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Dealing with expertise and non expertise knowledge about coastal risk

Santos L.I.V.^{a *}, Tavares A.O.^b, Antunes do Carmo J.S.^c

^a Ph.D student, University of Coimbra, 3030-788 Coimbra, Portugal

^b Assistant Professor, Department of Earth Sciences, Centre for Social Studies, University of Coimbra, 3000-272 Coimbra, Portugal

^c Associate Professor, Department of Civil Engineering, University of Coimbra, 3030-788 Coimbra, Portugal

Abstract

The Portuguese coastal zone is of major importance to the level of national economy and to the environment, and supports a huge biodiversity and landscape. However, there has been a significant population increase within the coastal zone generating strong pressures on the environment; which thus becomes progressively weaker.

To prevent and anticipate potential problems due to a lack of knowledge, or the inability to intervene and minimize impacts, this work makes a survey of three perspectives for the coastal zone of the Portuguese central region: scientific, technical and political, and another one emerging from citizens and communities.

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1. Introduction

The Portuguese coast has a high geomorphological diversity, dominated by beaches, cliffs and major wetlands, and assumes a widely recognized environmental and socio-economic importance. However, it also includes enormous fragility and different risk situations, which have been increasingly aggravated (MESPRD, 2007). More precisely, the west coast of Portugal is exposed to maximum tidal ranges around 3.6 m in relation to hydrographic zero (HZ), and significant storm heights of about 9.5 m HZ to a return period of 5 years (Ferreira & Dias, 1997). To promote the proper stewardship of the coastal zone, knowledge, respect and mutual understanding of the different perspectives are necessary (Kamphuis, 2005). Thereby, this paper considers three perspectives: scientific, technical and political, and another one about the citizen's perception. This work aims to diagnose, predict and anticipate the main future problems, mitigate their impacts, and contribute to the safeguard of a sustainable development and protection of the extensive Portuguese west coastline, of about 840 km, and its irreplaceable resources.

2. Study area

The coastal area portrayed in this work belongs to the central region of Portugal, more specifically to the lower Mondego River. This region includes the counties of Mira, Cantanhede and Figueira da Foz (Figure 1), which stand,

* Corresponding author (*). Tel.: +351 239 797 153
E-mail address: lara@student.dec.uc.pt

in certain urban areas, very close to the sea, like Praia de Mira, Palheiros da Tocha, Praia de Quiaios, Buarcos, Figueira da Foz, Cova-Gala, Costa de Lavos and Leirosa (from north to south). This piece of land has an area with approximately 56.5 km along the coastline, consisting of extensive sandy beaches in contact with low-lying dune systems, excluding the area of Cabo Mondego, dominated by active cliffs between Praia de Quiaios and Buarcos. All existing dune systems present a high vulnerability index, according to Andrade *et al.* (2002). There is also an important wetland, the Mondego estuary, between Figueira da Foz and Cova-Gala.

Currently, urban areas of Praia de Mira, Cova-Gala, Costa de Lavos and Leirosa are the most affected by erosion processes. This dune system is practically destroyed as a result of intense maritime agitation (storms and spring tides) and human interventions at the north (by groins and jetties), and are also threatened by coastal flooding and waves overtopping. All of these factors contribute to the higher vulnerability of the dwellings and other properties located at lower levels. In turn, the opposite situation is found at north of Cabo Mondego (a natural barrier) and also at north of Figueira da Foz jetties, where sand retention occurs on the updrift side (Palheiros da Tocha and Quiaios, Buarcos and Figueira da Foz).

3. Methodology

To prevent and anticipate potential problems over the lack of knowledge or inability to intervene and minimize its impacts, this work makes a survey of the three perspectives that have been implemented to analyze the recognized processes and impacts in the coastal zone of the Portuguese central region. From a set of several scientific and field works, by different authors, the main problems leading to a diagnosis were identified. A second approach considers Plans of Land Use Planning and Management Plans, involving the technical perspective and policy, at a regional and national administration levels. A third perspective is the result of interviews made to residents. According to an Italian research (interviews), coastal visitors (tourists and citizens), although informed, tend to reduce the number of visits to eroded and to artificially protected beaches, choosing other beaches (Polomé *et al.*, 2005).

The scientific approach considers several studies related to the sediment deficit (Lopes, 2003), the coastal erosion susceptibility index (Ferreira & Dias, 1997), the coastline evolution (Menezes, 2011) and also advantageous solutions, promoting the sustainable development of the Portuguese coast (Antunes do Carmo & Marques, 2003). The political and technical approach presents some aspects of the Plan for Coastal Zone Planning (PCZP), the Plan for Regional Spatial Planning of the Central Region (Central Region PRSP), the Coastal Zone Management Plans and also the Municipal Emergency Plans for risk management. For the third approach, 72 questionnaires were administered to residents in the coastal central region of Portugal between March 27 and April 19, 2012, with a total of 18 questions in order to qualify the location of dwellings, and the risks of sea proximity and their consequences.

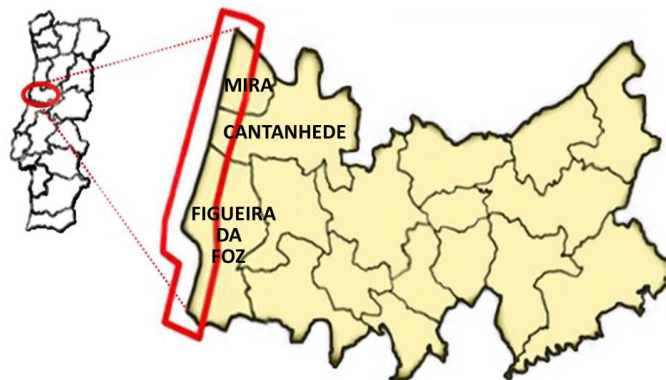


Figure 1. Geographical and administrative framework of the study area.

4. Database

4.1. Scientific approach

Nowadays there is a tendency for the coastline retreat, which depends primarily on dams built in rivers, rivers regularization works, widespread extraction of sand and still, and human interventions due to the construction of coastal protection structures. According to Ferreira & Dias (1997), a very high coastal erosion susceptibility index is located at the downdrift side of the groin located at south of Praia de Mira, while lower indexes stand out in Praia de Quiaios, Palheiros da Tocha and Praia de Mira north, being the latter covered by retention effect in the updrift side of the groin. The short-term rates evolution of the shoreline (1995-2010) confirms the erosion due to interventions in the north, reaching Praia de Mira. Between southern Praia de Mira and northern Praia de Quiaios (1998-2007) positive accretion rates were found (Menezes, 2011). At south of Figueira da Foz (Cova-Gala, Costa de Lavos and Leirosa), an increasing sediment deficit and consequent coastal regression (Lopes, 2003) due to the jetty construction and the dredging operations in the river Mondego estuary has been verified.

In order to mitigate such effects, advantageous and natural solutions are being considered; some of them are: i) artificial feeds of sands, ii) transposition of sands (bypass) from updrift to downdrift in places where long groins were installed, iii) making use of continental shelf sediments for supply to beaches and to dune systems, iv) deny authorization of new groins construction for fishing ports or recreational activities (Antunes do Carmo & Marques, 2003) and, finally, v) relocation of populations.

4.2. Political and technical approach

Successive public policies addressing the coast announced great programs and funding sources, such as the Littoral Program (1998) and the Finisterre Program (2003), in which there was only a mere statement of objectives, without significant impacts. Other instruments, developed in the 90's and in the last decade, as the River Basin Management Plans and PCZP have also failed to produce any significant results in terms of controlling the coastal erosion. More recently, the National Strategy for Integrated Coastal Zone Management (2009) highlights several positive aspects, such as deepening of scientific knowledge, development of mechanisms and networks for monitoring and observation, and strengthening and promotion of institutional coordination. It is believed that this instrument will succeed despite the uncertainty of funding sources and timing of different actions (Antunes do Carmo, 2012).

According to the Central Region PRSP, a very high erosion index on portions of the system beach/dune at north of Praia de Mira and between Cova-Gala and Southern Leirosa, and high levels of susceptibility in the stretch of cliffs of Cabo Mondego (more precisely in Murtinheira, at north) have been verified, and associated with mass movements. Regarding the susceptibility caused by marine pollution stress, a high index at the Mondego river estuary and at the coastal area in Praia da Leirosa, and a moderate to high index at Buarcos and Leirosa have also been identified (Tavares *et al.*, 2007). The Municipal Emergency Plans (Mira, Cantanhede and Figueira da Foz MEP's) point out and characterize some of the risks that devastate the coastal zone, including marine pollution, sea invasion, coastal erosion and possible occurrence of tsunamis, highlighting the high probability of flooding of urban and agricultural lands, based on MCPS (2006, 2009a and 2009b).

4.3. Approach of citizens and communities

The survey related to the citizens' perceptions denote that the respondents have dwellings near the sea, being distributed according to Figure 2. The respondents consider themselves well informed about the dangers inherent to sea action (about 86%), resulting from knowledge transmitted by relatives (31%), curiosity (27%), work in the area and professional interest (24%), knowledge through media (10%) and through local administrations, Municipalities and Associations / Organizations (8%). About 94% of the respondents consider that there are uncontrollable

processes related to the sea that may affect the place of residence and nearby structures, mainly the destruction of the dune system, the overtopping waves, the sea level rise and the maritime agitation.

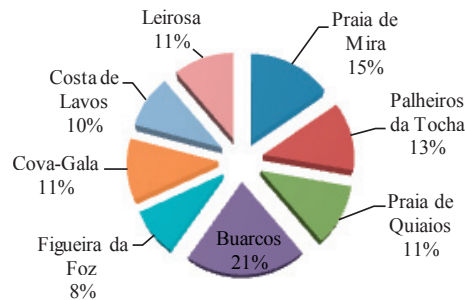


Figure 2. Spatial distribution of the respondents' dwellings location.

Figure 3 quantifies the consequences of the processes considered by the citizens taking into account the dwellings locations. Despite this perception, only 14 respondents reported that they were affected by any of these processes, including the dunes erosion at Praia de Mira, floods in Praia de Mira, in Buarcos and Cova-Gala, overtopping waves in Buarcos and, with higher incidence, maritime agitation at Praia de Mira, Figueira da Foz, Costa de Lavos and Leirosa. In a comparative analysis with the registered cases along the past 10 years, citizens living in Praia de Mira, Cova-Gala and Lavos Leirosa claim that they have been increasingly exposed to the dangers of the sea, due to global sea level rise (associated to climate changes), intensification of maritime agitation (mainly in winter), aeolian cuts in dune systems, and human interventions that cause sand reduction in the beaches, as well as the destruction of the dune systems and its flora. However, in Praia de Quiaios and Palheiros da Tocha, respondents state that the sea is calm, and that a large accumulation of sand to the updrift side of jetties occurs in Figueira da Foz. Respondents argue that if there is disruption of the dunes by the sea, the dwellings and other properties in Praia de Mira, Tocha, Cova-Gala, Lavos and Leirosa will be strongly affected and accompanied by severe losses of territory. The crop fields may also be affected, mainly near to Praia de Mira and Leirosa, and a degradation of water quality may occur. The accessibilities and beach facilities in Buarcos and Palheiros da Tocha can also be compromised.

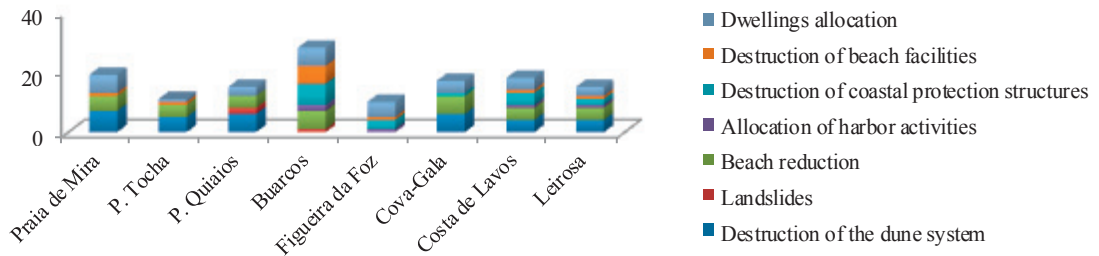


Figure 3. Consequences of the processes related to the sea mentioned by citizens.

Regarding the effectiveness of coastal defense structures (groins, breakwaters and jetties), approximately 49% of citizens consider them to be effective (locally and in the short-medium term), since they enhance sand accumulation and reduce the destructive force of the sea. Meanwhile 45% consider these kinds of defenses ineffective because they are in insufficient number and produce adverse effects along 20 km to the south. Finally, some protection alternatives have also been suggested, such as the public awareness for the potential hazards, ways to proceed in cases of occurrences, the dune system reconstruction (Praia de Mira and Leirosa), the construction of a surf zone - reef (Praia de Mira), the placement of rock armour (between Cabo Mondego and Buarcos), the construction of a bypass system that allows the passage of sand to the south of the harbor jetties of Figueira da Foz, the construction of a smaller jetty (between Costa de Lavos and Leirosa), the construction of a breakwater to protect the dune system

and outfall (south of Leirosa) and, lastly, the need for a harmless attitude of Man regarding the sea, since the operations performed have counteracted the natural tendency has been highlighted.

5. Conclusions

It is clear that there is a certain inconsistency in the diagnosis made by the various analysis groups. While academics underline the importance of the processes retroactivity, in which structural mitigation actions are relevant, the responsible technicians for the coast management establish a diagnosis focused on the foregoing elements and where the prevention or the appropriate action in emergencies are the most prominent aspects. Despite this distinction, both scientific and technical approaches agree when it comes to identify the most sensitive areas to the processes of coastal erosion, at north of Praia de Mira and south of Figueira da Foz (covering Cova-Gala, Costa de Lavos and Leirosa). Moreover, people show an increasing concern and a high level of risk perception, whether they support structural coastal protection, or consider that the present structures are effective. There are however local perception differences, as residents in Praia de Mira, Cova-Gala, Lavos and Leirosa refer that they are being increasingly exposed to the dangers of the sea when compared to the last 10 years, due to rising sea level and the consequences of coastal works (with intense destruction of the dune system and retreat of the coastline). The residents of Praia de Quiaios, Palheiros da Tocha and Figueira da Foz have inverse opinions because they have witnessed episodes of sand accumulation (marine accretion).

In final conclusion terms, it can be considered that we have been witnessing a certain consistency of strategic arguments of structural mitigation proposed by scientists and seen as trustworthy by the population. However, public policy-planning measures of risk prevention, or relief, emphasize the local contrasts emerging from risk perception, and are less recognized by citizens. These actions have arguably no place in top-down policies of coastal management. These remarks highlight the need for the involvement of different knowledge and perceptions in the management of the shoreline, as well as the creation of communication platforms among different actors (citizens, communities, enterprises, governmental and non governmental organizations and universities).

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