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Erosion Perceptions, Beliefs and the Sustainability of coastal areas: an individual or collective endeavour?

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Abstract

Coastal erosion (CE) is a phenomenon that has undergone a conceptual evolution. Nowadays, it is considered a physical and social process that is scientifically studied, quantified, and technically mitigated. It may also be approached by following the individual/collective perceptions of coastal communities. Risk and vulnerability associated with CE may also be addressed by considering different aspects that require a differentiated and trans-disciplinary analysis. A gap regarding the social perception of CE in Portuguese coastal communities was detected in the literature review. Therefore, the initial questions and aim of this study are, as follows: to research the social perceptions of CE and to understand how they impact public decisions/participation aimed at mitigating CE. The purpose of this research, supported by a hypothetical-deductive-approach, is exploratory and followed a multiple-case study strategy. The study was conducted using a mixed methodological paradigm (qualitative and quantitative). The Paramos/Espinho and Costa-da-Caparica cases, which differ environmentally, geographically and socioeconomically, were selected. Social and environmental vulnerability indicators were determined through the Analytical-Hierarchy-Process. These indicators were used to structure/draft the exploratory interviews and a questionnaire. These were applied to three categories of stakeholders: politicians/decision-makers, presidents of recreational associations and fishermen/inhabitants; all chosen by convenience sampling. The interviews identified both the historical and current perception of CE, as well as the public-institutional interaction within the scope of the planned/executed interventions targeting the mitigation of this problem. The questionnaire also revealed memories of damaging events, recognition of the causes of CE and sea encroachment, identification of risk perception, and understanding of the feedback about the strategies developed for mitigating erosion. The results showed that the perception of CE was derived from constructed experience and social memory. For the participants, the erosion «issue» is a serious daily problem. They identified risks and mentioned natural causes that are magnified by both climate change and human causes. Disengagement of the state through inefficient decision-making, inadequate construction and maintenance of defence structures, and through their laxness regarding building new constructions were all mentioned as significant examples of human causes. Participants highlighted the authorities' lack of sensitivity towards traditional knowledge and their lack of will to welcome/integrate the contribution participants' experience could make. The main contribution of this work resides in the empirically based development of a model for the social perception of CE, by positioning vulnerability in the context of CE. The perceived vulnerability/risk was deemed to result not only from CE, but also from a variable and dynamic context-specific framework, and from internal/external factors that were identified.

Keywords: Coastal erosion, social perception of risk, public participation, sustainability and social inclusion.

1. Introduction

The subjects of “global warming” and “climate change” have become part of both the popular lexicon and public discourse. By the start of the 21st century, it had become clear that climate change would bring serious harm to many regions, though to some more than others. Indeed, climate change could put additional stress on coastal areas, which are already affected by human activity, pollution, invasive species, and storms.

The problem of coastal erosion is becoming more acute in Europe. Several publications discuss pressure situations and more or less severe erosion processes along the entire coastline (Anthony et al, 2013; EUCC, 2004; EuroSION, 2004; Randazzo et al, 2013). They point to critical situations together with the densification of coastal urban areas partly due to successive waves of human migration towards coastal areas and estuaries. Nowadays, about 70 million of the 455 million people in 25 European Union countries (16% of the population) live in coastal areas (EuroSION, 2004). These are, surely, the most threatened communities due to their vulnerability to the sea, coastal erosion and flooding.

Although these issues have merited considerable international attention in recent years – with studies emerging from affluent countries (the United Kingdom and the Netherlands) and developing countries (the Caribbean or Pacific Islands) (Pranzinni et al, 2015) – in Portugal, literature is still scarce or nonexistent (Almeida, 2015). This research, therefore, intends to contribute towards broadening our knowledge about the perception of coastal risks, by studying two coastal populations that correspond to some of the most critical areas in Portugal, via both their vulnerability, and the urban pressure they have been subjected to.

The environmental and social aspects of coastal erosion

The coastline is a valuable biophysical support and, today, coastal areas fulfil important social, economic, and ecologic functions, with the most relevant being: i) protecting people and human assets against storm surges and saltwater intrusion; ii) creating jobs and improving quality of life; iii) absorbing land-based nutrients and pollutants draining from rivers to the sea, and iv) the feeding of fishes, crustaceans and birds. Due to this wealth of opportunities, the coastline became the target for mounting pressure from anthropic activities: from growing urbanisation, to sediment extraction for civil construction and the intensive use of natural shorelines for recreational and tourism purpose. All these activities have had a serious negative impact, environmentally and socially speaking (Gomes, 2007).

At the same time, and unrelated to this human pressure, coastal areas are subjected to physical processes resulting from storm surges and waves, thereby making coastal erosion a natural process through which the coastline adapts to tidal variations, energy levels imposed by undulation and ocean currents, the transport of sediments, the existing topography and the rise in sea level due to global warming. However, these processes have risen in intensity and frequency over recent years, putting at risk the population, urban, industrial, and tourist infrastructures, agricultural land and natural habitats (Dias, 2005). Over the past few decades, coastal erosion has been increasing worldwide, and many sandy coastlines, on a global scale, have been receding intensely (EUROSION, 2004).

Although coastal communities have always had to adapt to the dynamics of coastal areas, due knowledge of the social aspects that are affected by erosion has not accompanied this adaptation, nor has knowledge of the social perceptions of risk. This gap has become rather pertinent, particularly when taking into account the current era of limited budgets, economic hardship and difficult decisions regarding resource allocation.

Past coastal interventions directed at mitigating the risk of erosion and coastal flooding took place in direct response to social wishes and were expressed through the political system of public works, following legislation and protocols designed to be applied in the wake of high-intensity coastal incidents (Falk and Crouse, 1988). Nowadays, decision-makers are

increasingly aware that the robustness of public policies directed at this problem depends upon a holistic understanding of the coastal environment. Quite apart from the environmental and economic aspects, such an understanding must include human values: people's preferences, culture and traditional knowledge, i.e., human dimensions.

This terminology, "human dimensions", refers to knowing how and why human beings assign relevance to the feeling of belonging to a place, value natural resources, intend that they be managed, and in what way humans affect or are affected by decisions about the management of natural resources (Loomis and Paterson, 2013). Research on these aspects seeks to understand the human characteristics in order to understand how to incorporate that knowledge into the planning and management of coastal areas (Lertzman, 2009). This research encompasses a variety of ideas and practices, including: (i) cultural, social and economic values of individuals; (ii) individual and social behaviour; (iii) demographics; (iv) legal and institutional frameworks; (v) communication and education); and (vi) decision-making processes in coastal management (Decker, Brown and Siemer, 2001).

With regard to reducing vulnerability to coastal risks and supporting resilient communities, more strategies for adapting to this problem have been created (IPCC, 2007) and, as a result of extreme environmental events, a social movement seems to be emerging that shows there is the will to participate and collaborate in coastal area management programmes. Traditional knowledge about coastal environmental phenomena, as well as their impact on the coastline, has been enriched throughout the years by the experience of communities that have resided in risk-prone coastal areas for decades, as well as by all the information available online and now in their possession. These facts, according to Delicado, et al. (2012) allow and justify the option of adding the public's voice to specialist opinions.

Anthropic factors vs. coastal erosion in Portugal

The coastline of Continental Portugal, in terms of physiographic alternation and shore types, exhibits great contrasts and high dynamism (Araújo, 1998). If we add the predictions for climate change and the rise in sea levels (IPCC, 2007) to this complexity, it becomes clear just how difficult it is to have effective decision-making regarding the sustainable management of the coastline. According to Santos and Miranda (2006), it is estimated that climate change will aggravate this phenomenon due to the changes it inflicts on wave patterns and the rise in sea levels. In Portugal, one of the European countries most affected by coastal erosion, the sea level increased by about 15 centimetres throughout the 19th century, which is a number close to the global average. Recent studies (2012; Santos, 2012) indicate that it may rise by up to 1 m by the end of the century, which would clearly transform the morphology and occupation of coastal areas, and demand robust adaptive measures.

The Portuguese coastline is in faster recession, reaching erosion rates between 1mm/year and 10m/year, depending on shore type, the characteristics of human occupation, the intensity of sea disturbance and the coastal engineering structures that are in place (Freitas, 2010). As examples, let us take the following areas: to the North, in the region between Oporto and Aveiro, the coastline section between Vagueira and Mira lost 26 metres of beach between 2002 and 2010 (Bernardes, 2010); in the Centre, in Cova do Vapor (Costa da Caparica), the beach receded 26 metres per year from 1999 to 2007 (Pinto et al, 2007), and in the South, namely in Faro and East of Quarteira, the beach receded an average of 6 metres per year between 1991 and 2001 (Oliveira et al, 2005).

This erosion stems from several natural factors but also from human action over the territory. Over recent centuries, anthropic activities in the country have become as important as natural factors (through the amplification or minimisation of their effects) in modelling the seashore, and have contributed to the transgressive behaviour of the coastline. The consequences of this regime in the evolution of coastal areas are reflected in the flooding of riverine plains, the sanding-up of lagoons and estuaries, and in coastal erosion, as exemplified in Figure 1.



Figure 1. Sea impact on the Portuguese coast. (A) and (B) Beach zone and frontal dune area at Costa da Caparica; (C) Espinho beach, a week after artificial replenishment of sand (17/06/2011).

Demographic imbalance and the density of urban construction have accentuated vulnerability factors along the Portuguese coastline. The concentration of population along the coastline reinforces the vulnerability of said population (social vulnerability) to the risk of coastal erosion. Indeed, some 1,300,000 people are estimated to be exposed to the rise in sea levels and oceanic surges, due to their being located at the edge of the shoreline and because, in some cases, urban zonings are located below the average sea level (Craveiro et al., 2012).

In the year 2000, nearly 53% of the population was concentrated in the narrow 10 km of land that stretches along the Portuguese coastline, (DGA, 2000). This same strip of land is where the main urban nuclei are located, and where the major industries are strategically placed (Pires et al., 2012), making this the area of the country with the largest contribution towards the national GDP (DGA, 2000). The results of the 2011 Census indicate an increased tendency for the population to concentrate along the coastline (Census, 2011), exerting particularly intense anthropic pressure in highly sensitive, erosion-prone risk zones (depicted in Figure 2).

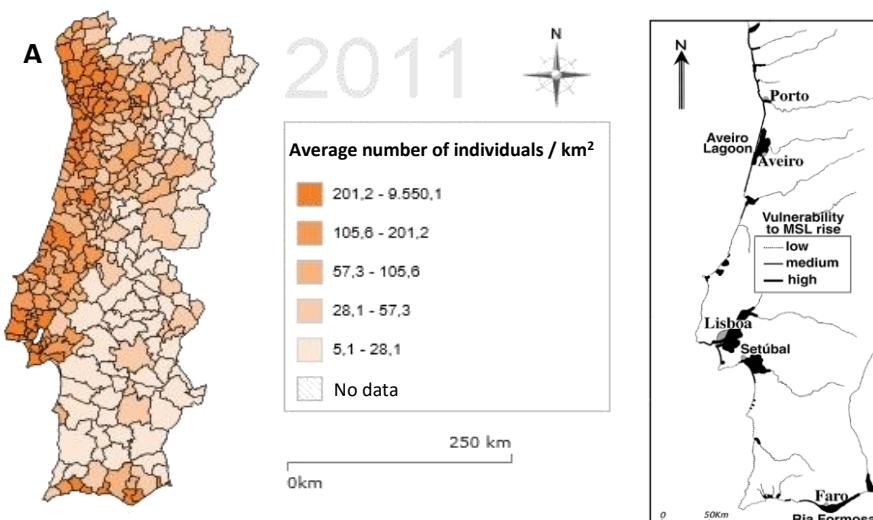


Figure 2. Anthropogenic pressure in Portuguese coastal zones. (A) Population density of Portugal municipalities; (B) Map of coastal erosion vulnerability zones in Portugal. (Source: Censos, 2011)

Estuaries and lagoons are also prone to seawater intrusion but, essentially, it is the sandy strips of the North and the poor protection of low-altitude cliffs that, together with bigger demographic and habitational density along the northern coastline strip, offer the most critical exposure to the risk of coastal erosion and oceanic surges. The vulnerability of coastal areas, as a concept, generally applies to the combined study of the physical, social, economic and political components that influence said system when it is threatened by a specific event, as well as its ability to mitigate such threats and recover, should the event come to pass (Almeida, 2015). As such, evaluating said vulnerability is crucial from the standpoint of present and future integrated management of coastal areas, making it essential to consider matching adverse factors and interests, so that the development model for these areas does not jeopardise future generations' use of resources.

Coastal erosion and the consequent recession of the Portuguese coastline constitute a real problem that has serious social and environmental consequences that frequently require diverse intervention. This intervention ranges from building or repairing coastal defence works, to the artificial strengthening of beaches, or more conflict-prone action such as the relocation of communities residing in areas considered to be at risk. The big challenge is reaching a balance between natural processes and anthropic activities while simultaneously considering the associated risks. If, on the one hand, human intervention contributes to morphologic changes to the coastline and the destruction of habitats and resources, the risk of human activities being affected by the dynamics of coastal processes is, in turn, also significant. The need to establish a balance and to promote integrated management in those areas implies the integration of scientific and traditional knowledge alike in matters pertaining to territorial planning, and to the definition of regional and local strategies for sustainability.

The importance of social perception and knowledge of the causes/effects of coastal erosion

In spite of the serious consequences it brings to populations in coastal areas and to natural ecosystems, coastal erosion and surging/receding phenomena (with consequent exposure and destruction of new terrain) are part of a dynamic system that constantly transforms the shape of the coastline, visible in the short (hours, days, months) to medium term (years, centuries, millennia), or even long term (millions of years) (Table 1). These processes only became important to humans when they became a threat to their existence and/or assets. In the absence of coast occupation, the erosion loses its impact. Nowadays, taking into account the continuous expansion of human occupation of the coastline, coastal erosion has become a serious problem, giving human communities a feeling of loss of territories they had claimed for themselves from the sea, forgetful that in nature nothing remains static and immutable.

Although coastal erosion has been “discovered” and studied by science, and science has dominated the narrative about this phenomenon which derives from climate change and anthropic action, the social sciences provide an unquestionably better approach to the way in which society responds to coastal change, through mitigation behaviour and adaptive strategies (Goodall, 2008)

Studying coastal erosion and its impact on society has evolved from a purely scientific effort to a matter of immediate importance in the political, social, economic and moral spheres (Hulme, 2009). Humans' relationship with the coastline, itself being perceived as a social phenomenon, as indeed it is, was constructed individually and collectively over time, with varying degrees of conflict. These social actors, who claim the right to location and the defence of their history and popular culture, are being increasingly confronted with the phenomenon of erosion, with (sometimes contradictory) scientific reports and results, with remarkable reports and individual/collective perceptions of a seemingly unsolvable problem.

The importance of knowing and understanding the causes and effects of the environmental impact in coastal areas, as well as adequate information about potential intervention, is imperative when under the lens of coastal vulnerability. Such perception may be rooted in: (i)

how fragile the coastline is, in the light of system changes and natural cycles, (ii) the significance of environmental impacts and risks, and (iii) the relative importance of evaluating such impacts as grounds for policymaking (Almeida, 2015). Measuring the environmental impacts and responses, alongside human responses to change, in this triple confluence, and rendering such an evaluation possible, requires the use of indicators that are selected in consonance with the objective of fulfilling all specific, social and environmental criteria necessary for the study.

The vulnerability of the coastline to energetic sea action reflects the sensitivity of those areas. Effectively, the higher the level of the tide and the greater the energy of the waves, the more vulnerable a “natural” coastline will be, and the more quickly it will recede (Alves et al., 1996). If the vulnerability of coastal areas is configured by the capacity for response to a catastrophic scenario, the risk of a coastal area is expressed as a function of the consequences of each situation and of the probability for disruptive events, be they of natural or anthropic origin.

Humans and the environment are mutually dependent on one another. Environmental risks will eventually translate into risks for humans due to their dependency on natural resources and, in turn, the environment is susceptible to situations and impacts of both natural and anthropic origin. Understanding this bi-directional relationship implies that reinforcement measures targeting global vulnerability, as well as the inclusion of strategies for mitigation and risk/catastrophe analysis should be part of the integrated and sustainable management of coastal areas. This should also contemplate aspects derived from both human and natural systems, as well as the applicable risks.

As far as coastal systems are concerned, vulnerability and risk are, indeed, about the relationship between people and the environment, and between the physical environment and socio-political structures that frame the settings people live in. Thus, the concept of vulnerability is a fundamentally ecologic and political one, which integrates not only economic and political power but also the environment (and its transformational power), and the biophysically and socially produced risk. Vulnerability is, thus, a unifying factor in the relationship between humans, the environment, social forces and institutions, and cultural values. Therefore, knowing and understanding the causes and effects of coastal erosion is inextricable from the general economic and political conditions that are very specific and that dominate a certain location. Studying vulnerability should, therefore, happen from a joint, location-centred perspective, as can be observed in Figure 3, wherein the many referenced elements cause and condition the vulnerability of specific locations and their inhabitants, upon interaction.

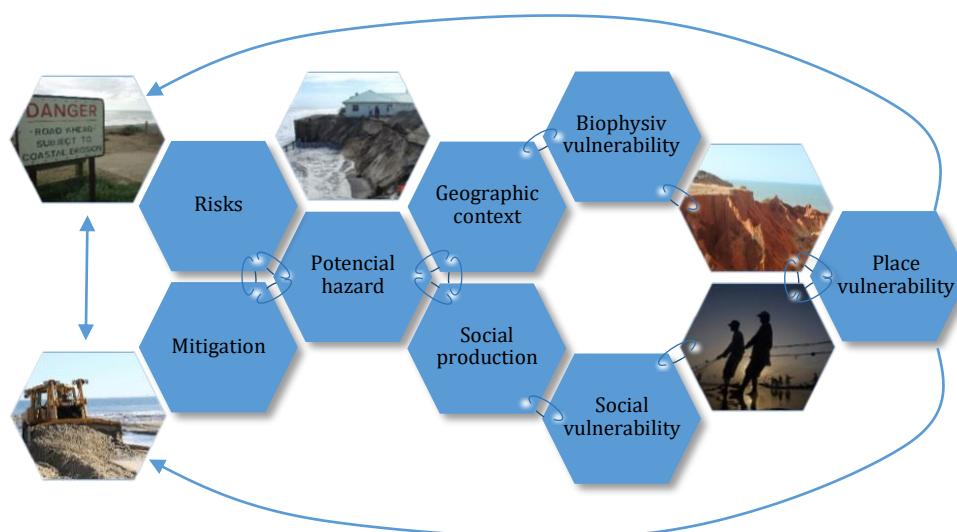


Figure 3. Conceptual model of Hazards of Place vulnerability

The existence of relationships between risk, mitigation actions (responses and adjustments), and location vulnerability is evident (Cutter, 1996), be it biophysical or social. From that perspective, an increase in mitigation actions may signify a decrease in risk and, consequently, of location vulnerability. On the other hand, risk may increase since if there are changes in the geographical context or in social production, they may lead (respectively) to an increased biophysical and social vulnerability, as well as location vulnerability. This process may also be triggered by an increase in potential danger, which may be both a consequence of and a contributory factor to an increase or decrease in the degree of vulnerability (Marandola and Hogan, 2004). Considering that, vulnerability is socially produced, and risk is consequently not uniformly distributed across the social spectrum. This raises the question of whether or not all individuals occupying coastal areas are equally vulnerable to the impacts of erosion, and whether they are aware of it. Through what has been laid out thus far, high degrees of vulnerability reflect a lack of adequate adaptation and, therefore, low resilience. Vulnerability is, therefore, explicitly connected to matters of sustainability, to the environment, the dangers and risks, and to the structure and organisation of society. This, in turn, connects the principles, values, and legitimate interests of citizens, with their need to be safeguarded by the State, in a social reality that changes by the very hand of collective life, over time.

In Portugal, the coastline is at risk. Vulnerability is mounting, and flooding and erosion are prone to an increase as a result of climate change. This situation raises critical questions regarding sustainability, from the perspective of the Triple Bottom Line.

On the other hand, matters such as social justice, social learning, genuine public participation and adequate dispersion of knowledge about both, the causes and effects of coastal erosion, as well as the mitigation strategies to be developed, are paramount to the sustenance of political and public trust. With regard to underlining the importance of the latter, it must be said that public participation, which translates into co-management, requires shared responsibilities between governmental institutions and citizens. Highlighting a process such as this one (bottom up) implies the active intervention of all stakeholders in the decision-making process and is only meaningful if properly explained.

Setting the gap and the research questions

Coastal erosion and the consequent recession of the Portuguese coastline constitute a real problem with serious social and environmental consequences that frequently require diverse intervention. These interventions range from building or repairing coastal defence works, to the artificial strengthening of beaches, or to more conflict-prone action such as the relocation of communities residing in areas considered to be at risk. This situation becomes all the more problematic when said interventions take place in areas where the social impact of coastal erosion is unknown, or in communities that perceive the risk in a very particular way due to its integration in their everyday life.

A gap regarding the social perception of CE among Portuguese coastal communities was detected in the literature review. Thus, the lack of awareness regarding the social impact of coastal erosion and the associated risk to these communities provided the opportunity for research that aims to make an innovative contribution to perceptions and beliefs about coastal erosion, and the sustainability of coastal areas.

Therefore, the initial questions are as follows:

RQ1: How do coastal communities perceive and evaluate the risk of coastal erosion and how do they act in regard to that?

RQ2: How does the social perception of the risk of coastal erosion affect public participation and inclusion in the decision-making processes regarding environmental issues?

To sum up, the phenomenon under analysis in its three dimensions – (i) the social impact of coastal erosion in human communities along the coast; (ii) the impact of anthropic pressure on the coastal zone; and (iii) the social perception of risk – expressed by the gap – is the research opportunity itself, i.e., the unawareness of the social perceptions about the risk of coastal erosion. We also seek to understand how those perceptions influence public participation in the decision-making processes concerning social/environmental issues.

2. Methods

Research on the perception of risk and social vulnerabilities was conducted in two Portuguese coastal communities, in different locations (Figure 4), namely: in Paramos/Espinho (Northern region) and in Costa da Caparica (Centre/South). Both locations are former fishing villages that became tourist destinations, and are considered to be extremely vulnerable to coastal erosion with high rates of shoreline recession in recent decades. In both of them, tourism and urban pressure brought about the need to protect the shoreline with rigid defence structures. Groin-fields were built during the 60s and 70s, creating conditions for greater human occupation and pressure, while at the same time amplifying the shoreline recession downstream (Craveiro et al, 2012).

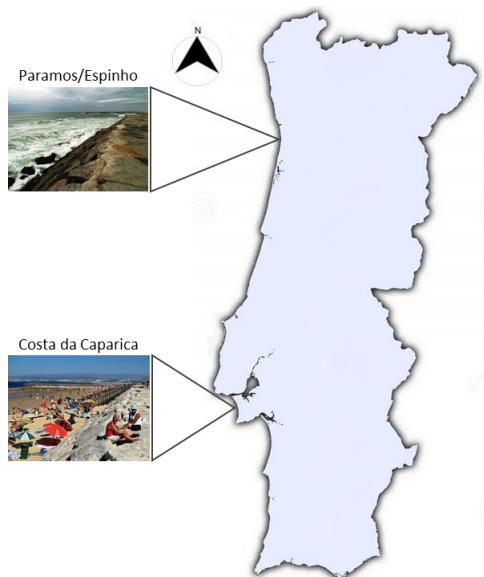


Figure 4. Portuguese geographic localization of Paramos/Espinho and Costa da Caparica

The results of this paper are based on two methodologies. On the one hand, a qualitative methodology based on 18 semi-structured interviews conducted in the two areas under study between September 2013 and July 2014 was used. For each case-study, a group of regional institutions in charge of managing these territories was selected (Regional Hydrographic Administrations, boards of protected areas, port administrations, Civil Protection), along with local institutions (city councils, parish councils), Environmental NGOs, as well as people with direct interests in the coastline (associations of residents and local entrepreneurs, tour operators, owners of sea-front restaurants), and those who depend on the coast for their livelihood or whose identity is strongly bound up in it (fishermen, surfers). On the other hand, with the objective of obtaining opinions that are representative of the population of all areas, we used a quantitative approach that comprised a survey carried out on a representative sample of both locations ($N=100$), in July 2014.

We collected both qualitative and quantitative data given that this approach is highly appropriate for sustainability research (Flick 2006; Bryman 2001).

The objective of these two approaches was to glean the public's perception of coastal risks and vulnerability of the “natural” coastline, what they knew about coastal mitigation interventions and how they evaluated both them and the actions taken by the institutions responsible for them. It was also to find out their involvement and participation in decision-making processes, and also their perspectives on the future of the coastline, namely regarding financing solutions and alternatives for territory management.

3. Results

The problem of coastal erosion is not only a question of keeping a register of extreme events that are more or less distant from the present generation, but it is more to do with ensuring the safety of urban communities that need an increasing density of engineering works to protect people and property from the advancing sea. And it is not so much the problem of rising sea levels or the possibility of overtopping coastal events, but much more the problem of urbanized land progressing towards the sea, the expansion of urban land use and other human occupations, and the increasing artificiality of the land in this land-sea interface.

Variation rate in soil occupation

Studying the variation in soil occupation in Espinho and in the area of Costa da Caparica over two decades, with recourse to the Geographical Information Systems (GIS), has shown a big growth in urban areas towards the sea in this period of time. This growth consequently increased anthropic pressure on the coastline, thus elevating the level of risk in those areas where the population either wants to establish itself, or has no desire to leave. In Costa da Caparica, houses - for first or second homes - hotels, restaurants, campsites, have been built increasingly closer to the coastline. This has changed the costal landscape from a small fishing community to a high-density urbanized area, whereas in Paramos/Espinho, a cluster of the old fishing community remains in the dunes, near the seashore.

Three levels of risk/vulnerability were identified – minor, medium and major – with direct and proportional relation to anthropic pressure, marked in Figures 5 and 6, which schematizes the variation rate in soil occupation in Paramos/Espinho and in Costa da Caparica respectively.

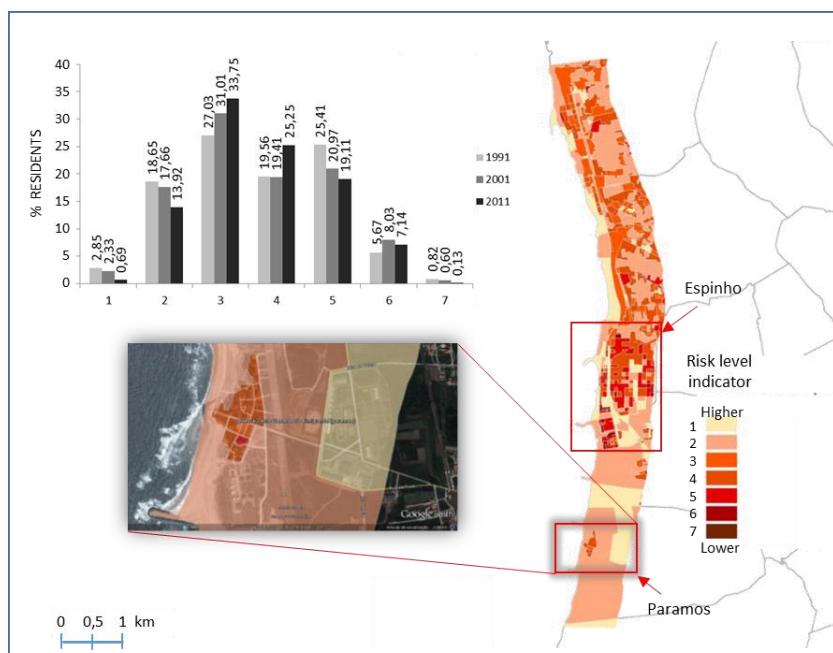


Figure 5. Land cover and risk level in the area of Paramos/Espinho.

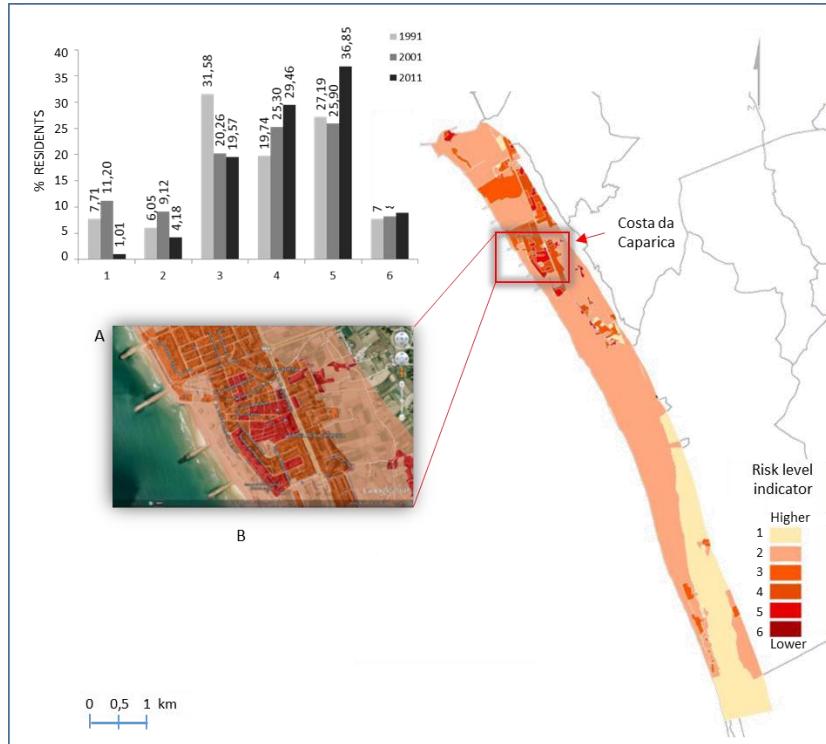


Figure 6. Land cover and risk level in the area of Costa da Caparica.

Both case studies also reveal to what extent the risk of coastal erosion may coincide with social stratification. The areas most subject to coastal erosion processes are where the older population is concentrated, where there are lower levels of education, greater economic dependence and, therefore, more vulnerability

Marine transgression perceptions and its relation to coastal erosion increasing

In order to enable good coastal management, the population must be involved in it, which is why it is fundamental to understand how the public faces coastal risks, namely the public's perception of the risks of erosion and its respective causes.

The results of the survey reveal that most respondents attest to an increasing advance of the sea over the land, which they attribute to coastal erosion. This is often acknowledged not metrically but through points of reference, which have been submerged by the sea, over time.

- *Houses retreated, there were people who lived nearer the front, then they went farther and farther back (Paramos/Espinho resident).*
- *There was another chapel (...) which was swallowed by the sea (Paramos/Espinho resident).*
- *The most fragile part is the part near the sea (...) the coast is metres below sea level (Paramos/Espinho fisherman).*
- *I remember a night when I was still a student, when during a storm the sea took 17 old establishments. I remember the sea damaging the railway line, more than once even (Costa da Caparica fisherman).*

According to the data gathered, beach recession, highlighted in Figure 7, is more significant for the respondents from Costa da Caparica (500m) than for those in Paramos/Espinho (30m).

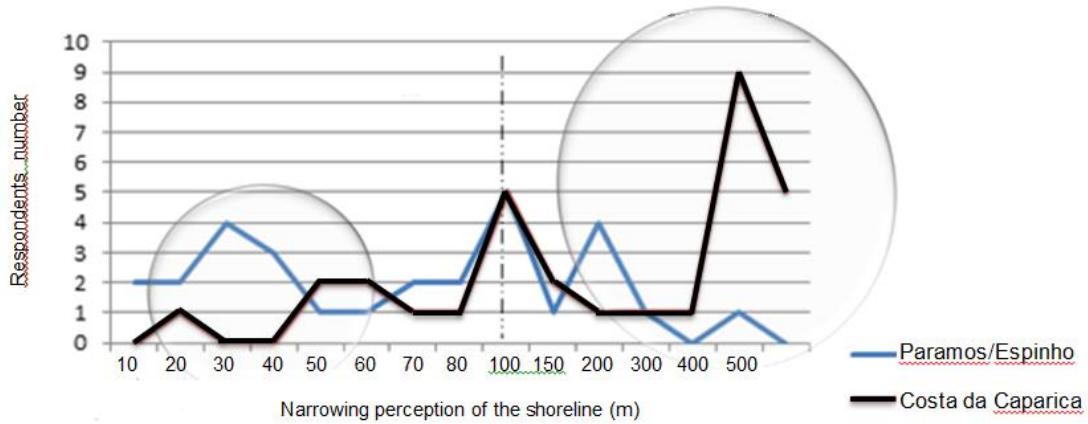


Figure 7. Perception of narrowing of the shoreline (30/40 years span).

To 44% of respondents, erosion has natural causes (winds, tides, rise in the average sea level, climate change). 17.5% consider it to be the consequence of anthropic activity (urbanization of the coastline, ports, dams, sand extraction).

Risk perception and causes of coastal erosion

Perception analysis was carried out to ascertain what the main threats affecting the coast in Paramos/Espinho and Costa da Caparica are perceived to be. With a view to understanding the main management priorities, as indicated by the interviewed stakeholders, we need to consider perceptions regarding the scope, intensity and frequency of risks in terms of how they affect activities and uses, infrastructures and environmental resources.

Results of the survey reveal that most respondents rate the risk of coastal erosion as serious or very serious, mainly in Costa da Caparica, where more than 75% consider it to be a serious problem that will “worsen in the future” (Figure 8).

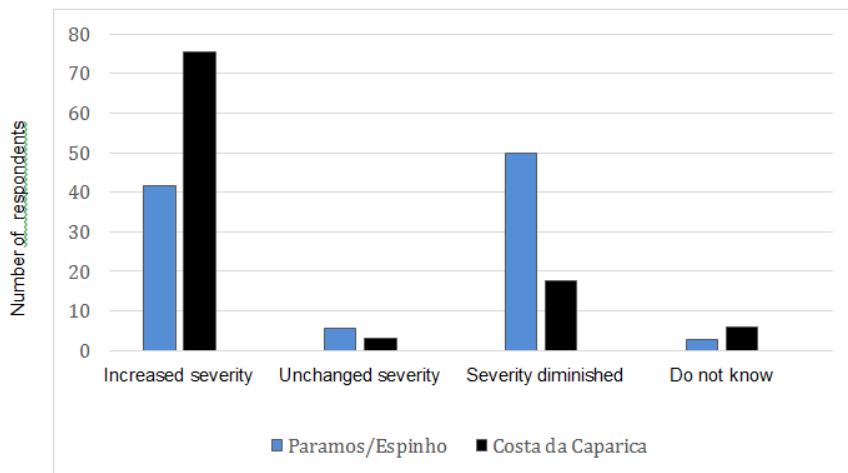


Figure 8. Perception of coastal erosion severity and sea advance.

The two main threats identified by interviewees were storm surges and urban encroachment in the near shore area. Beaches were perceived to be the most threatened element, since they are very vulnerable to storm surges and the endemic problem of erosion and flash floods.

There is also an economic impact on businesses (beach licensees and services) in terms of lost earnings when a beach is damaged or rendered unusable. A similar issue concerning the problems encountered by inshore fishing communities was also mentioned. This is how some interviewees explain matters:

- *The most affected are the people who visit us. We are also affected (...). We want to continue fishing (...) and we need sand to work.*
- *I regret the disappearance of the canning industry in the region.*
- *The houses have been retreating, there were people who lived farther forward, then retreated, retreated because of the strength of the sea's waves.*
- *There were no groins. 46 years ago I got married in the chapel, and to reach the sea I had to walk a lot, that's true, now the sea is already here and there is almost no sand, just rocks..*

As for the causes of coastal erosion Figure 9 shows the stakeholders' general impressions (from Paramos/Espinho and Costa da Caparica).

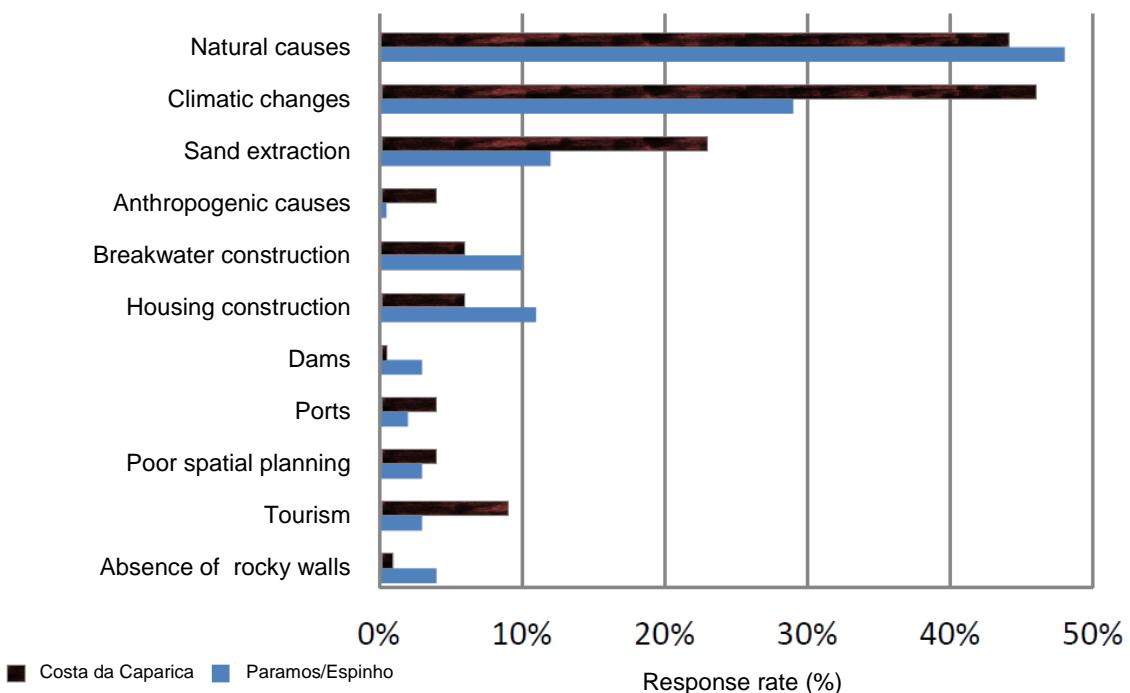


Figure 9. Coastal erosion causes.

Most consider the main causes to be natural and distant phenomena such as climate change. The only anthropogenic cause assigned more relevance is sand extraction, mentioned mostly by respondents from Costa da Caparica.

Perception of both the CE risk and the effectiveness of coastal defence works

The survey results show that the participants of the two areas considered it important that the coastline remains where it is, with the respondents of Paramos/Espinho being the ones who consider it most important that the coast remains unchanged (Figure 10). Over 90% agree or strongly agree that the coast has to be protected "at all costs".

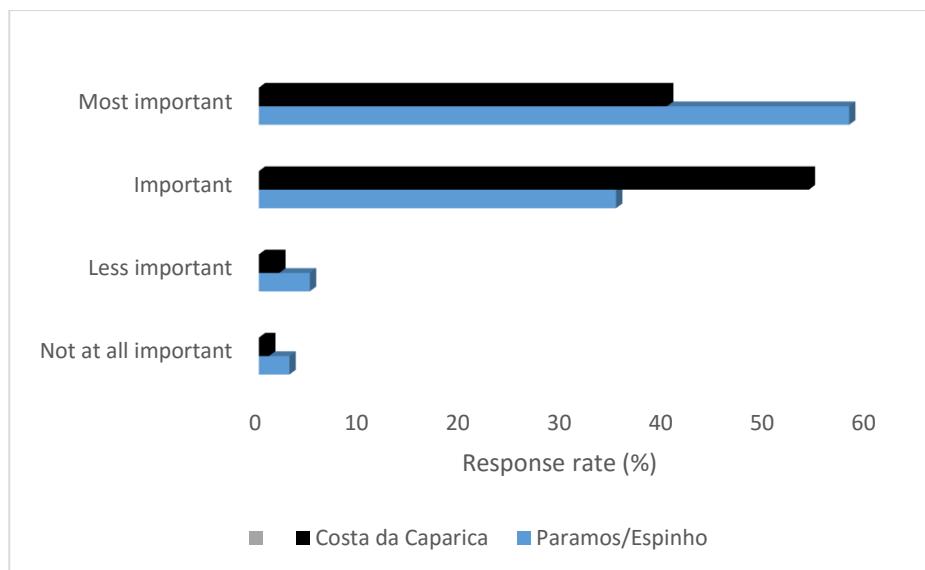


Figure 10. The importance to maintain the coast unchanged (%).

As for the perceived effectiveness of coastal defence construction (Figure 11), hard defences such as groins and concrete seawalls are seen as the most effective. This is probably because, in most cases, artificial beach strengthening with the addition of sand must be repeated periodically, becoming not only a recurring expense, but also a solution that is perceived as temporary and not very durable.

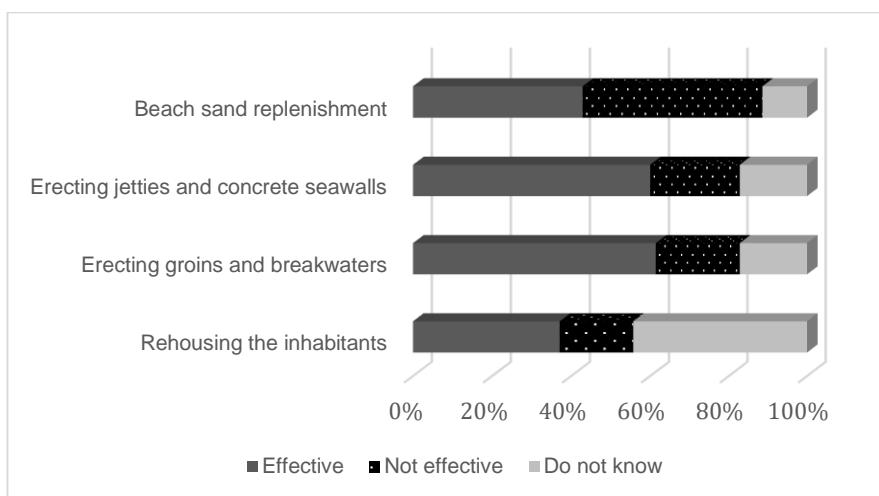


Figure 11. Stakeholders' perceptions regarding the effectiveness of coastal defence interventions.

Concerning the alternative of relocating buildings and re-housing populations at risk, it has become clear that neither community (Paramos/Espinho and Costa da Caparica) is keen on this solution.

However, while recognizing the need for hard interventions such as groins and jetties, the communities' stakeholders recognize their negative impact on the coast, particularly towards the south, often mentioning the loss of sediment and a decrease in beach sand in the southern areas near hard engineering coastal interventions. In Costa da Caparica, particularly, the coastal protection works are viewed negatively, especially regarding the jetties and other fixed infrastructures, despite the occasional protection they provide.

Public participation

According to the survey, the levels of participation in public discussions on coastal problems are extremely low. Fewer than 5% of the respondents have participated in any way in meetings that precede decision making on coastal management. Although worrying, the figure of 5% is not surprising. If on the one hand, and with regard to the decision-making process about the management of the territory, the institutional stakeholders complain that there is no culture of participation among the population, on the other, it is also true that the authorities seem to do no more than what is strictly necessary (and prescribed by law) to involve citizens in these processes.

Respondents, particularly those in Costa da Caparica, had very pessimistic expectations regarding the importance of public participation in the decision processes concerning coastal management (Figure 12). While in Caparica, around 75% consider public interventions are ineffective, fewer than 45% in Paramos/Espinho share the same opinion. However a small percentage (11% average) maintained a more optimistic view, noting that the area would gain some benefits from their participation in municipal meetings about coastal interventions, to inform and raise awareness among the locals.

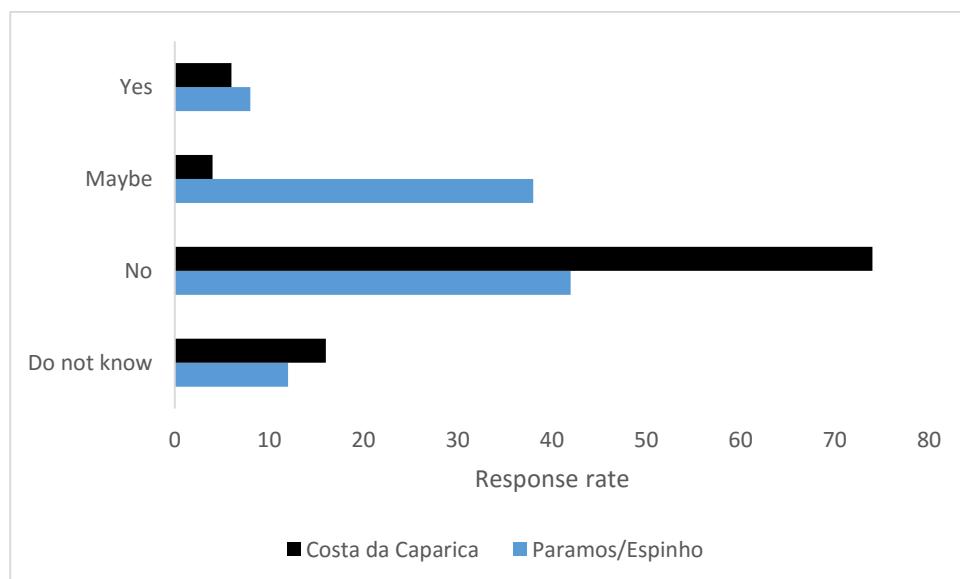


Figure 12. Stakeholders' perception of the importance of public involvement with regard to responsible coastal management by policy makers.

Following the appointment of a representative acting on behalf of the community and other public stakeholders, analysis of the interviews clearly showed the importance attached to the participation of citizens in local administration. However, the impact of a selected representative attending meetings of the municipal executive where plans of territorial management and intervention in at-risk areas are presented and discussed is classified as low, or ineffective. This marginalization of fisherman's opinion was often referred, by the participants, as a "social exclusion".

Framework of social vulnerability in the context of the coastal erosion phenomenon

A contribution arising from this research is the development of a contextual erosion vulnerability framework presented in Figure 13. This framework advances the work of O'Brien et al. (2007), and acknowledges the variety of factors which coalesce to construct a dynamic and fluid state of vulnerability. Vulnerability is determined by biophysical and socio-economic

processes on global, national, regional and local-scales (Almeida, 2015), and this is a key feature of the contextual erosion vulnerability framework. The contextual vulnerability framework aims to contribute to a scenario of vulnerability to coastal erosion that considers the physical (environmental), social, political and economic factors identified in both Paramos/Espinho and Costa da Caparica.

There are a number of factors that contribute to coastal vulnerability, and in order to evaluate it, it is necessary to define criteria and indicators of vulnerability, such as those that have been selected and studied in this research. The vulnerability assessments often refer to the study of a physical phenomenon that has an impact on coastal erosion, they address local and global manifestations and calculate the impacts that will occur in future scenarios. However, the degree of vulnerability is neither static nor does it progress at a steady rate. It exists along a continuum of greater/lesser vulnerability dependent on time circumstances and social perceptions.

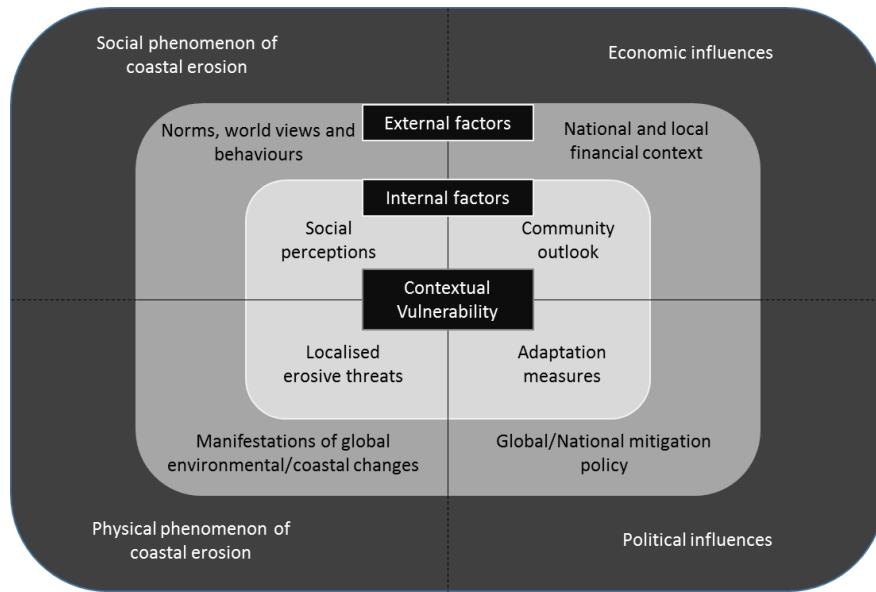


Figure 13. Framework of social vulnerability in the context of the coastal erosion phenomenon
Source: Adapted from O'Brien et al. (2007)

The contextual erosion vulnerability model presented in Figure 10 recognises the importance of the social phenomenon of coastal erosion, which will be constructed individually and collectively. The way the erosive phenomenon changes the coast, its impacts, and how the communities' vulnerability is perceived will contribute to actions and behaviours, including the relative vulnerability and the stakeholders' demand-side perceptions of coastal erosion issues.

3. Discussion

The factors which influence sustainability in coastal management comprise social, economic, institutional, biophysical and legal conditions. The clear trends of continued human migration to the coast and major growth in coastal tourism, has resulted in escalating investment in coastal locations. The Portuguese coast is experiencing severe erosion and loss of beachfront; processes which are expected to become worse with climate change impacts. These additional alterations are beginning to show at a time when financing for conventional coastal protection is no longer guaranteed at scales of investment that are likely to be required if coastlines are to be maintained in the future (Schmidt et al, 2013).

The two case studies are characterized by their exposure to coastal erosion. They show extreme situations of fragility not only regarding present or past overtopping coastal events, but also regarding the rate of coastline retreat, with the evolution of urbanization and the densification of human activities. In Espinho, for example, in some areas the coastline retreated an average of 6.93 meters per year between 1970 and 2002 and in extreme events recorded in the past (between the years 1895 and 1907) almost 1/3 of the oldest part of Espinho were irrevocably submerged by the sea (INAG, 2000). In turn, from the late nineteenth century, the Costa da Caparica area evidences situations of coastline retreat in excess of 500 meters, even reaching 1 km of beach loss in some parts (Ferreira, 2006). In both case studies, some of these events were recalled by the elderly who still live either in Paramos or Costa da Caparica. Despite the perceived risk and the coastal changes caused by erosion, and despite the existence of problems regarding the hard coastal defence works such as groins and breakwaters, the individuals continue to live in the areas threatened by erosion.

In both case studies, the socio-economic characterization of populations living in these areas illustrates a correspondence between the areas most affected by ecological and social stratification, which potentially exacerbates the vulnerability of populations exposed to environmental risk situations, such as coastal erosion (Pires, et al, 2010).

The findings also show that the communities' normal coping range was exceeded (Smit and Wandel, 2006) when the rate and magnitude of the coastal retreat increased, and when incremental adjustments such as the local protection of individual properties and relocation proved insufficient to avoid loss. In both Paramos/Espinho and Costa da Caparica, as community functions were perceived to be under threat (despite the hard coastal defences and coastal management interventions) and relocation was not a viable option, a social limit to further adjustments had been reached. The impact of the erosion was a 'real world indicator' that triggered an adaptive response; a finding corroborated in other studies (Dannevig et al., 2013). The erosion issue entered a collective system of meaning; it became not only a problem for property owners but also a threat to both communities and their way of life.

The perception of a common risk to coastal zones, the impacts of extreme weather events and coastal retreat, may contribute to the development of a stronger sense of community and may thus better prepare coastal populations to respond and adapt (Manzo and Perkins, 2006; Schmidt et al, 2012). But to achieve an adaptive governance approach, consistent trust between the different institutions dealing with coastal issues, as well as between them and the range of interested stakeholders, has to be brokered (Almeida, 2015).

Coastal erosion management strategies have social and political implications (Cooper and McKenna, 2008). Decisions regarding coastal management activities should be based on the best available science, but should also take into consideration stakeholder perspectives (Ariza et al., 2014). Stakeholders may have conflicting views about coastal erosion management strategies. Optimal policy decisions require the resolution of any conflicts that arise between coastal protection and development, environmental and nature conservation, and social traditions (Ariza et al., 2014 and Striegnitz, 2006). To this end, coordinated participation of different stakeholders on many primary beach management issues is needed as part of effective management practices (Schmidt et al., 2013). In addition, such participatory processes are crucial for truly sustainable outcomes (Schmidt et al., 2013; Almeida, 2015).

Public participation traditions in coastal management differ considerably across Europe, and varies from well-institutionalised participatory mechanisms involving stakeholders in coastal planning (Soma and Vatn, 2009), to clear and communicative public policies about interventions for mitigation and protection (Filatova et al., 2011), and to several experiences involving the implementation of more effective and localised adaptive governance mechanisms for coastal zones (Milligan et al., 2009; Schmidt et al, 2013).

Other research has shown that it is vital that local communities be genuinely involved and, indeed, actively explore issues such as sense of place or cultural identity (Adger et al., 2009). The process may be slow but, in time, a broader understanding and a more unified vision about

the future of the coast can be achieved. Our results also indicate disbelief, discouragement and distrust on the part of all social actors with regard to participating, to being heard and being recognised as partners by the political powers in their various governmental settings. However, despite current low participation levels and the inability to influence decisions (as perceived by the public), both in Paramos/Espinho and Costa da Caparica, there is still a general willingness to intervene. However, this is subject to an appreciation of sincerity and policy reliability on the part of all government entities responsible for managing the coastline.

In both locations, fishermen are a key-group. From what was observed in the stakeholder interviews, socially rooted and respected communities of fishermen, well represented by local fishing associations, can be important partners in building community ties. Similar findings were also achieved in the work of Schmidt (2013) and Almeida (2015).

The participants highlighted the authorities' insensitivity to traditional knowledge, and their lack of will to welcome/integrate the contribution of the participants' experience. Thus, to overcome these issues, as stated in the Aarhus Convention (1984), it is very important that relevant data be made available and easy to interpret. To make informed decisions, the participants need to have access to a range of information concerning different issues and perspectives (Bulkeley, 2000). Although information from stakeholders is very valuable, helping to bridge the gaps between expert and local knowledge, and collating and combining these different types of data and information in the case studies proved very difficult and time consuming (Dietz, et al, 2003). It is, therefore, essential to put in place a procedure to deal with this challenge from the beginning of the process. Coastal management is a long-term process (Webler et al, 2001) and it is important that there is co-ordination and flexibility among the many actors involved in coastal management, Government agencies, NGOs, businesses, research institutes and coastal communities (Almeida, 2015). All need to work together, with public participation providing input. However, public participation can only work if it has a co-ordinated structure, and that must be built up.

4. Conclusion

Extreme coastal events that adversely affect littoral communities with abundant and traumatic experiences are becoming more frequent. With each situation, citizens and leaders acquire knowledge of effective, as well as ineffective, adaptations that could help anticipate and reduce future impacts and also enhance future responses and recovery efforts. This body of knowledge forms a portion of the respective communities' social memory. While the actual memories were not lost, an inability to integrate critical knowledge of past coastal erosion into future plans and development rendered communities less resilient. It is important to work in close cooperation with actors and managers in order to fine-tune research on coastal erosion and coastal protection with social demands and fears.

The case study has shown that the technical knowledge is not a good enough fit to find robust solutions that satisfy both social needs and technical requirements. The complexity of coastal erosion risks requires that we go beyond the existing assessment frameworks and the role of the experts needs to be reformulated. This process should open up the debate to local stakeholders.

The case studies have shown that there is a strong awareness of widespread coastal erosion, and acknowledges that this problem is often exacerbated by inappropriate human infrastructure (including that intended for "coastal defence") and development too close to the shoreline with a significant demographic pressure on the coast; Engineering works in some port areas have been mentioned as contributing to accelerated erosion of the adjacent shoreline because the works did not adequately account for coastal dynamics and processes. Extraction of sand is another stated factor that can lead to coastal erosion.

The surveys point clearly to an underlying perception of coastal risks and the possible impacts of phenomena such as climate change. A disconnect between the "top" and the "bottom" of

coastal management decision-making processes was also identified. This leads to general suspicion and miscommunication between local stakeholders and the institutions in charge of coastal management. This has proved to be one of the main obstacles to the involvement of local stakeholders in coastal issues, as we have seen from previous studies and from our evidence.

Unfortunately, this issue it is not easy to transcend. The complexity of coastal erosion risks necessitates going beyond the existing assessment frameworks, where the majoritarian role of the experts needs to be reformulated. The management of erosion cannot be the prerogative of experts, but rather it has to include a diversity of perspectives that conforms to the socio-economic-environmental system under study. Experts certainly have a relevant and indispensable role, but their role within the integrated assessment processes should be rethought. They can act as advisors both to the administration and to the social stakeholders, to explain and warn against the environmental impacts, the uncertainties that affect the projects and the alternative options that could be taken into account in decision-making processes. This role is essential if it is performed with high scientific rigour, is fully transparent, and outlines the uncertainties for each alternative.

Through this study, we have found signs that point to an essential common objective for tackling coastal change: a strong disposition to engage in adaptive management approaches – provided there is a genuine desire for compromise on the part of authorities from Planning and Coastal Management – and it is possible, at least in the most threatened communities facing economic and coastal insecurity, to establish a constructive dialogue. Social groups with strong local roots, such as fishermen, often act as key elements of any future strategy of collective adaptation, because of their status and recognized environmental knowledge as perceived by coastal communities.

Technicians and those responsible for coastal defence interventions assure the perspective of technology (top down) but they lack the bottom up vision, which is what the shell fishermen of Costa da Caparica can provide with their specific knowledge of the context. They mentioned the profound transformation of the clam picking sites. Or the fishermen who reported that while the beaches are losing sand, "islands" of sand at a depth of 20m wide have appeared on the Tagus River. Even if some of these facts and perceptions result from a concept powered by the imagination, they have to be investigated before any coastal engineering intervention. Probably, in many of these perceptions, only those who have lived in the place for some time and who can, therefore, make a longitudinal comparison (i.e., over time) are the ones who really know and detect changes in the coastal zone. This is a bottom up input in the major engineering works (hard), generally not seen by public authorities in charge of coastline management as a strategic trend. If the perceptions of local residents are not adequately considered, it can hinder coastal interventions. The success of coastal defence interventions in mitigating the erosion problem could be impeded, as they are interventions focused on a point in time, and do not contemplate the changing environment over decades. This could be obviated if the people had been heeded prior to interventions in the coastal areas

Schmidt et al. (2013) argue that to achieve adaptive coastal governance, there are components that must be developed. Through the case studies of Paramos/Espinho and Costa da Caparica, it is possible to conclude that to build trust, a common vision and joint goals, there needs to be a common understanding between competent scientists and technicians, and well-informed community acceptance. However, trust-building depends on a participatory learning process which enables decisions and encourages investment in coast and communities. So, another component of the process is dialogue about future financial support that includes knowledge sharing and trust, and also takes into account the social justice dimension. Moreover, and to address the results of Schmidt (2013) and Almeida (2015), a final feature concerns the need for policy clarity and strong political will for coastal management, with agencies and governments revealing their capacity to pay heed and to respond.

Understanding how coastal communities perceive vulnerability and erosion contributes to the development of future actions that address locals' understanding of engineering works and interventions along the coastal areas subject to coastal erosion. To achieve a desired compromise on the part of authorities from Planning and Coastal Management and public participation, and the emergence of new behaviours, a model addressing a contextual erosion vulnerability framework was elaborated. This model contributes to a more holistic understanding of the vulnerability of littoral communities to coastal erosion. Importantly, the model can be transferred to other contexts. It clearly recognises the importance of spatial scale, along with social, political, economic and physical (environmental) factors in constructing vulnerability, and identifies the importance of understanding these contributory factors when assessing vulnerability. It must be emphasized that vulnerability to coastal erosion is not the result of climatic manifestations and impacts alone. While the physical manifestations will differ on local-scales, with some communities and places experiencing more adverse weather/sea erosive events than others, vulnerability is not detached from the wider social, economic and political environment in which the littoral communities exist.

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