Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

Dimitris Kokkinos and Panagiotis Prinos

School of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece

Abstract: The last few years, a proliferation of research efforts, regarding coastal adaptation to CC (Climate Change), has been noted, emphasizing that this policy field is of raising importance in the European continent. Acknowledging the above and, in parallel, a deficit in academic literature of comparison efforts at a national level to date, this paper examined and compared the NAP (National Adaptation Policy) of four MSs (Member States), located in the Mediterranean basin (namely France, Greece, Italy and Spain). The method used, was comparison analysis, which is a valuable tool for a better conceptualization and policy development. The analysis focused on two main comparison dimensions. The first one referred to the process of the creation and evolution of the NAPs, while the second one was associated with their content. The comparison highlighted the incentives and the importance of different stressors that have affected the development of the coastal adaptation policy in each country (administrative structure, role of research community and stakeholder's involvement). Simultaneously, a different perspective of each NAP was revealed, regarding the inclusion of possible coastal threats, as well as the categorization of possible adaptation measures. Finally, a database of research projects was developed, with participants from these four countries, focusing on coastal protection at national and international scale. The results showed a huge gap in results dissemination, a limited private participation and difficulties in determining the financial resources allocated to research initiatives for the protection of coastal areas, at each country.

Key words: Adaptation, coastal zone, Mediterranean, NAP.

1. Introduction

One of the main issues in the international political agenda is the CC (Climate Change), a term officially introduced in 1975 by a geochemist Wallace Broecker [1]. Since then, two different, but complementary, solutions were followed to confront its adverse effects, mitigation and adaptation. Mitigation refers to tackling the causes of greenhouse gases, whilst adaptation refers to coping with the consequences. Both of them are of equal importance and need further efforts. The World Economic Forum's Global Risk report for 2019 [2] refers to the failure of CC mitigation and adaptation measures for the next decade, as the second (2nd)

Global Risk of highest concern.

For the anticipation of the CC effects, the last two decades, several international acts have taken place on a global scale. However, only recently, adaptation was gradually recognized as a major response to CC challenges, with the adoption of the Paris Agreement [3]. Despite the voluntary nature of the Paris Agreement, all nations that ratified it have the obligation to formulate an NAP (National Adaptation Policy), as the recommended instrument to achieve coordination and coherence across the various levels of planning and management. A NAP consists of a NAS (National Adaptation Strategy) and/or a NAP (National Adaptation Plan). According to the European Environmental Agency report *National Adaptation Policy Processes in European Countries* [4], the NAS

Corresponding author: Dimitris Kokkinos, master, main research field: coastal vulnerability.

2 Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

and NAP are national documents, which articulate a country's strategic vision with regard to CC adaptation and the implementation of a country's CC adaptation strategy, respectively. In most cases, the NAP presents adaptation measures and provides information for the implementation (e.g. responsibilities, financial resources).

Given the significant effects of CC on most sectors of human activity, different strategies and policies have emerged in order to hamper them and lessen the possibility of disaster. One sector, with fundamental importance for human way of life, is the coastal zone. This dynamic natural environment, which is highly populated and contributes an estimated 61% of the world's total Gross National Product [5], already exhibits a great degree of impacts. Many of CC's observed impacts are unprecedented over decades and several examples of recent research have highlighted its adverse effects on human and environmental coastal communities. The increase of global temperature [6, 7], resulted in a sea level rise with greater rates, than of past centuries [8, 9], even though rates calculated vary from region to region [10, 11]. At the same time, scientific research highlights the increase of extreme weather events across the globe [12-15], whilst an increase of key risks is confirmed by IPCC AR5 (Intergovernmental Panel on Climate Change Fifth Assessment Report) [16]. It is estimated, that without adaptation, flood damage will increase up to 11 billion per year, only on European coasts [17]. The importance of coastal adaptation has been raised and there is an increasing focus on how to best support decision-makers to this direction.

In the EU (European Union) the regulatory framework, regarding the protection of the coastal zone, is shaped by the EC (European Commission) and it works as a guideline for its MSs (Member States), having though, a binding character. Within this framework, the concept of coastal adaptation to CC, has gradually evolved and incorporated in all aspects of policy, regarding the coastal zones. Outlining

adaptation needs, most countries across Europe, design and implement their NAP, nevertheless their progress varies significantly. Yet, the differences in the administrative system of each MS, along with the differing of local climatic, environmental and socio-economic conditions, determine how national responses are designed. Given their divergence in progress, their NAP formation offers an opportunity to identify the factors or stresses, which enabled or constrained the development and implementation of coastal adaptation and to transfer experience to other countries.

This paper is an attempt to offer a critical insight, into the NAP of four selected European MSs, through a process and content based comparative analysis, from the perspective of coastal adaptation. All four of them, are located in the Mediterranean basin (namely France, Greece, Italy and Spain). The second chapter analyses the approach and methods followed in this paper, while the next four chapters set out the overall results of the research. More specifically, as parts of the NAP shaping and implementation process, the administrative structure and the research progress of each country are compared, with respect to the coastal zone (for the research progress comparison, a database was developed including coastal adaptation research projects at national and international scale). Moreover, the national adaptation endeavors of all 4 MSs to date are illustrated, whilst, simultaneously, their NAPs are compared with respect to the coastal zone. The main conclusions of this paper are distilled in chapter 7, while in light of the findings, the last chapter (8) reveals and discusses some of the existing shortcomings, in connection with the implementation of the studied NAPs and proposes solutions, in order to overcome their effects.

2. Approach and Methods

Comparative policy analysis is an effective and efficient tool, in the hands of policy-makers, to draw on past experience, as they seek to optimize and

reformulate policy solutions. In recent years, several comparison strategies have emerged to describe and explain different aspects of public policy, such as the policy content, the policy creation process, the policy quality, its evolution and outcomes [18].

A nascent, but rapidly evolving, policy field is the adaptation to CC, with regard to the coastal zone. New examples of coastal adaptation policies are emerging throughout the world, while others are optimized or replaced, enriching global knowledge [19]. Nonetheless, as Vogel and Henstra [20] assert, it is too early to evaluate the quality and outcomes of already implemented examples. Consequently, comparative adaptation research should be strongly orientated towards a content and process based approach.

To date, cross-national comparative studies on coastal adaptation policies are very limited. Since there is no “one size fits all” adaptation response, along with the different range of regulations, degree of decentralization and constraints in each country, across-country comparative analysis may provide valuable insights and contribute to knowledge generation, pertinent to the enabling actors, the tendencies and the constraints of coastal adaptation policies to CC [21].

To this end, this paper attempts to analyze and compare the coastal adaptation policy on a national scale, for 4 Mediterranean countries, through a review of existing peer-review articles and grey literature (reports, government documents, evaluations, etc.). France, Greece, Italy and Spain were selected based on 3 criteria: (1) similar climate conditions due to their location as part of the Mediterranean basin, (2) the same regulatory framework due to their participation in the EU and (3) their coastline is of great monetary value for their GDP (Gross Domestic Product).

The first step is dedicated to the presentation and analysis of two critical variables (administrative structure and research initiatives), which played an important role in coastal adaptation policy shaping for the selected MSs, as well as to briefly describe the

evolution of their adaptation policy.

More specifically, in the beginning of this step, the system of governance, the structure and responsibilities of all administrative levels regarding the coastal zone, are presented. According to Nalau, et al. [22], “the unclear division of responsibility among adaptation actors hinders effective implementation of adaptation”. Thus, an illustrative assessment of governance driving forces for the creation of the coastal adaptation policy in each country, is essential, in order to draw insights of the dominant factors, which shape coastal adaptation policy.

The research community, also, plays a key role in all stages of coastal adaptation processes. According to EU directions, “all MSs shall regularly review and update their national programmes, taking into account technical and scientific progress as appropriate”. Thus, in order to help in reducing fragmentation of the results and providing impetus for the diffusion of the research progress, a database was created, including research projects regarding the coastal zone and its adaptation to the effects of CC. The criteria for the selection or rejection of the projects were the following: (1) one or more participants from the selected EU MSs; (2) focus on coastal adaptation (including hazard quantification and vulnerability assessment); and (3) implementation period from 2003 until 2018. The methodology included an extensive research for projects, through the EU’s web portals and national ministries. Several academic institutions and public bodies’ portals were also examined for their participation to related projects. At the same time, an e-mailing list of almost 150 individuals from these countries was prepared, composed of researchers of all ages and academic levels. They were asked to contribute to the process, by referring to 1-5 projects of the last 15 years and providing additional information or a relative link, according to a simple attached excel format. Several relevant papers were, also, examined for references or acknowledgements. The aim of this research was to find information, about the years of duration, the

4 Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

hazards taken into account, the objectives of the projects, the leader country, the number of partners and countries participating, the budget and the financial resources. Finally, this step includes a brief synopsis of the current state and the milestone events, which contributed to the creation of each NAP.

The second step comprises the comparison between the selected MSs in order to highlight any similarities and differences between their NAPs, with regard to the coastal zone. For the purpose of the comparison analysis, two dimensions were identified. The first one refers to the process of the creation and evolution of the NAPs. This includes engagement of the stakeholders, motivations of each country, the role of research, the inclusion of other countries experience and the progress achieved. The second dimension of comparison is associated with the content of the NAPs, comprising of information about the hazards included in them (regarding the coastal zone) and their comprehensiveness.

3. Administrative Structure of Selected Countries

Some researchers argue, that the higher levels of government are playing a leading role in adaptation [23, 24], whereas others assert that local authorities appear to have a key role for adaptation planning and implementation and therefore the actor with the greatest responsibility [22]. Adaptation to CC seems to be a global issue and the same time a profoundly local one [25]. Although it appears to have a clearly environmental complexion, it is mainstreamed into existing decision-making processes of multi-sector societal goals [26]. In addition to its multi-level and multi-sector character, differences in administrative structure of each country, have been instrumental in the way climate-related policies are formulated and transferred between all levels of governance [27], a fact which increases difficulty for effective adaptation responses.

This chapter aims at delineating the administrative

structure and how differently, the division of responsibilities is organized in the respective countries, regarding the environmental and coastal policy. A general idea of the governance system, along with the different levels of administration and their role in the protection of the coastal zone, is presented in Table 1.

All four countries of the current study, in the last 30 years aimed at moving towards a more decentralised system of state ownership and planned economy, recognizing that previous political status was obsolete and not so effective in development terms. With constitutional and legislative changes, they increased the responsibilities of regional and local authorities. Nowadays, France, Italy and especially Spain, are considered to be highly decentralized countries, while Greece still has several steps to accomplish to this direction. Regarding the environmental protection, the competences differ from country to country.

In Spain, the regional governments (ACs (Autonomous Communities)) can develop and enforce their own environmental legislation, complementary to the central government, while the local authorities have a more coordinating role. To co-ordinate the complex distribution of environmental powers, the MAGRAMA (Ministry of Agriculture, Food and Environment) periodically calls the Environment Sectoral Conference, which is devolved to discuss environmental policy and even propose new laws. With regard to the coastal zones, there are some overlapping and some distinct powers, that fall within the central government' and the ACs' remit. For example, the protection of the coast and the corresponding regulatory framework is a responsibility of the MAGRAMA and its Directorates, whereas, spatial planning and urban development falls exclusively within the competences of the ACs.

Italy appears to have a more complicated and fragmented allocation of functions. The central government has the exclusive legislative power in the area of environment and ecosystem protection, although in other policy fields regions share the

competence to legislate. For the protection of coastal environment the central government and the regions share competences, while the responsibility for the protection and observation of coastal areas, falls on the regional and local authorities (provinces and municipalities). The increasing number of overlapping responsibilities between the different levels of administration, has led to a great number of conflicts before the Constitutional Court [28]. This tension between central and regional government, often results in weak policy performance.

In France, the Constitution guarantees the fiscal autonomy and freedom of administration, in all levels of governance. However, this leads to overlapping competences. The central government is responsible for the legislative framework and its implementation in most policy sectors, while some public agencies have an auxiliary role in the implementation of environmental policies. Additionally, several official commissions have a supportive role. These consultations along with a top-down approach of governance often cause conflicts, resulting in vetoed governmental action [29]. Regarding the coastal zone, around 15 Ministries are involved with different aspects of its management. The implementation of a coherent policy is hampered by the division of powers and liabilities between all administrative levels.

Finally, in Greece, strategic planning has long proved difficult for the central government [30]. Greece used to be a heavily centralized country, but

after a reform which took place in 2010, regional/local authorities have been granted with new and extended competences. There are 3 levels of governance (Table 1), but only the central government has legislative powers. The role of the other 2 levels of administration is restricted only to planning, implementation and management according to state regulations. The competences of environmental issues are shared between central and regional government, whereas the roles and responsibilities of regions and municipalities in coastal zone planning and management are rather limited. The supervising role is split between 5 Ministries and several other public organizations, but the lack of coordination in conjunction with budgetary constraints constitute major impediments.

In general, all four countries, demonstrate political will, as is confirmed by many new laws and regulations covering the entire field of environmental regulation [29]. The division of powers, only represents a partial constraint on the pursuit of an effective national policy. The economic crisis, along with bureaucracy and the lack of coordination between the government bodies involved in adaptation matters, has also played a vital role in the process of policy shaping, acting as a strong limiting factor.

4. Presentation of the Research Initiatives for the Selected MS

EU has developed several financial mechanisms for research funding (Horizon 2020, LIFE+, INTERREG

Table 1 Administrative structure and competences regarding the protection of the coastal zone.

	France	Greece	Italy	Spain
Governance system	Unitary semi-presidential republic	Parliamentary republic	Parliamentary republic	Parliamentary monarchy
Number of regions/coastal regions	13/9*	13/12	21/15	17/12
LRA (Levels of Local/Regional Administration)	Regions, Departements, Municipalities	Regions, Municipalities	Regions, Provinces, Municipalities	Autonomous Communities, Provinces, Municipalities
LRA's role in environmental policy	Plan, implement	Plan, implement	Plan, implement	Legislate, plan, implement
Protection of the coastal zone	Shared competences for central, regional and local government	Shared competences for central and regional government	Shared competences for central, regional and local government	Shared competences for central and regional government

*The 5 overseas regions located outside the European continent were not taken into account.

6 Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

etc.), in order to enhance research, facilitate the EU MSs to reach European goals (Directives, Protocols, strategies) and protect the environment. Through them it provides the appropriate resources and motive, to European scientists to focus on issues consistent with Commissions priorities. CC is one of them and adapting to its impacts remains an imperative need. Additionally, MSs have created their own tools of research funding in order to anticipate the potential impacts of CC. National, Regional and even local financing provide several options to all research fields. The web portals of these founding initiatives along with Community Research and Development Information Service (CORDIS) data base, partially helped with the dissemination of the results to the public. But was this enough?

To answer this question a database was created with its scope being research projects, regarding coastal adaptation at a national and international scale. The attempt was focused on the Mediterranean basin and particularly on the 4 oldest MSs of the EU located in it: Spain, Italy, Greece and France.

The database included a list of 57 national and international projects. From a total of 38 international projects, only 50% of them provided sufficient information. The percentage was even smaller with regard to the national ones (37%). Almost 30% of them

did not even have their own web page and even if they did, they provided very few information in it. The most rare and difficult information to find was the total budget and it is sharing among the participants (37%). Information for most of them came from the EU databases and references from peer-reviewed journal papers and grey literature (reports), whereas there was a great difficulty to find national ones from the corresponding Ministries or universities. The native language was the major constraint.

Fig. 1 presents the total number of national and international projects and the participation of each funding country. It is obvious that there was a balance in participation to international projects among all countries due to their close cooperation and the common conditions and problems they face to their coastal zones. This conclusion is reinforced by the fact that the average number of partners was 22 per project and most of them were from these countries. This, also, displays that, there is a broad exchange of good practices and experiences among these four countries.

Italy was leading 32% of the research programs, while Spain was leading only 13% and the other two countries only 10%. The investment on international projects illustrates two things. First, the research level and scientific concerns regarding coastal protection are of high importance in Italy. Secondly, even though

Fig. 1 Number of national and international research projects for each MS.

Fig. 2 Objectives of the research projects and hazards inclusion (erosion, SLR and flooding) (Vuln = Vulnerability, DSS = Decision Support System, EWS = Early Warning System, DRR = Disaster Risk Reduction, DM = Data Management).

Italy is lacking in national progress regarding coastal adaptation policy [21], it is obvious that a lot of effort has been made by regional authorities and independent institutions, but in order to compensate for the lack of national financial resources, they have turned to EU funding.

The projects were grouped according to their objectives, as it is summarized in Fig. 2. Some of them had more than one participant and they were counted in more than one column. The same figure presents the number of projects, which took into account Sea Level Rise (SLR), beach erosion or flooding under the effects of CC, for the extraction of their results. It is noticeable, that a great percentage of projects referred to ICZM (Integrated Coastal Zone Management) (80%) and vulnerability assessment (62%). The other categories were almost equally funded and the only one which seemed to be without big effort in the Mediterranean basin is the category of Early Warning Systems. These results were partially expected, because the MSs are trying to comply with the obligations derived from the European adaptation policy. The latter, suggests that coastal adaptation should be mainstreamed into ICZM, which aims at coastal sustainable development through a multisector perspective. The same time vulnerability assessment is one of the first steps for an effective and

efficient coastal adaptation according to Klein, et al. [31].

Finally, it has to be mentioned that private sector participation was extremely limited. Only 21% of the projects involved a partner from the private sector, which implies that coastal adaptation research remains mainly a public sector responsibility in these four Mediterranean countries.

5. Brief Synopsis of the Selected Countries Adaptation Endeavors, to Date

In accordance with the obligations derived from the EU Adaptation Strategy and Article 4 of the UNFCCC (United Nations Framework Convention on Climate Change), all EU MSs needed to present an NAP, a strategy and/or a plan. NAPs provide the framework for regional and local authorities to develop and implement their own adaptation policies. Most countries have already achieved that goal to some extent.

This chapter displays the progress of 4 Mediterranean countries of the EU (France, Greece, Italy and Spain) on the coastal sector. (An overview of their progress is presented in Table 2).

Spain: Even though Spain has been usually characterized as a laggard in environmental policies

8 Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

[32], during the past 15 years, it has considerably improved and it was one of the first European MSs to adopt a formal NAP (PNACC (National Climate Change Adaptation Plan)) in 2006 among the European MSs [33]. It was based on the results of the ECCE project (“A Preliminary Assessment of the Impacts in Spain due to the Effects of Climate Change”) and its final report in 2005. The PNACC is implemented through 3 work programs, each one focusing on different sectors. The coastal sector was included in the WP1 (2006-2009) and its objectives were to identify the most vulnerable areas and to mainstream adaptation to CC into ICZM policy. The PNACC has 6 lines of action in coastal areas including among others coastal vulnerability assessment, evaluation of different types of strategies for different climate scenarios and application of alternative options to increase coastal stability. The WP3 will be developed during 2014-2020 period. It highlights governance key role and includes the field of DRR for the first time.

France: Adaptation policy was set in motion at national level by the Ministry of Ecology at the end of the 1990s, particularly under the impetus of the GICC (Climate Change Impacts and Management) research fund [34]. Adaptation was one of the main environmental priorities of French government since 2001 when the Environmental Code was published. Thus, France adopted its NAS in 2006 [35]. Five years later, an NAP was also adopted and its implementation period ended in 2015. Its purpose was to facilitate mainstream adaptation in different policy sectors. Until then 5 main reports were published focusing on various topics. The 4th one in 2015, was entitled *The Coastline in the Context of Climate Change* presenting

information about climatic projected threats, adaptation options and cost analysis of natural disasters. The same year, the evaluation (5th report) of the NAP was published giving precious guidance for the upcoming 2nd NAP, which is expected as a revision of the 1st one. France is considered to be a pioneer in evaluation of adaptation policies.

Italy: Italy adopted its NAS in 2015 [36], after a multilateral, extended and detailed literature review of existing adaptation measures and policies, setting out the general framework for regional and local authorities. The NAS proposes a set of actions (soft, green & grey) for each sector separately, as well as transversal cross-sectoral actions, whilst it provides information for projections of SLR and extreme climatic trends concerning the coastal zones. The same time an NAP is being prepared for the implementation of the NAS and was expected to be adopted in 2019.

Italy’s progress on adaptation, at a national level, has lagged behind. Even though it stands out amongst the most decentralized countries in EU, the level of implementation of regional authorities’ plans is, also, not sufficient. The responsibility for coastal defense is up to regional authorities and the central government is able, only, to propose a general guidance and provide the appropriate funding. Even though, up to date, there are few regional plans adopted.

Greece: The Greek NAS was adopted in 2016 [37]. It was based on European experience and guidance of EU Adaptation Strategy, as well as on two main reports from National Bank of Greece in 2011 and 2014 for the economic impacts of CC on coastal zones and Greek tourism sector, respectively Climate Change Impact Assessment Study Committee [38, 39]. Main pillars are the scientific valid research, the stakeholder

Table 2 Progress of adaptation to CC in the 4 Mediterranean countries.

Country	National communication under the UNFCC	NAS	Nap	Evaluation reports	Regional adaptation plans	Adaptation platform
France	7th published (2017)	from 2006	2012-2015	2	adopted	launched
Greece	7th published (2018)	from 2016	-	0	implementing	pending
Italy	7th published (2017)	from 2015	-	0	implementing	pending
Spain	7th published (2017)	from 2006	2006	4	adopted	launched

involvement and public awareness. With regard to the coastal zone, SLR projections, their impacts, as well as different adaptation approaches are included (retreat, accommodation, protection). It is also considered important to look at the implementation of ICZM. The Greek NAS constitutes a strategic document. As such, it does not analyse in depth the necessary sectoral policies or attempt to prioritize the proposed measures and policies, nor decides about the feasibility of individual adaptation measures and actions at local/regional level.

6. Differences and Similarities in NAPs

All four countries are at different stages of development and implementation of their NAPs. The cross-country comparison analysis revealed a number of similarities, as well as differences, with regard to the coastal adaptation policy.

During the adaptation policy formulating process, each country involved diverse groups of stakeholders. As aforementioned, Spain was the first Mediterranean country to adopt an adaptation framework. A one year open public consultation process followed, with a broad participation of most societal stakeholders including representatives from the public administration, NGOs (Non-Governmental Organizations) and other interested sectors [40]. France and Italy followed the same path, but acknowledging the relevance of public participation there was, also, a concertation in 2010 of elected people, communities, the state, employers, unions and associations [41, 42]. Moreover, an online based public consultation was taken into account in both cases, to promote the citizen's involvement. On the contrary, in the case of Greece there was a limited time for public consultation and the process was not open to the public. An active process of a broad stakeholder engagement is in hand for the revision of the NAP framework for all four countries. This will probably raise the degree of complexity and will require substantial efforts.

But what triggered the adaptation process? The

decision to adapt is motivated by several climate and non-climate factors [43]. For the EU MSs, the most common triggers were the extreme weather events, the EU policies and the damage costs [44]. In Table 3, the motivating factors for the creation of the NAPs are illustrated, based on the model of drivers proposed by Swart, et al. [45] in 2009.

Addressing emerging risks required an interdisciplinary and specialized perspective. Evidently, the role of research community has been instrumental for the development of the NAPs, in all four countries. In Spain, as already mentioned, the PNACC was based on the final report of the research project ECCE with the participation of more than 400 experts. In Italy, the CMCC (Euro-Mediterranean Centre for Climate Change) has a leading role in conjunction with other scientific bodies, while in France, this role has assigned to the ONERC (National Observatory on the Effects of Global Warming) in close cooperation with other scientific organizations (e.g. National Centre for Scientific Research, National Research Institute for Development, National Institute for Agricultural Research, Meteo-France). For the Greek case study, the lack of coordination and the constricted time scale for the NAP development, resulted in a limited scientific participation.

On the other hand, the progress achieved is differentiated from country to country. Spain and France are considered to be vanguards in adaptation issues on the European continent and they have gained experience by implementing an NAP and its evaluation. Spain is about to release its fourth monitoring report, while France has completed the evaluation of the first NAP and in 2018, will release a second one. They have, also, created a web-based platform with regard to national adaptation sharing information and insightful examples of case studies, enhancing processes towards adaptation. Conversely, in Italy and Greece, the NAS was adopted only recently and this delay provided them with the advantage of incorporating the experience of other countries into their NAS. The adoption of their

Table 3 Motivating factors for the creation of the NAPs.

	Internationalneg otiations	EU policies	Experiences of adaptation in other countries	Research on impacts & adaptation	Experience of weather-related extreme events	Economiccostso finaction	Recognisingopp ortunities
France	✓	✗	✗	✓	✓	✓	✗
Greece	✓	✓	✓	✗	✓	✓	✗
Italy	✓	✓	✓	✓	✓	✓	✗
Spain	✓	✗	✗	✓	✓	✓	✗

NAS was a major step for the achievement of the objectives stemming from their international obligations, helping regional authorities to design their policy within a coherent framework. A national plan in both cases is under configuration, which will articulate the ways of evaluation of the NAS and will provide information concerning financial resources.

As far as it concerns the content dimension of the comparison analysis, the NAPs of all four countries share the same basic principles derived from the EU Adaptation Strategy. Two of them have been adopted a few years earlier, but the experience stemming from their implementation, contributed to the formation of the European Strategy. Regarding the coastal zone, they all emphasize on the vulnerability assessment, hazard projection for future climate, evaluation of consequences and they recommend the establishment of progress monitoring mechanisms. They also suggest that CC adaptation should be mainstreamed into an ICZM.

A main difference is that the French and Spanish NAPs are taking into account a variety of threats due to CC (SLR, storm surge, extreme storms), while the other 2 countries focus mostly on the long-term threat of SLR. This probably happens because a part of the French and Spanish coastline is exposed to the Atlantic Ocean while Greek and Italian coastlines lay completely within an enclosed and protected basin, the Mediterranean.

Finally, a substantial divergence was noticed between these four NAPs in the way they categorize and manage the possible options against the ongoing pressures on the coastal areas. The Greek NAP did not include any specific guidance or actions at all. Due to

lack of adequate data, it merely scratched the surface of the coastal adaptation issue regarding the coastal zone. On the other hand, the Italian NAP proposed three main categories of short- and long-term actions: (1) “Grey”—infrastructural and technological measures; (2) “Green”—ecosystem-oriented measures; and (3) “Soft”—non-structural interventions. An alternative approximation was communicated into the French NAP for the categorization of the proposed measures: No regrets—Reversible—Increasing “safety margins”—Requiring long-term implementation.

Notwithstanding the above divergent perspectives, all NAPs aligned with measures, which aim to preserve the coastal status as it is. From the triptych retreat-accommodate-protect proposed by the IPCC (Intergovernmental Panel on Climate Change) [46], the option of retreat was purposely ignored in most cases, by the European countries. The reason is that, Europe is densely populated and other options do not have political cost nor do they require major institutional change or affect private property rights [47].

7. Conclusions

In accordance with the obligations derived from the EU Adaptation Strategy and Article 4 of the UNFCCC, most MSs have already developed an NAP. On the basis of a cross-country comparison, between four Mediterranean countries (Greece, France, Spain and Italy), their NAP was analysed and varying differences and similarities were highlighted. The results revealed a different level of progress between all four of them. In Spain and France, this is already reflected in tangible inferences, while the NAP of the other two

countries remains fairly vague with an interim guiding role.

Generally, EU's regulatory framework is attributed more and more with a dominant role in adaptation policy development. Even though, each country's specifics and differing endogenous factors might affect the NAP shaping and delay or hasten its implementation. Greece from 2008 faced a severe economic and societal crisis, which resulted in lack of financial assets for research, scientific "brain drain" and data deficit. These barriers contributed in a delayed political response pertinent to coastal adaptation. On the other hand, the repercussions of the windstorm Xynthia in 2010, forced the French government in a coordinated and rapid reaction aiming at coastal adaptation and protection. This extreme weather event had a substantive effect on raising public CC awareness and created an enabling governance environment for resources allocation to coastal protection. It is obvious that, different incentive factors triggered and facilitated the development of the NAP in each case.

Furthermore, devolved powers, along with political will and leadership from the central government, for creation and implementation of an NAP, is far from trivial [21]. However, this should not obscure the need for good governance and coordination. For example, Italy is a highly decentralized country, as Spain and France are, but the unclear distribution of competences resulted in inconsistency in coastal adaptation efforts. On the contrary, Spain and France have unequivocally addressed the challenge of coastal adaptation, in a more coherent way, with strong horizontal cooperation and coordination. In all cases, coastal adaptation is mainly recognized as an environmental problem and is assigned to and coordinated by their ministries of environment.

Cross-border and transnational cooperation offers opportunities for development and expenditures minimization, therefore is a priority for the EU, providing several financial tools to support it. To this

direction, the last 15 years, a respectful number of jointed research initiatives have emerged, relevant to coastal adaptation. In light of the findings, it is obvious that there is a huge gap in results dissemination of the coastal adaptation research projects. Remarkable efforts remain unrevealed to the public, as well as to the corresponding stakeholders of other MSs. This may result in the repetition of some studies from country to country and the loss of funding assets. Spain and France have developed a platform for the integration of adaptation processes across their country, but the native language of the reports is a restriction. The creation of a common web-platform concerning the adaptation of coastal areas of the EU and the translation of research results would be of great value and importance. Finally, due to the huge amount of information and the specialized technical terms, a consultative body in European scale, could be promoted, to collect and share information relevant to coastal adaptation, to provide stakeholders with advices and ensure consistency in adaptation strategies.

Further efforts are nevertheless necessitated, because adaptation is an iterative process and according to the Adaptation Green Paper "*Adaptation must revolve as much around current changes as around future and anticipated changes*" [48]. The implementation of adaptation projects to the coastal zone, will contribute to local economies as a development driver, because of the positive cost-benefit ratio. This ratio relies on high value of coastal tourism to all four of them. Several coastal areas could benefit from investments and if properly protected, they could attract significant income streams.

8. Discussion

Adaptation seems to be an imperative necessity, if the communities want to protect themselves, against the upcoming changes of the world's climate. The coastal zones are very vulnerable to CC effects, due to their dynamic nature and the Mediterranean basin is a bright paradigm.

12 Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

The EU, as a key participant to every global effort against CC, could not stay behind. The adoption of the Adaptation Strategy in 2013 [49] has set out the framework for a coherent policy across EU's borders, outlining adaptation needs. Nevertheless, this strategy recognized several possible constraints at the implementation of an adaptation policy.

One of them is the inadequate or unreliable data and information, which constitutes one of the major problems for the aforementioned Mediterranean countries [50, 51]. This leads to increased uncertainties in the projected effects of CC, in addition to the existing ones, due to the inherent uncertainties of climate models parameters and structures. There are also, information gaps, with regard to the interaction between the stakeholders involved in the coastal management [52], as well as the absence of exchange information systems in some cases (Greece, Italy).

The above might lead to “an adaptation that does not succeed in reducing vulnerability, but increases it instead”, which is called maladaptation [53] and might occur as a result of underestimating, overestimating or misestimating the impacts of CC. The issue of maladaptation is of high concern for the EU policy, but only a few MSs have taken it into account in their NAPs. France is one of them and the measures, which are proposed into the NAP, are categorized according to the Maladaptation Framework Assessment proposed by Magnan [54]. On the other hand, in Italy, some regions have carried out adaptation measures within the context of environmental protection or natural hazards prevention. This unilateral perspective of coastal management, which ignores the interaction among all sectors is a common cause for maladaptation and can increase the costs of impacts.

To prevent such phenomena, the MRE (Monitoring Reporting and Evaluation) solution is proposed, by the European Environment Agency (EEA). But, the centralized character of monitoring in these 4 MSs hinders and decelerates the adaptation processes evaluation. Decentralization, seems as the best option

in order to improve effectiveness, because region is where practical management happens and all 4 are heading to this direction. Spain and France have already approved regional adaptation plans for almost all of their regions, whilst Greece and Italy will do so in the next two years.

The adaptation to CC is an iterative process and unlike mitigation cannot be quantified. Thus, the use of indicators in order to display a comprehensive picture is promoted. EEA suggests 34 indicators with regard to CC adaptation. Based on that, the EC published in 2017, the adaptation preparedness scoreboard of each country, as a part of its Adaptation Strategy evaluation, which forms a valuable tool for the evaluation process.

However, the adaptation policy and plans are built upon the projections of global warming due to different emission scenarios of CO₂. Recent research reports that methane emissions might exacerbate the expected level of global temperature in the upcoming years [55, 56], despite the efforts for CO₂ mitigation at a global scale. This implicates that adaptation efforts should be enhanced, consecutively revised and evaluated. Simultaneously, the Global Landscape of Climate Finance report of 2015 [57] highlighted that only a 5% of total investment against CC was spent for adaptation. Acknowledging the adaptation deficit, a stepwise increasing trend for investments in adaptation measures is expected.

Acknowledgements

The authors would like to acknowledge the Greek State of Foundation for the funding support of this paper within the context of the action “Research projects for Excellence IKY/SIEMENS”.

References

- [1] Broecker, W. S. 1975. “Climatic Change: Are We on the Brink of a Pronounced Global Warming?” *Science* 189 (4201): 460-3. <https://doi.org/10.1126/science.189.4201.460>.
- [2] World Economic Forum. 2019. Global Risks Report 2019—14th Edition. Cologny/Geneva.

- http://wef.ch/risks2019.
- [3] United Nations. 2015. "Paris Agreement."
- [4] European Environment Agency. 2014. *National Adaptation Policy Processes in European Countries*. <http://www.eea.europa.eu/publications/national-adaptation-policy-processes>.
- [5] Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Synthesis*. Washington, DC: Island Press. <https://doi.org/10.1196/annals.1439.003>.
- [6] Taylor, K. E., Stouffer, R. J., and Meehl, G. A. 2011. "An Overview of CMIP5 and the Experiment Design." *Bulletin of American Meteorological Society* 93: 485-98.
- [7] Smith, S. J., Edmonds, J., Hartin, C., Mundra, A., and Calvin, K. 2015. "Near-Term Acceleration in the Rate of Temperature Change." *Nature Climate Change* 5: 333-6.
- [8] Jevrejeva, S., Moore, J. C., Grinsted, A., and Woodworth, P. L. 2008. "Recent Global Sea Level Acceleration Started over 200 Years Ago?" *Geophysical Research Letters* 35 (8): L08715. <https://doi.org/10.1029/2008GL033611>.
- [9] Kopp, R. E., Kemp, A. C., Bittermann, K., Horton, B. P., and Rahmstorf, S. 2016. "Temperature-Driven Global Sea-Level Variability in the Common Era." *Proceedings of the National Academy of Sciences* 113 (11): E1434-41. <https://doi.org/10.1073/pnas.1517056113>.
- [10] Nicholls, R. J. 2010. "Impacts of and Responses to Sea-Level Rise." In *Understanding Sea-Level Rise and Variability*, edited by Church, J. A., Woodworth, P. L., Aarup, T., and Wilson, W. S. Oxford: Blackwell Publishing. <https://doi.org/10.1002/9781444323276.ch2>.
- [11] Hay, C. C., Morrow, E., Kopp, R. E., and Mitrovica, J. X. 2015. "Probabilistic Reanalysis of Twentieth-Century Sea-Level Rise." *Nature* 517 (7535): 481-4. <https://doi.org/10.1038/nature14093>.
- [12] Coumou, D., and Rahmstorf, S., 2012. "A Decade of Weather Extremes." *Nature Climate Change* 2 (7): 491-6.
- [13] Hansen, J., Sato, M., and Ruedy, R. 2012. "Perception of Climate Change." *Proceedings of the National Academy of Sciences of the United States of America* 109 (37): E2415-23. <https://doi.org/10.1073/pnas.1205276109>.
- [14] Sippel, S., and Otto, F. E. L. 2014. "Beyond Climatological Extremes—Assessing How the Odds of Hydrometeorological Extreme Events in South-East Europe Change in a Warming Climate." *Climatic Change* 125 (3-4): 381-98. <https://doi.org/10.1007/s10584-014-1153-9>.
- [15] Fischer, E. M., and Knutti, R. 2015. "Anthropogenic Contribution to Global Occurrence of Heavy-Precipitation and High-Temperature Extremes." *Nature Climate Change* 5 (6): 560-4. <https://doi.org/10.1038/nclimate2617>.
- [16] IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland. <https://doi.org/10.1017/CBO9781107415324.004>.
- [17] European Environmental Agency. 2012. *Climate Change, Impacts and Vulnerability in Europe 2012*. Report No. 12/2012. <https://doi.org/10.2800/66071>.
- [18] Schmitt, S. 2012. "Comparative Approaches to the Study of Public Policy-Making." In *Routledge Handbook of Public Policy*, edited by Araral, E., Fritzen, S., Howlett, M., Ramesh, M., and Wu, X. London: Routledge. <https://doi.org/10.4324/9780203097571.ch3>.
- [19] Dupuis, J., and Biesbroek, R. 2013. "Comparing Apples and Oranges: The Dependent Variable Problem in Comparing and Evaluating Climate Change Adaptation Policies." *Global Environmental Change* 23 (6): 1476-87. <https://doi.org/10.1016/j.gloenvcha.2013.07.022>.
- [20] Vogel, B., and Henstra, D. 2015. "Studying Local Climate Adaptation: A Heuristic Research Framework for Comparative Policy Analysis." *Global Environmental Change* 31: 110-20. <https://doi.org/10.1016/j.gloenvcha.2015.01.001>.
- [21] Westerhoff, L., Keskitalo, E. C. H., and Juhola, S. 2011. "Capacities across Scales: Local to National Adaptation Policy in Four European Countries." *Climate Policy* 11 (4): 1071-85. <https://doi.org/10.1080/14693062.2011.579258>.
- [22] Nalau, J., Preston, B. L., and Maloney, M. C. 2015. "Is Adaptation a Local Responsibility?" *Environmental Science and Policy* 48: 89-98. <https://doi.org/10.1016/j.envsci.2014.12.011>.
- [23] Ford, J. D., Berrang-Ford, L., and Paterson, J. 2011. "A Systematic Review of Observed Climate Change Adaptation in Developed Nations." *Climatic Change* 106 (2): 327-36. <https://doi.org/10.1007/s10584-011-0045-5>.
- [24] Harman, B. P., Heyenga, S., Taylor, B. M., and Fletcher, C. S. 2015. "Global Lessons for Adapting Coastal Communities to Protect against Storm Surge Inundation." *Journal of Coastal Research* 314: 790-801. <https://doi.org/10.2112/JCOASTRES-D-13-00095.1>.
- [25] Bulkeley, H., and Betsill, M. 2003. *Cities and Climate Change: Urban Sustainability and Global Environmental Governance*. London: Psychology Press Ltd. <https://doi.org/10.5038/2375-0901.17.2.5>.
- [26] Gupta, J. 2007. "The Multi-level Governance Challenge of Climate Change." *Environmental Sciences* 4 (3): 131-7. <https://doi.org/10.1080/15693430701742669>.
- [27] Weisser, F., Bollig, M., Doeverspeck, M., and Müller-Mahn, D. 2014. "Translating the 'Adaptation to Climate Change' Paradigm: The Politics of a Travelling Idea in Africa." *Geographical Journal* 180 (2): 111-9.

14 Comparison Analysis of Coastal Adaptation Policies against Climate Change Effects at a National Level, for 4 Mediterranean Countries: France, Greece, Italy and Spain

- <https://doi.org/10.1111/geoj.12037>.
- [28] Vesperini, G. 2009. "Regional and Local Government in Italy: An Overview." *SSRN Electronic Journal* 1-24. <https://doi.org/10.2139/ssrn.1332762>.
- [29] Mény, Y., Uterwedde, H., and Zohlnhöfer, R. 2017. *Sustainable Governance Indicators 2017*. France Report.
- [30] Sotiropoulos, D. A., Featherstone, K., and Karadag, R. 2016. *Sustainable Governance Indicators*. Greece Report.
- [31] Klein, R. J. T., Nicholls, R. J., Sachooda, R., Capobianco, M., and Aston, J. 2001. "Technological Options for Adaptation to Climate Change in Coastal Zones." *Journal of Coastal Research* 17 (3): 531-43.
- [32] McEwen, N., Swenden, W., and Bolleyer, N. 2010. *Multi-level Government & the Politics of Climate Change*, edited by McEwen, N., Swenden, W., and Bolleyer, N. Edinburgh: University of Edinburgh.
- [33] Oficina Espaniola de Cambio Climatico. 2006. Plan Nacional de Adaptación al Cambio Climático. Madrid, Spain. (in Spanish)
- [34] French Ministry of Ecology Sustainable Development and Energy. 2013. "The Sixth National Communication of France to the United Nations Framework Convention on Climate Change." Ministry of Ecology, Sustainable Development and Energy, Paris, France.
- [35] Observatoire National Sur les Effets du Réchauffement Climatique. 2006. Stratégie nationale d'adaptation au changement climatique. Paris, France. (in French)
- [36] MATTM. 2014. Strategia Nazionale di Adattamento ai Cambiamenti Climatici Indice. Rome, Italy. (in Italian)
- [37] MEECC. 2016. Εθνική στρατηγική για την προσαρμογή στην κλιματική αλλαγή. Athens, Greece. (in Greek)
- [38] Climate Change Impact Assessment Study Committee. 2011. Μεταβολές Στάθμης Θάλασσας—Επιπτώσεις στις Ακτές. Bank of Greece report. (in Greek)
- [39] Climate Change Impact Assessment Study Committee. 2014. Ελληνικός τουρισμός και κλιματική αλλαγή: πολιτικές προσαρμογής και νέα στρατηγική ανάπτυξης. Bank of Greece report. (in Greek)
- [40] European Commission. 2017. *Adaptation Preparedness Scoreboard: Draft Country Fiche for Spain*. E.C. report. https://ec.europa.eu/clima/sites/clima/files/consultations/docs/0035/es_en.pdf.
- [41] European Commission. 2017. *Adaptation Preparedness Scoreboard: Draft Country Fiche for France*. E.C. report.
- [42] European Commission. 2017. *Adaptation Preparedness Scoreboard: Draft Country Fiche for Italy*. E.C. report.
- [43] Adger, W. N., Arnell, N. W., and Tompkins, E. L. 2005. "Successful Adaptation to Climate Change across Scales." *Global Environmental Change* 15 (2): 77-86. <https://doi.org/10.1016/j.gloenvcha.2004.12.005>.
- [44] European Environment Agency. 2014. *National Adaptation Policy Processes in European Countries*. Report No. 4/2014. <http://www.eea.europa.eu/publications/national-adaptation-policy-processes>.
- [45] Biesbroek, G. R., Swart, R. J., Carter, T. R., Cowan, C., Henrichs, T., Mela, H., et al. 2009. "Europe Adapts to Climate Change: Comparing National Adaptation Strategies." *Global Environmental Change* 20 (3): 440-50. <https://doi.org/10.1016/j.gloenvcha.2010.03.005>.
- [46] Bijlsma, L. 1997. "Climate Change and the Management of Coastal Resources." *Climate Research* 9: 47-56. <https://doi.org/10.3354/cr009047>.
- [47] Harman, B. P., Heyenga, S., Taylor, B. M., and Fletcher, C. S. 2015. "Global Lessons for Adapting Coastal Communities to Protect against Storm Surge Inundation." *Journal of Coastal Research* 314: 790-801. <https://doi.org/10.2112/JCOASTRES-D-13-00095.1>.
- [48] European Commission. 2007. "Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Adapting to climate change in Europe—Options for EU Action." *Official Journal of the European Communities*: 1-27.
- [49] European Commission. 2013. "COM (2013) 216—Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: An EU Strategy on Adaptation to Climate Change." *Official Journal of the European Communities*. <https://doi.org/10.1017/CBO9781107415324.004>.
- [50] Benoit, G., and Comeau, A. 2012. *A Sustainable Future for the Mediterranean: The Blue Plan's Environment and Development Outlook*. Blue Plan (UNEP/MAP) report. <https://doi.org/10.4324/9781849770323>.
- [51] Soriani, S. 2015. "Problems and Pitfalls in ICZM Implementation: Lessons from Some Selected Mediterranean and Black Sea Cases." *Journal of Coastal Zone Management* s1: 1-7. <https://doi.org/10.4172/2473-3350.1000S1-002>.
- [52] Cantasano, N., Pellicone, G., and Ietto, F. 2017. "Integrated Coastal Zone Management in Italy: A Gap between Science and Policy." *Journal of Coastal Conservation* 21 (3): 317-25. <https://doi.org/10.1007/s11852-016-0479-z>.
- [53] IPCC. 2001. *Climate Change 2001: Impacts, Adaption, and Vulnerability*. New York: Cambridge University Press.
- [54] Magnan, A., 2014. "Avoiding Maladaptation to Climate Change: towards Guiding Principles." *S.a.P.I.E.N.S* 7 (1): 1-11.
- [55] Saunio, M., Jackson, R. B., Bousquet, P., Poulter, B., and Canadell, J. G. 2016. "The Growing Role of Methane in Anthropogenic Climate Change." *Environmental*

Research Letters 11 (12): 120207.

<https://doi.org/10.1088/1748-9326/11/12/120207>.

- [56] Herrero, M., et al. 2016. "Greenhouse Gas Mitigation Potentials in the Livestock Sector." *Nature Climate Change* 6: 452-61.

<https://doi.org/10.1038/NCLIMATE2925>.

- [57] Buchner, B., Stadelmann, M., Wilkinson, J., Mazza, F., Rosenberg, A., and Abramskiehn, D. 2015. *Global Landscape of Climate Finance 2015*. Climate Policy Initiative report.