

AFTER THE 1972 STOCKHOLM CONFERENCE: 50 YEARS OF COASTAL MANAGEMENT IN PORTUGAL

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INTRODUCTION

Stockholm Conference, held in 1972, represents the first United Nations Conference on the Human Environment. The declaration presented at the end of the conference considered the need for principles to inspire and guide in the preservation and enhancement of the human environment. Past 50 years over this event, some analyses are demanded. Thus, based on Stockholm Conference main proclamation, this work aims to present an evaluation of what was the Portuguese coastal management over the last five decades, highlighting what was done and what is still missing.

STOCKHOLM CONFERENCE

The declaration of the United Nations (UN, 1972) proclaimed that it is the duty of all Governments to protect and improve the human environment, as affects the well-being of peoples and economic development. UN (1972) stated 26 principles and 109 recommendations. No special attention was given to the littoral, but several management and planning policies are highly connected to coastal zones, mainly considering principles 2, 13, 15 and 19, among others. Reference to coast are only explicit when referring to pollution.

Principle 2 states that the natural resources of the earth, including water and land, must be safeguarded for the benefit of present and future generations through careful planning or management. Principle 13 considers that States should adopt an integrated and coordinated approach to their development planning so as to ensure that development is compatible with the need to protect and improve environment for the benefit of their population. Principle 15 refers that planning must be applied to human settlements and urbanization with a view to avoid adverse effects on the environment and obtaining maximum social, economic and environmental benefits for all. Principle 19 states that education in environmental matters, for the younger generation as well as adults, giving due consideration to the underprivileged, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving the environment in its full human dimension. It is also essential that mass media of communications avoid contributing to the deterioration of the environment, but, on the contrary, disseminate information of an educational nature on the need to protect and improve the environment in order to enable man to develop in every respect.

In summary, transferring the UN (1972) to a littoral perspective, it can be understood that sediments are a limited natural resource at sandy beaches under erosion and that the adequate strategies to consider, to guaranty safeguard and careful planning and management, were not defined at the time. It is needed to include all the stakeholders in the decision-making processes to achieve a compatible development of the coastal zones.

It is also highlighted that since 1972, “benefits” are referred in several principles. However, the way to quantify and compare social, environmental and economic benefits is not clear.

PAST PORTUGUESE COASTAL MANAGEMENT

Portugal is bordered by the Atlantic Ocean along an estimated length of 987 km, being part of one of the most affected coastlines worldwide by the erosion phenomenon. Presently, shoreline evolution is mainly conditioned by the energetic wave climate, the presence of numerous manmade structures and the progressive weakening of the alluvial sources, nowadays responsible for the retention of approximately 80% of the sediments that could be potentially transported in natural conditions (GTL, 2014). According to Marinho *et al.*, (2019), during the past few decades, the difficulty of reconciling the safety of people and assets with the benefits offered by natural coastal resources has been exacerbated. Part of this situation is mainly attributed to the growing population density near the coast (with 75% of the inhabitants living in coastal municipalities), increasing capital investments (in coastal defense) and the previously referred failing in river sediment discharges (EUrosion, 2006; APA, 2016). Thus, considering the previous, the cost of coastal erosion mitigation actions has been increasing. Between 1995 and 2014, public expenditures dedicated to coastline protection against the risk of erosion and flooding have reached an estimated amount of 196 million euros (M€), whereas the cost of repairing the damage caused by the major storms from January to March of 2014 has totalized approximately 23 M€ (Figure 1).



Figure 1 - Example of coastal damages registered at Furadouro beach, NW Portugal, during the 2014 storms.

Presently, 14% of the Portuguese shoreline is protected by artificial structures, including groins, longitudinal revetments, breakwaters and harbor infrastructures, which adds up to around 140 km of the coast. These coastal defense structures were mostly implemented since the 1970's and were essentially focused on maintaining the shoreline position. However, it is observed a recent paradigm shift, with the artificial

nourishments becoming a favorite mean to mitigate erosion and maintain the coastline (Pinto *et al.*, 2018). In fact, mainly during the last decade it was observed a general increasing tendency to favor environmentally friendly coastal protection solutions through sand nourishments and reinforcement of dune systems. Artificial nourishments have arisen as a high-potential alternative, passive to be applied in some locations, although their potential effects have not been well quantified yet.

PORTUGUESE POLICIES ACTUAL TRENDS

From economic, cultural and environmental point of views, Portuguese coastal areas still face multiple challenges and conflicts which demand a deep restructuration interfering with the coastal management policy, the functionality of the governmental services and the responses to the society/affected citizens. Any action affecting coastal areas should look for a balance between enhancement of the land use and preservation of the environmental values. This implies necessarily some qualitative and quantitative understanding of the coastal morphological processes, as a precondition for a successful coastal management project, so all the parties concerned can be in position to understand not only the past, but also how the present situation has developed and how to anticipate future evolution tendencies. Thus, increased knowledge about Portuguese coast (monitoring and the development of advanced studies), involving stakeholders in the decision processes (participatory approaches), also supported by cost-benefit assessment studies are recent trends in Portuguese coastal policies.

Continuous monitoring was achieved with COSMO (2022) programme, which includes topographic and hydrographic surveys applied to previously selected sites, presenting great vulnerability and exposure of people and assets to hazard. COSMO, "Coastal Monitoring Programme of Continental Portugal" is a programme designed and developed by the Portuguese Environment Agency (APA) and consists of collection, processing and analysis of information on the evolution of beaches, dunes, nearshore seabed and sea cliffs along the Continental Portuguese coastline. Systematic and identical, standardized surveys, are used for data collection, processing and analysis applied to the coastline. The COSMO results are essential for timely and informed decision making on the coast, contributing to the optimization of coastal management and planning (COSMO, 2022).

Very recently, Portuguese Environmental Agency asked for studies on alternative solutions for the Atlantic coast (bypassing systems and detached breakwaters), discussing the costs and benefits of their implementation in a medium to long-term perspective. The feasibility study of sand by-passing at Aveiro and Figueira da Foz tidal inlets aimed to evaluate a sediment by-passing system (Figure 2), discussing the technical solution and the economic impacts, including a cost-benefit assessment. The study included a historical analysis of the evolution of the shoreline and nearshore morphology, before and after interventions, and provided elements that have contributed to decision-making on the

sediments by-passing at the Aveiro and Figueira da Foz tidal inlets. The study has also presented a discussion on the volume of sediments to be transposed and their place of deposition. As referred, the definition and comparison of technical solutions for sediments transposition included cost estimates and a cost-benefit analysis (Coelho *et al.*, 2021).



Figure 2 - Example of a sediments by-passing system at Golden Coast, Australia.

Other recent study demanded by the Portuguese Environmental Agency corresponds to the feasibility study of a detached multifunctional breakwater in front of Praia da Vagueira, at the Northwest coast of Portugal (Sancho *et al.*, 2022). This project main objective was the characterization and definition of parameters of sizing and location of a detached breakwater, in front of Praia da Vagueira (Figure 3).



Figure 3 - Praia da Vagueira, NW Portugal, where the construction of a new detached breakwater was evaluated.

It was intended that this breakwater should be multifunctional, fulfilling the following objectives in order of priorities: i) to reduce the risk of coastal overwashes in the urban front of Praia da Vagueira; ii) to promote the possible increase of the beach in front of the rocky revetment, reinforcing the natural defense against the erosion and coastal flood and increasing its greater recreational use by the population and bathing security; iii) create physical conditions to promote reference surf waves, boosting the economy associated with this activity. The study aimed to present alternatives and solutions for a detached breakwater, a preliminary solution scheme and its location, the indication of the main conditions and information on the possible need to obtain additional

elements for the execution of the project. It is highlighted that both studies included a cost-benefit assessment, considering the definition of economic values to the interventions and to the land/services/ecosystems, weighting environmental, cultural, social and historical aspects.

Finally, participatory approaches are being adopted in innovative projects that involve stakeholders, who assess different options, create meaningful debates over important assumptions (INCCA, 2022; COAST4US, 2022). This represents more knowledge among the stakeholders, serving on the management of the littoral. INCCA - INtegrated Coastal Climate Change Adaptation for Resilient Communities aims to reduce the vulnerability of coastal territories and increase the resilience of local communities, defining a Coastal Adaptation Action Plan to the case of the pilot study, on the coast of the municipality of Ovar, NW Portugal. Adaptation approaches that integrates short (2030), medium (2050) and long term (2100) perspectives, considering the social, environmental, economic and engineering dimensions are still scarce. Decision-making entities should devise action plans for implementing sustainable and long-lasting strategies. Thus, the main objectives of this project are to conduct a cost-benefit analysis of intervention strategies for the Portuguese coast in those different time horizon perspectives, assessing social and environmental impacts at the local level of the Adaptation to Climate Change options and involving local populations and stakeholders through workshops in order to develop a participatory and economic model (Figure 4).



Figure 4 - Participatory workshop developed in the aim of the INCCA project.

COAST4US - Application of the COAST tool to the Portuguese coast, aims to develop a study about the technical and economic potential of the application of the COAST tool - a software to perform cost-benefit analyses. This tool contributes to a more efficient coastal planning, helping public and private entities (Coelho *et al.*, 2020). The project discusses several different intervention scenarios to be tested at three coastal stretches highly vulnerable to erosion: 1) São Jacinto - Gafanha da Boa Hora; 2) Cabo Mondego - Cova Gala; and 3) Cova do Vapor - Cornélia, in Costa de Caparica. The intervention scenarios are being discussed with the central government and the local authorities, representing another example that combines a participatory approach and a cost-benefit assessment in a medium-term perspective (20 years).

CONCLUSIONS

In 1972, Stockholm Conference outputs pointed out the importance to preserve the environment. The Portuguese coastal management along the last 50 years experienced different strategies to achieve that goal. Presently, its evident the importance of monitoring, integrated studies, combining social, economic and environmental aspects, stakeholder's involvement, education and dissemination. However, Portuguese coastal areas still face multiple environmental challenges and conflicts, which continuously demand for an adequate coastal management, looking for a sustainable future.

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