possibility of forwarding the questionnaire to other relevant stakeholders, thus making use of the “snowball technique”.

The questionnaire gathered 154 answers that were exported and elaborated using spread-sheet software. Open-ended answers were coded and analyzed using “clouds” to identify the most recurrent opinions.

Based on the early elaboration of results, the need to clarify and deepen the understanding of three main issues emerged:

1. the greatest share of the respondents came from four specific socio-economic sectors: Forestry, Biodiversity and ecosystems; Agriculture, aquaculture and fisheries; Energy;
2. respondents’ views on the possible contents of the Strategy converged towards the issues of land protection, behavioural changes and more sustainable use of resources, being unclear what these mean for them (e.g. risk averse behaviour or environmental-friendly behaviour);
3. respondents’ preferences mostly tended towards synergies between adaptation and mitigation when they had the choice of a number of options.

Some unclear feedback from the first questionnaire led to the design of the second questionnaire (Q2) and to the identification of the stakeholders to be involved among those who responded to the on-line questionnaire. Considering the type of information needed, stakeholders from the four most represented sectors in the Q1 were selected. The second round of consultation took place in June 2013. Twenty-four stakeholders were invited to provide feedback on five questions, three common ones and two specific for each sector through oral or written interviews, covering the following themes:

1. Main motivation of the respondent to participate to the Q1;
2. Clarification about the meaning of “behavioural changes” as a modality for implementing adaptation;
3. View on synergies between mitigation and adaptation within the strategy;
4. Priority interventions within the specific sector of competence;

5. Possible cross-sectoral issues and synergies within the strategy.

In the analysis of this second set of results all opinions had to be elaborated one by one. Each answer given by the stakeholders was synthesized into main messages, one general and one specific to the sector, and key concepts, which helped to sort out the great variety of responses. Since 17 stakeholders provided full responses, this generated 17 main messages and 17 specific messages which were then compared to understand general similarities and differences. Key concepts were instead used to deepen understanding and specificities of issues.

RESULTS

DISTRIBUTION OF RESPONDENTS TO Q1

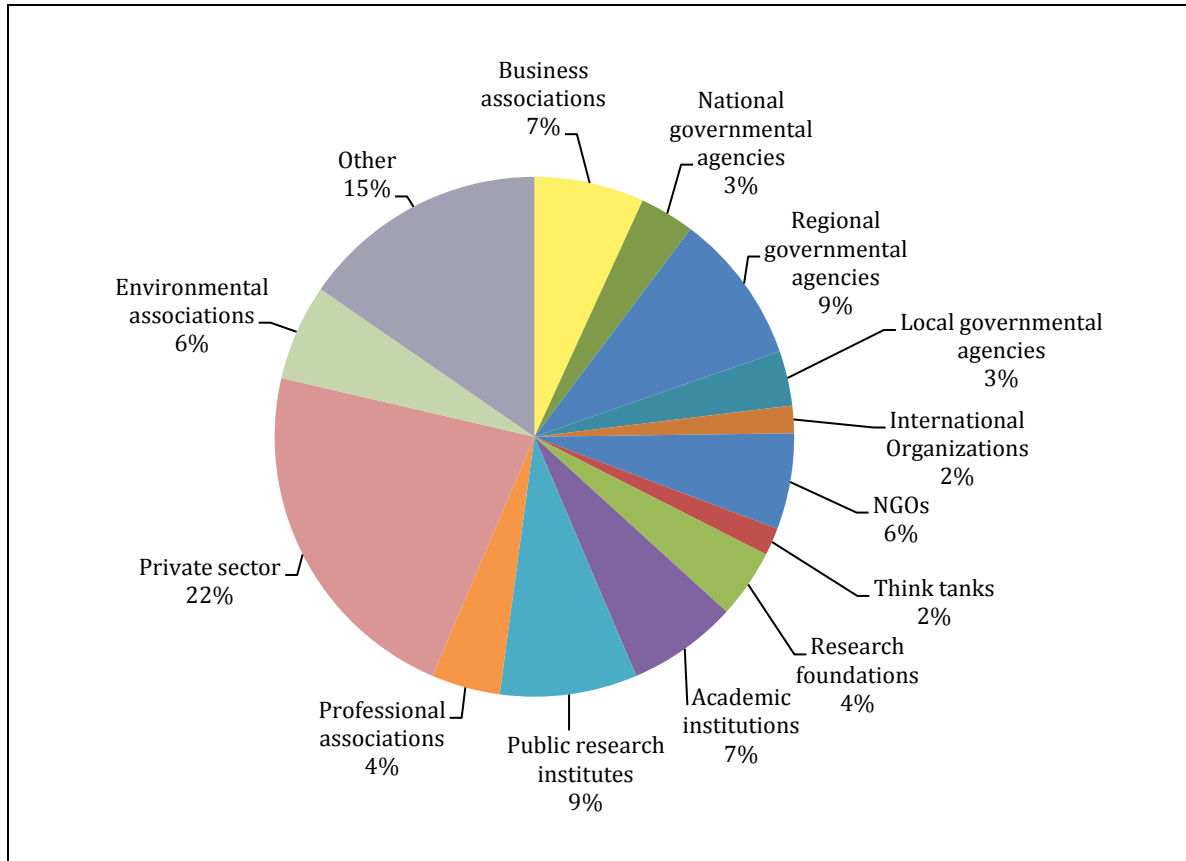
As mentioned above, the first on-line questionnaire gathered 154 answers. Overall, the participation of stakeholders has been characterized by a wide heterogeneity both across professional affiliations and sectors, going beyond the list of preferred stakeholders, which is unavoidable in an open publicly available survey (see Fig.1 and Fig.2).

Looking at the type of professional affiliation, the analysis of the participants shown in Fig.9 suggests that quite a variety of non-governmental stakeholders was captured by the Q1 survey. However, stakeholders from public agencies and institutions were also represented at both national and local level with about 16% of total respondents.

The largest number of stakeholders came from the private sector, which accounted for 22% of the total respondents. Moreover, roughly the same share of the respondents belonged to the scientific community as a sum of national academic institutions, research foundations and think tanks (13%) as well as public research institutes (9%). The involvement of professional and business associations was also significant (11%). Finally, international and various non-governmental organizations (8%) along with associations for the protection of the environment and nature (6%) accounted for 14% of the total participation.

It is important to note, however, that the large majority of respondents (73%) said they answered the questionnaire according to their personal opinion, not representing their institution’s point of view.

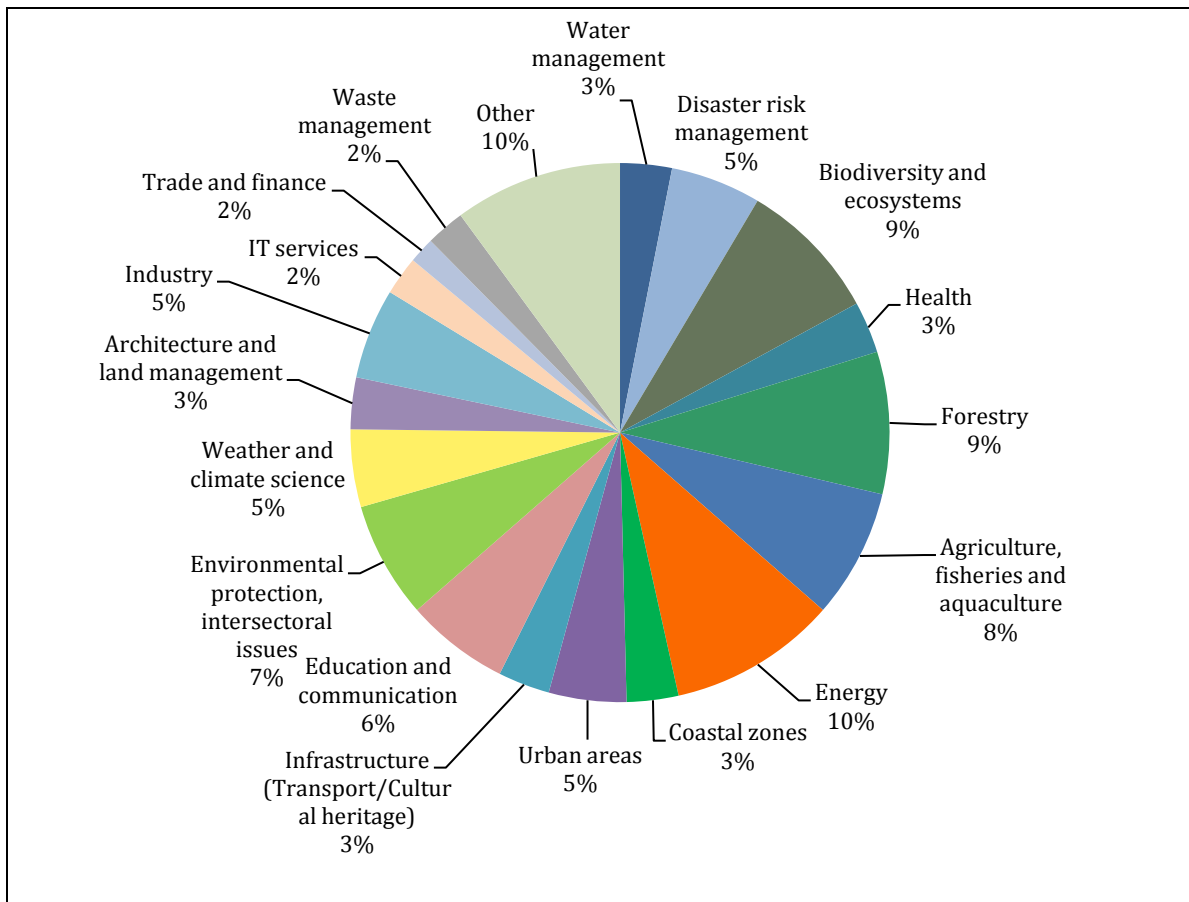
Figure 9. Stakeholder participation in the on-line questionnaire (Q1) by professional affiliation



Looking at the sectors of activity, respondents were mostly distributed along four major sectors.

As shown in Fig.10, 10% of participants were employed in the Energy sector, followed by the Forestry and Biodiversity sectors, which respectively represented 9% of the total, while stakeholders from the Agriculture, fisheries and aquaculture sector accounted for 8%. Nevertheless, the remaining participants belonged to a wide range of fields, including Communication and education, Protection of environment (broadly speaking), Disaster risk management related to flood and landslide risks, Weather and climatic sciences, as well as Urban sector and Industry.

Figure 10. Stakeholder participation in the on-line questionnaire (Q1) by sector

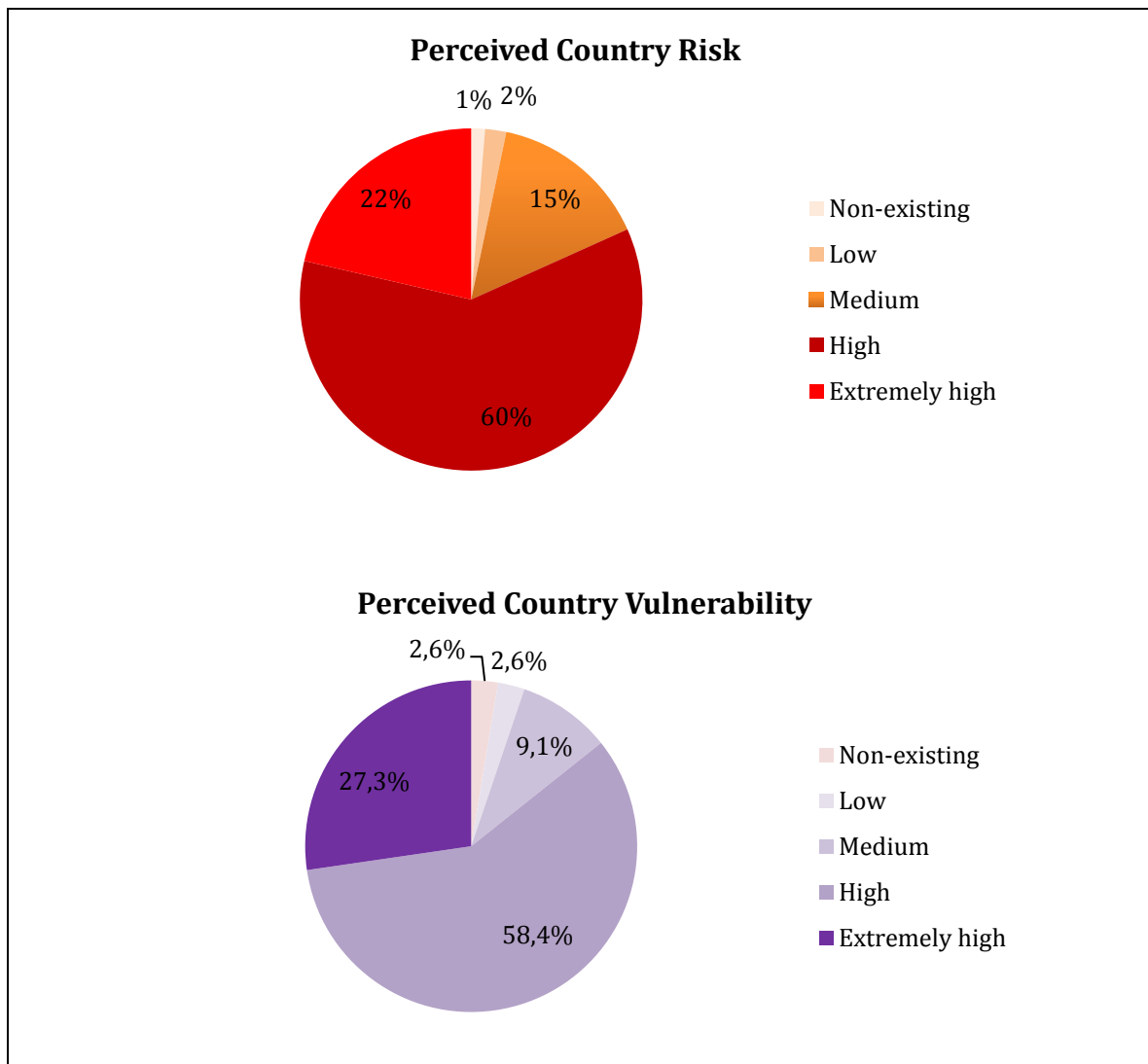


RESULTS OF Q1

By analyzing the results of the initial questionnaire (Q1) as a whole, it appears clear that the majority of Italian stakeholders perceive a high or extremely high degree of risk (81.8% of respondents) and great vulnerability (85.7%) related to impacts of climate change, while generally acknowledging a low adaptive capacity. Main concerns were the increase in frequency and intensity of extreme events, and the damages these can cause, mainly in relation to flooding. Other impacts of concern include decrease in snow cover, biodiversity and ecosystem services loss, soil erosion and degradation, drought, and the risk of floods and landslides. The latter is a recurrent issue, traceable throughout the questionnaire: the need to investigate the shared opinion that climate change will exacerbate Italy's special exposure to landslides and floods led to the formulation of specific questions in the second round of interviews (Q2).

Narrowing down the focus to the sectoral perception, the picture seems to get worse. According to the majority of stakeholders (54%) their sector has scarce or no capacity to adapt, while about one third recognizes a medium adaptive capacity (33%) and only a remaining few think that their sector has the potential to fully adapt (12%). Moreover, no institution seems to be addressing climate change impacts in a satisfactory manner: almost half of the respondents (45%) state that there is no adaptation initiative, and for those who are aware of some, the actions are insufficient, not coordinated or patchy (66%).

Figure 11. Climate change risk, vulnerability and adaptive capacity in Italy as perceived by the respondents to the on-line questionnaire (Q1)



Specific priorities of NAS according to the stakeholders should include limiting land-use change and halting soil sealing, managing water resources sustainably, and, again, reducing hazards related to floods and landslides. Also, a large share of respondents believe that the entire productive system should be streamlined to achieve a more sustainable use of natural resources and improved energy efficiency, both in energy production and consumption. Respondents also indicated that government efforts should be directed towards the enhancement of communication and information about climate change and adaptation issues, and the strengthening of coordination among policies that are relevant for adaptation.

As expected, sustainable land use was identified as a possible priority by most stakeholders with landscape degradation - caused by soil sealing and new constructions mainly - one of the key vulnerabilities in Italy. Therefore, a specific question was envisaged to understand in more detail what sustainable land use means for them. The preferred action among the ones presented was the reduction of urbanization and reuse of abandoned sites. Other beneficial actions to fight landscape degradation mentioned by stakeholders include: reduction of deforestation, sustainable water resources management, and widespread land-use planning.

Another emerging area of concern in climate change adaptation taken into account in the design of the questionnaire was urban adaptation. The most relevant actions identified by the respondents in this sector was to halt urbanization and excessive exploitation of land for economic activities and promote reuse of abandoned sites (not further specified), which overlap sustainable land-use management. Also, assessing the vulnerability of the territory and the infrastructure in order to better address them in investment policies and spatial planning was considered a priority. Other actions that most stakeholders selected relate more to mitigation, such as: increase renewable energy production, increase efficiency of local public transportation, and promote efficient car-pooling and car-sharing. Finally, some selected actions concern both adaptation and mitigation, i.e. are possible synergies: improve energy efficiency in buildings, reduce energy consumption and expand green areas.

Finally, with regard to the legal form, the vast majority of participants (about 82%) believe that the NAS should be legally binding. Just less than 10% instead believe that it should take the form of guidelines or recommendations, while the remaining ones indicated other solutions (in most cases a mix of the first two options). In addition, in the opinion of the respondents the strategy should be supported by an implementation plan.

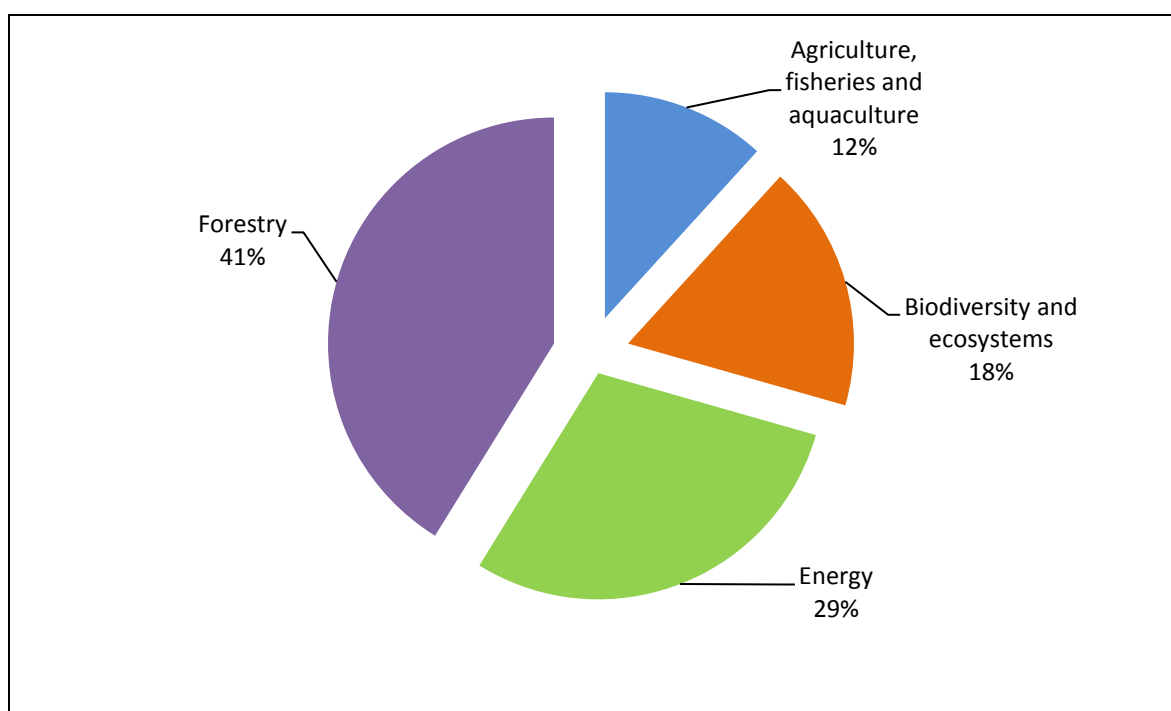
Regarding the financial resources needed to implement the NAS, respondents suggest that public funds should be primarily spent on measures promoting sustainable management of natural resources, reduction in energy consumption, improvement of energy efficiency in building, research and information, and renewable energy production. That is to say, resources should rather be used on mitigation than on adaptation or, better, actions that imply synergies among the two policies and win-win solutions.

DISTRIBUTION OF RESPONDENTS TO Q2

Answers to open ended questions given to the online questionnaire raised some issues, which were addressed through the second questionnaire (Q2) spread among selected stakeholders, who had previously answered Q1. Of the twenty-four invited non-governmental stakeholders only seventeen answered either in written or oral form (Skype interview).

Fig.13 shows the distribution of the respondents according to their sector of professional expertise. Stakeholders from Forestry and Energy sectors were the most represented with 7 and 5 interviewed persons respectively, while only 3 respondents belonged to the Biodiversity and ecosystems sector and 2 to the Agriculture, fisheries and aquaculture sector.

Figure 13. Stakeholder participation in the interviews (Q2) by sector



RESULTS OF Q2

A set of three general questions were asked to all stakeholders.

The first question was about the motivation of the respondents in participating in this process. Answers show that stakeholders agreed to answer this in-depth questionnaire because they have the expectation of contributing to the development of the NAS with their personal expertise. Some of them have studied related subjects and/or followed professional curricula which make them experts in the sector. They are professionally engaged in adaptation or work in a sector which is impacted by climate change. Therefore they were mainly motivated by a civic sense, driven by their education, which is what they point out as necessary to foster behavioural changes needed to best adapt to climate change.

This relates to the second question about the actual meaning of “behavioural changes” as a modality for making adaptation happen. Education and dissemination of information about adaptation, climate change, and the environment were pointed out as preconditions to “improve” personal behaviours. Several institutions were found to be accountable for this: the MATTM should promote environmental education programmes for schools, universities should form future technicians and

climate change professionals, local chambers of commerce or trade organizations should disseminate information within firms and production sectors, and, last but not least, organizations that stakeholders belong to could organize campaigns to disseminate good practices. Economic incentives and disincentives, and product labels could also help to promote best consumers choices.

One stakeholder had a completely opposite opinion, and pointed out the impact of single citizens is marginal with respect to the dimensions of the problem.

The third question referred to the creation of synergies between adaptation and mitigation within the NAS. This was intended as a two-fold possibility: on the one hand, integrating adaptation across sectors could contribute to design win-win strategies and to achieve co-benefits with mitigation, such as those given by ecosystem services. On the other hand, synergies could be created by fostering the increase of environmental resilience, which could be achieved by assigning a larger role to local stakeholders (e.g. forest owners or tourism sector workers). For these synergies to take place, some point to top-down solutions, i.e. the MATTM should be in charge of coordinating and facilitating the creation of integrated plans also through the use of incentives and de-taxation; others point out bottom-up solutions, i.e. the stakeholder engagement at the local scale. Some practical possibilities identified include: the use of renewable energy (which could be derived from forest biomass), forest restoration and sustainable management to decrease flood and landslides hazards and fire risk, and to increase carbon stock, rain water harvest and infiltration in the water table.

Key messages were drawn from the first three general questions, and could be divided into two topics according to their main focus, as follows.

Adaptation and sustainable development

- Integrated approach to adaptation: scientific knowledge-base and inter-sectoral plans are pre-requisites; ecosystem services provided by forests (such as water table recharge and flood control areas) are examples of possible synergies;
- Decision-making: scientific knowledge on adaptation should inform policies;

- Communication and information: campaigns to raise awareness on adaptation and environment are key since citizens with the proper information would use resources more responsibly; information in different public structures could be improved by institutions and by trade associations at all levels, e.g. in primary and secondary schools, universities, research centres, work places; more information is needed on what public sector is doing to promote adaptation and sustainable development;
- Stakeholder involvement: local administrations should involve local stakeholders in the management of natural resources.

Synergies between adaptation and mitigation

- Integrated plans and policies: land-use plans and land management, industry and energy are needed, and these should be fostered by a new generation of technicians formed in universities; win-win strategies, coherent with the NAS, should be adopted to create synergies in forest management between adaptation and mitigation;
- Communication and information: information campaigns to raise awareness and promote use of lower climate impact products should be encouraged;
- Forest management: forest management can produce biomass, which can be used as a renewable source of energy; a holistic approach should give forest management a role within the NAS; forest owners should be informed and involved and made to understand the impact of management choices; they should receive incentives (e.g. from the electricity bill) associated with management plans to extract biomass for energy production, which would protect their forest and increase the carbon stock;
- Energy production and consumption: unsustainable energy consumption to be reduced by increasing efficiency and promoting good practices; however, limited room for improvement exists for energy efficiency and energy saving since the implementation of measures would be costly (outlier opinion).

Stakeholders then answered to two questions, specific to their four sectors of expertise, concerning the priority interventions and the possible cross-sectoral

issues and synergies within the NAS. The answers are presented below per each sector.

AGRICULTURE, AQUACULTURE AND FISHERIES

Stakeholders in the sector of Agriculture, aquaculture and fisheries identified the following priorities, especially taking into consideration food security issues: optimizing agricultural production, increasing resilience, planting a range of diverse and resilient genotypes, promoting local and traditional varieties, and following seasonal calendars.

Stakeholders also identified actions which should be implemented in other sectors to mitigate impacts they have on agriculture. Land devoted to agricultural use should be, most importantly, preserved, avoiding land-use changes. Growing consumption patterns in many sectors (e.g. energy, food, building) increase pressure on the environment, and on farming areas in particular: this trend needs to be reversed, promoting sustainable land-use practices.

The key messages for this sector include:

- adopt management options that increase agricultural system resilience, such as more resilient and diverse genotypes, and local products;
- promote synergies among different sectors to reduce consumerism and to encourage sustainable behaviours.

BIODIVERSITY AND ECOSYSTEMS

Stakeholders in the sector of Biodiversity and ecosystems identified the following priorities to protect ecosystem services: fighting invasive species, “renaturation” of rivers, restoration and management of forests, protection of coastal habitat (dunes and Mediterranean shrubland), creation of habitat corridors, and reduction of soil-sealing.

Moreover, they suggest that the NAS should provide a framework within which sectoral policies are designed and implemented, taking into account possible synergies and mitigating impacts. In particular, sectors such as industry, energy and transport that are impacted by climate change, and have an impact on other sectors,

should have their own plan designed within a holistic national climate adaptation and mitigation strategy. A sector which can be elected to enable synergies with biodiversity conservation is agriculture: available funds should be used to promote ecosystem preservation.

The key messages for this sector include:

- seek a holistic approach for dealing with adverse impacts;
- restore and maintain ecosystems within the broader framework of integrated land-use plans;
- promote ecosystem conservation by involving relevant stakeholders and creating synergies with other sectors (e.g. agriculture).

FORESTRY

Stakeholders in the sector of Forestry identified the following priorities to preserve ecosystem services: use of traditional management practices and regulations, promotion of sustainable forest management, revision of biodiversity preservation analysis, revision of park design and regulation, promotion of intrinsic forest value including its recreational value, and promotion of ecosystem services that healthy forests could provide.

Stakeholders commonly described Italian forest as degraded and abandoned. To overcome this situation, moving towards the design and implementation of management practices is necessary. Forest management could restore ecosystem functions such as biomass production, and reduce the risk of landslides and other mass movements. One way to enable adoption of sustainable management practices could be the rediscovery of traditional rules of common forest tenure, which would foster ownership by local stakeholders. These are, in fact, management practices which have been developed in some cases through centuries of trial and error, and their longevity proves de facto their sustainability. However, forest owners in general should be motivated to adopt sustainable forest management, e.g. by designing ad hoc mechanisms, certification schemes and incentives.

The key messages for this sector include:

- increase resilience and adaptive capacity of forests through sustainable forest management plans;
- promote ecosystem services through forest management;
- learn from tradition about common forest tenure, use it to foster ownership, which would in turn improve forest preservation;
- enable good practices to maximize control over energy consumption and production;
- acknowledge the intrinsic value of forests;
- inform forest management and conservation plans through research on impacts of climate change on forests and fund these activities appropriately.

ENERGY

Energy stakeholders agree that a sustainable energy policy is needed in Italy. First of all, by improving energy efficiency, and secondly, by increasing the share of energy from renewable sources. In fact, all but one stated that renewable energy is a key priority. The strong “outlier” response poses doubts as to the life cycle assessment of any new energy source introduced: would the intrinsic cost of substitution bring a marginal gain, which is generally a deficit in cumulative terms. This opinion highlights the fact that when a power source is more convenient and it takes precedence over others, economy will convert spontaneously and suddenly, and that the mix of renewable sources is somewhat unnatural: there is as of now no real alternative energy source (if an energy source needs incentives it will not be sustainable).

As another priority action, respondents suggested that smart grids could be introduced to reduce demand peaks and adjust energy production to the needs, thus avoiding blackouts. Overall, according to the interviewed experts, the adaptation strategy should also take into account measures to prevent impacts of climate change and extreme events on energy infrastructure.

The key messages for this sector include:

- promote efficient energy use;

- increase resilience of electricity grid (smart grids) and infrastructure to impacts of climate change;
- make buildings self-sufficient for energy production and consumption;
- increase energy production from renewable sources, but at the same time acknowledge that it may be costly.

DISCUSSION OF RESULTS

In this participatory exercise we aimed, first, at obtaining stakeholders' views on the content of the NAS and, secondly, deepening a variety of aspects that could be informative for the next steps of the NAS development but needed clarification. In this section we discuss the most meaningful results of the two surveys.

When analyzing the outcomes we recognized that the target group for which the original questionnaire was designed had been hit as a large share of respondents came from private sector and non-governmental institutions. Also, in the second part of the survey it became clear that most stakeholders were experts in their sector of affiliation, as per our initial preference. In fact, we learnt that their participation was mainly motivated by their personal interest in contributing to the NAS with their expertise as they felt it was their duty to share their knowledge for such a purpose.

As a first result, we could assess the perception of the respondents about climate change risk, vulnerability and adaptive capacity. It is interesting to observe that, according to 46% of the respondents, their sector apparently has capacity to respond, but still more than 85% note a great overall vulnerability. This may signify that respondents think that there is capacity, but this capacity will not be turned into action. However, from the recent overview of adaptation action in Italy (Medri et al., 2013), we know that there is capacity and a number of initiatives on adaptation have already started, at least in some sectors, around the themes of rural development, safeguard of biodiversity, fight against desertification, health protection, and many others. These may not be labelled as adaptation yet. Therefore, what is partly lacking is the knowledge of citizens on the existing institutional, economic, technological and cultural means to actually reduce vulnerability and the ongoing action on adaptation.

Some of the respondents may also understand vulnerability as independent from adaptive capacity (e.g. as a potential hazard) and therefore consider it high, regardless of the potential action undertaken. However, as they are assumed to be “expert stakeholders”, provided with a clear definition of terms in the questionnaire, this explanation seems to be less likely.

In the second place, we noticed that stakeholders focused their attention on “territory” and “behavioural changes” when they were asked about the meaning of adaptation. Significantly, the risk of floods and mass movements associated to soil and land management emerges as one of the issues of utmost concern for the Italian stakeholders (the so-called “*dissesto idrogeologico*” in Italian). This may be due to the great resonance that these types of phenomena have had in the Italian media in recent years, as they triggered major natural disasters: Lunigiana and Cinque Terre (2011), Genova (2011), Vicenza (2010). Indeed, Italy has an infamous history starting with the sadly known landslide in Agrigento, and the floods in Florence and in Venice (1966), which led to the national debate for the reform of the “*Legge Urbanistica Nazionale*” (National Urban Law), and to the “*Legge Ponte*” (L. 765/1967) and the “*Decreto sugli Standard Abitativi*” (D.M. 1444/1968) (see for example Astengo, 1966; Salzano, 1998). More recently, in 1998, the most tragic event of this type occurred in Sarno (Campania), which devastated three villages and killed about 160 people: a series of special legislative measures for environmental protection were named after this as “*Legge Sarno*”. In fact, stakeholders’ alarm is real, as in Italy the risk of landslides and floods concerns pretty much all the national territory (two municipalities out of three): Calabria, Umbria and Aosta Valley regions are the most threatened, along with Marche and Tuscany (Legambiente, 2011).

Furthermore, there is a shared perception that individual life-styles have to change, which is mostly intended as changing personal habits especially by reducing the unsustainable use of resources. In the free text answers all over the Q1, in fact, the issue of the importance of individual life-styles “to promote climate change adaptation” emerges strongly. From this very general comment it was unclear whether stakeholders meant risk-averse behaviour (like emergency planning) or climate-friendly behaviour (like energy saving). This aspect was looked into more

specifically in the second round of interviews. We found that, in short, behavioural change is intended as a broader environment-friendly and sustainable approach by all citizens.

In this framework, stakeholders pointed out that there is the urgency to rethink energy use making the national economic system shock-averse. The general perception is, in fact, that climate change adaptation should be promoted through actions aimed at modifying existing energy uses, such as improving energy efficiency and diversifying energy source mix, measures that are commonly linked to mitigation policies but that can be synergistic for adaptation too.

The Q2 focused interviews confirmed that energy-related mitigation objectives should be among the main goals of a NAS in Italy. It is worth emphasizing that stakeholders supported renewable energy as main priority to be addressed in the energy sector, but did not consider in their answers that an over-exploitation of renewable sources may increase vulnerability to climate change (there is considerable controversy, especially with regard to biomass production and hydropower).

This desired combination of adaptation and mitigation in one single strategy can be at least partially explained by the fact that mitigation is still the major issue at the local and regional levels where the stakeholders' activity is mostly based. Regions, Provinces and Municipalities have so far developed Climate Action Plans (*"Piani d'azione clima"*) or Sustainability Plans that only, or almost exclusively, consider mitigation issues (e.g. Lombardy and Lazio Region, Bologna Province).

According to some, the NAS should be an integral part of a wider strategy for sustainable development or sustainable urban growth. Moreover, the NAS should be implemented through a series of coordinated sectoral strategies, focusing specifically on the following sectors: energy, agriculture, and land-use planning. Many potential synergies were identified by the respondents, including: forest management and rural development, land-use planning and environmental protection, energy tariffs and forest management.

Another important message that we got from stakeholders is about communication and education. According to the interviewed persons, the NAS should promote

specific awareness-raising campaigns in schools and support climate and adaptation research in universities to form a new generation of professionals with multi-disciplinary knowledge. More than this, the NAS should enable decision-making processes and management of natural resources to be informed by the latest scientific knowledge on adaptation. Information should then be made available in the widest possible mode.

CONCLUSIONS

In this paper we have analyzed the first phase of the process of engaging civil society, specifically targeting professionals, non-governmental organizations and the private sector, to collect opinions and, possibly, build consensus around the Italian NAS, whose development is still ongoing. The following recommendations have been formulated with the aim to support the continuation of the participatory process and the finalization of the NAS, based on the lessons that we have learnt.

First of all, some insights can be drawn about the success factors and barriers associated with a survey-like participatory process, which other European countries may need to be aware of as they approach the issue of participation in the context of adaptation planning.

Among the positive elements of the Italian participatory process, we can recognize that:

- by involving local stakeholders and experts in the development of a NAS, the gap between the top-down and bottom-up approaches to adaptation can be bridged;
- the criteria we used led to identify stakeholders who shared knowledge useful for NAS design: specialized sectoral stakeholders could not always be able to identify synergies among various adaptation options across sectors, but they can be precious in contributing to uncover adaptation options relevant to their own domain that were not considered before;
- using internet-based surveys enables widespread participation.

Among the limits, that are typical of all participatory processes, we acknowledge that:

- the participatory process entails an implicit self-selection of the most concerned and most informed stakeholders; in this case, the most expert and influential stakeholders (e.g. NGOs, trade unions, private sector) were pre-selected, which may have represented an additional bias to the actual “openness” of the process;
- respondents may have voiced their frustration about poor environmental management in general rather than share their specific views on adaptation. This is one of the main problems with questionnaires and interviews, which can only partly be avoided by the design of questionnaires;
- the design of the content of a questionnaire is crucial and may bias the results: while open-ended questions are relatively easier to formulate, their feedback is harder to interpret systematically. In multiple-choice questions it is difficult to cover all the possible answers and some relevant options may be thus left out unintentionally; or, conversely, the inclusions of too many/certain options may prejudice the respondents choice;
- the snowball methods carry bias: if the first selection of stakeholders leaves someone relevant out, they will not be found; however, it is very useful to reach a large number of experts.

We also recall that there are significant gradations of public participation ranging from forms of “non-participation” to “citizen power”. When Arnstein (1969, p. 216) stated that *“the idea of citizen participation is a little like eating spinach”* he meant that participation is in theory highly praised by everyone, however real engagement is quite hard to obtain due to implicit limitations fixed by power-holders.

The process has been envisaged as a consultative participation mode, where the government has involved stakeholders for mutual exchange of information and expects actual contribution to shape the NAS, without having the obligation to heed their input. To best support the successful development of a NAS, on one side there is a need to strongly insist on a more (non-tokenist) informative interaction in the form of awareness-raising campaigns, release of dedicated publications and

establishment of a national adaptation portal, especially aimed at communicating scientific results on vulnerabilities and potential adaptation measures, shedding light on the different opportunities that exist within adaptation and mitigation policies. On the other side, a higher number of consultative events, such as

Focus on Europe

A variety of approaches to engaging society has been realized in support of the different phases of adaptation planning across European countries. These can also provide good (and bad) practice examples. See, for instance, the experiences of Austria, France and Malta.

workshops with specific groups, roundtables and dialogue should take place. This participatory process was designed in a way that allowed experts to be heard more. The next phases of the NAS development should be more inclusive and make an effort to address the potentially most affected groups in the country

besides the most influential and competent ones. One good example to look at would be the process that led to the development of the National Biodiversity Strategy in Italy, that included a broad consultation aimed at gathering all the possible contributions from the relevant actors belonging to institutions, private sector and society (over 500 participants in 3 targeted workshops) (MATTM, 2010). Decisional participation may be postponed to the stage of designing the implementation plan of the NAS, where more specialized support would be needed from stakeholders.

The outcomes of Q1 and Q2 provide some insights and concrete proposals from expert stakeholders, which could be integrated in the strategy, for instance by emphasizing some sectoral priority actions, such as land-use planning, disaster risk reduction, sustainable energy policy, and sustainable water management. This, however, does not mean that a focus on the four sectors that were more represented in the participatory process (Agriculture, aquaculture and fisheries; Energy; Forestry; Biodiversity and ecosystems) has to be reflected in the NAS. Although they are among the key vulnerable sectors already identified by the Technical Board in the course of the NAS development, other priority areas that were not covered by this survey due to the progressive selection of stakeholders must be taken into account. Further stakeholder consultation may be required to help identify adaptation options in other sectors.

There is clear advice from stakeholders that adaptation be framed as a component of an overarching climate change strategy, or even sustainable development strategy, along with mitigation to exploit mutual benefits. In fact, the tendency towards mixing adaptation and mitigation in the respondents' feedback can be attributed only partly to possible imperfect design of the survey. The importance of the overlaps between the two policies is largely recognized by the stakeholders, as they demonstrated in the single interviews (without being subject to the limitations of multiple-choice questions). Significantly, in 2007, in the context of the first National Conference on Climate Change, the MATTM had already put forward a list of recommended actions for sustainable adaptation that largely included synergies with mitigation, such as the support to the system of incentives for energy saving in the residential sector and the definition of standards that would enable the development of green buildings (APAT-MATTM, 2007). Within the ongoing NAS process, mitigation aspects are being considered when identifying potential sectoral adaptation measures.

Furthermore, the issue of sustainable consumption and climate-friendly behaviours that arose from the voice of stakeholders, has been addressed by the MATTM in this list of actions, starting with the promotion of "water labelling" of goods and products (APAT-MATTM, 2007).

The NAS, at its current stage of formulation, also seems to be in line with the stakeholders' recommendations, as the MATTM, by the means of draft guidelines for economic planning, has emphasized the need to cope with flood and landslide risk through a comprehensive adaptation approach (MATTM, 2013).

The general expectation is that the future NAS would fix the current incoherence of the action on adaptation across sectors and multiple scales of governance and thus put an end to the so-called "failure of adaptation narrative" (Juhola et al., 2011).

CHAPTER 6 – Conclusions

The dissertation constituted four research papers that have been presented in Chapter 2, Chapter 3, Chapter 4 and Chapter 5 corresponding to the objectives set out earlier in Chapter 1.

This final Chapter draws together the main conclusions by providing a summary of the findings of each chapter in Section 6.1. Section 6.2 discusses the policy implications of the findings that highlight the potential transferability of knowledge from other European countries to Italy. Section 6.3 points out the limitations of the present study and sets out some ideas for future research in this area.

RESEARCH CONCLUSIONS

CHAPTER 2 - A SYNTHESIS OF CLIMATE CHANGE CHALLENGES AND ADAPTATION RESPONSES OF EUROPEAN COUNTRIES AND THE EU

This paper presented a synthesis of knowledge on adaptation challenges across Europe and a critical desktop review of the relevant policy responses, gathering the most up-to-date information from various strands of evidence including IPCC and EEA reports, European Commission documentation, comparative literature and the Climate-ADAPT Platform.

According to the review, sixteen of the assessed European countries have a national adaptation strategy (NAS) in place, while the others are about to formulate or adopt their NAS. This intended as a vision document reflecting the direction of the government on how to tackle the consequences of climate change, as opposed to an action plan detailing the level of action with allocation of resources and responsibilities that can come with a strategy or be developed at a different stage. Eight of the countries with a NAS have also developed an action plan, therefore are considered in the phase of implementing adaptation. Large differences can be observed between NASs in terms of objectives, scope, spatial focus, detail of action as well as participatory processes that support them. Despite the great differences in exposure and vulnerabilities across countries, evaluated through national assessments of at least qualitative nature, they share a similar sectoral approach and

primarily address traditional public policy areas such as water resources management, agriculture and food security, forestry and so on, generally giving little attention to private sector issues.

This paper confirmed that there are precise shortcomings in the European NASs. These are the lack of consideration of transboundary issues across Europe, the neglected emerging international threats and new opportunities associated with climate change, and the marginal attention paid to synergies (or conflicts) between adaptation and mitigation. Finally, the paper noted that the operational components for implementing adaptation measures and precise indications of the monitoring and evaluation methods are usually missing from the national strategies assessed.

The Commission recognized such significant gaps in countries' action on adaptation, which it aims to address through the policies and tools put forward in the European Adaptation Strategy adopted in April 2013.

CHAPTER 3 – DIFFERENCES AND SIMILARITIES IN INSTITUTIONAL SETTINGS THAT SUPPORT NATIONAL ADAPTATION STRATEGIES ACROSS EUROPE

This paper provided an original and statistically sound analysis of the influence of political systems on national adaptation policy planning in European countries. Fourteen countries were selected on the basis of a proposed definition of NAS (specified as a policy document adopted by the government or a piece of legislation, containing a vision focusing solely or substantially on adaptation at the national level) and categorized according to their political-administrative structure (unitary, administrative-federal, federal). About fifty institutional settings established to respond to horizontal and vertical integration challenges of adaptation within the existing NASs were analyzed along their main characteristics (number of institutions, formalization, novelty, timing and focus of action, coordination mode, transversality). A *Principal Component Analysis* was applied for the first time to the adaptation research domain. Assuming that the pattern of response of any nation to climate change is conditioned by the configuration of political systems, the aggregated country data were tested in order to verify the patterns and relations between the political systems and the institutional capacity.

The results suggested that European countries have two main approaches to adaptation policy planning: 1) a vision document focused on adaptation and 2) a broader climate change strategy. Neither of them includes the allocation of funds and responsibilities for implementation that are generally dealt with in a later phase, through a more detailed implementation plan. However, monitoring, reporting and review provisions usually exist and are mandatory under the typology of strategy that entails the adoption of a climate change act. The differences in definitions are likely to become politically relevant for the countries once their degree of adaptation preparedness and the value of their NAS has been assessed by the Commission in 2017 with a view to effectively implement the EU Adaptation Strategy.

Furthermore, this study presented empirical evidence of the promptness of federal countries in adopting a NAS as opposed to a late reaction by the majority of unitary countries. In fact, only three out of eighteen unitary countries have a strategy, while almost all administrative-federal (except Norway and Italy) and all the federal countries have finalized their NAS document.

Through the PCA, some significant statistical correlation could be found between the political dimension and the institutional capacity, particularly for what concerns the degree of novelty of institutions dedicated to a NAS: this means that federal countries tend to use pre-existing institutions, mechanisms and processes, while unitary tend to create new institutions. Ultimately, although the correlation was found to be meaningful, political systems only explain a limited part of the countries' choices in terms of adaptation governance settings, and other external or internal variables may have a stronger influence, such as financial and economic circumstances, different political conditions, cultural values, as well as societal expectations.

Finally, four clusters of countries emerged, as they seemed to be linked by certain similarities in the institutional capacity for adaptation: 1) France and Portugal; 2) Denmark and Finland; 3) UK, Netherlands and Germany; 4) Spain and Belgium. This suggested that lessons on adaptation planning should be continuously exchanged between countries that are closer in terms of governance.

CHAPTER 4 – OVERVIEW OF CLIMATE CHANGE IMPACTS, VULNERABILITIES AND ADAPTATION RESPONSES IN ITALY

This paper provided an extensive review of the information on climate change impacts, vulnerabilities and current adaptation action, gathered from national studies and broader analyses on the Mediterranean and Europe. The research acknowledged that Italy expects a number of impacts from the changing climate, which, coupled with the low adaptive capacity that characterizes Southern Europe, would increase the country's vulnerability to climate change. In particular, areas with scarce water resources and areas at risk of desertification, coastal areas, Alpine regions and mountain ecosystems, and areas prone to flood and landslide risks were assessed as the most critical national circumstances with respect to future climate change.

The paper demonstrated that, despite the lack of a NAS and of comprehensive national cost-benefit assessments on adaptation, a remarkable variety of climate change adaptation initiatives – including legislation, measures, pilot projects – were carried out in the context of the policies for environment protection, natural hazard prevention, sustainable management of natural resources and health protection, but were mostly not labelled as “adaptation”.

With respect to the policy for adaptation, this assessment could confirm that the earliest “thirteen actions for sustainable adaptation” put forward by the Italian Ministry for Environment in 2007 are still needed, although much happened on adaptation in a decentralized way. The NAS is likely to assign priority to disaster risk prevention and land management actions aimed at reducing the risk of floods and landslides under a comprehensive strategy, according to the preliminary ministerial guidelines for future economic planning. However, enhancing research, improving the involvement of society and engaging the private sector remain key cross-cutting actions.

The paper concluded that the finalization of the NAS would finally provide a coherent umbrella for the action that had been going on at the sub-national level.

CHAPTER 5 – STARTING A PARTICIPATORY APPROACH FOR A FUTURE GOVERNANCE OF THE NATIONAL ADAPTATION STRATEGY IN ITALY

This paper aimed at analyzing how the issue of participation had been faced in the initial phases of the NAS development in Italy, in order to deepen the understanding of the involved stakeholders' opinion with regards to the objectives of the strategy and its possible priority actions. While joining the practically unanimous sentiment expressed by scholars with respect to the need for participatory approaches when developing adaptation strategies, the paper discussed the very significant challenges involved in identifying and actively engaging them in a meaningful way.

The results of a first open questionnaire suggested that the majority of Italian stakeholders perceive a high or extremely high degree of risk and great vulnerability related to impacts of climate change, while generally acknowledging a low sectoral adaptive capacity. In part, the respondents seemed to lack the necessary information on the national situation with regard to means to increase adaptive capacity and ongoing adaptation action. The most widely shared ideas on the meaning of adaptation were the need for sustainable consumption and behavioral changes, then risk prevention, improved land-use planning and higher energy efficiency.

A further round of interviews provided better insights and concrete proposals by expert stakeholders from the four most represented sectors within the initial sample (Energy, Biodiversity and ecosystems, Forestry and Agriculture).

According to the respondents, ideally the Italian NAS should have a holistic approach and coordinate sectoral action. This could require binding climate change legislation in support of a strategy that would exploit synergies between adaptation and mitigation, accompanied by an implementation plan. Alternatively, an adaptation strategy could be part of a wider strategy for sustainable development. The NAS should mainly: promote more environmental-friendly behaviours that could be beneficial to adaptation and sustainable development; enhance disaster risk reduction with regard to landslides and floods and rethink energy use, making the national economic system shock-averse, including the employment of renewable energy. These objectives appeared to be largely in line with the 2007 “thirteen actions for sustainable adaptation” and the primary attention given by the Italian

Ministry for Environment, within the current NAS process, to the need for interventions dedicated to prevention and protection from flood and landslide risks over the national territory.

This paper recommended that the next phases of the NAS development take the form of both informative interaction to raise awareness and knowledge of the participants, and consultative participation, but be more inclusive. The potentially most affected groups should be involved, besides the most influential and competent ones that have already been identified. For instance, on the model of the participatory process carried out for the development of the National Biodiversity Strategy.

POLICY IMPLICATIONS

The four papers and the introduction and conclusions form a coherent package focused on national governance for adaptation that puts the Italian situation into a European context.

The European Adaptation Strategy calls, in particular, Italy and other countries at early phases of adaptation planning for speeding up their processes in order to fulfill certain quantitative and qualitative standards that will determine whether effective progress in adaptation action and preparedness have been reached. In this context, Italy would have to learn from other European countries a number of good practices that could help to efficiently frame the existing demand for adaptation that arises from regions, municipalities and socio-economic sectors.

The following policy-relevant recommendations can be drawn from the present research:

1. National strategies seem to be the most efficient way to coordinate adaptation action at the country level. To be effective, strategies should adopt flexible adaptation pathways that can be adjusted based on new knowledge and changing circumstances. The involvement of institutional and non-institutional stakeholders at different governmental levels is deemed crucial to properly realize such adaptive management practices. Therefore, **it is urgent to finalize the NAS development in Italy to frame the existing**

initiatives and offer an incentive to further implement and harmonize adaptation measures. The NAS should have a holistic vision and be capable to evolve over time. Adequate national governance for adaptation in Italy must be established in order to tackle the challenges of integrating adaptation horizontally and vertically, and making the society part of the planning for adaptation in a more structured fashion.

2. There is no significant difference between an adaptation-only and a climate-change-legislation type of strategy across European countries. However, monitoring and reporting schemes and the review of the strategy can be obligatory under a climate change act, which helps to ensure that the NAS is implemented properly and remains effective over time. Furthermore, the participatory exercise in Italy found that the expectations of society would be that the NAS be framed as a broader climate change or sustainable development strategy. Also, the majority of the stakeholders wish to have a legally binding NAS, which contributes to guarantee that action will be undertaken. Therefore, **Italy should consider increasing its ambitions for what concerns the form of the NAS, which is currently foreseen as a non-mandatory policy paper. A climate change act could be considered as complementary to the NAS. Regarding the scope, the NAS should at least take up the 2007 ministerial priority actions for sustainable adaptation, so to include sustainable consumption concerns into the strategy and enhance the focus on synergies between adaptation and mitigation.**
3. How adaptation options will be delivered is typically specified in an implementation plan following the strategy. Preparing an implementation plan is also a crucial element in the EU guidelines on national adaptation planning. Therefore, in order to avoid delays in the realization of the strategy associated with political or financial barriers, **Italy should already consider that after the completion of the ongoing NAS formulation, there will be urgent need for more specific inter-ministerial and multi-level consultation and planning to allocate budget and indicate the roles of the Ministries, the Regional governments and other relevant authorities**

in implementing the strategy. Furthermore, provisions and methods for monitoring and evaluation should be considered already in the NAS.

4. Analyses of costs of climate change impacts and tailored cost-benefit assessments on the options for adaptation at the national and sectoral scales are generally lacking in European NASs. However, these are essential to support decision-makers to choose the most appropriate adaptation strategies and represent one policy step recommended by the Commission for the NAS development. Therefore, **Italy should strive to provide a comprehensive updated risk and vulnerability assessment including the necessary estimates of costs of action and costs of inaction, besides the current qualitative assessment that informs the NAS at this stage.**
5. Federal countries embraced the “adaptation ferment” coming from their sub-national constituents and were relatively proactive in developing a NAS that takes into account those instances, with respect to other countries. Italy is considered an administrative-federal country, but it assigns significant autonomy to the twenty regions and two autonomous provinces. **Lessons can be learnt from Italy with respect to the establishment of adaptation governance from those administrative-federal and federal countries that show more similar administrative conditions, in order to start building horizontal and especially vertical institutional arrangements for adaptation.**
6. Strategies to cope with climate change should be tailored to specific biogeographical and socio-economic circumstances. Europe is acknowledged to be split into different “climate change regions” that do not necessarily match the borders of national states. A variety of impacts across the Italian territory entail transboundary policies, for instance in the Alpine space. **Italy should learn how to face such impacts from countries belonging to similar climate change regions and include explicit consideration of transnational issues in the future NAS. Furthermore international threats and opportunities arising from climate change that may affect national economic interests should be assessed in the NAS.**

7. Adaptation is a multidisciplinary knowledge-intensive topic that requires shared responsibilities and coordinated action between different governmental and non-governmental actors at different scales and within different policy sectors. Many European countries can provide examples of their own participatory processes. Learning from these can help identify limitations and success factors. **Italy should continue pursuing a participatory process to sustain the development and implementation of the NAS, by identifying and engaging the right stakeholders, selecting a proper format for consultations to effectively integrate the contributions received, and ensuring an open consultation process that enables the building of consensus and ownership.**

LIMITATIONS AND FUTURE RESEARCH

The main limitations of this research lay in its scope. The in-depth analysis of the national adaptation planning processes was limited to the countries that had adopted a NAS by the time the study was conducted. The progress on adaptation governance and the institutional capacity of all the other European countries were not taken into account in the analysis shown in Chapter 2 and Chapter 3, as specific information was more difficult to source. However, in order to support the transferability of knowledge across Europe, it is crucial to understand the role that political, socio-economic and cultural factors play in the development and implementation of adaptation strategies, especially in those countries that have not adopted a NAS, so to enable them to find similarities with other countries at more advanced stages of developing and implementing a NAS and learn from good practices.

In the next years, more insights on all the 32 EEA member countries' adaptation action will be publicly available, as they comply with the reporting obligations of the enhanced EU Monitoring Mechanism and the UNFCCC National Communications. In particular, the EEA has recently conducted a survey based on countries' self-assessment of national adaptation action. The outcomes of that study may soon open up opportunities to analyze national institutional arrangements on a wider basis, including countries without a NAS.

Furthermore, another limitation had to do with the analysis of the participatory process in Italy. While this analysis was restricted to the first public on-line questionnaire and follow-up interviews, two more steps are foreseen in the phase of formulating the Italian NAS: an on-line consultation on the draft strategy document and another public meeting to be held in the coming months. In order to definitely evaluate if the (right) stakeholders have been engaged along the whole course of the NAS development in Italy and what their feedback is, then, it will be important to keep scrutinizing the process and outcomes of the future participatory events.

Annexes

ANNEX 1. LIST OF CONTACT PERSONS FOR THE VALIDATION OF INFORMATION ON THE NATIONAL ADAPTATION STRATEGIES

Country	Contact person	Affiliation
Austria	Andrea Prutsch	Environmental Agency Austria
Belgium	Johan Bogaert	Flemish government - Department of Environment, Nature and Energy
Denmark	Ditte Hølse	Ministry of the Environment - Danish Nature Agency
Finland	Jaana Kaipainen	Ministry of Agriculture and Forestry- Natural Resources Department
France	Sylvain Mondon	Ministry of Ecology, Sustainable Development and Energy - National Observatory on Climate Change Impacts (ONERC)
Germany	Petra Mahrenholz	Environmental Agency Germany
Hungary	Ákos Lukács	Ministry of National Development - Department of Climate Policy
Ireland	Margaret Desmond	Environmental Protection Agency
Malta	Lucy Kemp	Ministry for Sustainable Development, the Environment and Climate Change
Netherlands	Rob Schoonman	Ministry of Infrastructure and Environment - Directorate for Spatial Development and Water Affairs
Portugal	Paulo Canaveira	Ministry of Agriculture, Sea, Environment and Spatial Planning Portuguese Environment Agency
Spain	José Ramón Picatoste Ruggeroni	Ministry of Agriculture, Food and Environment - Spanish Office for Climate Change
Switzerland	Martina R. Zoller	Federal Office for the Environment - Climate Division
UK	Roger Street	UKCIP, Environmental Change Institute, University of Oxford

ANNEX 2. LIST OF SELECTED STAKEHOLDERS INVITED BY THE MATTM TO THE PRELIMINARY QUESTIONNAIRE OF THE ITALIAN NATIONAL ADAPTATION STRATEGY

<i>Sector of interest</i>	<i>Organization name</i>	<i>Type of organization</i>
Energy and industry	Gestore servizi energetici Terna ENEL Siemens Italcementi	Private sector
	A.N.E.V. - Associazione Nazionale Energia del Vento	NGOs
Water management / Hydrographical basin of Po River	Federazione delle imprese energetiche ed idriche Federgasacqua Associazione idrotecnica italiana A.N.B.I. - Associazione nazionale bonifiche e irrigazioni Consorzi acquedotti Consorzi di bonifica	Trade associations
	CICMA - Comitato italiano contratto mondiale sull'acqua	NGOs
Tourism	FederCamping Federalberghi Federazione Italiana Associazioni Imprese Viaggi e Turismo Federazione Italiana degli Esercenti Pubblici e Turistici Federazione italiana associazioni imprese viaggi e turismo	Trade associations
	F.I.A.B. - Federazione Italiana Amici della Bicicletta F.I.E. - Federazione Italiana Escursionismo C.T.S. - Centro Turistico studentesco e Giovanile T.C.I. - Touring Club Italiano MES - Movimento Eco Sportivo	NGOs
Mountain areas	C.A.I. - Club Alpino Italiano Mountain Wilderness Italia U.R.C.A. - Associazione Nazionale Cacciatori dell'Appennino	NGOs
Coastal zones	Guardia Costiera Ausiliaria	NGOs
Transport infrastructure, / Urban areas / Cultural heritage	Ordine architetti, pianificatori, paesaggisti e conservatori Consiglio nazionale degli ingegneri Ordine urbanisti	Professional associations
	FederProprietà - Federazione Nazionale della Proprietà Edilizia	NGOs
Flood and landslide risk	Consiglio nazionale dei geologi	Professional associations
	SIGEA - Società Italiana di Geologia Ambientale Società Speleologica Italiana	NGOs
	Unicredit Assicurazioni	Private sector
Agriculture, fisheries and aquaculture	Ordine agronomi e forestali Coldiretti Confagricoltura Unione coltivatori italiani Confederazione italiana agricoltori Associazione italiana per l'agricoltura biologica Associazione italiana ingegneria agraria Lega Pesca – Associazione nazionale delle cooperative di pesca	Trade/ Professional associations
	Industriali agroalimentare Barilla La molisana	Private sector
	F.I.P.S.A.S. - Federazione Italiana Pesca Sportiva ed	NGOs

	Attività Subacquee	
Forestry	Ordine agronomi e forestali	Professional associations
	Industria del legno	Private sector
Biodiversity and ecosystems	Associazione Nazionale Guardiaparco Enti parco – Federparchi Ordine nazionale dei biologi e dei chimici	Trade/ Professional associations
	ASSTRAI - Associazione Salvaguardia e Sviluppo Trasimeno e Acque Interne LIPU - Lega Italiana Protezione Uccelli	NGOs
Health	Associazioni di categoria dei medici	Professional associations
Other issues: environmental protection, intersectoral issues	Accademia Kronos - AK A.C.L.I. - Anni Verdi Agriambiente - Associazione italiana per la protezione, lo sviluppo e la difesa dell'ambiente rurale Agriturist - Associazione nazionale per l'agriturismo, l'ambiente e il territorio A.I.I.G. - Associazione Italiana Insegnanti di Geografia A.I.W. - Associazione Italiana per la Wilderness Ambiente e Lavoro Ambiente e/è Vita Amici della Terra A.N.I.S. - Associazione Nazionale Istruttori Subacquei A.N.P.A.N.A. - Associazione Nazionale Protezione Animali, Natura, Ambiente A.N.T.A. - Associazione Nazionale per la Tutela dell'Ambiente A.S.I. - Alleanza Sportiva Italiana Associazione Culturale Greenaccord Associazione Europea Operatori Polizia Associazione Nazionale dei Rangers d'Italia Associazione Nazionale GIACCHE VERDI - A.N.G.I.V. ASSOVERDE - Associazione Italiana Costruttori del Verde Centro per la Conservazione della Natura CODACONS Onlus - Coordinamento di Associazioni per la Tutela dell'Ambiente e dei Diritti di Utenti e Consumatori Ekoclub International E.N.D.A.S. - Ente Nazionale Democratico di Azione Sociale E.N.G.E.A. - Ente Nazionale Guide Equestri Ambientali E.N.P.A. - Ente Nazionale per la Protezione degli Animali F.A.I. - Fondo per l'Ambiente Italiano Fare Verde Federazione Nazionale delle Compagnie GIUBBE VERDI F.E.D.E. - Federazione Europea Difesa Ecologica Feder.G.E.V. Italia - Federazione Nazionale Guardie Ecologiche Volontarie Federazione Nazionale Pro-Natura Fondazione Sorella Natura Forum Ambientalista Green Cross Italia GreenPeace Gruppi Ricerca Ecologica Guardie Ambientali d'Italia I.N.U. - Istituto Nazionale di Urbanistica Italia Nostra L.A.C. - Lega per l'Abolizione della Caccia L'AltrItalia Ambiente L.A.V. - Lega Anti Vivisezione LegAmbiente Lega Navale Italiana	NGO/non-profit organization

	<p>LIDA - Lega Italiana dei Diritti dell'Animale L'Umana Dimora M.A.N. - Associazione Mediterranea per la Natura (Mediterranean Association for Nature) MareAmico MareVivo OIPA ITALIA - Organizzazione Internazionale Protezione Animali Società Geografica Italiana The Jane Goodall Institute Roots & Shoots Italia - Istituto Jane Goodall Radici & Germogli Italia U.G.A.I. - Unione Nazionale Garden Clubs e Attività Similari d'Italia V.A.S. - Verdi Ambiente e Società WWF Italia - Associazione italiana per il World Wilde Fund for Nature</p>	
	<p>CGIL CISL UIL</p>	Trade-unions
	<p>Ambiente italia Fondazione Lombardia per l'Ambiente Kyoto Club Fondazione Cima OGS - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale</p>	Research institutions/ Consultancy

ANNEX 3. STRUCTURE OF THE ON-LINE QUESTIONNAIRE OF THE ITALIAN NATIONAL ADAPTATION STRATEGY (IN ITALIAN)

Questionnaire on-line from the 1st of October to the 15th of November 2012.

Developed by Valentina Giannini (CMCC), Marinella Davide (CMCC and FEEM), Sara Venturini (CMCC), Sergio Castellari (CMCC).

Scheda anagrafica

Nome di chi compila il questionario	
Email	
Nome organizzazione	
Voglio rispondere al questionario anonimamente	
Rispondo come individuo rispondo come rappresentante della seguente organizzazione	
Tipo di organizzazione:	Scrivere qui di quale org
Indicare il proprio settore di appartenenza:	<ul style="list-style-type: none"> • associazione di imprese • sindacato • autorità pubblica nazionale • autorità pubblica regionale • autorità pubblica locale (comunale, provinciale) • organizzazione internazionale • ONG o associazione di ONG • think-tank • fondazione ricerca • istituzione accademica • ente di ricerca pubblico • ordine/associazione professionale • organizzazione religiosa • società privata • altro: specificare _____
La sua organizzazione fa parte di una rete? Se risponde sì: con quali organizzazioni?	<ul style="list-style-type: none"> • Risorse idriche (quantità e qualità) • Desertificazione, degrado del territorio e siccità • Disastri, dissesto idrogeologico (inondazioni, frane) • Biodiversità ed ecosistemi (marini, terrestri, acquatici) • Salute • Foreste • Agricoltura, acquacoltura, pesca • Energia (Produzione e consumo di energia elettrica) • Zone costiere • Centri urbani e metropolitani • Infrastruttura critica (Beni culturali, Trasporti) • altro: specificare _____

A. Percezioni

1. Come definirebbe il livello rischio derivante dai cambiamenti climatici a cui è esposta l'Italia?
 - Altissimo
 - Alto
 - Medio
 - Basso
 - Inesistente
2. Quali sono i principali rischi causati dai cambiamenti climatici per il suo settore?

3. Come percepisce la vulnerabilità rispetto ai cambiamenti climatici nel nostro Paese?
 - Altissima
 - Alta
 - Media

- Bassa
- Inesistente

4. Quali sono i principali elementi di vulnerabilità causati dai cambiamenti climatici per il suo settore?

5. Cosa significa per Lei adattarsi ai cambiamenti climatici?

6. Come definirebbe la capacità di adattamento ai cambiamenti climatici nel suo settore?

- Altissima
- Alta
- Media
- Bassa
- Inesistente

7. Quali sono le necessità primarie avvertite nel suo settore rispetto all'adattamento a nuove condizioni climatiche?

B. Obiettivi e contenuti della Strategia Nazionale di Adattamento ai Cambiamenti Climatici

8. Quali ritiene debbano essere le caratteristiche principali di una Strategia Nazionale di Adattamento mirata alla realtà italiana?

_____ Quali fra questi impatti dei cambiamenti climatici La preoccupa di più? È possibile dare risposta multipla, massimo 6 risposte consentite

- Ondate di calore
- Ondate di freddo
- Eventi meteorologici estremi (es. grandinate, piogge di grande intensità, siccità prolungata, ecc.)
- Diminuzione copertura neve e/o ghiacciai
- Inondazioni causate da alluvioni o da straripamento dei fiumi
- Tempeste marine e inondazioni costiere
- Caduta massi e frane
- Degrado ed erosione dei suoli
- Erosione costiera
- Innalzamento del livello del mare
- Diminuzione della produzione di alcuni prodotti alimentari
- Variazioni degli assetti culturali e delle produzioni tipiche
- Diminuzione della quantità e peggioramento della qualità dell'acqua / salinizzazione
- Perdita di biodiversità e degrado dei servizi dell'ecosistema
- Migrazione delle zone bioclimatiche e delle specie di fauna e flora
- Peggioramento della qualità dell'aria
- Incremento delle malattie trasmesse da vettori (insetti)
- Aumento delle intolleranze e della sensibilità a fattori ambientali (allergie, malattie respiratorie e della pelle, ecc.)
- Interruzioni nella distribuzione di energia (elettricità, gas) dovute a danneggiamenti delle reti causate da eventi estremi oppure a picchi di consumo (black out)
- Interruzione delle reti di comunicazione (telefono, cablaggi, wi-fi) dovute a danneggiamenti causati da eventi estremi
- Interruzioni di reti e servizi di trasporto (strade, ferrovie, metropolitane, bus) dovute a danneggiamenti causati da eventi estremi
- Interruzione delle reti di distribuzione dovute a danneggiamenti causati da eventi estremi
- Diminuzione delle attività turistiche dovuta a fattori quali la carenza di neve, l'eccessivo caldo, ecc.
- Aumento dei rischi per la salute nelle fasce deboli di popolazione (anziani, immigrati recenti, persone a basso reddito, ecc.)
- Peggioramento della qualità della vita quotidiana nelle residenze, negli spazi pubblici, nei luoghi di lavoro
- Altro: _____

10. Quali priorità dovrebbe avere la Strategia Nazionale di Adattamento?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Riduzione dei consumi non sostenibili delle risorse naturali						
Riduzione delle produzioni non sostenibili						
Gestione delle risorse idriche						
Gestione delle risorse marine						
Riduzione della deforestazione						
Riduzione della desertificazione						
Riduzione del dissesto idrogeologico						
Conservazione della biodiversità e dei servizi ambientali						
Riduzione dello sfruttamento del suolo						
Diminuire gli impatti e le esternalità negative legati alla produzione di cibo						
Migliorare le prestazioni ambientali degli edifici e degli spazi pubblici						
Valutare ed attenuare la vulnerabilità climatica dei servizi pubblici						
Aumentare le dotazioni di verde urbano con finalità di attenuazione dei picchi climatici						
Incrementare le opportunità di mobilità dolce (pedonale e ciclabile) e la efficienza del trasporto pubblico						
Limitare il consumo di nuovo suolo e aumentare le superfici permeabili						
Aumento dell'efficacia della produzione e riduzione degli sprechi di energia						
Migliorare la resilienza delle infrastrutture agli impatti dei cambiamenti climatici						
Promozione e creazione di infrastrutture "verdi"						
Migliorare il ruolo degli strumenti di mercato per incentivare le misure di adattamento						
Altro: specificare _____						

11. Quali argomenti e problematiche della ricerca sull'adattamento ai cambiamenti climatici ritiene prioritario vengano approfonditi?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Impatti dei cambiamenti climatici sulla società, sull'economia e sugli ecosistemi e loro vulnerabilità						
Analisi del rischio						
Sensitività (grado secondo il quale un sistema è perturbato da impatti da cambiamenti climatici)						
Capacità adattativa (capacità di un sistema di adattarsi ai cambiamenti climatici)						
Analisi dei costi e benefici delle diverse strategie di adattamento						
Metodologie per la definizione di processi decisionali in condizioni di incertezza						
Monitoraggio e valutazione dei piani di adattamento ai cambiamenti climatici						
Modalità di informazione e sensibilizzazione dei cittadini e loro coinvolgimento nei processi decisionali						
Forme di collaborazione tra istituzioni diverse (governance)						
Andamento demografico (popolazione e tendenze)						
Morfologia e geologia						
Dissesto idrogeologico						
Metodi per la redazione dei piani di adattamento ai cambiamenti climatici a livello locale						
Gestione delle risorse idriche						
Adattamento/Innovazione dei sistemi produttivi						
Nuovi percorsi formativi e nuove competenze/professioni						

12. Quali ritiene debbano essere i campi privilegiati di erogazione di risorse pubbliche finalizzate all'attuazione della Strategia Nazionale di Adattamento?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Risorse per la riduzione dei consumi energetici						
Risorse per l'installazione di impianti di produzione di energia da fonti rinnovabili						
Risorse per strategie di gestione delle risorse idriche a ridotto impatto ambientale						
Risorse per favorire l'utilizzo di colture maggiormente resistenti alla siccità e che favoriscano anche l'uso di tecniche tradizionali di ritenzione idrica e di irrigazione naturale						
Risorse per il monitoraggio e la previsione delle situazioni di dissesto idrogeologico						
Risorse per il monitoraggio delle acque e della suscettibilità a cambiamenti climatici						
Fondi per la gestione ambientale ecosostenibile						
Risorse per la ricerca, formazione e informazione						
Risorse per il settore agro-ambientali per la manutenzione del territorio						
Risorse per un utilizzo adeguato dei servizi ecosistemici da parte di specifici settori						
Risorse per l'adeguamento dei regolamenti edilizi e della pianificazione urbana e territoriale						
Risorse per la riqualificazione della zona costiera						
Risorse per la redazione dei Piani di Adattamento a livello locale						
Risorse per l'adeguamento e la messa in sicurezza di insediamenti e infrastrutture						
Risorse per il miglioramento delle prestazioni energetiche degli edifici						
Risorse per incrementare la vivibilità dello spazio pubblico (verde, piazze, servizi)						

13. Ritiene che le organizzazioni private (ONG, industrie, settore non-profit, terziario, ecc.) e le istituzioni pubbliche a livello nazionale o regionale/locale stiano prendendo iniziative per l'adattamento ai cambiamenti climatici? Se sì, quali sono i riferimenti di tali azioni?

NOME ORGANIZZAZIONE O ISTITUZIONE	POLITICHE, REGOLAMENTI, DOCUMENTI O MATERIALI PRODOTTI

C. Specificità settoriali

14. Quali fra le seguenti aree di possibile intervento sono le più rilevanti ai fini di un uso sostenibile del territorio?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Desertificazione						
Deforestazione						
Consumo di suolo e riqualificazione delle aree dismesse						
Conversione di pascoli in colture						
Conversione di aree a seminativo per biocarburanti						
Parcellizzazione del territorio, del paesaggio e degli habitat						
Razionalizzazione e coordinamento dei diversi strumenti di governo del territorio						
Attuazione di interventi di adattamento a livello locale						
Programmazione di opere diffuse di manutenzione del territorio,						

delle infrastrutture e dei servizi						
Coinvolgimento dei cittadini e delle associazioni nelle pratiche di adattamento climatico						
Sfruttamento delle risorse idriche						
Abbandono delle pratiche diffuse di tutela dal dissesto idrogeologico						
Sfruttamento e riduzione della manutenzione degli alvei fluviali						
Bacinizzazione fluviale per reperire risorse idriche o per l'idroelettrico						
Riqualificazione ecologica dei sistemi fluviali e del reticolo idrografico minore e dei servizi ecosistemici correlati						
Riqualificazione ecologica delle aree terrestri marginali e delle relative zone umide (zone buffer)						
Azioni per la protezione della biodiversità (es. Rete Natura 2000)						
Occupazione delle acque di transizione per acquacoltura						
Riqualificazione della zona costiera (almeno in parte) - es. recupero di stagni e dune a protezione della zona costiera						
Opere di sbarramento delle aree lagunari e/o baie soggette a innalzamento del livello di marea (es. MOSE a Venezia)						
Sovra sfruttamento risorse ittiche						
Istituzione di una rete di aree marine protette per rigenerare gli stock ittici						
Altri cambiamenti d'uso: specificare quali						

15. Quali aspetti sono da ritenersi maggiormente rilevanti ai fini dell'adattamento climatico degli insediamenti urbani?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Miglioramento delle prestazioni energetiche di edifici pubblici e privati						
Efficienza dei trasporti pubblici locali, incremento delle opportunità di mobilità dolce, iniziative di <i>car pooling</i> e <i>car sharing</i>						
Riduzione consumi energetici e promozione della produzione di energia rinnovabile						
Incremento delle aree verdi urbane (verde pubblico, verde agricolo, aree naturali e seminaturali) e loro configurazione sistemica (rete ecologica) anche in connessione con il reticolo idrico superficiale						
Miglioramento della vivibilità degli spazi pubblici						
Coordinamento con tutti gli attori del governo del territorio						
Sicurezza degli approvvigionamenti idrici e contenimento dei consumi idrici						
Trattamento delle acque reflue finalizzato al loro riutilizzo						
Riqualificazione degli spazi pubblici e miglioramento della loro vivibilità						
Arresto del consumo di nuovo suolo e riqualificazione - anche con finalità di adattamento climatico - delle aree dismesse						
Conoscenza delle vulnerabilità territoriali (aree inondabili per piene fluviali o per innalzamento del livello del mare; aree franose) e infrastrutturali (strade, ferrovia, grandi servizi, reti energetiche, reti fognarie) e loro adeguata considerazione nelle politiche di investimento e di governo del territorio						
Innovazioni eco-compatibili e promozione di nuova occupazione legata alla <i>green economy</i>						
Attività costanti di informazione e formazione dei cittadini sui temi dell'adattamento						
Predisposizione di politiche mirate per le fasce di popolazione maggiormente esposte agli impatti dei cambiamenti climatici (anziani, malati, immigrati recenti, famiglie a basso reddito)						

D. *Necessità e priorità per l'attuazione della Strategia Nazionale per l'Adattamento ai cambiamenti climatici*

16. Quale natura legale dovrebbe avere una Strategia Nazionale di Adattamento per essere efficace? È ammessa solo una risposta

- Legalmente vincolante (obbligo di adeguamento normativo)
- Linee guida, raccomandazioni (l'adeguamento normativo è volontario)
- Altra forma, specificare: _____

17. Una Strategia Nazionale di Adattamento dovrebbe essere:	Non importante	Poco importante	Mediamente importante	Molto importante	Estremamente importante	Non so
Revisionata periodicamente su base scientifica						
Supportata da risorse economiche						
Supportata da informazioni periodicamente aggiornate						
Integrata in una strategia di crescita urbana o in una strategia per la sostenibilità						
Supportata da un piano di adattamento o da un piano di attuazione						

E. *Potenzialità o limiti (barriere) all'attuazione della Strategia Nazionale di Adattamento ai cambiamenti climatici*

18. Quali obiettivi complementari dovrebbe avere la Strategia Nazionale di Adattamento ai cambiamenti climatici?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Creare posti di lavoro sicuri e promuovere la crescita economica						
Contribuire positivamente agli obiettivi sociali italiani						
Far sì che l'economia italiana sia più resiliente ai cambiamenti climatici ed agli eventi estremi						
Far diventare l'ambiente più resiliente						
Evitare il peggioramento delle conseguenze degli impatti da cambiamento climatico e l'incremento dei disastri						

19. Quali delle seguenti politiche ha maggiori potenzialità nel migliorare la qualità dell'ambiente e di adattamento agli impatti negativi da cambiamenti climatici?	Nessun potenziale	Poco potenziale	Medio potenziale	Molto potenziale	Moltissimo potenziale	Non so
Politiche agricole e rurali						
Politiche sui cambiamenti climatici						
Sussidi statali						
Politiche per le aree urbane						
Politiche per le infrastrutture						
Politiche per la salute						
Cooperazione allo sviluppo						
Politiche finanziarie ed economiche, incluso tasse						
Politiche per l'educazione e la cultura						
Politiche per l'occupazione						
Politiche per l'energia						
Politiche per le piccole-medie imprese						
Politiche per le relazioni esterne						
Politiche marittime e per la pesca						
Norme standard per prodotti e servizi						

Politiche sugli appalti pubblici						
Politiche regionali						
Politiche per la ricerca ed innovazione						
Politiche commerciali						
Politiche per i trasporti						
Politiche per la protezione e la conservazione della natura e dei beni ambientali						
Altro: specificare _____						

20. In quali settori le azioni previste dalla Strategia Nazionale di Adattamento darebbero un contributo più rilevante per migliorare la resilienza agli impatti negativi da cambiamento climatico?	Non rilevante	Poco rilevante	Mediamente rilevante	Molto rilevante	Estremamente rilevante	Non so
Risorse idriche (quantità e qualità)						
Desertificazione, degrado del territorio e siccità						
Disastri, dissesto idrogeologico (inondazioni, frane)						
Biodiversità ed ecosistemi (marini, terrestri, acquatici)						
Salute						
Foreste						
Agricoltura, acquacoltura, pesca						
Energia (Produzione e consumo di energia elettrica)						
Zone costiere						
Centri urbani e metropolitani						
Infrastruttura critica (Beni culturali, Trasporti)						
Ricerca/Innovazione/formazione						

21. Quali attività e settori produttivi potrebbero essere maggiormente ricettivi rispetto alla Strategia Nazionale di Adattamento?	Non ricettivo	Ricettivo	Indicare organizzazioni e persone referenti da coinvolgere nella consultazione per la redazione della Strategia Nazionale di Adattamento
Risorse idriche (quantità e qualità)			
Desertificazione, degrado del territorio e siccità			
Disastri, dissesto idrogeologico (inondazioni, frane)			
Biodiversità ed ecosistemi (marini, terrestri, acquatici)			
Salute			
Foreste			
Agricoltura, acquacoltura, pesca			
Energia (Produzione e consumo di energia elettrica)			
Zone costiere			
Centri urbani e metropolitani			
Infrastruttura critica (Beni culturali, Trasporti)			
Ricerca/innovazione/formazione			

22. Gli interventi sui seguenti settori o aree in che finestra temporale dovrebbero essere presi in considerazione?	0 - 10 anni	11-30 anni	31-50 anni	Oltre 50 anni	Nessun intervento previsto	Non so
Risorse idriche (quantità e qualità)						
Desertificazione, degrado del territorio e siccità						
Disastri, dissesto idrogeologico (inondazioni, frane)						
Biodiversità ed ecosistemi (marini, terrestri, acquatici)						
Salute						
Foreste						
Agricoltura, acquacoltura, pesca						

Energia (Produzione e consumo di energia elettrica)						
Zone costiere						
Centri urbani e metropolitani						
Infrastruttura critica (Beni culturali, Trasporti)						
Ricerca/Innovazione/formazione						

F. Commenti finali

23. Altro da aggiungere?

Bibliography

CITED REFERENCES

Aaheim, A., Dokken, T., Hochrainer, S., Hof, A., Jochem, E., Mechler, R. & Vuuren, D.P. Van (2010). *National responsibilities for adaptation strategies: lessons from four modelling frameworks. Making Climate Change Work for Us. European perspectives of adaptation and mitigation strategies 1: 4*. Hulme, M. and Neufeldt, H., (eds). Cambridge: Cambridge University Press.

Aarjan, D., McGray, H., Gonzales, J. & Desmond, M. (2012). *Ready or Not: Assessing Institutional Aspects of National Capacity for Climate Change Adaptation* (WRI Report). World Resources Institute, Washington DC. Retrieved from WRI: <http://www.wri.org/publication/ready-or-not>

Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit B. & Takahashi, K. (2007). Assessment of adaptation practices, options, constraints and capacity. In Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (Eds.), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 717-743). Cambridge: Cambridge University Press.

Agrawal, A., McSweeney, C. & Perrin, N. (2008, July). *Local Institutions and Climate Change Adaptation* (Social development notes no.113). Washington, DC: World Bank. Retrieved from: <https://openknowledge.worldbank.org/handle/10986/11145>

Agrawal, A., Perrin, N., Chhatre, A., Benson, C., & Kononen, M. (2009, June). *Climate Policy Processes, Local Institutions, and Adaptation Actions: Mechanisms of Translation and Influence* (Paper No. 119). Washington, DC: World Bank. Retrieved from: <http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1164107274725/sdp119.pdf>

Agrawala, S., & Fankhauser, S. (Eds.) (2008). *Economic Aspects of Adaptation to Climate Change: Costs Benefits and Policy Instruments*. Paris: OECD, 138 pp.

Alberini, A. & Chiabai, A. (2007). *Valutazione degli impatti dei cambiamenti climatici sulla salute*. APAT & CMCC.

Albouy, C., Guilhaumon, F., Araujo, M.B., Mouillot, D. & Leprieur, F. (2012). Combining projected changes in species richness and composition reveals climate change impacts on coastal fish assemblages. *Global Change Biology*, 18(10), 2995–3003. doi: 10.1111/j.1365-2486.2012.02772.x

Allison, I., Bindoff, N. L., Bindschadler, R.A., Cox, P.M., de Noblet, N., England, M.H., ...Weaver A.J. (2009). *The Copenhagen Diagnosis: Updating the World on the Latest Climate Science*. The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia, 60 pp. Retrieved from: <http://www.copenhagendiagnosis.com>

Antonioli, F. et al. (2007). *Dossier ENEA per lo studio dei cambiamenti climatici e dei loro effetti*. Roma: ENEA.

Antonioli F. & Silenzi S. (2007). *Variazioni relative del livello del mare e vulnerabilità delle pianure costiere italiane*. Quaderni della Società Geologica Italiana (SGI) 2. SGI.

APAT (Agenzia per la protezione dell'ambiente e per i servizi tecnici) & MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare) (2007). *Conferenza Nazionale sui Cambiamenti Climatici 2007 - Sintesi dei lavori*. Rome: APAT.

Astengo, G. (1966). Urbanistica. In *Enciclopedia Universale dell'Arte*, vol. XIV, Venezia: Sansoni.

- Araújo, M. B., Thuiller, W. & Pearson, R. G. (2006). Climate warming and the decline of amphibians and reptiles in Europe. *Journal of Biogeography*, 33, 1712–1728. Blackwell Publishing Ltd.
- Aucelli, P.P.C., Aminti, P.L., Amore, C., Artom, C., Bellotti, P., Bozzano, A., ... Veltri, P. (2006). *Lo stato dei litorali italiani*. Studi Costieri, 10/2006, 5-112. Gruppo Nazionale per la Ricerca sull'Ambiente Costiero - GNRAC.
- Autorità di bacino del fiume Po (2010). *Piano di Gestione del distretto idrografico del fiume Po*. Autorità di bacino del fiume Po.
- Bauer, A., Feichtinger, J., & Steurer, R. (2012). The Governance of Climate Change Adaptation in 10 OECD Countries: Challenges and Approaches. *Journal of Environmental Policy & Planning*, 14(3), 279-304. doi:10.1080/1523908X.2012.707406
- Beierle, T.C. & Cayford, J. (2002). *Democracy in practice – Public Participation in Environmental Decisions*. Washington: RFF Press Book.
- Beniston M. (2006). *Climatic change in the Alps: Perspectives and impacts* (Proceedings of the “Wengen 2006 Workshop – Adaptation to the Impacts of Climate Change in the European Alps”). Organisation for Economic Co-operation and Development (OECD).
- Beniston, M., Stephenson, D.B., Christensen, O.B., Ferro, C.A.T., Frei, C., Goyette, S., ... Katja Woth (2007). Future extreme events in European climate: an exploration of regional climate model projections. *Climatic Change*, 81(1), 71-95. doi: 10.1007/s10584-006-9226-z
- Beriot, N., & Jouzel, J. (2011). *First National adaptation plan of France*. Presentation at the COP17/ CMP7 United Nations Climate Change Conference 2011. Retrieved from: http://www.developpement-durable.gouv.fr/IMG/pdf/ONERC_Side_event_PNACC_Durban_EN_FR.pdf
- Berkhout, F. (2005). Rationales for adaptation in EU climate change policies. *Climate Policy*, 5(3), 377-391. doi:10.1080/14693062.2005.9685564
- Biesbroek, G.R., Swart, R.J., Carter, T., Cowan, C., Henrichs, T., Mela, H., Morecroft, M.D., & Rey, D. (2010). Europe adapts to climate change: Comparing National Adaptation Strategies. *Global Environmental Change*, 20, 440–450. doi:10.1016/j.gloenvcha.2010.03.005
- Bigano, A. & Bosello, F. (2007). *Impacts of climate change on tourism in the Italian alps: an economic assessment* (Report). ClimChalp Project.
- Bigano, A. & Pauli, F. (2007). Dimensioni socio-economiche, costi dell'inazione e strategie di adattamento per l'impatto del cambiamento climatico sul sistema idrogeologico italiano. In Carraro, C. (Ed.) (2008) *Cambiamenti climatici e strategie di adattamento in Italia. Una valutazione economica*. Bologna: Società editrice il Mulino.
- BMVBS (German Federal Ministry of Transport, Building and Urban Development) (2010, October). *National strategies of European countries for climate change adaptation: A review from a spatial planning and territorial development perspective* (BMVBS-Online-Publikation, No. 21/2010). Retrieved from the Federal Institute for Research on Building, Urban Affairs and Spatial Development: http://www.bbsr.bund.de/nn_1125340/BBSR/EN/Publications/BMVBS/Online/2010/ON212010.html
- Bonati, G., Coderoni, S., Pontrandolfi, A. & Vagnozzi, A. (2011). Strumenti per la mitigazione e l'adattamento per il settore agricolo e forestale. In MiPAAF & RRN (2011) *Libro bianco - Sfide ed opportunità dello sviluppo rurale per la mitigazione e l'adattamento ai cambiamenti climatici*. Roma: MiPAAF, RRN.
- Bosello, F., Eboli, F. & Parrado, R. (2010). *Climate change impacts in the Mediterranean: final results by means of a CGE analysis*. CIRCE Project.
- Bosello, F., Nicholls, R.J., Richards, J., Roson, R. & Tol, R. S. J. (2012). Economic impacts of climate change in Europe: sea-level rise. *Climatic Change*, 112, 63–81.
- Breil, M., Catenacci, M. & Travisi, M. (2007). *Impatti del cambiamento climatico sulle zone costiere: Quantificazione economica di impatti e di misure di adattamento – sintesi di risultati e indicazioni metodologiche per la ricerca futura*. APAT & CMCC.
- Brunner, R.D., Steelman, T.A., Coe-Juell L. et al (2005). *Adaptive governance: integrating science, policy and decision making*. New York: Colombia University Press.

- Bulgarian Ministry of Environment and Water (2012). *Third National Action Plan on Climate Change – for the period 2013-2020*. Retrieved from MOEW: http://www3.moew.government.bg/files/file/Climate/Climate_Change_Policy_Directorate/THIRD_NATIONAL_ACTION_PLAN.pdf
- Burton, L., Diringier & E., Smith, J. (2006, November). *Adaptation to Climate Change: International Policy Options* (Prepared for the Pew Center on Global Climate Change).
- Carraro, C. (Ed.) (2008). *Cambiamenti climatici e strategie di adattamento in Italia. Una valutazione economica*. Bologna: Società editrice il Mulino.
- Carraro, C., Crimi, J. & Sgobbi, A. (2008). La valutazione economica degli impatti dei cambiamenti climatici in Italia e delle relative misure di adattamento. In Carraro, C. (Ed.) (2008) *Cambiamenti climatici e strategie di adattamento in Italia. Una valutazione economica*. Bologna: Società editrice il Mulino.
- Carraro, C. & Sgobbi, A. (2008). *Climate change impacts and adaptation strategies in Italy: an economic assessment* (FEEM Research Paper; CMCC Research Paper No. 14.) Milan: FEEM; CMCC.
- Caserini, S. & Pignatelli, R. (2009). Cambiamenti climatici e trasporti: il contesto e gli impatti. In Castellari, S. & Artale, V. (Eds.) (2009) *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.
- Castellari, S. (2008). *Climate change, impacts and adaptation strategies in the alpine space: some results from the INTERREG III B project CLIMCHALP*. (Proceedings of the International Conference “Mountains as Early Indicators of Climate Change”, 17-18 aprile 2008, Padova, Italy, pp. 81-91. Vienna: United Nations Environment (UNEP) Programme Regional Office for Europe.
- Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.
- Cebrian, E., Uriz, M.J., Garrabou, J. & Ballesteros, E. (2011). Sponge Mass Mortalities in a Warming Mediterranean Sea: Are Cyanobacteria-Harboring Species Worse Off?. *PLoS ONE* 6(6). PLOS.
- Cecchi, L., Orlandini, S., Forestiere, F. & Morabito, M. (2007). Urban environments and socioeconomic sectors. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.
- Cecchi, L., Orlandini, S., Morabito, M., Bindi, M. & Morindo, M. (2007). Ecosystems, forests and agriculture. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.
- Cheung, W.W.L., Lam, V.W.Y., Sarmiento, J.L., Kearney, K., Watson, R., Zeller, D. & Pauly, D. (2010). Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. *Global Change Biology*, 16, 24–35. doi: 10.1111/j.1365-2486.2009.01995.x
- Cheung, W.W.L., Sarmiento, J.L., Dunne, J., Frölicher, T.L., Lam, V.W.Y., Deng Palomares, M.L., Watson, R. & Pauly, D. (2012). Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems. *Nature Climate Change*, 3, 254–258. doi:10.1038/nclimate1691
- CIPE (Inter-Ministerial Committee for Economic Planning) (1999). *National Action Programme to Combat Drought and Desertification*. Rome: CIPE.
- ClimateCost (2010). *The Costs and Benefits of Adaptation in Europe: Review Summary and Synthesis* (Policy Brief). Retrieved from ClimateCost: http://www.climatecost.cc/images/Review_of_European_Costs_and_Benefits_of_Adaptation.pdf
- Coma, R., Ribes, M., Serrano, E., Jiménez, E., Salat J. & Pascual, J. (2009). Global warming-enhanced stratification and mass mortality events in the Mediterranean. *PNAS* 2009, 106 (15), 6176-6181. doi: 10.1073/pnas.0805801106
- Council of the European Union (2013). An EU strategy on adaptation to climate change (Council Conclusions 11151/13). Brussels, 18 June 2013. Retrieved from Consilium: <http://register.consilium.europa.eu/pdf/en/13/st11/st11151.en13.pdf>

Czech Ministry of the Environment (2004). *National Program to abate the Climate Change Impacts in the Czech Republic*. Retrieved from MZP: [http://www.mzp.cz/C125750E003B698B/en/national_programme/\\$FILE/OZK-National_programme-20040303.pdf](http://www.mzp.cz/C125750E003B698B/en/national_programme/$FILE/OZK-National_programme-20040303.pdf)

C2ES (Center for Climate and Energy Solutions) (2012, December). *The Durban Platform: Issues and Options for a 2015 Agreement* (Policy brief). Retrieved from C2ES: <http://www.c2es.org/docUploads/durban-platform-issues-and-options.pdf>

Danovaro, R., Fonda Umani, S. & Pusceddu, A. (2009). Climate Change and the Potential Spreading of Marine Mucilage and Microbial Pathogens in the Mediterranean Sea. *PLoS ONE*, 4(9), e7006. doi:10.1371/journal.pone.0007006

de Bruin, K., Dellink, R.B. & Agrawala, S. (2009). *Economic Aspects of Adaptation to Climate Change: Integrated Assessment Modelling of Adaptation Costs and Benefits* (OECD Environment Working Papers, No. 6). OECD Publishing. <http://dx.doi.org/10.1787/225282538105>

de Bruin, K., Dellink, R.B., Ruijs, A., Bolwidt, L., van Buuren, A., Graveland, J., de Groot, R.A., Kuikman, P.J., Reinhard, S., Roetter, R.P., Tassone, V.C., Verhagen & A., van Ierland, E.C. (2009). Adapting to climate change in the Netherlands: an inventory of climate adaptation options and ranking of alternatives. *Climatic Change*, 95, 23–45. doi: 10.1007/s10584-009-9576-4

Dumollard, G., & Leseur, A. (2011, March). *Drawing up a national climate change adaptation policy: Feedback from five European case studies* (Climate Report No. 27). Retrieved from CDC CLIMAT: <http://www.cdclimat.com/Climate-Report-no27-Drawing-up-a.html?lang=en>

EEA (European Environment Agency) (2007, December). *Climate change: the cost of inaction and the cost of adaptation* (EEA Technical report No 13/2007). Retrieved from EEA: http://www.eea.europa.eu/publications/technical_report_2007_13.

EEA (European Environment Agency) (2007a). *Climate change and water adaptation issues* (EEA Technical report No 2/2007). Copenhagen: EEA.

EEA (European Environment Agency) (2010, November). Adapting to Climate Change (Thematic Assessment Report). In *The European Environment - State and Outlook 2010 (SOER 2010)*. Retrieved from EEA: <http://www.eea.europa.eu/soer/europe/adapting-to-climate-change>

EEA (European Environment Agency) (2012, November). *Climate change impacts, vulnerability in Europe 2012* (EEA Report No 12/2012). Retrieved from EEA: <http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012>

EEA (European Environment Agency) (2012a, May). *Urban adaptation to climate change in Europe Challenges and opportunities for cities together with supportive national and European policies* (EEA Report No 2/2012). Retrieved from EEA: http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change?b_start:int=12

EEA (European Environment Agency) (2013, May). *Adaptation in Europe: Addressing risks and opportunities from climate change in the context of socio-economic developments* (EEA Report no. 3/2013). Retrieved from EEA: <http://www.eea.europa.eu/publications/adaptation-in-europe>

EEA (European Environment Agency), JRC (Joint Research Centre) & WHO (World Health Organisation) (2008, September). Adaptation to climate change. In *Impacts of Europe's changing climate - 2008 indicator-based assessment* (EEA Report No 4/2008). Copenhagen: EEA. Retrieved from EEA: http://reports.eea.europa.eu/eea_report_2008_4/en

EC (European Commission) (2007, June). *Adapting to climate change in Europe: options for EU action*. Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0354:FIN:EN:PDF>

EC (European Commission) (2009, April). *Adapting to climate change: Towards a European framework for action*. White Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF>

EC (European Commission) (2009a, April). *Impact Assessment*. Commission staff working document accompanying the White Paper *Adapting to climate change: Towards a European framework for action*. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2009:0387:FIN:EN:PDF>

EC (European Commission) (2009b). *Reform of the Common Fisheries Policy*. Green Paper. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0163:FIN:EN:PDF>

EC (European Commission) (2013, April). *An EU Strategy on adaptation to climate change*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0216:FIN:EN:PDF>

EC (European Commission) (2013a, April). Guidelines on developing adaptation strategies (Commission Staff Working Document). Accompanying the Communication *An EU Strategy on adaptation to climate change*. Retrieved from DG CLIMA: http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_134_en.pdf

EC (European Commission) (2013b, April). Impact Assessment – Part 1 (Commission Staff Working Document). Accompanying the Communication *An EU Strategy on adaptation to climate change*. Retrieved from DG CLIMA: http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_en.pdf

EC (European Commission) (2013c, April). Impact Assessment – Part 2 (Commission Staff Working Document). Accompanying the Communication *An EU Strategy on adaptation to climate change*. Retrieved from DG CLIMA: http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_2_en.pdf

EC (European Commission) (2013d, April). *Green Paper on the insurance of natural and man-made disasters*. Green paper. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0213:FIN:EN:PDF>

ENEA (Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile) (2011). *Politiche e misure nazionali sui cambiamenti climatici. Elementi per una valutazione*. Roma: ENEA.

Ebi, K.L. (2008). Adaptation costs for climate change-related cases of diarrhoeal disease, malnutrition, and malaria in 2030. *Global Health*, 4(9). doi:10.1186/1744-8603-4-9

Ebi, K.L., Lim, B. & Aguilar, Y. (2004). Scoping and Designing an Adaptation Project. In Lim, B., Spanger-Siegrfried, E., Burton, I., Malone, E., Huq, S. (Eds.), *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures* (pp. 35-46). Cambridge: Cambridge University Press.

ETC/CCA (European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation) (2013). *Questionnaire transport and adaptation to climate change in EEA member countries - Answers for Italy*. EEA, ETC/CCA. Unpublished.

EUROSAI-WGEA (EUROSAI-Working Group on Environmental Auditing) (2012). *Adaptation to climate change – are governments prepared? A cooperative Audit* (Joint Report). Retrieved from EUROSAI-WGEA: <http://www.eurosaiwgea.org>

FAO (Food and Agriculture Organization) (2008). *Climate Change for fisheries and aquaculture* (technical background document from the expert consultation held on 7 to 9 April 2008, FAO, Rome, Italy). Rome: FAO.

Finnish Ministry of Agriculture and Forestry (2005). *Finland's National Strategy for Adaptation to Climate Change*. Retrieved from Ministry of Agriculture and Forestry: http://www.mmm.fi/en/index/frontpage/climate_change_energy/adaption.html

Flörke, M., Wimmer, F., Dworak, T., Laaser, C., Vidaurre, R., Tröltzsch, J., Marinova, N., Fons, J., Fulco, L., Giupponi, C., Bosello, F. & Mysiak, J. (2011). *Final Report for the project Climate Adaptation modelling water scenarios and sectoral impacts* (report). CESR - European Commission Directorate-General Environment.

Forestiere, F. (2007). Air quality and health. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.

Ford, J.D., Berrang-Ford, L. & Paterson, J. (2011). A systematic review of observed climate change adaptation in developed nations. *Climatic Change*, 106, 327–336. doi: 10.1007/s10584-011-0045-5

French Ministry of Ecology, Sustainable Development, Transport and Housing (2011). *National Plan Climate Change Adaptation*. Retrieved from: http://www.developpement-durable.gouv.fr/IMG/pdf/ONERC_PNACC_Eng_part_1.pdf

Funari, E., Martinelli, A., Blasi, M.F., Carere, M., Della Bella, V., Mancini, L., Marcheggiani, S., Mattera, F. & Stefanelli, M. (2007). Water. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.

Funari, E., Blasi, M.F., Carere, M., Della Bella, V., Mancini, L., Marcheggiani, S., Mattera, F. & Stefanelli, M. (2007). Flooding and health. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.

Galeotti, M., Gorla, A., Mombrini, P. & Spantidaki, E. (2004). *Weather Impacts on Natural, Social and Economic Systems (WISE) Part II: Individual Perception of Climate Extremes in Italy* (FEEM, Note di Lavoro 32.2004). Milan: FEEM.

Gagnon-Lebrun, F. & Agrawala, S. (2006, May). *Progress on adaptation to climate change in developed countries: An analysis of broad trends* (OECD Report ENV/EPOC/GSP(2006)1/FINAL). Paris: OECD.

Gambarelli, G. & Gorla, A. (2004). *Economic evaluation of climate change impacts and adaptation in Italy* (FEEM, Note di Lavoro 103.04). Milan: FEEM.

Gaudio, D. & Masullo, A. (2009). Impatti dei cambiamenti climatici sul settore energetico. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.

Giupponi, C., & Shecherto, M. (Eds.) (2003). *Climate Change in the Mediterranean: Socio-economic Perspectives of Impacts, Vulnerability and Adaptation*. Venice: FEEM.

Government of Liechtenstein Principality (2007). [*National Climate Change Strategy for the Liechtenstein Principality*]. Retrieved from; http://www.llv.li/pdf-llv-aus-nationale_klimaschutzstrategie_07.pdf

Government of Norway, 2008. [*Adaptation in Norway – The government efforts to adapt to climate change*]. Retrieved from: http://www.regjeringen.no/upload/MD/Vedlegg/Klima/Klimatilpasning/Klimatilpasning_redegjorelse150508.pdf

Government Of The Republic Of Lithuania (2008). *Resolution On The Approval Of The National Strategy For The Implementation Of The United Nations Framework Convention On Climate Change Until 2012*. Retrieved from Ministry of the Environment of the Republic of Lithuania: <http://www.am.lt/VI/en/VI/index.php#a/202>

Greek National Gazette (2003). [*National Action Plan regarding Climate Change*]. Retrieved from National Gazette: <http://www.ypeka.gr/LinkClick.aspx?fileticket=0nzVol6bIBw%3d&tabid=431&language=el-GR>

Green, A. O. & Hunton-Clarke, L. (2003). A typology of stakeholder participation for company environmental decision-making. *Business Strategy and the Environment*, 12(5), 292–299. doi:10.1002/bse.371

Greiving, S., et al. (2011). *Climate change and territorial effects on regions and local economies* (Main Report - Final project report version 31/5/2011). Dortmund: ESPON & IRPUD, TU. Retrieved from ESPON: <http://www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/CLIMATE/ESPO Climate Final Report-Part B-MainReport.pdf>

Griffiths, A.L. & Nerenberg, K. (Eds.) (2005). *Handbook of Federal Countries*. Forum of Federations. McGill Queen's University Press.

Gupta, J., Termeer, C., Klostermann, J., Meijerink, S., Van den Brink, M., Jong, P., Nooteboom, S. & Bergsma, E. (2010). The Adaptive Capacity Wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science & Policy*, 13, 459-471. doi:10.1016/j.envsci.2010.05.006

Haasnoot, M., Middelkoop, H., Offermans, A., Van Beek, E. & van Deursen, W.P.A. (2012). Exploring pathways for sustainable water management in river deltas in a changing environment. *Climatic Change* 115 (3-4), 795-819. doi:10.1007/s10584-012-0444-2

- Herold, A., Acker, H., Busche, J., Graichen, J., Gugele, B., Hermann, H., Oberthür, S., Seum, S. & Seuss, K. (2011). *Review of Decision No 280/2004/EC (Monitoring Mechanism Decision) in view of the agreed Climate Change and Energy package* (Draft final report). Report prepared for DG CLIMA, Berlin, March 2011. Retrieved from: http://ec.europa.eu/clima/policies/g-gas/monitoring/docs/monitoring_2011_en.pdf
- HMG (2008). *Climate Change Act 2008*. Retrieved from Legislation.gov.uk: http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf
- HMG (2010). *Climate Change: Taking Action - Delivering the Low Carbon Transition Plan and preparing for a changing climate*. Retrieved from Gov.uk: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69256/pb13359-cc-taking-action-100325.pdf
- HMG (2013). *The National Adaptation Programme: Making the country resilient to a changing climate*. London: The Stationery Office. Retrieved from Gov.uk: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209866/pb13942-nap-20130701.pdf
- HMG (2013a). *The National Adaptation Programme Report: Analytical Annex Economics of the National Adaptation Programme*. Retrieved from Gov.uk: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209867/pb13942a-nap-annex-economics.pdf
- HMG & DEFRA (Department for Environment Food and Rural Affairs) (2008). *Adapting to climate change in England: a framework for action*. Retrieved from DEFRA: <http://archive.defra.gov.uk/environment/climate/documents/adapting-to-climate-change.pdf>
- Icelandic Ministry for the Environment (2007). *Iceland's Climate Change Strategy*. Retrieved from: http://eng.umhverfisraduneyti.is/media/PDF_skrar/Stefnumorkun_i_loftslagsmalum_enlokagerd.pdf
- IDGEC (Institutional Dimensions of Global Environmental Change) (1999). *Science Plan*. Retrieved from: <http://www.ihdp.unu.edu/article/read/idgcec-science-plan>
- Inman, R.P. (2007). Federalism's Values and the Value of Federalism. *CESifo Economic Studies*, 53(4), 522–560. doi:10.1093/cesifo/ifm018
- INTOSAI WGEA (2010). *Auditing the Government Response to Climate Change – Guidance for Supreme Audit Institutions*. Retrieved from: <http://www.environmental-auditing.org/LinkClick.aspx?fileticket=c0u4iUMLYvU%3d&tabid=128&mid=568>
- IPCC (Intergovernmental Panel on Climate Change) (2007). Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (Eds.). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, 976pp.
- Italian Ministry of Health (2005). *Piano Operativo Nazionale per la Prevenzione degli Effetti del Caldo sulla Salute*. Retrieved from Ministero della Salute: http://www.salute.gov.it/imgs/C_17_pubblicazioni_983_allegato.pdf
- Jeuken, A. & Reeder, T. (2011). *Short-term decision making and long-term strategies: how to adapt to uncertain climate change. Examples from the Thames Estuary and the Dutch Rhine-Meuse Delta*. Water Governance 1.
- Jordan, A. & O'Riordan, T. (1997). *Social Institutions and Climate Change: Applying Cultural Theory to Practice* (CSERGE Working Paper GEC 97- 15). Retrieved from CSERGE: http://www.cserge.uea.ac.uk/sites/default/files/gec_1997_15.pdf
- Juhola, S., Keskitalo, E.C.H. & Westerhoff, L. (2011). Understanding the framings of climate change adaptation across multiple scales of governance in Europe. *Environmental Politics*, 20(4), 445-463. doi: 10.1080/09644016.2011.589571
- Kazmierczak, A. & Carter, J. (2010). *Adaptation to climate change using green and blue infrastructure. A database of case studies* (Report). University of Manchester, GRaBS project.
- Keskitalo, E.C.H. (Eds.) (2010). *Developing adaptation policy and practice in Europe: Multi-level governance of climate change*. Berlin: Springer.

Klein, R.J.T., Huq, S., Denton, F., Downing, T.E., Richels, R.G., Robinson, J.B. & Toth, F.L. (2007). Interrelationships between adaptation and mitigation. In Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (Eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 745–777). Cambridge: Cambridge University Press.

Kovats, S.R. & Ebi, K.L. (2006). Heatwaves and public health in Europe. *European Journal of Public Health*, 16(6), 592–599. doi:10.1093/eurpub/ckl049

Krosnick, J.A., MacInnis, B. (2012). *Trends In American Public Opinion On Global Warming Policies Between 2010 and 2012*. Stanford University. Retrieved from: <http://www.ipsos-na.com/download/pr.aspx?id=11609>

Kwadijk, J.C.J., Haasnoot, M., Mulder, J.P.M., Hoogvliet, M.M.C., Jeuken, A.B.M., van der Krogt, R.A.A., van Oostrom, N.G.C., Schelfhout, H.A., van Velzen, E.H., van Waveren, H. & de Wit, M.J.M. (2010). Using adaptation tipping points to prepare for climate change and sea level rise: a case study in the Netherlands. *Wiley Interdisciplinary Reviews: Climate Change*, 1 (5), 729–740. doi: 10.1002/wcc.64

Legambiente (2011). *Ecosistema Rischio 2011. Monitoraggio sulle attività delle amministrazioni comunali per la mitigazione del rischio idrogeologico* (Dossier). Retrieved from Legambiente: http://www.legambiente.it/sites/default/files/docs/dossier_ecosistemarischio2011.pdf

Lithuanian Ministry of Environment (2012). *Lithuanian climate change management policy and its implementation* (Leaflet in English). Retrieved from: <http://www.am.lt/VI/files/File/Lankstinukas%20Klimato%20kaita%20ENG.pdf>

Madonna, F. (2012). *Indicatori di consumo per la climatizzazione degli edifici - Rapporto RSE per la Ricerca di Sistema, Marzo 2012* (Report). Ricerca Sistema Energetico.

Maltese Ministry for Resources and Rural Affairs (2012). *National Climate Change Adaptation Strategy*. May 2012.

Markandya, A. & Chiabai, A. (2009). Valuing Climate Change Impacts on Human Health: Empirical Evidence from the Literature. *International Journal of Environmental Research and Public Health*, 6(2), 759–786. doi:10.3390/ijerph6020759

Massey, E. (2009). *Adaptation policy and procedures in Central & Eastern Europe* (Report nr. R-09/012). Netherlands Environmental Assessment Agency. Retrieved from VU-DARE: <http://hdl.handle.net/1871/20933>

Massey, E., & Bergsma, E. (2008). *Assessing adaptation in 29 European countries* (Report W-08/20). Institute for Environmental Studies. Amsterdam: Vrije Universiteit.

Majori, G. (2007). Vector-borne diseases. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.

MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare - Direzione Generale per la Difesa del Suolo) (2008). *Il rischio idrogeologico in Italia*. Roma: MATTM.

MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare) (2009). Vulnerability assessment, climate change impacts and adaptation measures. In *Fifth National Communication under the UNFCCC*. Rome: MATTM.

MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare) (2010). *Italian National Biodiversity Strategy*. Rome: MATTM.

MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare - Direzione Generale per la Protezione della Natura e del Mare) (2011). *Report Nazionale sui progressi realizzati in materia di gestione integrata delle zone costiere (2006-2010)*. Rome: MATTM.

MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare) (2013). *Linee strategiche per l'adattamento ai cambiamenti climatici, la gestione sostenibile e la messa in sicurezza del territorio. Bozza di delibera del CIPE* (Draft documentation for the Inter-ministerial Committee for Economic Planning).

- McCallum, S., Dworak, T., Prutsch, A., Kent, N., Mysiak, J., Bosello, F., Klostermann, J., Dlugolecki, A., Williams, E., König, M., Leitner, M., Miller, K., Harley, M., Smithers, R., Berglund, M., Glas, N., Romanovska, L., van de Sandt, K., Bachschmidt, R., Völler, S. & Horrocks, L. (2013). *Support to the development of the EU Strategy for Adaptation to Climate Change: Background report to the Impact Assessment, Part I – Problem definition, policy context and assessment of policy options*. Vienna: Environment Agency Austria.
- McCallum, S., Prutsch, A., Berglund, M., Dworak, T., Kent, N., Leitner, M., Miller, K. & Matauschek, M. (2013a). *Support to the development of the EU Strategy for Adaptation to Climate Change: Background report to the Impact Assessment, Part II – Stakeholder Involvement*. Vienna: Environment Agency Austria.
- Meadowcroft, J. (2009, May). *Climate change governance* (Policy Research Working Paper 4941). A paper contributing to the 2010 World Bank World Development Report. Retrieved from The World Bank: <http://wdronline.worldbank.org/worldbank/a/nonwdrdetail/156>
- Medri, S., Venturini, S. & Castellari, S. (2013). *Overview of climate change impacts, vulnerabilities and adaptation action in Italy* (CMCC Research Paper nr. RP0178). Bologna: CMCC.
- Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.
- Menne, B., Sinisi, L. & Bertolini, R. (2009). Conclusions. In Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.
- Michelozzi, P., de Donato, F. & Kirchmayer, U. (2007). Heat and health. Menne, B. & Wolf, T. (Eds.) (2007). *Environment and health risks from climate change and variability in Italy*. Rome: WHO-APAT.
- Mickwitz P., Aix, F., Beck, S., Carss, D., Ferrand, N., Görg, C., Jensen, A., Kivimaa, P., Kuhlicke, C., Kuindersma, W., Máñez, M., Melanen, M., Monni, S., Pedersen, A., Reinert, H. & van Bommel, S. (2009). *Climate Policy Integration, Coherence and Governance* (PEER-Report No 2). Helsinki: Partnership for European Environmental Research. Retrieved from PEER: <http://www.peer.eu/publications/climate-policy-integration-coherence-and-governance/>
- Miglietta, F., Bindi, M. & Vaccari, F. P. (2009). Impatti dei cambiamenti climatici sull'agricoltura. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.
- Mima, S., Criqui, P., & Watkiss, P. (2011). The Impacts and Economic Costs of Climate Change on Energy in Europe. Summary of Results from the EC RTD ClimateCost Project. In Watkiss, P. (Ed.), *The ClimateCost Project. Final Report. Volume 1: Europe*. Stockholm: Stockholm Environment Institute.
- MiPAAF (Ministero delle Politiche Agricole Alimentari e Forestali), Ispettorato Generale - Corpo Forestale dello Stato & CRA (Istituto Sperimentale per l'Assesamento Forestale e per l'Alpicoltura). *INFC 2005 – Inventario Nazionale delle Foreste e dei Serbatoi Forestali di Carbonio*. Sistema Informativo Agricolo Nazionale (SIAN).
- MiPAAF (Ministero delle Politiche Agricole Alimentari e Forestali) & Rete Rurale Nazionale (2011). *Libro bianco - Sfide ed opportunità dello sviluppo rurale per la mitigazione e l'adattamento ai cambiamenti climatici*. Roma: MiPAAF, RRN.
- Morelli, L. M. et al. (2007). Conclusioni. In MiPAAF & RRN, 2011. *Libro bianco - Sfide ed opportunità dello sviluppo rurale per la mitigazione e l'adattamento ai cambiamenti climatici*. Roma: MiPAAF, RRN.
- Mullan, M., Kingsmill, N., Matus Kramer, A. & Agrawala, S. (2013). *National Adaptation Planning: Lessons from OECD Countries* (OECD Environment Working Papers, No. 54). OECD Publishing. Retrieved from OECD Library: <http://dx.doi.org/10.1787/5k483jpfpsq1-en>
- Navarra, A. & Tubiana, L. (Eds.) (2013). *Regional Assessment of Climate Change in the Mediterranean. Volume 1. Advances in Global Change Research, 50*, 338 p. Springer.
- Navarra, A. & Tubiana, L. (Eds.) (2013a). *Regional Assessment of Climate Change in the Mediterranean. Volume 2. Advances in Global Change Research, 51*, 404 p. Springer.
- NES (2008). *National Climate Change Strategy 2008-2025*. Retrieved from: http://klima.kvvm.hu/documents/14/National_Climate_Change_Strategy_of_Hungary_2008.pdf
- Newman, D. (2004). *Sociology: Exploring the architecture of everyday life*. Thousands Oaks: Pine Forge Press.

Niang-Diop, I. & Bosch, H. (2004). Formulating an adaptation strategy. In Lim, B., Spanger-Siegfried, E., Burton, I., Malone, E., Huq, S. (Eds.), *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures* (pp. 185–204). Cambridge University Press, Cambridge.

Norwegian Ministry of Environment (2012). [White Paper – Adaptation in Norway]. Retrieved from: <http://www.regjeringen.no/pages/38318903/PDFS/STM201220130033000DDDPDFS.pdf>

Official Journal of the EU (2013, May). *Regulation no. 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC*. Retrieved from EUR-LEX: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:165:0013:0040:EN:PDF>

Paavola, J. (2008). Science and social justice in the governance of adaptation to climate change. *Environmental Politics*, 17(4), 644 – 659. doi: 10.1080/09644010802193609

Paavola, J. & Adger, W.N. (2006). Fair adaptation to climate change. *Ecological Economics*, 56, 594-609. doi:10.1016/j.ecolecon.2005.03.015

Pasqui, M. et al. (2011). Scenari di cambiamento climatico; impatti sull'agricoltura e adattamento. In MiPAAF & RRN (2011). *Libro bianco - Sfide ed opportunità dello sviluppo rurale per la mitigazione e l'adattamento ai cambiamenti climatici*. Roma: MiPAAF, RRN.

Patt, A., Pfenninger, S. & Hinkel, J. (2012). *Typology of adaptation problems*. (MEDIATION Deliverable D.4.3). MEDIATION Seventh Framework Project (Methodology for Effective Decision-making on Impacts and Adaptation).

Perini, L., Salvati, L., Ceccarelli, T., Sorrenti, S. & Zitti, M. (2008). *La desertificazione in Italia. Processi, indicatori, vulnerabilità del territorio*. Acireale – Roma: Bonanno Editore.

Perkins, B., Ojima, D. & R. Corell (2007). *A survey of climate change adaptation planning*. Washington: The H. John Heinz III Center for science, economics and the environment.

Petriccione, B., Cindolo, C., Cocciufa, C., Ferlazzo, S. & Parisi, G. (2009). *Gli effetti dei cambiamenti climatici sugli ecosistemi forestali*. Atti del Terzo Congresso Nazionale di Selvicoltura. Taormina (ME), 16-19 ottobre 2008. Accademia Italiana di Scienze Forestali, Firenze, p. 570-574.

Pfenniger, S., Hanger, S., Dreyfus, M., Dubel, A., Hernandez-Mora, N., Esteve, Pl., Varlea-Ortega, C., Watkiss, P. & Patt, A. (2010, submitted to the European Commission). *Report on perceived policy needs and decision contexts* (Final draft Report, Mediation Deliverable D1.1.) MEDIATION Seventh Framework Project (Methodology for Effective Decision-making on Impacts and Adaptation).

Polish Ministry of the Environment (2013). [Strategic Plan for Adaptation to sectors and areas vulnerable to climate change by 2020, with a view to 2030]. Retrieved from: http://www.mos.gov.pl/g2/big/2013_03/e436258f57966ff3703b84123f642e81.pdf

Portoghese I., Vurro, M. & Mariotti, A. (2009). Impatti sul ciclo idrologico e risorse idriche. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.

Portoghese I. & Vurro M. (2009). Le risorse idriche e i cambiamenti climatici. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.

PRC (Policy Research Corporation) in association with MRAG (2009). *The economics of climate change adaptation in EU coastal areas*. ("Country overview and assessment". Chapter 11. "Italy"). European Commission, Directorate-General for Maritime Affairs and Fisheries.

Preston, B., Westaway, R., & Yuen, E. (2011). Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. *Mitigation and Adaptation Strategies for Global Change*, 16, 407–438. doi: 10.1007/s11027-010-9270-x

- Prutsch, A., Grothmann, T., Schauser, I., Otto, S., & McCallum, S. (2010, November). *Guiding principles for adaptation to climate change in Europe* (European Environment Agency ETC/ACC Technical Paper 2010/6). Retrieved from ETC/ACC: http://acm.eionet.europa.eu/docs/ETCACC_TP_2010_6_guiding_principles_cc_adaptation.pdf
- Prutsch, A., McCallum, S., Leitner, M., Lexer, W., Offenthaler, I., Hildén, M., Mäkinen, K., Weiland, S., Beck, S., Castellari, S., Swart, R., Conix, I., Biesbroek, R., Capela Lourenço, T., Alves, F., Havranek, M., Street, R.B., Downing, C., Ramieri, E., Iglesias, A. & Isoard, S. (2013, May). *Contributions to EEA assessment reports: Assessment of national adaptation policy process in 32 EEA Member. Final Work Plan.* (ETC/CCA Study).
- PWC (Price Waterhouse Coopers) (2013). *International threats and opportunities of climate change to the UK* (Report). 13 June 2013. Retrieved from DEFRA: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18348>
- Pye, S., Skinner, I., Meyer-Ohlendorf, N., Leipprand, A., Lucas, K. & Salmons, R. (Eds.) (2008, July). *Addressing the social dimensions of environmental policy - a study on the linkages between environmental and social sustainability in Europe* (Policy briefing for the European Commission - Directorate-General Employment, Social Affairs and Equal Opportunities).
- Reed, M.S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation* 141, 2417-2431. doi:10.1016/j.biocon.2008.07.014
- Republic of Lithuania (2009, July). *Law on financial instruments for climate change management.* Retrieved from: http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=353938&p_query=&p_tr2=2
- Republic of Slovenia - Government Office of Climate Change (2011). *Draft Strategy for the transition of Slovenia to a low carbon society by 2050.* Retrieved from Ministry of Agriculture and the Environment: http://www.arhiv.svps.gov.si/fileadmin/svps.gov.si/pageuploads/strategija/Low_carbon_strategy_Slovenia.pdf
- Republic of Turkey (2010). *Climate Change Strategy 2010-2020.* Retrieved from: http://iklim.cob.gov.tr/iklim/Files/Stratejiler/IDES_ENG.pdf
- RRN (Rete Rurale Nazionale) (2010). *Climate Change and Renewable Energy measures in EU RDPs 2007 – 2013 Member state profile - Italy.* European Network for Rural Development (EN RD).
- Romanian Ministry of Environment and Forests (2005). [National Climate Change Strategy (2005-2007)]. Retrieved from: http://www.mmediu.ro/protectia_mediului/schimbari_climatice/1_Documentatie/SNSC_ro.pdf
- Romanian Ministry of Environment and Forests (2008). *National Guide on the Adaptation to Climate Change Effects.*
- Romanian Ministry of Environment and Forests (2011). [Adaptation component of the National Climate Change Strategy (2012-2020)]. Retrieved from: http://www.mmediu.ro/protectia_mediului/schimbari_climatice/4_Adaptarea/2012-02-01_schimbari_climatice_snsccomponentaadaptare.pdf
- Roson, R. (2007). *Gli impatti macroeconomici del cambiamento climatico sui vari settori economici e sul commercio internazionale con un modello di equilibrio generale.* APAT & CMCC.
- Salzano, E. (1988). *Fondamenti di urbanistica.* Bari: Laterza.
- Seddaiu, G., Solinas, S., Pisanu, P. A. & Roggero, P. P. (2009). *Buone pratiche di lotta alla desertificazione.* NRD – Nucleo di Ricerche sulla Desertificazione - Università di Sassari.
- Schipper, E.L.F. & Burton, I. (Eds.) (2008). *The Earthscan Reader on Adaptation to Climate Change.* Earthscan Reader Series. London: Earthscan.
- Sciortino, M., Luise, A. & Genesio, L. (2009). La desertificazione e il degrado del territorio. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti.* Bologna: Bononia University Press.
- Scottish Government (2008). *Scotland's Climate Change Adaptation Framework.* Retrieved from: <http://www.scotland.gov.uk/Resource/Doc/295110/0091310.pdf>

Sen, A. (2002). Institutions for Sustainable Development. In World Bank (Ed.), *WDR 2003: Sustainable Development in a Dynamic World: Transforming Institutions, Growth, and Quality of Life*. Washington: World Bank and Oxford University Press.

Sinisi, L. (2009). Cambiamenti climatici e determinanti ambientali di salute. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.

Slovenian Ministry for Agriculture and the Environment (2008, June). [National Adaptation Strategy for Forests and Agriculture]. Retrieved from Ministry of Agriculture and the Environment: http://www.arhiv.mkgp.gov.si/fileadmin/mkgp.gov.si/pageuploads/saSSo/Sektor_za_naravne_nesrece/Strategija_prilagajanja_slovenskega_kmetijstva_in_gozdarstva_podnebnim_spremembam.pdf

Smith, J.B., Vogel, J.M. & Cromwell III, J.E. (2009). An architecture for government action on adaptation to climate change. An editorial comment. *Climatic Change*, 95, 53–61. doi: 10.1007/s10584-009-9623-1

Soncini, A. & Bocchiola, D. (2011). Assessment of future snowfall regimes within the Italian Alps using general circulation models. *Cold Regions Science and Technology* 68 (3), 113–123. <http://dx.doi.org/10.1016/j.coldregions.2011.06.011>

Stern, N. (2007). *Stern Review: The Economics of Climate Change* (report). Retrieved from HM Treasury: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/sternreview_index.htm

Swart, R., Biesbroek, R., Binnerup, S., Carter, T.R., Cowan, C., Henrichs, T., Loquen, S., Mela, H., Morecroft, M., Reese M. & D. Rey (2009). *Europe Adapts to Climate Change: Comparing National Adaptation Strategies* (PEER Report No 1). Helsinki: Partnership for European Environmental Research. Retrieved from PEER: <http://www.peer.eu/publications/europe-adapts-to-climate-change/>

Swedish Ministry of the Environment - The Commission on Climate and Vulnerability (2007, December). *Sweden facing climate change - threats and opportunities*. Retrieved from Swedish Government: <http://www.government.se/sb/d/574/a/96002>

Swedish Ministry of the Environment & Ministry of Enterprise, Energy and Communications (2009, March). *An integrated climate and energy policy* (information sheet about the government bills 2008/09:162 and 163). Retrieved from EESI (Environmental and Energy Study Institute): http://files.eesi.org/sweden_policy_030009.pdf

Termeer, C.J.A.M., Biesbroek, G. R. & van den Brink M.A. (2009). *Institutions for adaptation to climate change: Comparing national adaptation strategies in Europe*. Presented at ECPR APSA Panel for Toronto 2009 (September 3-6) on Energy Policy and Global Warming: American and European Approaches.

Turkish Ministry of Environment and Urbanization (2010). *Turkey's National Climate Change Adaptation Strategy and Action Plan (Draft)*. Retrieved from: <http://www.forclimadapt.eu/sites/default/files/TURQUIE.pdf>

UNEP (United Nations Environment Programme) (2009). *Climate change science compendium*. Nairobi: UNEP. Retrieved from UNEP: <http://www.unep.org/compendium2009/>

UNFCCC (United Nations Framework Convention on Climate Change) (2009). *Potential costs and benefits of adaptation options: A review of existing literature* (Technical paper FCCC/TP/2009/2). Retrieved from UNFCCC: <http://unfccc.int/resource/docs/2009/tp/02.pdf>

Vafeidis, A.T., Nicholls, R.J., McFadden, L., Tol, R.S.J., Spencer, T., Grashoff, P.S., Boot, G. & Klein, R.J.T. (2008). A new global coastal database for impact and vulnerability analysis to sea-level rise. *Journal of Coastal Research* 24(4), 917–924. Coastal Education and Research Foundation (CERF).

Valentini, R., Petriccione, B., Sezzi, E., Santini, M., Vannini, Vettraino, A.M. & Spano, D. (2009). Foreste e cambiamenti climatici. In Castellari, S. & Artale, V. (Eds.) (2009). *I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti*. Bologna: Bononia University Press.

Valentini, R. & Santini, M. (2008). Climate impact scenarios on forest biodiversity and land use changes in Alpine zone. In ClimChAlp INTERREG IIIB Alpine Space (2008) *ClimChAlp - Extended Scientific Final Report*. ClimChAlp INTERREG IIIB Alpine Space.

Van Passel, S., Massetti, E. & Mendelsohn, R. (2012). *A Ricardian Analysis of the Impact of Climate Change on European Agriculture* (FEEM note di lavoro 83.2012). Milan: FEEM.

Vaquer-Sunyer, R. & Duarte, C. M. (2011). Temperature effects on oxygen thresholds for hypoxia in marine benthic organisms. *Global Change Biology*, 17, 1788-1797. Blackwell Publishing Ltd.

Venturini, S., Capela Lourenço, T., Avelar, D., Castellari, S., Leitner, M., & Prutsch, A. (forthcoming). *Do political systems matter? Differences and similarities in institutional settings that support national adaptation strategies across European states*. Under preparation.

Venturini, S., Giannini, V., Davide, M. & Castellari, S. (forthcoming). *A national adaptation strategy to climate change in Italy: can the right stakeholders be engaged?*. Under preparation.

Venturini, S., Medri, S. & Castellari, S. (2012). *Overview of climate change impacts, vulnerabilities and adaptation action in Europe* (CMCC Research Paper nr. RP0142). Bologna: CMCC.

Venturini, S., Medri, S. & Castellari, S. (forthcoming). *Times to make strategies work: A review of climate change challenges and adaptation responses of European countries and the EU*. Under preparation.

Viaroli, P., Marinov, D., Bodini, A., Giordani, G., Galbiati, L., Somma, F., Bencivelli, S., Norro, A. & Zaldívar Comenges, J.M. (2007). Analysis of clam farming scenarios in Sacca di Goro lagoon. *Transitional Waters Monographs*, 1, p. 71-92. University of Salento - SIBA.

Welsh Assembly Government (2010). *Climate Change Strategy for Wales: Adaptation Delivery Plan*. Retrieved from Wales.gov.uk: <http://wales.gov.uk/docs/desh/publications/101006ccstratdeliveryadaptationen.pdf>

Werners, S., Swart, R., van Slobbe, E., Bölscher, T., Pfenninger, S., Trombi, G. & Moriondo, M. (2012). *Turning Points In Climate Change Adaptation* (Conference paper). Submitted to The Governance of Adaptation — An international symposium, Amsterdam, the Netherlands, March 22-23, 2012). Retrieved from: <http://www.adaptgov.com/wp-content/uploads/2012/03/Werners-et-al.pdf>

Werners, S., Pfenninger, S., van Slobbe, E., Haasnoot, M., Kwakkel, J.H., & Swart R.J. (2013). Thresholds, tipping and turning points for sustainability under climate change. *Current Opinion in Environmental Sustainability*, 5, xx-yy (advanced on-line version). Retrieved from ScienceDirect: <http://www.sciencedirect.com/science/article/pii/S1877343513000742>

Wilbanks, T.J., Kane, S.M., Leiby, P.N., Perlack, R.D., Settle, C., Shogren, J.F. & Smith, J.B. (2003). Possible Responses to Global Climate Change: Integrating mitigation and adaptation. *Environment*, 45(5), 28-38. doi: 10.1080/00139150309604547

World Bank (1996). *The World Bank participation sourcebook* (Report no. 15363). Washington, DC: The World Bank. Retrieved from: <http://documents.worldbank.org/curated/en/1996/02/696745/world-bank-participation-sourcebook>

Yohe, G. & Tol, R.S.J. (2002). Indicators for social and economic coping capacity: moving toward a working definition of adaptive capacity. *Global Environmental Change*, 12, 25-40. doi: [http://dx.doi.org/10.1016/S0959-3780\(01\)00026-7](http://dx.doi.org/10.1016/S0959-3780(01)00026-7)

CONSULTED WEBSITES

EEA: <http://www.eea.europa.eu>

EU Member States: http://europa.eu/about-eu/countries/member-countries/index_en.htm

EU ADAPTATION STRATEGY package:
http://ec.europa.eu/clima/policies/adaptation/what/documentation_en.htm

EUROPE 2020: http://ec.europa.eu/europe2020/index_en.htm

Climate-ADAPT: <http://climate-adapt.eea.europa.eu>

IPCC: www.ipcc.ch

Italian Ministry for the Environment, Land and Sea: <http://www.minambiente.it>

UNFCCC: www.unfccc.int

Glossary of basic terms

Adaptation

Any adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation;

Autonomous adaptation – adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation;

Planned adaptation – adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state (IPCC, 2007).

Adaptation benefits

The avoided damage costs or the accrued benefits following the adoption and implementation of adaptation measures (IPCC, 2007)

Adaptation costs

Costs of planning, preparing for, facilitating, and implementing adaptation measures, including transition costs (IPCC, 2007).

Adaptive capacity (in relation to climate change impacts)

The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2007).

Climate change impacts

The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts:

potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation;

residual impacts: the impacts of climate change that would occur after adaptation (IPCC, 2007).

Mitigation

An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks (IPCC, 2007).

National adaptation strategy

A general plan of action for addressing the impacts of climate change, including climate variability and extremes. It will include a mix of policies and measures with the overarching objective of reducing the country's vulnerability. Depending on the circumstances, the strategy can be comprehensive at a national level addressing adaptation across sectors, regions and vulnerable populations, or it can be more limited, focusing on just one or two sectors or regions. (Lim et al., 2004)

Resilience

The amount of change a system can undergo without changing state (IPCC, 2007).

Sector

A part or division, as of the economy (e.g., the manufacturing sector, the services sector) or the environment (e.g., water resources, forestry) (Lim et al., 2004).

Vulnerability

The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2007).

REFERENCES

IPCC (Intergovernmental Panel on Climate Change) (2007). Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (Eds.). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, 976 pp.

Lim, B., Spanger-Siegfried, E., Burton, I., Malone, E., Huq, S. (Eds.), *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. Cambridge: Cambridge University Press, 258 pp.

Estratto per riassunto della tesi di dottorato

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Dottorato: Scienza e Gestione dei Cambiamenti Climatici

Ciclo: XXVI

Titolo della tesi :

BUILDING NATIONAL GOVERNANCE FOR CLIMATE CHANGE ADAPTATION DECISION-MAKING IN EUROPEAN COUNTRIES: THE ITALIAN CASE

L'ELABORAZIONE DELLA STRUTTURA ORGANIZZATIVA NAZIONALE A SUPPORTO DEL PROCESSO DECISIONALE PER L'ADATTAMENTO AI CAMBIAMENTI CLIMATICI IN EUROPA: IL CASO ITALIANO

Abstract:

This doctoral dissertation explores how European governments deal with three challenges of adaptation governance: enhancing cross-sectoral coordination of policies (horizontal integration), improving multi-level responses (vertical integration), and engaging society in the adaptation planning process (stakeholder involvement). First, it provides an updated review of the adaptation policy landscape in Europe, emphasising the crucial dimensions of existing strategies. Secondly, it measures the influence of political systems on the institutional capacity to tackle horizontal and vertical challenges within national adaptation strategies. Thirdly, it assesses the Italian situation with regard to climate change impacts, vulnerabilities and adaptation responses in view of a future comprehensive strategy. Finally, it analyzes the challenge of participation of non-governmental stakeholders in the ongoing development of the Italian national adaptation strategy. As a conclusion, the dissertation provides policy-relevant recommendations for the continuation of the adaptation planning process in Italy.

La tesi esplora le modalità in cui i governi europei affrontano le sfide principali dell'architettura amministrativa per l'adattamento: rafforzare il coordinamento intersettoriale delle politiche (integrazione orizzontale), migliorare la risposta multi-livello (integrazione verticale), e coinvolgere la società nel processo di pianificazione dell'adattamento. In primo luogo, viene presentata una revisione aggiornata delle politiche di adattamento in Europa, sottolineando le dimensioni cruciali delle strategie esistenti. In secondo luogo, viene misurata l'influenza dei sistemi politici sulla capacità istituzionale per affrontare le sfide orizzontali e verticali all'interno delle strategie nazionali di adattamento. In terzo luogo, viene valutata la situazione italiana per quanto riguarda gli impatti dei cambiamenti climatici, le vulnerabilità e le risposte di adattamento, in vista di una futura strategia. Infine, si analizza la partecipazione degli attori non governativi nello sviluppo della strategia nazionale di adattamento italiana. In conclusione, la tesi fornisce raccomandazioni per la continuazione del processo di pianificazione per l'adattamento in Italia.

Firma dello studente
