

Article

Mainstreaming Adaptation to Climate Changes: A Comparison between Sardinia, Italy and Valencia, Spain

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Abstract: Climate change is a major concern and many regions, such as the European Union, are promoting the development of adaptation to climate change (ACC) strategies. This study examines the legislative contexts of Spain and Italy to guide the integration of climate adaptation measures into regional spatial planning. It specifically evaluates ACC strategies in Valencia (Spain) and Sardinia (Italy), focusing on adapting transportation infrastructure to flood risks. Through comparative analysis, the study identifies strengths, gaps, and opportunities in regional planning, emphasizing the importance of policy coherence and cross-sectoral collaboration to align strategies with global sustainability goals. Methodologically, the study employs a comparative assessment approach to analyze planning documents systematically, revealing complex relationships between sectors. We report that Valencia's landscape strategy and Sardinia's ACC strategy demonstrate coordinated planning efforts. Valencia sets clear policy objectives and actions, enhancing implementation effectiveness, while Sardinia's approach shows ambiguities that could compromise policy outcomes. The proposed methodology is applicable to other regions with developed ACC strategies, offering a way to evaluate how well objectives and actions are integrated across relevant sectors. It aims to assist planners in assessing coordination among various planning sectors effectively.

Keywords: adaptation to climate change; transport; flood risk; spatial planning; scrutiny of regional plans



Citation: Cuevas-Wizner, R.; Ledda, A.; Martín, B.; Ortega, E.; Calia, G.; De Montis, A. Mainstreaming Adaptation to Climate Changes: A Comparison between Sardinia, Italy and Valencia, Spain. *Sustainability* **2024**, *16*, 7099. <https://doi.org/10.3390/su16167099>

Academic Editor: Adriana Del Borghi

Received: 18 July 2024

Revised: 12 August 2024

Accepted: 14 August 2024

Published: 19 August 2024



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1. Introduction

Climate change is increasingly alarming society [1–3], with extreme weather events, droughts, and floods affecting human life [4]. Climate change ranks among the primary factors driving the escalation of severe floods and the attendant risks [5]. Due to climate change, an increase in extreme storms is expected as a result of the rise in torrential rains and extreme winds, leading to accidents and disruptions in transportation networks [6]. Catastrophic damage and economic losses to transportation infrastructure due to climate change are emphasized by Huibregtse et al. (2016) [7].

As climate-related incidents increase in frequency and severity, there is a critical need for robust strategic planning that integrates adaptation to climate change (ACC) into all facets of regional development. Extreme weather events wield significant influence over adaptation policy [8,9]. Effective strategic planning must anticipate future climate scenarios, incorporate advanced risk assessment tools, and ensure that infrastructure systems are designed and maintained to withstand the impacts of extreme weather events. A proactive approach to ACC, involving comprehensive planning and cross-sectoral collaboration, is essential to mitigate the adverse effects [10].

This study addresses the multifaceted challenges posed by climate change within the realm of regional strategic planning, focusing particularly on enhancing transportation infrastructure resilience and mitigating flood risks. We design, test, and apply a comparative assessment method to evaluate two real-world situations (in Valencia, Spain and Sardinia, Italy). To unravel the complexities of cross-sectoral planning and policy integration, we address our institutional analysis on two issues: the general spatial planning framework and the intertwining between several planning and sectoral tools.

Our work is moved by the following research questions (RQs). RQ1 is general and attains the ways regional strategic planning systems address the challenges posed by climate change, with respect to enhancement of transportation infrastructure resilience and mitigation of flood risks. RQ2 is methodological and concerns the assessment and improvement of the level of integration of adaptation concepts into regional planning tools. RQ3 is operational and is related to developing an analytical framework that facilitates the comparison of planning instruments and serves as a conduit for understanding the broader policy implications. RQ4 is forward looking, as it regards the exploitation of the insights drawn from case studies in Sardinia (Italy) and Valencia (Spain) for informing policy discourse and advancing adaptation efforts against climate-change impacts.

We expect to obtain insights on some key issues. The assessment of the integration of adaptation concepts into regional planning is highlighting areas of success and areas needing improvement, using specific case studies as illustrative examples. The development of a structured analytical framework is a promising tool for: i. allowing the comparison of planning instruments and policies, ii. better understanding broader policy implications, iii. providing recommendations for enhancing the effectiveness of planning and policy interventions in the future, iv. identifying and addressing key challenges and barriers to the effective implementation of adaptation measures in regional spatial planning. Finally, we expect to generate knowledge to inform policy discourse, inspire best practices, and catalyze collective action toward a more sustainable and resilient future in the face of climate change.

This paper unfolds as follows. In the next section, we provide the readers with a literature review on the scientific cornerstones, i.e., the current landscape of planning regarding climate change, transportation infrastructure, and flood risk, and the coordination between different sectors in regional strategic planning. In Section 3, we present the methodology employed in this study, by focusing on the choice of the case study regions, the selection and scrutiny of relevant planning documents, as well as the analysis of their relationships. In Section 4, we present the results of the scrutiny of the regional plans. It includes detailed analyses of framework structures and interconnections between thematic areas, shedding light on the strengths and weaknesses of current planning approaches. In Sections 5 and 6, we present the discussion and conclusion of this exercise, by focusing on the answers to the research questions and the limitations and perspectives of future research work.

2. The Scientific Cornerstones: A Literature Review

Mitigation strategies, though essential for long-term effects, are insufficient to address immediate concerns about the safety and well-being of communities [11]. Thus, ACC has taken precedence, employing various infrastructural, ecological, and planning measures [12]. The fact that even the immediate cessation of greenhouse gas emissions would not halt climate change entirely highlights the urgency for balancing short-term actions with long-term strategies [4,13–18]. ACC encompasses adjustments aiming to minimize damage or maximize benefits from climatic events [19,20].

Internationally, frameworks like the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement have been pivotal [21,22]. The European Union (EU) has recognized the necessity of adaptation with its specific strategies and updates [17,18]. Member states have followed suit with national strategies and plans [23], mirroring EU principles in frameworks like Italy's National Climate Change Adaptation Strategy (NCCAS) and National Climate Change Adaptation Plan (NCCAP) [24]. Europe, particularly vulnerable regions like the Mediterranean basin, has emphasized the adoption of measures at all levels,

highlighting the importance of coordination and coherence across different planning levels [25]. Variations in adaptation planning and adaptive capacity are evident across different regions in Europe [8]. There is no single, standardized approach to climate-change planning [8,26].

Regions within Italy, such as the Autonomous Region of Sardinia (ARS, Italy), have adopted its Regional Strategy for ACC (RSACC), aligning with national and EU frameworks [27] and the Italian national adaptation strategy and plan [28]. RSACC has recently been updated [29]. Strategies in Italy set overarching goals, while plans and programs define specific actions with a variety of details [20]. In Spain, climate change was not factored into the initial phase of flood directive implementation due to conflicting conclusions between the IPCC and various national and regional studies [5]. Similarly, in Poland, efforts have been made to harmonize national legislation with EU directives. The country is actively implementing key directives such as the water framework directive, aimed at achieving good water status across all surface water and groundwater bodies, and the floods directive, focusing on flood-risk assessment and management [30].

Portugal's spatial planning system operates through national, regional, intermunicipal, and municipal levels, governed by legally binding plans and programs like the National Spatial Planning Policy Program (PNPOT). Municipal master plans, mandatory at the local level, ensure alignment with national and regional strategies, covering socio-economic development, infrastructure, and environmental conservation [31]. Poland's spatial planning system comprises national, regional, and local levels, with municipalities playing a pivotal role despite the absence of a binding national strategic framework.

The integration of adaptation and mitigation efforts, as highlighted by Biesbroek et al. (2009) [32], emphasizes the role of spatial planning in addressing climate-change challenges. Adger et al. (2005) [33] further underscore the collaborative nature of ACC, involving both private and public actors across various levels. This interconnected approach can be instrumental in introducing adaptation objectives into spatial planning practices, facilitating measures, such as flood protection and biodiversity conservation [34]. Moreover, there is a recognized need for multi-level governance to effectively implement ACC measures, spanning from regional to sub-regional spatial planning initiatives [20,35–37]. This underscores the necessity for multi-level governance, where decisions span local to national scales, to effectively implement adaptation measures. There are complex interactions between different scales and levels of governance [38,39].

In Europe, there is no unified European framework for regional transportation planning [40], nor a common vision of the main elements of a regional transportation plan [41]. The implementation of spatial planning involves coordination among agencies at local, national, and international levels, following frameworks influenced by custom and planning traditions [25]. Different levels of government play roles in spatial planning, with the European Union member states typically exhibiting three levels of governance [25]. Unlike countries such as Denmark, Malta, and Sweden, which have only two levels of government involved in planning, countries like Germany and Ireland operate with four levels [25]. In Italy, spatial planning operates across four administrative tiers: state, region, province, and municipality [42]. The European Committee of the Regions et al. (2018) [25] outline that national planning tools often adopt a visionary approach, while strategic or framework-setting instruments characterize the regional level, and regulative planning tools are typical at the local level. At subnational levels, regions, provinces, and municipalities employ various planning tools with functions such as coordination, operative regulation, and implementation [43–47]. In Spain, regional level governance plays a pivotal role in spatial planning [48]. Autonomous communities pass territorial planning laws and oversee the approval of territorial or sectorial plans. Regional authorities collaborate closely with local governments, empowering them to devise and implement municipal urban plans for territorial planning within their jurisdiction. Other administrative levels, such as subregional and supra-local, also contribute to planning within these autonomous communities. Consequently, it is customary for autonomous communities to endorse territorial plans (strategies, plans, guidelines) at the regional scale before further refining

them at a smaller scale, usually subregional, to address specific territorial needs. This approach enables local administrations to find proximate references for defining and refining their land-use requirements in municipal urban plans. The transition from economic growth to territorial sustainability, influenced by EU frameworks like the European Spatial Development Perspective, marks a significant evolution in Spain's spatial policies [31].

Subnational spatial planning tools are essential for mainstreaming ACC [32], as they serve to bridge national and regional adaptation strategies with local measures [20]. In Sardinia, for instance, the Regional Landscape Plan (RLP) functions as a territorial governance instrument aimed at conserving environmental, historical, and cultural heritage for future generations [49]. Strategic sub-regional spatial planning plays a critical role in implementing actions geared towards ACC [50–52], with municipalities translating strategic guidance into tangible measures [52].

A cross-sectoral approach, integrating policies and strategies across various sectors, is crucial for addressing complex contemporary challenges, ensuring necessary alignment and harmonization to achieve overarching policy objectives [10]. Mackay and Ashton (2004) [53] emphasize the importance of conducting a thorough analysis of policy, legislation, regulation, as well as strategy and program objectives across different initiatives. This analysis lays the groundwork for achieving overarching policy objectives. This approach is important because it helps to optimize resource use, reduce conflicts between sectoral policies, and achieve sustainable development goals more effectively. A proposed framework for the water–energy–food (WEF) nexus highlights the importance of cross-sectoral coordination [54]. The relationship between transportation, climate change, and flood risk underscores the vulnerability of transportation systems to extreme weather events. Climate change, with its associated increase in extreme weather phenomena like heavy rainfall and rising sea levels, exacerbates the risk of flooding, threatening roads, bridges, and rail networks. Such exposure can disrupt transportation access, impeding the movement of goods and people and potentially causing economic disruptions [55]. Transportation planning can be a key element in spatial planning to establish long-term, sustainable frameworks for social, environmental, and economic development [56,57]. Floods and water scarcity represent Europe's most pressing vulnerabilities in the context of climate change. Therefore, adaptation planning and implementation efforts predominantly concentrate on flood protection and water management [8].

An important contribution to this field is provided by Nowak et al. (2023) [31] focusing on Greece, Spain, Portugal, and Poland, which aimed to identify how spatial planning instruments support selected objectives related to ACC. The study addresses how zoning and land-use restrictions can support climate adaptation objectives, and which sectoral instruments can better link spatial planning to specific adaptation goals.

Spatial planning plays a crucial role in fostering adaptation to climate change and enhancing resilience [58]. However, there has been a notable lack of attention to ACC within the context of regional spatial planning in the literature [32]. To address this gap, Ledda et al. (2020, 2021) [20,35] proposed and applied a set of criteria to evaluate the effectiveness of regional plans in terms of adaptation. Adaptation strategies can be formulated at various levels, ranging from supranational to local, with particular emphasis on national and local decision making [59–62]. Challenges include the discordance between climate-change risk evaluation and spatial planning scales, the absence of a structured mechanism to synchronize adaptation and mitigation strategies, and deficiencies within existing laws and regulations [63,64]. One of the current gaps in addressing interconnected challenges is the lack of comprehensive frameworks that facilitate thorough cross-sectoral analysis. Developing such frameworks is essential for identifying and leveraging synergies between sectors to enhance overall resilience. Rasul and Neupane (2021) [54] suggest that further research is needed to quantify these synergies and to develop a systematic understanding, which underscores the importance of advancing cross-sectoral coordination and integration efforts. Although there are efforts aimed at coordinating the approaches of different sectors, as well as developing joint actions

to achieve those objectives efficiently and effectively [65], there is a lack of research on the evaluation of shared objectives and actions among planning instruments in diverse sectors.

Researchers have extensively studied ACC, exploring diverse planning tools ranging from local ACC plans to action plans and urban strategies, employing both qualitative and quantitative methodologies at regional and urban scales [50,52,66]. Examining governance structures at the regional level, scholars analyzed regional plans in Sardinia, Italy, to assess the integration of ACC objectives and measures [20,34,35]. Similarly, Baker et al. (2012) [66] evaluated seven local ACC plans in Southeast Queensland, Australia, utilizing a quantitative evaluation framework [66]. Kumar and Geneletti 2015 [50] investigated the incorporation of climate-change considerations in spatial planning, scrutinizing 59 local planning tools adopted by Indian cities [50]. Hurlimann et al. (2012) [52], on the other hand, focused on the incorporation of ACC and mitigation strategies within urban planning in Victoria, Australia, employing a qualitative-quantitative assessment approach [52]. Furthermore, Cortinovis and Geneletti (2018) [67], alongside Lai et al. (2019) [68], advocate for the integration of green spaces, including green infrastructures, in urban planning processes to provide ecosystem services and enhance ACC measures [67,68]. To address this gap, methodologies are being developed to assess the integration of adaptation concepts into regional planning, with case studies such as Sardinia, Italy and Valencia, Spain providing valuable insights. Filling this research gap is crucial for advancing scientific understanding and enhancing adaptation efforts to combat the impacts of climate change [27]. In essence, this study serves as a clarion call for a holistic approach to regional strategic planning—one that recognizes the intrinsic interconnectedness of thematic areas and embraces the imperatives of climate resilience, infrastructure sustainability, and disaster risk management. Through a rigorous examination of planning instruments and methodologies, this research seeks to inform policy discourse, inspire best practices, and catalyze collective action towards a more sustainable and resilient future.

3. Materials and Methods

In this section, we present the methodology employed for our analysis. The methodology is structured around a series of steps, as illustrated in Figure 1. In the first step, we conducted a ‘selection of sector’, which involved identifying and delineating three distinct sectors relevant to our study: transport, adaptation to climate change, and flood risk. In the second step, we undertook a ‘selection of documents’ process, where a comprehensive review of several documents led to the identification of eight key planning documents for further analysis. In the third step, we proceeded with a ‘framework analysis’, utilizing a criteria-based approach to develop conceptual maps that elucidate the relationships between various planning instruments. In the fourth and last step, an ‘interconnection analysis’ was performed, resulting in the generation of a tabulated overview detailing relationships based on objectives and actions.

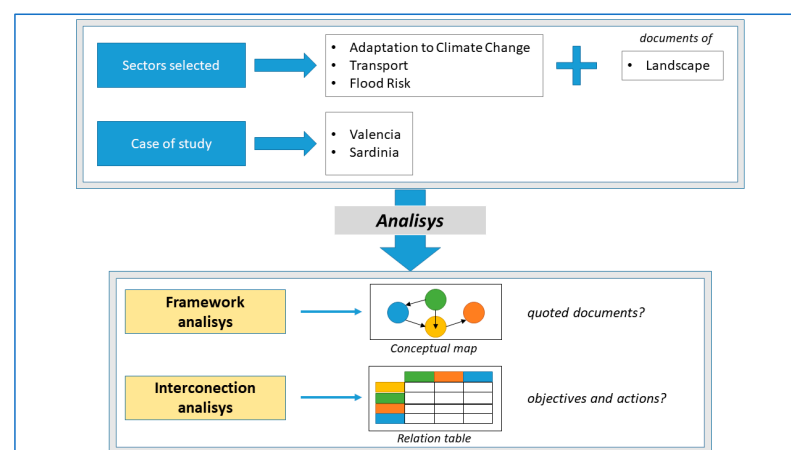


Figure 1. Methodology diagram.

In the following three sub-sections, we develop upon the identification of the two regions to be compared, the selection of regional plans, and the scrutiny of these tools.

3.1. Case Study

The two study regions are located in the Mediterranean Sea. Sardinia, Italy's second-largest island, spans approximately 24,100 square kilometers and is home to around 1.6 million people [69]. From 1951 to 1999, Sardinia experienced an average annual minimum temperature ranging between 7.2 and 14.6 °C, while the maximum temperature ranged between 15.6 and 22.7 °C. Annual precipitation averaged between 414 and 1118.9 mm during this period [28]. Widening the temporal perspective to a centuries-old scale, the difference in maximum temperatures recorded in Sardinia since 1880 has varied over the years compared to the 30-year reference climatology 1971–2000 [70]. Three periods can be found: a cold 40-year period (1880–1920) with maximum temperatures consistently below average, often by more than one degree; a variable 70-year period (1920–1990) with maximum temperatures sometimes below, sometimes above average, but with a smaller anomaly, generally less than 1 °C in absolute value; and finally a warm 30-year period (1990–2021) with maximum temperatures consistently above the climate average, with deviations reaching and exceeding +2 °C in recent years [70].

The Region of Valencia is situated on the Iberian Peninsula, in Spain, boasting a population of 5,003,769 inhabitants [71] and ranking as Spain's fourth most populous region. With a total area spanning 23,255 square kilometers, the landscape here epitomizes the allure of the Mediterranean. The region experiences a semi-arid Mediterranean climate, witnessing an annual rainfall ranging from 300 to over 1000 mm. This precipitation follows the typical Mediterranean seasonal pattern, characterized by a summer dry spell and two wet seasons in autumn and spring. Additionally, intermittent heavy rainfall during summer and autumn contributes significantly to the annual precipitation levels [72]. Notably, there has been a surge in extreme torrential rainfall in the region's basins, as documented by Miró et al. (2018) [73].

The region of Sardinia belongs to one of the most vulnerable areas in Europe in terms of climate change [20,24], as does the region of Valencia [74]. The regions of Valencia and Sardinia are highly sensitive to the effects of floods, with numerous episodes causing damage to transportation infrastructure [75]. Floods are regarded as the predominant natural peril in Spain, with the nation boasting one of the highest rates in Europe for both the frequency of flood events and the resulting fatalities annually [76,77]. According to [28], the main impacts in the region of Sardinia deriving from climate change include the increase in extreme weather events, erosion and coastline retreat, and rising sea levels. Among the climatic factors, floods stand out for their significant impact on transportation infrastructures, an issue likely to worsen considering the effects of climate change [78].

Sardinia and the Valencian community share similarities in their socio-economic landscapes, yet they also exhibit notable differences. Both regions boast rich cultural heritages and vibrant tourism sectors. In terms of economic activity, agriculture plays a significant role in both areas, with Sardinia known for its wine production and the Valencian community renowned for its citrus fruits. However, while Sardinia faces challenges stemming from its insularity, such as limited industrial development and higher transportation costs, the Valencian community benefits from its strategic location on the Iberian Peninsula, facilitating greater connectivity and trade with other European regions. Furthermore, the Valencian community has experienced more rapid economic growth in recent years, driven in part by its diversified economy, strong manufacturing base, and robust service sector. In contrast, Sardinia grapples with issues of unemployment and youth emigration, exacerbating disparities between urban and rural areas.

Both Sardinia and the Valencian community have invested in modern transportation infrastructure to facilitate mobility and economic development. Sardinia boasts a network of roads connecting its major cities and towns, although the island's mountainous terrain presents challenges for efficient transportation. Sardinia has developed a weak public

transport service structure due to urbanization and low population density, resulting in excessive dependence on private cars. Proof of this is that almost all people who travel to the island for work and tourism use a car as their main mode of transportation [79]. Additionally, the region is served by three main airports, including Cagliari-Elmas Airport, providing vital links to mainland Italy and international destinations. In comparison, the Valencian community benefits from a well-developed transportation network, including highways, railways, and ports. Valencia's port is one of the busiest in the Mediterranean, facilitating trade and commerce with global markets. Moreover, the region is served by high-speed rail connections, enhancing accessibility and connectivity within Spain and beyond.

One significant aspect of their infrastructure development lies in their railway networks, which play pivotal roles in facilitating mobility, trade, and regional connectivity. In Sardinia, the railway system is characterized by an old, often single, track [80] network of lines connecting major cities and towns, albeit with some limitations. While the island benefits from connections such as the Trenitalia service, which links urban centers like Cagliari, Sassari, and Olbia, the railway network's coverage is relatively sparse compared to mainland regions. This limited coverage poses challenges for seamless intercity travel and hampers the efficient movement of goods and passengers, particularly in more remote areas. Contrastingly, the Valencian Community boasts a comprehensive and modern railway infrastructure, featuring high-speed rail connections and extensive commuter services. The region is a key hub in Spain's high-speed rail network, with lines connecting Valencia to major cities like Madrid, Barcelona, and Alicante. Additionally, commuter rail services provide efficient intra-regional transportation, facilitating daily commuting and enhancing accessibility to employment centers. The stark contrast in railway infrastructure underscores broader socio-economic disparities between the two regions. While the Valencian community benefits from enhanced connectivity and accessibility, Sardinia faces challenges associated with its insular geography, necessitating greater investment and strategic planning to bolster its railway network and mitigate transportation barriers. In conclusion, the discrepancy in railway infrastructure reflects divergent development trajectories and underscores the importance of transportation connectivity in driving economic growth and regional development. Addressing the infrastructure gap in Sardinia's railway network could contribute to narrowing socio-economic disparities and fostering greater integration with mainland Europe.

The Valencian community stands out among autonomous communities in its commitment to territorial planning [48,81]. Since the approval of the Territorial Strategy of the Valencian Community in 2001, the regional administration has shown a determined effort to advance spatial planning. The hierarchical scale of planning in the Valencian community places the Valencian territorial strategy at the forefront, serving as the primary guiding document at the regional level for territory planning. Following this are territorial action plans, which can be either integrated subregional or sectorial. This hierarchical structure is further supplemented by strategic territorial actions and municipal urban plans, each with its own set of management categories, ranging from structural to detailed [31].

By virtue of the regionalization of spatial planning competencies, in Italy the regions have established their own planning system by passing specific regional planning laws. Each region proceeded largely independently and according to its own preferences [47]. Sardinia approved its regional planning law n. 45 in 1989 [47]. According to the law, regional landscape plan, directives, restrictions, territorial planning schemes, and municipal and inter-municipal master plans are the planning tools aimed at using and protecting the territory [28].

In 2006, the Autonomous Region of Sardinia approved the Regional Landscape Plan and the Regional Hydrogeological Plan, which constitute the reference framework for territorial and landscape planning in Sardinia [82,83]. The Regional Landscape Plan aims at preserving, protecting, enhancing and handing down to future generations the environmental, historical, cultural and settlement identity of Sardinia, protecting and safeguarding

the cultural and natural landscape with its biodiversity and ensuring the preservation of the territory and promoting sustainable development. The Regional Hydrogeological Plan represents an important normative and technical-operative tool for the planning and programming of actions and rules concerning the land use. The plan aims to preserve the soil and prevent hydrogeological risk. Subregional plans affecting the territory and landscape must be consistent with the Regional Landscape Plan and the Regional Hydrogeological Plan. In this regard, the municipal master plan is the main instrument for implementing the Regional Landscape Plan [84].

3.2. Document Selection

The selection of planning documents for scrutiny has been conceived to ensure a comprehensive representation of sectoral priorities and strategic imperatives. By focusing on documents that hold higher hierarchical standing within their respective regions and sectors, this study endeavors to capture the essence of regional strategic planning and its implications for sustainable development.

To broadly determine which sectors to choose, multiple planning documents have been consulted, as will be explained in this section. The original names of the documents have been translated into English, although a summary table with the original names is included in Appendix B. European documents such as the European Strategy 2021 have been consulted, as well as national documents, such as transportation strategies (Strategy for Safe, Sustainable, and Connected Mobility 2030) and ACC (National Plan for Climate Change Adaptation 2021–2030, National Integrated Energy and Climate Plan, Strategy for Climate Change Adaptation of the Spanish Coast for Spain, and National Plan for Adaptation to Climate Change for Italy). As result, three sectors have been identified as more relevant to our study: transport, ACC, and flood risk.

The focus has been on ACC, with planning documents related to climate-change mitigation, energy, and the environment being discarded, as the primary emphasis lies on adaptation. Furthermore, the Valencian Integrated Energy and Climate Change Plan has been omitted, despite its similar planning scale, as it is a plan rather than a strategy, with the national-level management strategy being chosen instead.

Regarding transportation, documents such as the Sustainable Metropolitan Mobility Plan for the Area, one for each province of Valencia (Valencia, Castellón, and Alicante), have been disregarded due to their local scale or other documents related with cycling planning (Regional Cycling Mobility Plan of Sardinia or Sectoral Territorial Action Plan for the Network of Non-Motorized Routes of the Valencian Community).

In selecting relevant sectors, priority has been given to flood risk, which, although closely linked to hydrological management, possesses sufficient distinctiveness to be considered a separate sector. General hydrological management documents (Hydrological Plan of the Júcar River Basin, Hydrogeological Management Plan of Sardinia) have also been consulted, as well as more specific documents on flood-risk management (Territorial Action Plan on Flood Risk Prevention in the Valencian Community).

In addition to the documents associated with the three study sectors (transport, ACC, and flood risk), it has been considered important to study the territorial scope document, as it is the document that sets objectives, goals, principles, and guidelines for land-use planning and organizes its various sectors. Territorial action plan documents geared towards a more detailed provincial planning scale have been discarded.

As a result of this selection process, more than 20 documents have been reviewed, and finally, eight planning documents have been chosen. The selected documents align best with the concept of regional strategy for each of the four considered sectors: landscape, transport, climate change adaptation, and flood risk, in each of the regions: Valencia and Sardinia. Table 1 shows the name of the selected planning documents for each region and planning area and the year of approval.

Table 1. Documents selected for regional planning in Sardinia and Valencia, in the thematic areas of landscape planning, climate-change adaptation, transportation, and flood risk. Appendix B summarizes the main objectives and structure of each of the 8 documents.

Region	Planning Sectors	Name	Acronym	Year
Valencia	Landscape	Landscape Strategy Valencia	LS-V	2012
		Territorial Strategy of the Valencian Community (Estrategia Territorial de la Comunitat Valenciana, ETCV)		
	Transport	Transport Strategy Valencia	TS-V	2018
		Strategic Document for the Improvement of Mobility, Infrastructure, and Transport of the Valencian Community (Document estratègic per a la millora de la Mobilitat, Infraestructures i el Transport de la Comunitat Valenciana, UNEIX)		
	Climate-change adaptation	Adaptation Climate Change Strategy Valencia	ACCS-V	2020
		Valencian Energy and Climate Change Strategy (Estrategia Valenciana de Energía y Cambio Climático, EVCC)		
Sardinia	Flood risk	Flood Risk Strategy Valencia	FRS-V	2023
		Flood Risk Management Plan for the Júcar River Basin (2nd Cycle) (Plan de Gestión del Riesgo de Inundación de la Demarcación del Júcar(2º Ciclo), PGRIDJ)		
	Landscape	Landscape Strategy Sardinia	LS-S	2006
		Regional Landscape Plan (Piano paesaggistico regionale, PPR)		
	Transport	Transport Strategy Sardinia	TS-S	2008
		Regional Transport Plan (Piano Regionale dei Trasporti, PRT)		
	Climate-change adaptation	Adaptation Climate Change Strategy Sardinia	ACCS-S	2019
		Regional Strategy for Adaptation to Climate Change (Strategia Regionale Di Adattamento ai Cambiamenti Climatici, SRACC)		
	Flood risk	Flood Risk Strategy Sardinia	FRS-S	2021
		Flood Risk Management Plan (Piano di Gestione Rischio Alluvioni, PGRA)		

3.3. Document Scrutiny

The document scrutiny includes two steps. First, a framework analysis is conducted to identify how the eight documents are framed in planning in relation to other sectors in Valencia and Sardinia, identifying which other documents from the study sectors are mentioned. In the second step, we have conducted an interconnected analysis of the planning documents for the three sectors—ACC, transportation, and flood risk—based on the application of a set of criteria defined in the scientific literature and adaptation strategies for assessing the regional plans.

3.3.1. Framework Analysis

A preliminary analysis of the structural planning framework of the documents has been conducted. The objective is to understand the interrelationships between various sectors through the implicit citation of planning documents, revealing levels of coordination among them despite the absence of explicit objectives or actions related to those specific sectors in the analyzed text. A selection of keywords such as plan and strategy in both

Spanish and Italian has been systematically used in the digital versions of the documents, as well as a manual search to identify other planning documents mentioned throughout the text. The documents mentioned regarding landscape, ACC, transportation, and flood risk have been organized into a conceptual map for each region. In the conceptual map, we indicate with an arrow which documents are mentioned literally in the selected documents. This way, we visualize all the documents mentioned in the regional strategic documents of each sector. This search facilitates the establishment of a conceptual map regarding how the documents are integrated with the array of planning tools at both international, national, regional, and local levels. The number of arrows emanating from each of the documents indicates how many planning documents are cited in the text of the document. We understand that the specific mention indicates a level of coherence between the objectives set forth in both documents indirectly. This relationship is closer when the arrow directly links two of the selected documents, but it can also be established when it relates to other planning documents of the sector at another level (local or national). Additionally, it allows us to understand how it integrates with the rest of the documents.

3.3.2. Interconnection Analysis

The objective is to determine if the documents explicitly express actions or objectives related to the other study sectors, thereby revealing the level of coordination among different sectors. This analysis sheds light on how integrated these sectors are with each other, facilitating a comprehensive understanding of their interrelationships within the context of climate-change adaptation. Following the principles outlined by Ledda et al. (2020) [20], we distinguish between direct and indirect adaptations based on the purpose of the measures adopted. According to Eisenack and Stecker (2012) [85], a direct adaptation is defined as one whose “purpose targeted at an impact of climate change” and is considered explicit. An indirect adaptation is also called explicit if the ultimate purpose refers to an impact of climate change; otherwise, the action is labeled as an implicit adaptation [85] (Eisenack and Stecker, 2012). In this study, following Donner et al. (2016) [86], we consider implicit adaptation measures those that can reduce society’s vulnerability to extreme climate events, even if they have not been defined as a response to climate change, while explicit measures are those planned as a response to climate change. Ricci (2014) [87] focuses on the adaptive capacity in peri-urban areas of Dar es-Salaam in Tanzania, highlighting that explicit and implicit adaptation measures characterize autonomous adaptation practices, which can be useful for institutions to identify potential entry points for adaptation. Similarly, Eisenack and Stecker (2012) [85] point out the importance of implicit adaptations as potential entry points for explicit ACC. Dubois et al. (2016) [88] report on the findings of a research project developed in the Toulouse region (France) involving urban practitioners (planners, engineers, landscape architects, etc.). The authors found that participants implicitly proposed adaptation measures that could reduce exposure to climate risks. However, we have refined and expanded upon this methodology by applying it to the interconnected analysis of three sectors: ACC, transportation, and flood risk. This same approach is applied not only to ACC but also to the sectors of transport and flood risk. In these sectors, measures can also be categorized as implicit or explicit based on whether their ultimate purpose is directly related to addressing impacts of other sector-specific challenges. By leveraging the foundational methodology conducted by Ledda et al. (2020) [20] and building upon it to encompass multiple sectors, we aim to provide a more holistic understanding of how these sectors interact within the context of climate-change adaptation. This enhancement enables us to offer insights into potential synergies and challenges across these sectors, thereby informing more comprehensive planning and decision-making processes.

Specifically, the objectives and actions of each document have been reviewed, and it has been sought whether there were explicit, implicit, or no connections with the other sectors under study. After reviewing the objectives and actions of the selected documents, a sheet has been created for each landscape, ACC, transport, and flood risk document. In these sheets, there is a section for each of the three study sectors ACC, transport, and flood

risk, where it is indicated whether there are no objectives related to that sector, if there are explicit objectives, or if there are implicit objectives. Similarly, the same has been done with the actions, indicating whether there are no actions regarding that sector, if there are implicit actions, or if there are explicit actions. This information has been captured in table format. Finally, a count of the objectives and actions by types has been made for each of the regions, to be represented in a graphical format to compare which types of objectives and actions prevail in each of the regions.

4. Results

We present the results of the document scrutiny in the following two subsections attaining the application of framework and interconnection analysis.

4.1. Framework Analysis

The regional plans have been analyzed considering the selected criteria (Section 3.3.1). Figure 2 illustrates the relationships between the documents of the three planning sectors and landscape, with their planning documents in Valencia, according to the framework analysis criteria. In the Appendix A, simplified versions of Figure 2 are included to independently visualize only the documents cited by each sector: Figure A1 (transportation); Figure A2 (ACC); and Figure A3 (flood risk). Simplified versions for Figure 3 are also included, in this case: Figure A4 (transportation); Figure A5 (ACC); and Figure A6 (flood risk).

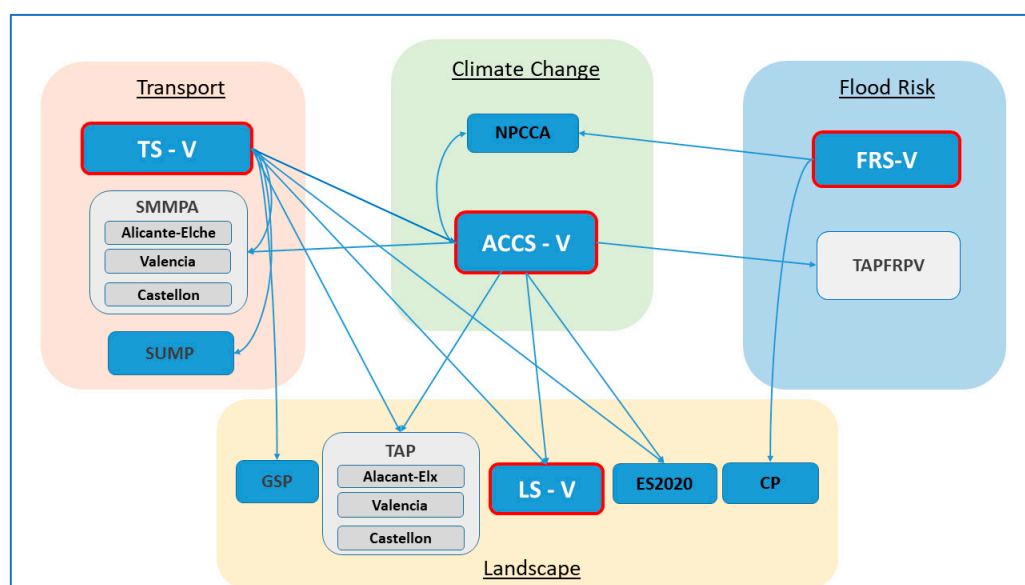


Figure 2. Framework analysis of the relationship between the sectors in the documents selected for Valencia. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

Our examination reveals that Valencia's dynamics demonstrate a strong correlation between the transport sector and the ACC sector with the landscape planning sector. The TS-V mentions most of the planning documents related to landscape: European Strategy 2020, the Territorial Action Plan, Structural General Plans, and the LS-V. The ACCS-V mentions European Strategy 2020, the Territorial Action Plan, and LS-V. In contrast, flood risk planning documents exhibit a low relationship with the landscape planning sector, and FRS-V does not directly mention TS-V, ACCS-V, or LS-V, citing only civil protection (landscape sector). On the other hand, the transport sector directly links with the ACC sector through the TS-V, which cites the ACCS-V, whereas the ACC sector establishes an indirect connection with the transport sector. Notably, flood risk and transport show no direct association, and the linkage between flood risk and ACC sectors is solely indirect, through FRS-V and the National Plan for Climate Change Adaptation (ACC sector).

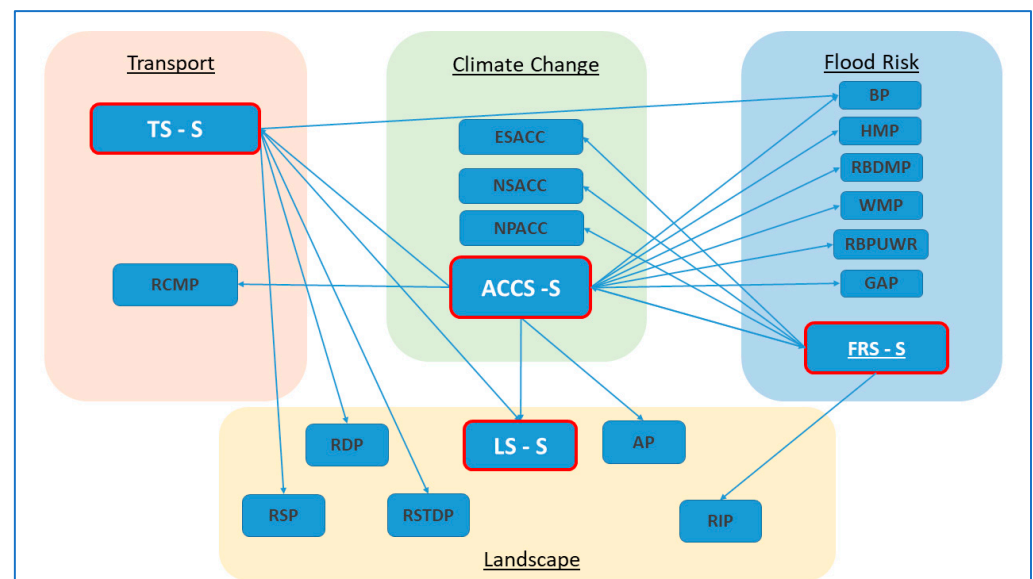


Figure 3. Framework analysis of the relationship between the sectors in the documents selected for Sardinia. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

Turning our attention to Sardinia (Figure 3), our analysis reveals that ACC-S directly interfaces with all sectors: transport with TS-S and Regional Bicycle Mobility Plan, landscape with LS-S and the local plan, and flood risk with FRS-S and every document. While FRS-S directly connects with ACC through ACCS-S and every other climate change document, it lacks a direct link with transport because there is no connection with TS-S, although an indirect connection exists with the Basin Plan from the flood risk sector. Transport and ACC establish direct connections with landscape, with a direct connection between TS-S and ACCS-S with LS-S, whereas flood risk's connection is solely indirect with landscape through the Regional Infrastructure Plan.

In summary, in Valencia, landscape with LS-V serves as the pivotal framework for other planning documents, while in Sardinia, this role is assumed by ACC with ACCS-S. Transport and flood risk emerge as the least interconnected sectors in both regions. However, the connection between ACC and flood risk is notably stronger in Sardinia than in Valencia.

4.2. Interconnection Analysis

The results of the analysis on the interrelation among different sectors in terms of objectives and actions are presented in Table 2. The table displays whether each selected document from every sector and region makes explicit or implicit references to the other three sectors in the defined objectives and actions. Each row represents a document analyzed for each sector, separated by regions, totaling eight rows for the eight chosen documents. The columns are divided for each of the study sectors, distinguishing between objectives and actions, allowing for marking explicit or implicit references, or indicating the absence of any of these options.

Some key findings from the results include:

In LS-V, explicit mentions of ACC, transport, and flood risk are made in both objectives and actions. For instance, the objectives of LS-V on adaptation to climate change are explicit, as seen in objective number 14, "Prepare the territory for its adaptation and fight against climate change". The actions to achieve these objectives are also explicitly stated, such as "Guideline 67. Risks derived from climate change". Conversely, in LS-S, only FRS-S is implicitly mentioned in the actions.

Table 2. Interconnection comparative analysis.

Documents	Sectors											
	ACC				Transport				Flood Risk			
	Objectives		Actions		Objectives		Actions		Objectives		Actions	
	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit
LS-V	X		X		X		X		X		X	
LS-S												X
ACCS-V						X		X	X		X	
ACCS-S									X		X	
TS-V	X		X									
TS-S				X						X		X
FRS-V	X		X				X					
FRS-S	X		X		X		X					

In the case of ACCS-V, FRS-V is explicitly referenced in objectives and actions, with implicit references to TS-V. It is noted that the objectives between ACCS-V and the transport sector are implicit, as indicated by the objective to “Identify vulnerabilities and increase the resistance of the economic fabric and Valencian society,” which indirectly involves the transport sector. Similarly, the actions are implicit, like “Encourage research on the effects of climate change on the built environment in order to promote resilience,” where the built environment likely includes transportation. In Sardinia, ACCS-S explicitly refers to FRS-S in objectives and actions but does not mention TS-S.

In most cases, explicit objectives in a document are accompanied by explicit actions to achieve them, indicating systematic planning and execution in the region. However, discrepancies can be observed in some instances, such as between established objectives and proposed actions, like in the case of FR-V with TS-V, where there are explicit actions but no objectives. This misalignment may suggest a lack of coherence in policy or strategy planning and execution.

Certain cases, like in the transport planning documents of TS-V and TS-S, show implicit or unspecified objectives but explicit actions, such as TS-S with ACCS-S or TS-V with FRS-V. While variations exist in the presentation of objectives and actions across regions in most documents, some alignment can be found in the flood risk document, where objectives and actions from other sectors coincide, as all objectives and actions are implicit, as seen in FRS-V with ACCS-V, FRS-S with TS-S, and FRS-S with ACCS-S, leaving only FRS-V with TS-V without explicit objectives.

In Valencia, there is a tendency towards specificity in the presentation of objectives and actions, while in Sardinia, there is a trend towards lack of specificity or even total absence of objectives and actions in some cases. In Sardinia, there is a tendency towards the presence of implicit actions rather than explicit actions. Overall, there is a consistency in the presentation of objectives and actions in the Valencia region, where both objectives and actions are usually explicitly specified in the analyzed documents. On the other hand, in the Sardinia region, there is a tendency towards the absence of objectives and actions in the evaluated documents, especially in the case of the LS-S and ACSS-S documents (Figure 3).

5. Discussion

This study has successfully addressed its primary objective: evaluating the integration of ACC into regional planning documents, focusing on aspects related to the assessment transportation infrastructure and mitigation of flood risks. Through a comparative assessment of official planning documents on Valencia (Spain) and Sardinia (Italy), we have gained valuable insights into the current state of regional planning and its effectiveness in incorporating ACC measures.

Addressing RQ1, our results provide actionable insights into the current state of regional planning and its effectiveness in integrating ACC. These findings have significant implications for improving policy coherence, enhancing cross-sectoral collaboration, and ensuring that regional planning objectives align with broader sustainability goals. The shift towards ACC has become paramount, emphasizing immediate community safety alongside long-term strategies. Internationally, frameworks like the UNFCCC [21] and the Paris Agreement guide global and regional adaptation efforts [89], reflected in the EU Adaptation Strategy of 2021 [17] influencing national strategies across Europe, including Italy and Spain [23,90]. Regions within these countries have tailored their adaptation strategies to local vulnerabilities, integrating them into spatial planning frameworks to coordinate infrastructural development with environmental conservation and disaster risk management. Challenges persist in harmonizing national legislation with EU directives, evaluating regional adaptation plan effectiveness, and integrating climate considerations seamlessly into spatial planning [91]. Addressing these requires enhanced cross-sectoral coordination to align policies [10] across transportation, water management, and land-use planning, as flood risk, impacted by climate change, is crucial for these sectors [78].

The proposed methodology is highly relevant, as it provides a structured approach to evaluating the integration of ACC into regional planning. By employing a comparative assessment method, we were able to systematically analyze planning documents and their interrelationships, offering a clear picture of how different regions address climate adaptation. This methodology not only identifies gaps and strengths in the relationships between planning documents but also facilitates the development of recommendations for enhancing planning and policy interventions. The insights gained from this approach can inform future research and policymaking, ensuring that regional planning is more robust in the face of climate change. This work serves as a framework, upon which the developed methodology is implemented to analyze the criticality of infrastructure in the face of climate change (see RQ2). It facilitates the analysis of relating the methodology to each of these areas. Guidelines to implement specific ACC measures should be included in lower-level strategic documents (such as plans or technical documents implemented by plans). However, it is essential to first understand the interrelationships between sectors, which occurs at higher strategic levels (strategies), as it is established in the legislative frameworks of Spain and Italy. Previous research has highlighted shortcomings in assessing the integration of ACC strategies into regional plans [20,32], exploring across various sectors and different geographical and administrative contexts. The proposed method has successfully been applied in practice and this result might be relevant to other European regions belonging to the Mediterranean area, with geographical and institutional contexts similar to those of Valencia and Sardinia. In other words, we feel that pointing out shortcomings in the relationships between planning documents, also in terms of ACC, might be a common approach to start promoting the mainstreaming of adaptation objectives and measures, which need to at least be consistent with the European adaptation strategy and the national strategies and plans.

As formulated in RQ3, we have developed a framework analysis that can have significant influence in regional planning decisions, by providing a structured approach to evaluate existing policies and their interconnections. This includes identifying key documents and understanding their relationships, facilitating the formulation of coherent and integrated policies. Such comprehensive analysis sheds light on the intricate interrelationships between key planning documents across sectors in Valencia and Sardinia. This systematic cross-sectoral coordination is crucial for optimizing regional planning outcomes, addressing ACC and sustainability challenges effectively. As highlighted by Rasul and Neupane (2021) [54], such cross-sectoral approach emphasizes the importance of frameworks in identifying synergies between sectors, which historically have been hindered by the lack of such coordinated efforts.

Our results show that the relationship between sectors is complex, with direct and indirect associations between different planning documents. This complexity is illustrated by the intricate web of connections between sectors (Figures 2 and 3). Valencia's framework

places a central role on the landscape sector (LS-V), emphasizing regional priorities such as environmental conservation and landscape management. Our findings are consistent with the perspective put forth by Nowak et al. (2023) [31]. In contrast, Sardinia emphasizes adaptation to climate change (ACC-S), highlighting the urgent need to address climate-related challenges. Although, by definition, LS-S should be the central document of the planning process, as pointed out by Ledda et al. (2020) [20]. This emphasis reflects a more straightforward and direct planning process, focusing on the immediate necessity of climate adaptation. Despite these differences, both regions show convergence in shared priorities, such as flood-risk management, suggesting recognition of common challenges and the importance of cross-sectoral collaboration.

Figure 2 shows that Valencia's explicit objectives and actions indicate a detailed and structured approach to planning, enhancing policy coherence and implementation effectiveness. This meticulous planning reduces the likelihood of conflicting initiatives and ensures efficient resource utilization. In contrast, Sardinia's trend towards ambiguity, with implicit actions and the absence of objectives in some instances, could lead to inconsistencies and hinder the effectiveness of policy implementation. The lack of specificity in Sardinia's planning documents might result in ambiguity and inconsistent application, highlighting the need for a balance between flexibility and precision in policy formulation. Coherence and consistency between policy objectives and actions are vital for achieving desired outcomes, ensuring that all efforts are aligned towards common goals. As Rasul and Neupane (2021) [54] emphasize, cross-sectoral coordination is crucial for harmonizing policy goals and ensuring compatibility of strategies, which can lead to more effective resource allocation and implementation of policies across sectors. Examples of successful integration of objectives and actions include the implementation of drainage systems to manage excess water, the design of green spaces to combat the urban heat island effect, and the establishment of hydraulic-forestry arrangements to mitigate hydrogeological risks like landslides, floods, and soil erosion [88]. To enhance the integration of planning documents across sectors, several mechanisms and frameworks can be employed. These include, for example, establishing inter-sectoral committees, implementing integrated planning tools, and promoting continuous stakeholder engagement.

Our results give insights to inform policy and advance in ACC (RQ4) (see Figures 2 and 3). Valencia's regional planning framework, centered on landscape planning (LS-V), demonstrates pivotal linkages with transport (TS-V), adaptation to climate change (ACC-V), and flood-risk (FRS-V) sectors, highlighting the integration of landscape considerations for resilience enhancement. In contrast, Sardinia emphasizes adaptation to climate change (ACC-S) as a central framework, directly integrating with transport (TS-S), landscape (LS-S), and flood-risk (FRS-S) planning documents, indicative of a comprehensive approach to climate impact mitigation. Policy implications include recommendations for Valencia to strengthen intersectoral integration, particularly between flood risk and other sectors, and for Sardinia to enhance specificity in objectives and actions across all sectors to improve adaptation-planning effectiveness. These insights contribute to advancing regional policy discourse and capacity-building efforts aimed at fostering climate-resilient development strategies.

6. Conclusions

This study emphasizes the importance of better coordination between sectors to comprehensively address ACC. By highlighting the need for integrated policies, our research contributes to political science and public administration, advocating for strategies that address multiple sectors in a coherent and coordinated manner. Our methodology, based on two phases (framework and interconnection analysis) developed using a conceptual map and a relation table, systematizes a way to present the relationships between sectors and analyze how aligned the objectives and actions of each of the representative documents of regional strategy are with each other. This allows for a diagnosis and evaluation that can help planners assess sectoral coordination in planning to take measures that harmonize and optimize their resources. This research can be considered one of the first comparative

studies that provides insights to inform policy and advance in ACC, by focusing on landscape planning, the transport sector, and flood risk at regional scales in the Mediterranean basin, and we feel it might be of inspiration to scholars interested in similar studies.

The study demonstrates the importance of incorporating climate resilience into regional planning, revealing both strengths and gaps in the current strategies of Valencia and Sardinia. Effective regional planning requires better coordination between sectors, with the study highlighting the need for integrated policies to address climate resilience comprehensively. While Valencia and Sardinia prioritize different aspects of climate resilience, both regions recognize the importance of flood-risk management, underscoring shared challenges and the necessity of cross-sectoral collaboration. The study suggests that Valencia should enhance intersectoral integration, particularly between flood risk and other sectors, while Sardinia should improve the specificity and consistency of its planning objectives and actions to achieve better climate adaptation outcomes.

Despite the significant findings of our study, there are limitations that must be acknowledged. These include the scope of data collection, potential biases in stakeholder input, and the dynamic nature of regional planning contexts. In contrast to previous studies such as MacKay et al. (2004) [53], which primarily focused on water management using the WEF framework, and Boas et al. (2016) [10], which applied the nexus approach to analyze the interconnectedness of water, energy, food security, climate change, health, education, and gender in relation to sustainable development goals and global sustainability, our research places a significant emphasis on regional risk management in transportation amidst the challenges posed by climate change in Mediterranean regions. Specifically, our study underscores the critical importance of addressing flood risks as a central concern in this context [5–7]. However, the three sectors selected are relevant and it is a good starting point that is useful for transport planners, and that could be improved in future research. The study focuses on the relationship between transportation, flood risk, and climate-change adaptation. Future work should focus on expanding the dataset—other related sectors, such as fire risk or civil protection, could be included to broaden the perspective on the topic—and continuously updating the analysis to reflect changing conditions. Additionally, assessing the practical implementation and effectiveness of these documents in the regions studied will help to better understand their real impact on preparation and adaptation efforts. Although the focus of the study has been on the adaptation of transportation infrastructure to climate change, with a special focus on flood risk, we believe that the proposed methodology is valid for other groups of closely related sectors, such as WEF. The EU has placed special emphasis on ACC for years, and countries have been developing ACC strategies. In other regions of the world, such as developing countries, it is still necessary to develop these strategies before being able to evaluate their coordination with other planning sectors.

Author Contributions: Conceptualization, A.D.M., E.O. and B.M.; methodology, R.C.-W. and A.L.; formal analysis, R.C.-W. and A.L.; data curation, R.C.-W. and A.L.; writing—original draft preparation, R.C.-W. and A.L.; writing—review and editing, R.C.-W., A.L., A.D.M., G.C., E.O. and B.M.; visualization, R.C.-W.; supervision, A.D.M., E.O. and B.M.; funding acquisition, A.D.M., E.O. and B.M. All authors have read and agreed to the published version of the manuscript.

Funding: Rodrigo Cuevas-Wizner is supported by the University Teacher Training Scholarship (FPU) [FPU19/03825] from the Ministry of Science, Innovation, and Universities of Spain. Rodrigo Cuevas-Wizner is supported by a grant for international research stays funded by Universidad Politécnica de Madrid (UPM). This work was also supported by Universidad Politécnica de Madrid, by the project ‘Herramientas cartográficas para el desarrollo urbano y regional sostenible’ [RP220430C029]. Andrea De Montis is supported by the Agritech National Research Center (CN00000022, Concession Decree 1032 of 17/06/2022) and the National Biodiversity Future Center—NBFC (CN00000033, Concession Decree 1034 of 17/06/2022 adopted by the Italian Ministry of University and Research, CUP J83C22000870007), European Union Next-GenerationEU, Projects funded under the National Recovery and Resilience Plan (NRRP; Piano Nazionale di Ripresa e Resilienza), Mission 4 Component 2 Investment 1.4. This manuscript reflects only the authors’ views and opinions, and neither the European Union nor the European Commission can be considered responsible for them. Antonio

Ledda is supported by the project titled “Studio dei fattori predisponenti le infestazioni acridiche in Sardegna e sviluppo di sistemi di monitoraggio e controllo innovativi e sostenibili”, bando interno per la ricerca collaborativa tra ateneo di Sassari e ateneo di Cagliari—DM 737/2021 risorse 2022–2023, funded by the European Union NextGenerationEU. Andrea De Montis and Antonio Ledda are supported by the project titled “Conoscenza e gestione sostenibile dei sistemi agricoli e forestali con il miglioramento sostenibile delle produzioni primarie: il caso dell’allevamento bovino in Sardegna”, bando per progetti di ricerca interdisciplinare—DM 737/2021 risorse 2021–2022, funded by the European Union NextGenerationEU.

Data Availability Statement: The data sources are listed in the references section.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

This appendix includes simplified versions of the framework analysis, Figures 2 and 3, representing only the documents cited in each sector. First, for the Valencia region: Figure A1 (transportation); Figure A2 (ACC); and Figure A3 (flood risk). Then, for the Sardinia region: Figure A4 (transportation); Figure A5 (ACC); and Figure A6 (flood risk).

Valencia

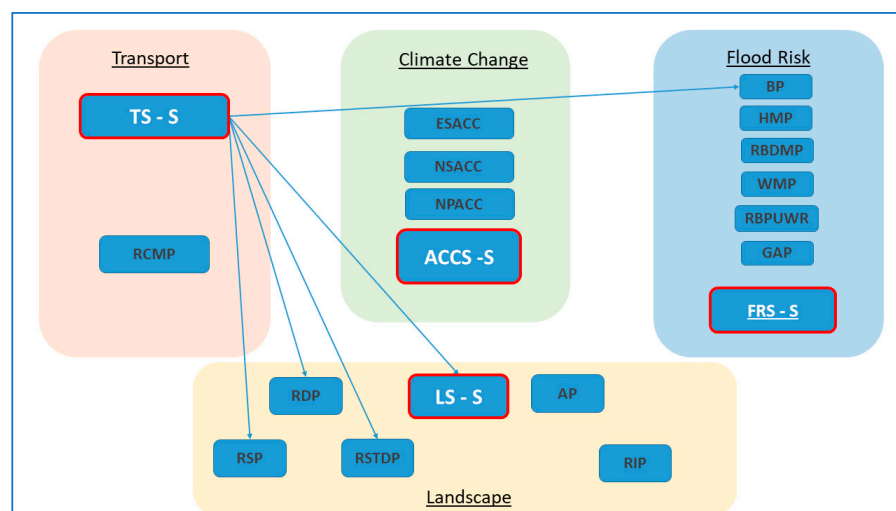


Figure A1. Documents quoted by TS-V. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

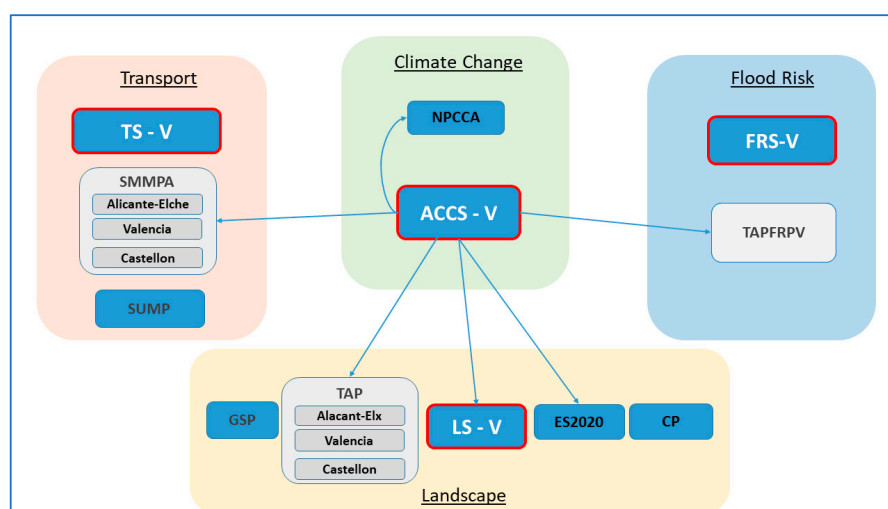


Figure A2. Documents quoted by ACCS-V. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

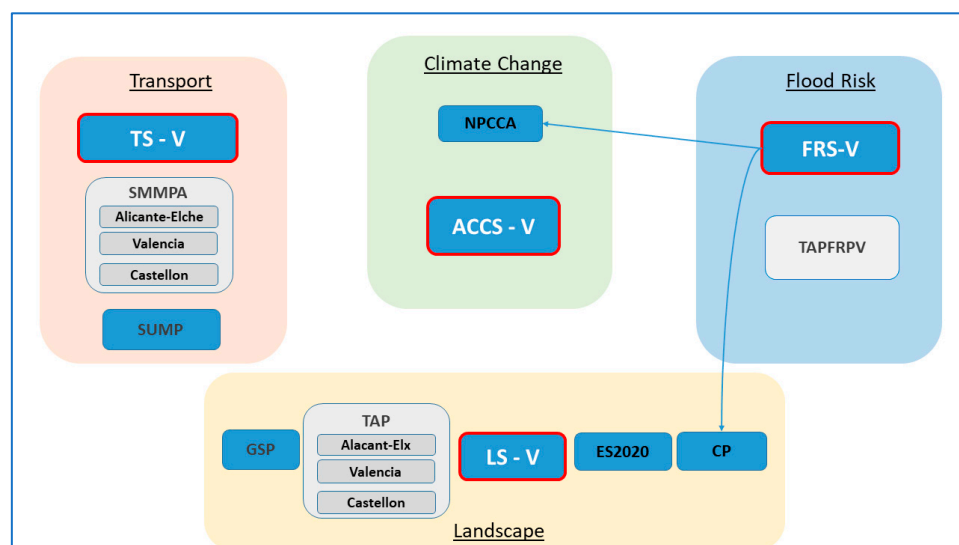


Figure A3. Documents quoted by FRS-V. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

Sardinia

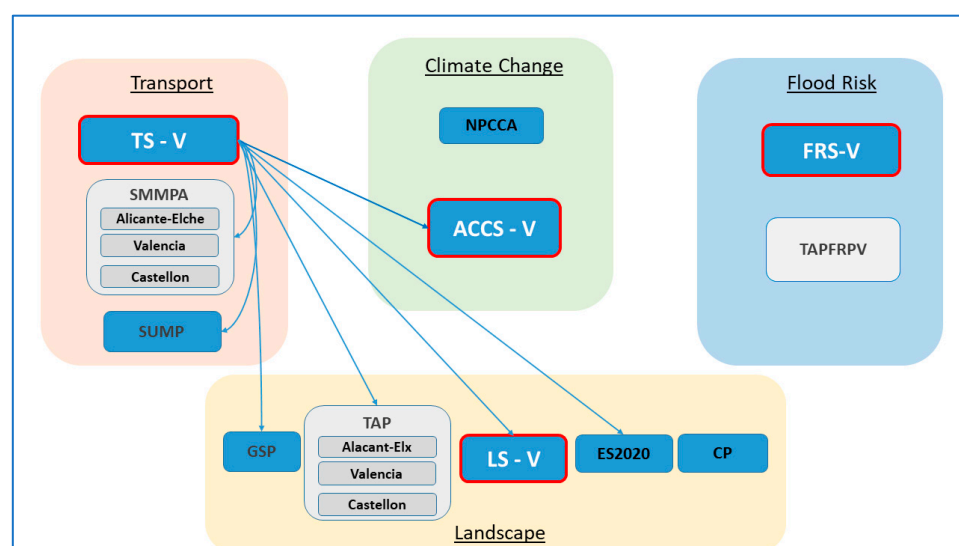


Figure A4. Documents quoted by TS-S. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

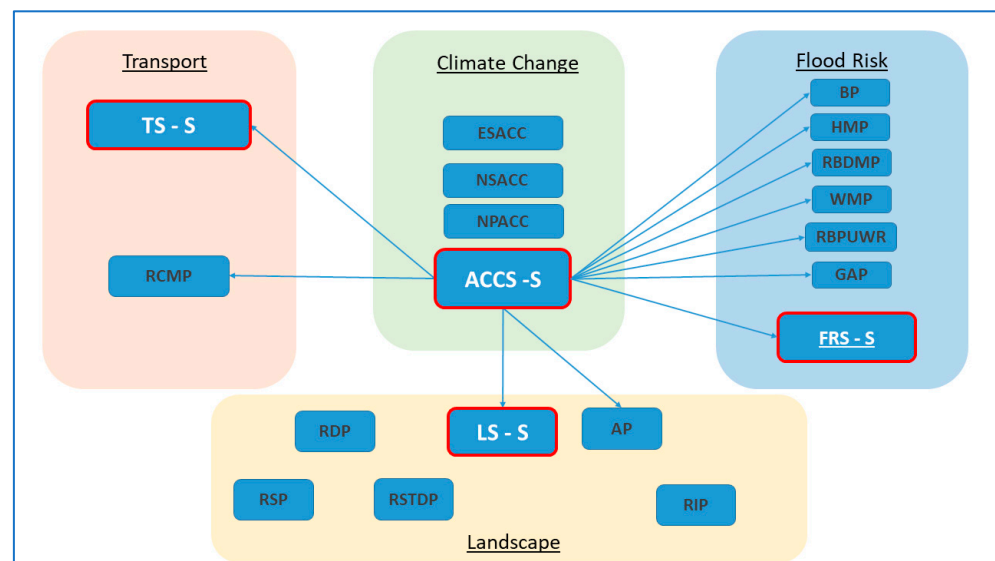


Figure A5. Documents quoted by ACSS. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

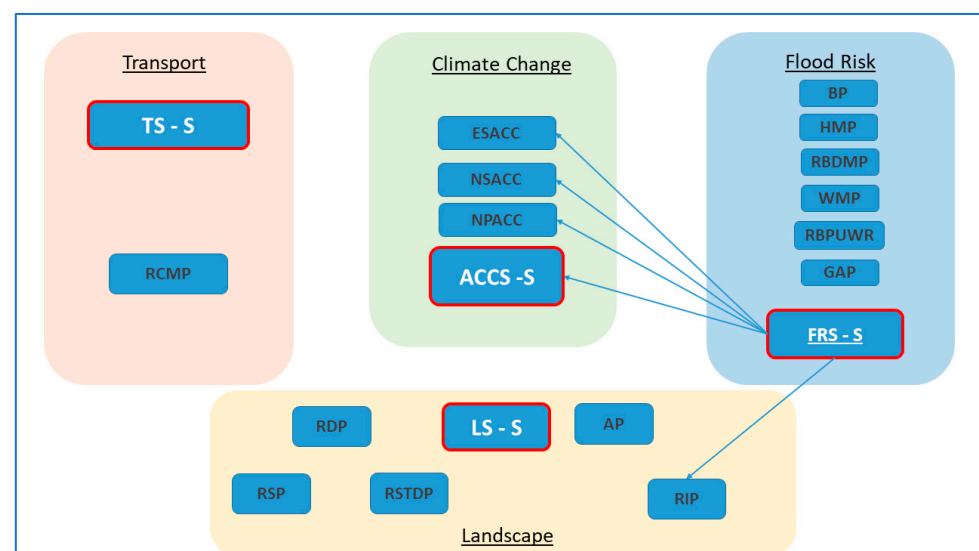


Figure A6. Documents quoted by FRS-S. In Table A1 of the Appendix A, the full names of the documents and acronyms in English and their original versions are detailed.

Appendix B

This appendix expands the information on the 8 reviewed documents: LS-V, LS-S, TS-V, TS-S, ACC-V, ACC-S, FRS-V, and FRS-S. Table A1 presents a list of the other planning documents mentioned in the text with their acronyms, English names, and original names.

LS-V document outlines 25 overarching objectives for sustainable development and territorial management in the Valencia Region. These goals encompass maintaining city system diversity, positioning Valencia's urban area within European metropolises, enhancing the urban areas of Alicante and Elche as central nodes, developing Castellón's metropolitan potential, improving rural living conditions, managing environmental heritage creatively, achieving water resource efficiency, minimizing natural and induced risks, reclaiming the coastline as a territorial asset, promoting sustainable tourism, protecting and valorizing landscapes, applying equitable territorial instruments efficiently, actively managing cultural heritage, preparing for climate change adaptation, leveraging new energy potentials, establishing Valencia as a Mediterranean logistics hub, fostering in-

novation and creativity, enhancing territorial connectivity, addressing mobility demands efficiently, balancing infrastructure deployment with territorial preservation, improving social cohesion, ensuring housing access through territorial planning, promoting rational and sustainable land use, providing adequate land for economic activities, and innovating territorial governance models.

TS-V aims to achieve a more balanced modal distribution for sustainable mobility, improved accessibility throughout the territory, and enhanced competitiveness of the productive sector, all within the framework of sustainable development encompassing social, environmental, and economic aspects. The document is structured into seven thematic areas, along with separate chapters on financing and participation. Each thematic area analyzes the current situation, establishes objectives and guidelines, and proposes specific actions or programs. These areas include sustainable mobility, terrestrial transport infrastructure, ports, airports, and coasts, logistics, quality (covering safety, accessibility, noise, and air pollution), innovation and new technologies, and transparency, dissemination, and collaboration.

ACSS-V addresses the challenge of climate change in the region by emphasizing the need for mitigation and adaptation measures. It aims to reduce greenhouse gas emissions, increase renewable energy usage, and enhance energy efficiency to transition towards a more sustainable socio-economic model. The strategy integrates energy considerations from the outset, aligning with European and national goals for emission reduction, renewable energy deployment, and energy efficiency improvements by 2030. Collaboration with various stakeholders and continuous review of measures ensure adaptation to evolving commitments and legislation, both locally and internationally, thus advancing towards a resilient and sustainable future for the Valencian community.

FRS-V document delineates nine overarching objectives for flood-risk management, including enhancing public awareness and self-protection measures, improving administrative coordination, advancing knowledge for effective management, enhancing predictive capabilities, optimizing land-use planning, reducing flood hazards, bolstering resilience, preserving water body quality, and facilitating efficient flood event management for swift recovery.

LS-S focuses on protecting and enhancing the coastal areas and broader regional landscape. Key objectives include preventing new construction in untouched areas, rehabilitating existing coastal settlements towards high-quality hotel sectors, and restricting new coastal buildings to hospitality use. The plan promotes biodiversity conservation, maintaining low-density settlement models, and limiting rural construction to essential business needs. It also establishes strict regulations for landscape and cultural heritage preservation, identifying and cataloging around 12,000 georeferenced cultural and natural assets to ensure their protection and cultural significance for future generations.

TS-S aims to guarantee universal mobility for people and goods, focusing on both interregional (Sardinia/continent) and intraregional (within Sardinia) connections. Key objectives include enhancing accessibility, particularly for vulnerable groups, ensuring system reliability and safety, and promoting sustainable transport to reduce energy consumption and environmental impact. The plan emphasizes integrating transport with urban planning, infrastructure development, and service design, aiming for modal balance and intermodality. It outlines infrastructure improvements for rail and metropolitan networks in Cagliari and Sassari, optimization of port logistics, promotion of airport systems, and enhancement of road networks to improve internal accessibility and reduce congestion, accidents, and pollution.

ACSS-S outlines the objectives and approaches for enhancing regional resilience to climate impacts. It divides its objectives into two main categories: transversal goals, which pertain to broad knowledge, production, and dissemination related to climate change, and specific sectoral goals that necessitate cross-sector cooperation and co-benefits. The strategy emphasizes the importance of operational measures and strategic guidelines to achieve these goals, focusing on increasing systemic awareness, institutional cooperation, identifying adaptation needs, promoting financial mechanisms, and encouraging informed

decision making. Additionally, it highlights the need for investment in technological innovation and the internationalization of economic activities. The document underscores the urgency of implementing these objectives and suggests a participatory approach to ensure context-specific and inclusive adaptive responses.

FRS-S aims to safeguard human life and mitigate the impacts of flooding on exposed assets, aligning with national and European regulations. The strategy emphasizes a blend of structural protection measures and fostering a shared risk culture. The FRS-S moves away from relying solely on infrastructural solutions, advocating for non-structural interventions such as knowledge actions, active maintenance, and monitoring. It outlines objectives to reduce negative consequences on human health, the environment, cultural heritage, and economic activities through both structural and non-structural measures. The plan also highlights the importance of public awareness and self-protection, integrating flood management with land planning and nature conservation policies.

Table A1. Planning documents referenced in the text with English translation and original name. Marked as quoted are those that appear in the framework analysis, Figures 2 and 3.

Region	Quoted	Name Adapted		Original Name	
		Acronym	Document Name	Acronym	Name
Valencia	✓	SMMPA	Sustainable Metropolitan Mobility Plan for the Area	PMoMe	Plan de movilidad metropolitana sostenible del área
	✓	SUMP	Sustainable Urban Mobility Plans	PMUS	Planes de Movilidad Urbana Sostenible
	✓	GSP	General Structural Plans	PGE	Planes Generales Estructurales
	✓	TAP	Territorial Action Plan	PAT	Plan de Acción Territorial
	✓	ES2020	European Strategy 2020	ES 2020	Estrategia Europea 2020
	✓	CP	Civil Protection	PC	Protección Civil
	✓	NPCCA	National Plan for Climate Change Adaptation 2021–2030	PNACC	Plan Nacional de Adaptación al Cambio Climático 2021–2030
	✓	TAPFRPV	Territorial Action Plan on Flood Risk Prevention in the Valencian Community	PATRICOVA	Plan de Acción Territorial sobre Prevención del Riesgo de Inundación en la Comunidad Valenciana
		SSSCM	Strategy for Safe, Sustainable, and Connected Mobility 2030	EMSSC	Estrategia de Movilidad Segura, Sostenible y Conectada 2030
		NIECP	National Integrated Energy and Climate Plan	PNIEC	Plan Nacional Integrado de Energía y Clima
		SCCASC	Strategy for Climate Change Adaptation of the Spanish Coast	EACCCE	Estrategia de Adaptación al Cambio Climático de la Costa Española
		VIECCP	Valencian Integrated Energy and Climate Change Plan	PVIEEC	Plan Valenciano Integrado de Energía y Cambio Climático
		TAPNNMRVC	Sectoral Territorial Action Plan for the Network of Non-Motorized Routes of the Valencian Community	PATRINMCV	Plan de Acción Territorial de Carácter Sectorial de la Red de Itinerarios No Motorizados de la Comunitat Valenciana
		HPJRB	Hydrological Plan of the Júcar River Basin	PHDJ	Plan Hidrológico de la Demarcación del Júcar

Table A1. Cont.

Region	Quoted	Name Adapted		Original Name	
		Acronym	Document Name	Acronym	Name
Sardinia	✓	RCMP	Regional Cycling Mobility Plan	PMRC	Piano Regionale della mobilità ciclistica
	✓	RSP	Regional Strategic Plan	PSR	Piano Strategico Regionale
	✓	RDP	Regional Development Plan	PRS	Piano Regionale di Sviluppo
	✓	RSTDP	Regional Sustainable Tourism Development Plan	PRSTS	Piano Regionale di Sviluppo Turistico sostenibile
	✓	AP	Area Plan	PA	Piano d’ambito
	✓	RIP	Regional Infrastructure Plan	PRI	Piano Regionale delle Infrastrutture
	✓	BP	Basin Plan	PB	Piano di Bacino
	✓	HMP	Hydrogeological Management Plan	PAI	Piano stralcio per l’Asse Idrogeologico
	✓	FMP	Floodplain Management Plan	PSFF	Piano Stralcio delle Fasce Fluviali
	✓	RBDMP	River Basin District Management Plan	PGDI	Piano di Gestione del Distretto idrografico
	✓	WPP	Water Protection Plan	PTA	Piano di Tutela delle Acque
	✓	RBPUR	Regional Basin Plan for the Use of Water Resources	PSDRI	Piano stralcio di bacino regionale per l’utilizzo delle risorse idriche
	✓	GAP	General Aqueducts Plan	PRGA	Piano Regolatore Generale degli Acquedotti
	✓	ESACC	European Strategy for Adaptation to Climate Change	SEACC	Strategia Europea di Adattamento al Cambiamento Climatico
	✓	NSACC	National Strategy for Adaptation to Climate Change	SNACC	Strategia Nazionale di Adattamento ai Cambiamenti Climatici
	✓	NPACC	National Plan for Adaptation to Climate Change	PNACC	Piano Nazionale di Adattamento ai Cambiamenti Climatici

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