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Review

Traditional vs. novel approaches to coastal risk management: A review and insights from Italy

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ABSTRACT

Coastal areas frequently face critical conditions due to the lack of adequate forms of land use planning, environmental management and inappropriate coastal risk management, sometimes leading to unexpected and undesired environmental effects. Risk management also involves cultural aspects, including perception. However, the acknowledgement of risk perception by stakeholders and local communities, as one of the social pillars of risk analysis, is often lacking. Starting from an overview of the risk concept and the related approaches to be addressed, the paper investigates the evolution of coastal risk management with a focus on the Italian case study. Despite the design and adoption of national policies to deal with coastal risks, coastal management still shows in Italy a fragmented and poorly coordinated approach, together with a general lack of attention to stakeholder involvement. Recent efforts in the design of plans aiming at reducing risks derived from climate change and mitigating their impacts (National Strategy on Climate Change Adaptation; National Climate Change Adaptation Plan; National Recovery and Resilience Plan activities) should be effective in updating knowledge about climate change risks and in supporting national adaptation policies.

1. Introduction

Modernity has brought about profound change in the society in which we live. Beck (1992) defines modern society as the society of risk, which deals systematically with threats and insecurities induced and introduced by modernization itself. At the heart of Beck's thinking on risk is the awareness that the main threats facing society are no longer primarily external - more obviously as natural hazards. Instead, great part of these are produced as undesirable consequences induced by human activity, for example in the form of climate change.

The comprehension of risks is typically based on a deep understanding of the main physical phenomena to be addressed. However, the radical uncertainty of our society leads to a considerable difficulty in assessing the risks. The recognition about stakeholders' and local communities' risk perception, as one of the social pillars of risk analysis, is often missing, and protection declines into mere technical safety, often leading to unexpected and undesired effects.

In this view, coastal areas are territories of even more increasing economic interests, as well as wide spreading of different kinds of human settlements. As the matter of fact, during the twentieth century both population and activities in such territories have increased dramatically, leading to the increase in their vulnerability and causing several negative consequences (Adger et al., 2005). Moreover, the impacts of climate change on coastal communities will be enormous, increasing the exposure to specific hazards, such as flooding and coastal erosion (USAID, 2009).

The critical situations that coastal areas frequently face are often due to lack of adequate forms of land use planning and environmental management as well as inappropriate coastal defense works (Besio, 2014; Bobbio, 2014). The latter have led to settlements that are more physically protected but less able to adapt to subsequent environmental changes. The "hard" engineering works has proven to be inadequate for planning sustainable use of coastal resources, raising a number of economic or public interest issues. In order to improve a long-term

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management vision for the coastal zone and ecosystems, environmental and social aspects must also be considered, and communication plays a key role in this process.

In line with this, the international scientific and policy debate has developed on the design and, even more so, on the implementation of an approach to the use and management of coastal areas, which is appropriate to address the complexity of the problems in such areas, known as Integrated Coastal Zone Management (ICZM). However, the implementation of its principles and recommendations still shows great difficulties. This highlights the need to move from approaches that reduce the impacts to regenerative approaches, aiming to establish restorative and co-evolutive relationships between human settlement and environment, and considering human developments, social structures and cultural concerns as an inherent part of ecosystems, and humans as proactive players in re-establishing those relationships.

Starting from an overview of the concept of risk and the related approaches to deal with, the paper aims at investigating the evolution of risk management in coastal areas, with a focus on the case of Italy. The fragmented nature of the information, reflecting the cumbersome governance of coastal areas in Italy, required investigating different formal and informal sources, in order to draw a comprehensive picture of the processes taking place in coastal areas. Against this backdrop, the paper is structured as follows. First, the concept of risk and the related approaches to dealing with are described (Section 2). Then, Section 3 offers an overview of the evolution of risk management in coastal areas and the role of risk perception. Finally, Section 4 gives an insight on the coastal risk issues and management in Italy, followed by conclusions.

2. The concept of risk and the related approaches to deal with

2.1. Defining risk and its characteristics

Risk is a human-centered concept that is applied when human beings and their properties can be adversely affected in the foreseeable future. The concept of risk lacks a shared meaning by the scientific community that is appropriate for all applications. This is reflected in the variety of definitions in international guidelines (Selvik and Abrahamsen, 2021). Alexander (2002:29) defines risk as "the likelihood of impacts"; UNISDR (2009:25) defines it as "the combination of the probability of an event and its negative consequences"; Renn and Rohrmann (2000:13) as the "possibility that an undesirable state of reality (adverse effects) may occur as a result of natural events or human activities", and Kron (2015:20) as "the product of (the probability of) a hazard and its adverse consequences".

A unique definition of risk is not commonly accepted because it differs widely across sciences and scientists. Technical disciplines such as engineering, among others, call attention to quantitative aspects of the concept. Thus, they prefer definitions of risk based on "the probability and physical measurements or corresponding utilities of negative outcomes". On the contrary, social sciences give much importance to the qualitative aspects of risk, which they consider crucial facets of the concept (Renn and Rohrmann, 2000:13).

Risk posed by hazards on society and their assets may differ depending on their characteristics.

The United Nation Office for Disaster Risk Reduction (UNDRR, 2016: 18) defines hazard as "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation". Going into detail, it makes a distinction between natural and anthropogenic hazards; the former types are predominantly associated with natural processes and phenomena, while the latter ones are entirely (or predominantly) induced by human activities and choices. Understanding the interactions between natural hazards and anthropogenic processes is of great importance because "anthropogenic processes may influence the occurrence, frequency or intensity of natural hazards" (Gill and Malamud, 2017: 247). In addition, anthropogenic processes may play a key role as a trigger for natural hazards, generating a network of interactions between them.

Climate change increases the probability of hazards' occurrence with negative and cascading impacts on society, as it enhances the frequency and severity of both sudden- and slow-onset hazards (Glasser, 2020).

On the other hand, vulnerability, defined as "the susceptibility to harm, powerlessness, and marginality of both physical and social systems" (Adger, 2006:268), is an important aspect for guiding actions to enhance well-being through the reduction of risk. Vulnerability has to be considered as a "whole", characterized by multiple underlying factors and by multi-dimensional aspects closely interrelated (Galderisi and Profice, 2012). This implies not only considering physical and spatial features and bio-geo- physical responses of territories, but also involving economic, institutional and socio-cultural aspects (Galderisi and Profice, 2012; Woodroffe, 2007). Hazard and vulnerability interact at different scales and can facilitate the propagation of impacts and cascading effects of disasters (Pescaroli and Alexander, 2016). In this regard, it can be affirmed that "uncertainty" is one of the main key words that identifies risk assessment and on which it should be paid attention while deciding to manage risk (Renn and Rohrmann, 2000; Kron, 2015).

2.2. Steps towards a new paradigm for risk management

Within the frame outlined above, a new paradigm for risk management has been defined by the Sendai Framework on Disaster Risk Reduction (SFDRR) 2015–2030. This marks a shift from a reactive to a preventive way, from the management of the disasters' impact to the management and reduction of risks that lead to disasters (Mizutori, 2020). In this perspective, disaster risk reduction is intended as "the concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events" (UNISDR, 2009).

Moreover, the SFDRR recognizes that the States have the primary role to reduce disaster risk, highlighting the importance to share knowledge and pragmatic guidance in the context of the development and implementation of local, national, regional and global plans and strategies with stakeholders including local government, the private sector and other non-State stakeholders.

However, most European countries, instead of acting in this perspective, still act in a sectoral way with fragmented competences focusing mostly on the hazards' characteristics, without paying attention to the vulnerability issues and, thus, leading to a lack of common strategies (Galderisi and Profice, 2012).

In line with this, and in the light of climate change consequences, new planning strategies and management activities are required by means of a reliable, understandable and timely knowledge of processes affecting coastal hazards, getting decision makers, stakeholders and local communities involved (IRGC, 2017).

In this regard, an important approach has been developed in the last years, which deals with the concept of "risk governance". The International Risk Governance Council (IRGC, 2017:5) adopts a broader definition of risk: "risk refers to uncertainty about and the severity of the consequences of an activity or event with respect to something that humans value". It gives attention to the different spheres of "uncertainty": it "can pertain to the type of consequences, the likelihood of these occurring (often expressed in probabilities), the severity of the consequences or the time or location where and when these consequences may occur" (IRGC, 2017:5).

As a matter of fact, risk governance is not just about risk management. It starts with the early stage of pre-assessment, and then it goes through the stages of appraisal, evaluation and management (Table 1). Moreover, this approach highlights the importance of the cross-cutting aspects, in particular communication and stakeholder engagement. Thus, risk governance is an inclusive approach able to frame, assess,

Table 1
Interlinked elements which characterize the Risk Governance Framework approach (IRGC, 2017).

Elements	Description	
	General	Detailed
Pre-assessment	Identification and framing; setting the boundaries of the risk or system	Problem framing; Early warning; Screening; Determination of scientific conventions
Appraisal	Assessing the technical and perceived causes and consequences of the risk	a) Risk Assessment: Hazard identification; Exposure and vulnerability assessment; Risk characterization b) Concern Assessment: Risk perception; Social concerns; Socio-economic impacts
Evaluation	Making a judgment about the risk and the need to manage it	Judging the tolerability, acceptability and the need for risk reduction measures
Management	Deciding on and implementing risk management options	a) Decision making: Option identification and generation; Option assessment; Option evaluation and selection b) Implementation: Option realization; Monitoring and control, Feedback from risk management practice
Cross-cutting Aspects	Communicating, engaging with stakeholders, considering the context	

evaluate, manage and communicate risk issues, often marked by complexity, uncertainty and ambiguity.

IRGC (2017) and other studies (Ali et al., 2022; Renn, 2008) stress the necessity to integrate physical with perceived risk for building effective risk management. Risk perception plays a crucial role into risk management processes because it gives understanding about how people perceive and respond to hazards (Ali et al., 2022), and it is usually elicited and studied by means of questionnaires and interviews (Carlton and Jacobson, 2013; Schmidt et al., 2014; Martinez et al., 2020; De Longueville et al., 2020). It is recognized that risks are considered in different ways depending on whether they are considered by experts or non-experts. The latter mostly elaborate risk in a non-rational way and this leads to attitudes and decisions driven by emotions, values and affections (Slovic, 1987). Moreover, as highlighted by Healy and Malhotra (2009), despite investments in risk preparedness can reduce the potential damages of future disasters, voters are more likely to reward politicians for their relief spending rather than for investing in disaster preparedness. Consequently, this myopic vision leads public officials to lessen investments in preparedness even if it could effectively improve public welfare.

3. Evolution of risk management in coastal areas

The management of coastal areas, also due to climate change, has to face hazards that are becoming more and more crucial, such as coastal flooding and erosion. Protection against storm surges owing to meteorological extremes and coping with rising sea level will be a major challenge in the 21st century, especially for low elevation coastal zones hosting an increasing percentage of the world population. Moreover, non-climatic anthropogenic drivers, due to historical as well as recent demographic trends and relevant change in land use, have played a very important role in increasing low-lying coastal communities' exposition and vulnerability to sea level rise and extreme sea level events (Oppenheimer et al., 2019). Commonly, an indicator-based approach is adopted in risk assessment and management, i.e. vulnerability key indicators are selected, physical but also socio-economic (Klein and Nicolls, 1999). Methodological advances in exposure and vulnerability assessments rely on new technologies for coastal monitoring and improved downscaled projections for future scenarios, which include also socio-economic issues (Oppenheimer et al., 2019).

Several strategies can be used to counteract coastal erosion processes and related risks. Hard coastal protection measures are widely used, but they often relocate the problem down-drift to other parts of the coast. Coastal defense structures can also have critical impacts on coastal ecosystems, such as the disruption of surrounding soft-bottom environments and introduction of new artificial hard-bottom habitats, with consequences on biodiversity at the regional scale (Airoldi et al., 2005). Thus, environmental management goals should be clearly stated and incorporated into the planning, construction, and monitoring stages of this kind of interventions. On the other side, approaches focusing on the so-called "soft protection" interventions (such as beach nourishment) are becoming more and more adopted.

Nature-Based Solutions (NBS) and other ecosystem-based adaptation measures represent a novel means in mitigation and adaptation policies facing natural hazard. They are increasingly seen as the solution for the achievement of sustainable development goals by bringing a set of societal benefits (Gallotti et al., 2021). In the case of coastal protection, this approach goes in the direction of restoring the natural dynamics of the shoreline (by involving the preservation or restoration of coastal dunes, wetlands, marine seagrass, etc.), also providing ecosystem services. However, the lack of perceived scientific certainty around the efficiency and durability of NBSs and their cost-effectiveness may cause this approach less attractive than more traditional, purely engineering ones (Möller, 2019) and may hinder decision-making with regard to future investments in restoration projects (Narayan et al., 2016). To reduce this knowledge gap, raising awareness about NBSs in decision-makers, is fundamental to ensure support and promotion of these practices (Loizidou et al., 2023).

Other approaches focusing on adaptation options, such as set-back policies relocating the line of defense landwards of its existing position ("managed realignment"), are also currently taken into account rather than adopting defenses to maintain the shoreline position. However, since this approach is rather new, there is still little knowledge of the longer-term impact, considering that under realignment the landward movement does not occur at places and at rates determined by natural processes (French, 2006). In addition, managed retreat can be viewed by local communities as disproportionate compared to their risk perception (Ocean and Climate Platform, 2022).

As introduced before, a more comprehensive and systemic approach, compared to sectoral perspectives, is required in strategies addressing risk management in the coastal zones. Integrated Coastal Zone Management (ICZM) is defined as "a dynamic process for the sustainable management and use of coastal zones, taking into account at the same time the fragility of coastal ecosystems and landscapes, the diversity of activities and uses, their interactions, the marine orientation of certain activities and uses and their impact on both the marine and land parts" (UNEP/MAP/PAP, 2008). Even if the enforcement of its principles and recommendations still shows great difficulties in being adopted, some countries have demonstrated efforts to apply ICZM to policies and jurisdiction pertaining to the protection and development of the coastal zone, through a broad perspective aiming at integrating environmental, economic and social issues. For example, in Europe, the ICZM strategy was supported by the recommendation for the implementation of ICZM of the European Parliament in 2002 (2002/413/CE)[1] and by projects such as RESPONSE (LIFE Environment project 2003–2006).

Both vertical (national to regional-local) and horizontal (intersectorial and interdisciplinary) integration and harmonization are requested for this approach, as well the use of regulatory and economic-political instruments to preserve coastal and marine areas. However,

[1] RECOMMENDATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe, available at: https://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF.

difficulties to translate the ICZM concepts and recommendations into practice and to assess their effectiveness is still a critical point. Several reasons are cited for this, such as: the huge pressure for economic exploitation in coastal areas, in particular for tourism development; the common fragmentation and poor coordination of the coastal management framework; the frequent absence of monitoring and assessment strategies; a weak political support in the medium-long term; conflicting visions and interests regarding the management of coastal and marine resources, etc. (Buono et al., 2015).

The ICZM process should be supported by relevant techniques and analysis tools, providing information necessary for the follow-up of projects and for decision-making, and by participatory actions involving local communities and stakeholders (institutional or not institutional), focusing on risk perceptions in decision-making processes. This would allow to improve communications and consultation, facilitating collaboration and consensus-building (Carbonnel and Richard, 2010). Socio-economic issues are, in fact, also part of the debate in coastal risks management. Stakeholders' and local communities' perceptions of the adopted strategies are often influenced by the scarce communication causing a lack of knowledge and understanding, as the importance of communication process is often not valued as it should be in order to promote their engagement (Slovic, 1987; Luís et al., 2018).

3.1. The perception of risk

Several studies on coastal areas have been conducted to emphasize the importance of risk perception in coastal management processes. One example is the study by Carlton and Jacobson (2013) focused on climate-related coastal environmental risk perception in Florida among undergraduate students. This targeting on a population cohort makes it impossible to generalize the results of the study to the entire population. Some results, however, are of general interest: on one hand, that risk characteristics are not sufficient to explain risk perception; on the other hand, that cognitive and affective processes strongly influence risk perception. In line with these findings, Martinez et al. (2020), in their study on two coastal communities in Northern Germany and Western Portugal based on interviews and participatory observations, emphasize the key role of culture and related socio-economic and political aspects for dealing with risks and for an effective formulation and implementation of disaster risk reduction solutions. As a consequence, they stress the importance of community involvement in such processes, in order to enhance the level of trust in scientific information on community as well as decision making of coastal authorities. Another example is the study by De Longueville et al. (2020), which focuses on a coastal area in Benin heavily affected by erosion. The study analyzed risk perception with different perspectives. Through the submission of questionnaires, it elicited the perceptions of people who experience the risk, in particular of residents about the coastline dynamics, the effectiveness of "hard" defense infrastructures and of coastal development policies. On the other hand, through semi-structured interviews, it collected the perception of people who manage the risk. By the comparison between responses of people who experience the risk and those who manage the risk, the study firstly allowed to emphasize that relevant differences between the perceptions of non-experts and experts exists. Secondly, it highlighted the necessity to act not only using traditional "hard" defense measures but also through the enforcement of cooperation between multiple governance levels and the involvement of local communities in decision-making processes. Another similar study was performed by Schmidt et al. (2014), in three Portuguese coastal areas whose economies have been increasingly dependent on tourism and related housing and economic activities. The data from the surveys and interviews highlight that in each location there is a strong commitment to maintaining current levels of coastal protection and preserving the integrity of local societies and economies. This suggests giving importance to investigate coastal common risk and to prepare coastal communities to respond and adapt to extreme weather events and coastal retreat.

Recent studies dealing with the influence of risk perception in the acceptability of relocation strategies have been carried out in the southern coast of France, testing the residents' preferences for different relocation policies aimed at coping with climate change (Dachary-Bernard et al., 2019). The Authors point out different kinds of risk perception with respect to relocation scenarios: while residents at the coast, physically exposed to risk, are generally opposed to relocation, hinterland residents are more sensitive to long-term benefits in terms of safety and attractiveness of coastal areas, being in favor of this policy. Risk perception and levels of concern, thus, influence public awareness and behavior: Dachary-Bernard et al. (2019) describe some of the surveyed people as "unaware individualists", favoring individual approaches and responsibility, and compensation measures, while other display "informed solidarity", having greater risk awareness and concern about concerted managed retreat policy.

Cognitive biases in risk perception, combined with emotional and cultural attachment to assets and landscapes, thus often results in resistance towards change and adaptative scenarios. In this view, raising awareness is the base for "creating a new risk culture, in which a set of perceptions and behaviors are adopted by society in the face of risks, thereby allowing it to consider adaptation as a solution to their constraints" (Ocean and Climate Platform, 2022: 31).

4. Coastal risk issues and management in Italy

4.1. Coastal risk issues

Coastal erosion is a crucial problem for Italy, which has significant social and economic implications: fifteen out of twenty Italian regions are bathed by the sea and 644 municipalities are located along the Italian coastline (approx. 8000 km), corresponding to 8.1% of all municipalities (Falco and Barbanente, 2021).

As reported by the National Committee on Coastal Erosion (TNEC), Italy's coastal areas are exposed to severe shoreline retreat, and the prospects are worrisome due to the rapid evolution of beach retreat phenomena in recent years. Average percentages of coast at erosion risk is 48%, distributed as represented in Fig. 1a. Beach erosion in Italy is mostly the result of reduced river sediment supply and of the construction of harbors and other coastal structures altering the natural beach dynamics. Morphological constraints have led to the concentration of settlements along the coast, accelerated by the development of infrastructure and related activities, and later the tourism industry. As highlighted in Fig. 1b, more than half of the Italian coastline is occupied by infrastructures and urban settlements of varying density (Zanchini and Manigrasso, 2017). Following this, softer defences, such as beach nourishment and dune restoration, were adopted in the last decades (Pranzini, 2018).

To protect the Italian coastlines from coastal erosion and flooding, approximately 16% of such areas is defended with "hard" coastal protection measures. This approach is particularly adopted where urban centers, road and rail infrastructures and socio-economic activities develop along the coastline (ISPRA, 2021).

Following this, softer defences, such as beach nourishment and dune restoration, were adopted in the last decades (Pranzini, 2018). Among coastal defense structures, Fig. 2 shows that, compared to other European countries, in Italy some NBS are mostly at an experimental stage while "hard" solutions are used more frequently. However, it was also pointed out that after a period of widespread beach nourishment, some without stabilizing structures, for a number of reasons such as some pitfalls and the scarcity of offshore sand (together with environmental protection constraints, such as locally extended Posidonia Oceanica prairies), a return to rigid structures can be observed, also due to the preference of such hard and more visible structures by local authorities and stakeholders (Pranzini, 2018).

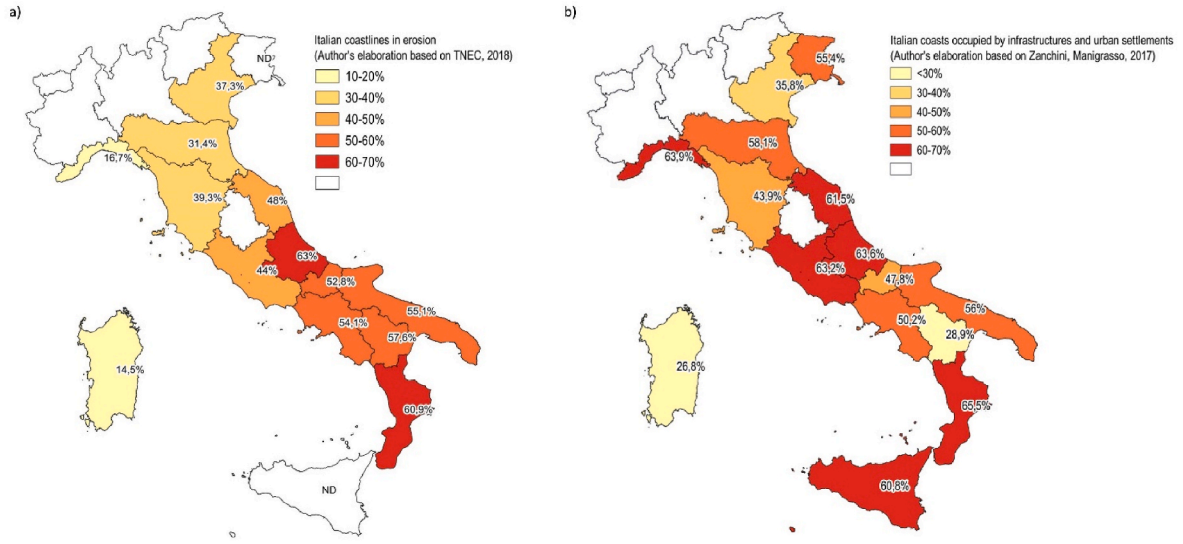

Fig. 1a. Coastal erosion in the Italian Regions. Numbers indicate the percentages of coastline in erosion. Data for Friuli Venezia Region are deducted from local press (adapted and updated from TNEC, 2018). Fig. 1b. Coastal use in the Italian Regions. Numbers indicate the percentages of coastal lengths occupied by infrastructures and urban settlements (authors' elaboration from Zanchini and Manigrasso, 2017).

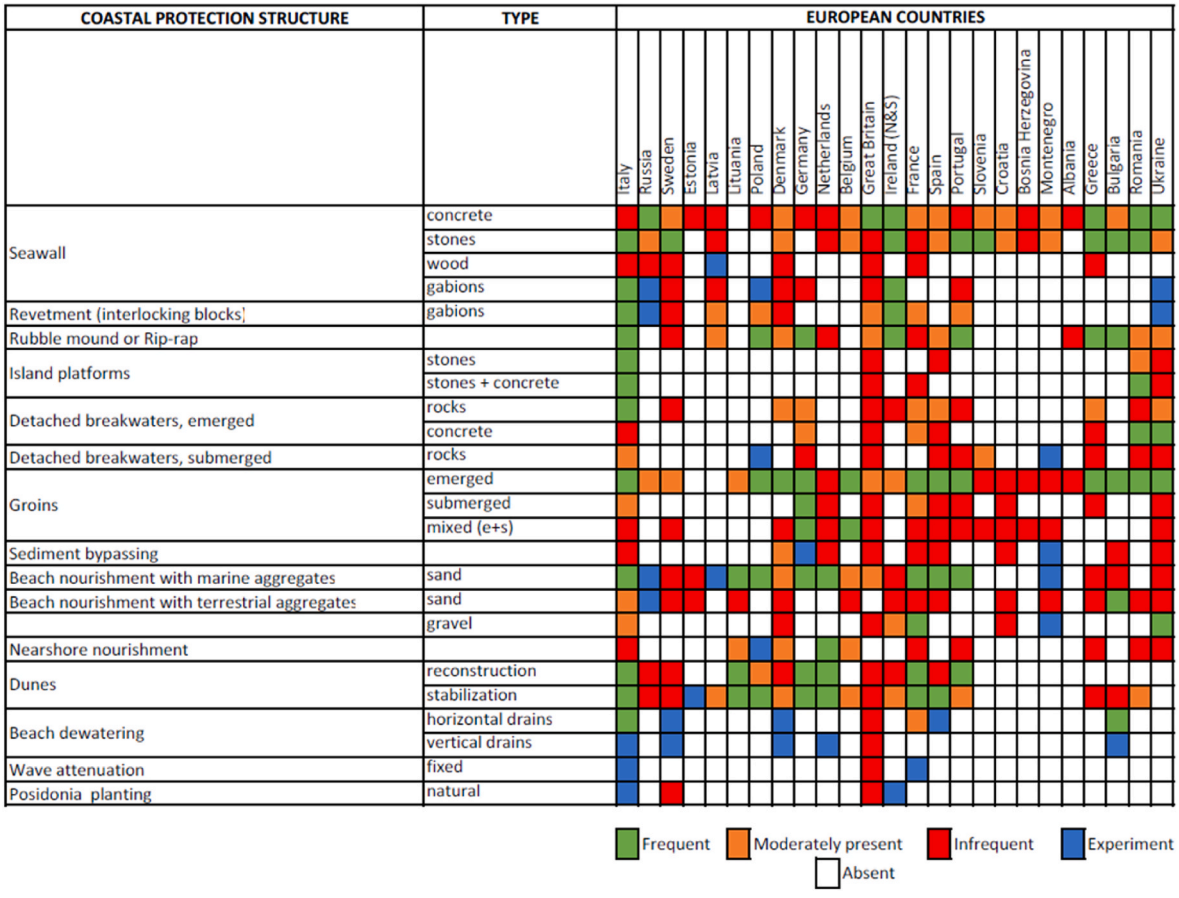

Fig. 2. Coastal defense structures along the European coasts (adapted from Pranzini et al., 2015).

4.2. Coastal management policies dealing with climate change

In Italy, the management of coastal areas is characterized by a marked division of competences between the governing authorities -State, Regions and Municipalities-as well as different sectors of the public administration. The protection and management of coastal areas, as well as the regulation of human activities, rely on the enforcement of various laws, codes, and regulations that overlap with each other, such as maritime domain laws, civil and sailing code, landscape and urban planning regulations, concession laws and national strategies (Falco, 2017). Each of these acts on different parts of the coastal areas and provides for specific permission systems for building and infrastructure

developments as well as for concessions in the public domain areas. The fragmentation derived from this situation, leads to consequences on actions and inactions from local authorities, which usually tend to implement national policies and strategies depending on the central government for funds (Falco, 2017). Fragmentation and poor co-ordination in coastal management, together with a lack of attention to stakeholder involvement are, thus, common features of the Regions' performance, regardless of the instruments they have in place (Buono et al., 2015).

As an example of this, in 2008 Italy signed the Mediterranean ICZM Protocol, but this has not been yet ratified. As a matter of fact, a clear policy on the application of ICZM has not so far emerged, so each Region is providing autonomous strategies, often relying on voluntary and project-based actions (Buono et al., 2015). Anyway, such ICZM initiatives contribute at promoting ICZM practices and instruments, favoring the capitalization of knowledge and sustainable technologies already acquired in the field of coastal protection and adaptation (Montanari and Marasmi, 2010).

The complexity of the Italian coastal areas, due to the diversity of the coastal characteristics led each Region to adopt different approaches to face coastal risks. The diversities in their approaches were not only based on sound scientific knowledge of coastal characteristics and different levels of vulnerability but were also largely influenced by the importance of the beach economy and the demands and pressures of economic stakeholders. This implies that plans and guidelines for managing coastal risk are very different among the Italian regions: some of them are equipped with Operational intervention plans, Coastal management and protection plans, Hydrogeological management plans, Guidelines, and Technical standards, while others adopted only some of these instruments (see Table 2).

At the national level, the Italian government started to design and adopt different policies to deal with risks, some specific on coastal risks, others more general, in line with the EU Directive 2007/60/EC on the assessment and management of flooding and submersion risks.

In 2015, the Italian Ministry of the Environment started a first effort for a coordinated management of coastal erosion risk, through the National Committee on Coastal Erosion (TNEC), which involves all the coastal Regions, with the technical coordination of the Italian Institute for Environmental Protection and Research (ISPRA) and representatives of the national scientific community (National Research Council and University) in the attempt to produce national guidelines for the Italian Coastal Erosion Strategies (MATTM, 2018).

More specifically, the aim of the TNEC is to broad the collaboration among the agencies having competence in coastal defense and interests in the economic development of these territories in the different coastal regions, with the unique objective of fostering the defense and sustainable development of the coasts. This process failed to include key stakeholders such as NGOs and trade associations, since it involved only technical and scientific experts from regional and interregional agencies, regional administrations, universities and research institutes. Furthermore, despite the comprehensive technical framework of the Document and the detailed operational and management recommendations it contains, the aspects of risk perception, awareness raising, public education (e.g. environmental campaigns) and information are ignored. This gap seems to disregard what the same document reports (MATTM, 2018, p. 84), namely that "recently a tendency to return to the building of rigid works is being observed, also driven by local populations or economic operators in the coastal area and a perception of risk that is often different from the real risk that characterizes certain coastal areas". Hence, encouraging the knowledge exchange (Fazey et al., 2013) between domain experts and local stakeholders and communities is crucial to reduce the gap between risk assessment and risk perception (Loizidou et al., 2023), and to foster social learning. Moreover, that gap clearly contrasts with the wide recognition in the literature and in various international documents of those aspects as key elements for sustainable and effective risk management, as highlighted in Section 2.2.

Another effort made by the Italian national government is the design of specific strategies and plans aiming at reducing risks derived from climate change. It dates back to 2015 the adoption of the National Strategy on Climate Change Adaptation (NSCCA) by the Ministry of the Environment, with the main aim of developing a national vision on common pathways to tackle climate change by counteracting and mitigating its impacts (MATT, 2014). A participatory process has been conducted, among socio-economic actors and key stakeholders, and through the administration of an online survey to involve the public at large in order to acquire different national point of views on climate change adaptation and risk issues.

With reference to coastal areas, the NSCCA recognizes the presence of coastal erosion in most of the Italian beaches, due to both rising sea levels and wind-generated wave action, unsustainable uses of coastal and inland territory, and the reduction of solid inputs from rivers. However, the Strategy did not refer to the phasing of implementation, monitoring and evaluation, governance actors to be involved, details about the allocation of financial resources and who will be in charge of those aspects (Falco, 2017).

In order to implement the NSCCA, in 2018, the Ministry has started the design process for the National Climate Change Adaptation Plan (NCCAP). A specific working group has been set up in 2022 with the aim of accelerating activities for the approval of the NCCAP, defining measures and related "soft" and "non-soft" actions. Even for coastal areas, the NCCAP identifies some "hard" and nature-based actions. The NCCAP devolves the design and adoption of sectoral plans and programs with specific climate change adaptation measures and actions to the regional and local levels. Moreover, in October 2022 the Ministry published the National Platform on Adaptation to Climate Change (https://climadat.

Table 2
Regional plans and guidelines for coastal risk in Italy (Updated from TNEC, 2018).

	Operational intervention plans	Coastal management and protection plans	Hydrogeological management plans	Guidelines	Technical standards
Abruzzo	X	X	X	X	X
Basilicata		X	X	X	X
Calabria	X		X	X	X
Campania	N/A	X	X	N/A	N/A
Emilia Romagna	X	X	X	X	X
Friuli V.G.			X		
Lazio	X	X	X	X	
Liguria	X	X	X	X	X
Marche	X	X	X	X	X
Molise	X		X	X	X
Puglia		X	X	X	
Sardegna	X		X	X	
Sicilia			X		
Toscana	X	X	X	X	X
Veneto		X	X	X	

isprambiente.it/), a portal aimed at informing and raising awareness among citizens and stakeholders on the issue of adaptation, as well as making data and tools available to support public bodies in decision-making processes.

Recently, in the framework of the National Recovery and Resilience Plan (NRRP) fundings, as part of the Next Generation EU (NGEU) program, the project RETURN ("*multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate*") is being developed by MUR (Ministry of University and Research), aiming at a better understanding of environmental, natural, anthropogenic and climate-related risks, at enhancing risk prevision, adaptation and mitigation strategies. The comprehensive, multi-hazard and multi-sectorial approach adopted in the project (also including coastal risks) should lead to the formulation of a new risk management framework and testing, including model-guided assessment of social and economic impacts (https://www.fondazionereturn.it/).

5. Conclusions

The analysis of the state of the art of risk management, with a particular focus on coastal erosion and on the Italian case, highlights the still widespread management of coastal risks through traditional engineering-technical and sectoral approaches, which often lead to unexpected and often ineffective or even worsening results. To overcome this situation, new strategies have been developed, such as Nature-based solutions, ecosystem-based adaptation measures, and set-back policies. In addition, a more comprehensive and systemic approach has been developed, the Integrated Coastal Zone Management (ICZM), aiming at integrating environmental, economic and social issues. Within this perspective, the comprehension of risk perception from local communities and stakeholders (institutional and not institutional) is recognized as a fundamental component in coastal risk management, allowing to improve communication and consultation and facilitating collaboration and consensus-building.

In Italy, it emerges that the management of coastal areas is characterized by a marked division of competences between the governing authorities -State, Regions and Municipalities-, as well as different sectors of the public administration. Despite some efforts to design and adopt different policies to deal with costal risk issues and climate change with the aim of reducing fragmentation issues, they are poorly integrated and coordinated. Moreover, little attention is paid to local communities and stakeholder involvement, leading with consequences for the actions and inactions from local authorities.

More efforts are therefore needed to promote the potential of new approaches to coastal risk management that can re-establish co-evolutionary relationships between human settlement and coastal environment and can provide a key element of national adaptation policy.

Authors contribution

G. Motta Zanin: Conceptualization; Methodology; Writing – Original Draft (Sect 1, 2, 5); Writing - Review & Editing; Visualization. **A. Barbanente**: Methodology; Writing – Original Draft (Sect. 1); Writing - Review & Editing; Supervision. **C. Romagnoli**: Writing – Original Draft (Sect. 3, 4); Writing - Review & Editing. **A. Parisi**: Writing – Original Draft (Sect. 5); Writing – Review & Editing. **R. Archetti**: Writing – Original Draft (Sect. 3, 4); Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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