

# PERCEPTION OF RISK OF COASTAL EROSION: AN EXPLORATORY STUDY ON INDIVIDUAL AND CULTURAL DETERMINANTS

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## Abstract

Coastal Erosion is a major issue in many areas of the world. In addition to being present over many coastal areas, erosion is a complex problem in terms of its causes, consequences, and potential coping strategies. Coping strategies and averting behaviour crucially depend on the expected value for individuals, which is affected by monetary gains and losses and by the perceived probability of occurrence of an erosion problem, that is the individual risk perception, which is the main focus of this paper. Perception of risk depends, among others, on variables specific to the type of risk, to the individual, and to the individual's familiarity and experience with the source of risk. This paper proposes to analyse the risk of coastal erosion perceived by different types of individuals with respect to their relation with the area under study. It further investigates the determinants of risk perception with a special focus on familiarity with risk and risk attitudes.

**Keywords:** Risk Perception, Coastal Erosion

## 1 MOTIVATION

Coastal erosion has been a problem in countries with extensive coastal areas, as is the case of Portugal, for many years. In a context where sea levels will likely continue to rise, many challenges arise both from a policy perspective and for individuals making decisions as to property. While an area may be more prone to negative impacts of coastal erosion due to its coastal location, it may also be perceived as an appealing holiday destination and as such attract property investment. Therefore, the perception of coastal erosion will influence individuals' property market decisions. In this paper we explore the role of risk perception towards coastal erosion and how different groups of individuals evaluate that risk.

The paper is organized as follows. First, we briefly discuss the literature on risk perceptions. Second, we present the methodology and data collection to then discuss the main results. The final section concludes the paper with some implications of this line of research.

## 2 LITERATURE REVIEW

A vast literature has discussed, over the years, the determinants of risk perceptions in general concluding that perceptions vary across individuals and between groups of individuals with some common characteristic. One first explanation advanced for the divergence in risk perception is the degree of information. Considering that experts have access to more information and higher ability to process complex information, it was argued that risk perception by experts was more accurate than that of lay people (Burgess, Harrison, & Filius, 1998). However, according to Slovic (1999, p. 690) "the probabilities and consequences of adverse events are assumed to be produced by physical and natural processes in ways that can be objectively quantified by risk assessment. Much social science analysis rejects this notion, arguing instead that risk is inherently subjective". Bickerstaff (2004) argues that

perception of risk is a social-cultural construct, and not solely a psychological one. In other words, the perception of risk by individuals depends on social and cultural variables. According to Renn (2004, p. 406) "people construct their own reality and evaluate risks according to their subjective perceptions". Slovic (1999, p. 699) argues that "danger is real but risk is socially constructed". Risk assessment is thus a highly complex social, political and psychological task.

The literature has identified several determinants of risk perception. Slovic, Fischhoff, Lichtenstein, & Roe (1981) argue that people respond to hazards as they perceive them. If their perception is deficient, their behavior will not be optimal, or efficient. In addition, the authors argue that if the risk is familiar or has high probability of occurring, it is easier for lay people to form more accurate perceptions of risk. Thus, familiarity is key to forming risk perceptions. When the problem is complex or unfamiliar, people tend to use heuristics (i.e., rules to simplify choice decisions) to ease their task. The perception depends on individuals' ability to control the risk or confidence that others have on that ability. Trust in management programs and authorities plays a key role in risk perception according for example to Schmidt, Gomes, Guerreiro, & O'Riordan (2014) and Slovic (1999). Slovic (1999) concludes that "social and democratic institutions, (...) , breed distrust in the risk arena". Moreover, results show that trust is much easier to lose than to gain. "But serious attention to participation and process issues may, in the long run, lead to more satisfying and successful ways to manage risk" (Slovic, 1999, p. 700). Carlton & Jacobson (2013) found that risk perception decreases in situations where individuals trust the organizations managing risks. However, increased confidence might not have desirable consequences for risk mitigation. Filatova, Mulder, & van der Veen (2011) found that an increase in the sense of security in management of coastal erosion processes built through experiencing successful initiatives may lower the perception of risk and thus decrease precautionary attitudes.

Risk perceptions, in addition, are determined by the consequences of the risk. Lima (2004) argues that risk perception depends on risk effects. Risks with catastrophic consequences and those with some sense of being unavoidable lead to higher risk perceptions than equally likely risks with non-catastrophic and/ or avoidable consequences. Slovic, Fischhoff & Lichtenstein (1980) in a study on stated risk perception, asked respondents to rate several hazards. Using factor analysis, their results show that uncontrollable, potentially catastrophic, and dangerous for future generations and involuntary hazards are perceived as more severe. Schmidt, Gomes, Guerreiro, & O'Riordan (2014) and Wakefield, Elliott, Cole, & Eyles (2001) argue that risk perception depends on individuals' relation to the site. In particular social capital, place attachment and a common sense of purpose influence risk perception and consequently behavior towards risk. Renn (1998, p. 49) argues that "public perception should govern the selection of criteria on which acceptability and or tolerability are to be judged. In addition, public input is needed to determine the trade-offs between criteria. Finally, public perceptions are needed to design resilient strategies for coping with remaining uncertainties". The author argues that all perspectives should be taken into account during risk assessment tasks.

In sum, it is consensual that risk perception is conditioned or determined by a variety of factors. Factors, which in turn can explain existing differences between groups of individuals and within groups. The present paper explores some of the dimensions suggested by previous literature adding two new features: comparing the robustness of alternative measures of risk perception, and controlling for individual risk attitudes.

### **3 METHODOLOGY AND DATA COLLECTION**

In order to test the hypotheses regarding the determinants of coastal erosion risk perception, we use a mixed method approach to study risk perceptions of coastal erosion in a beach in Northern Portugal and target both permanent users and non-permanent users of the area. Through expert interviews, focus groups and pre-testing, we design a questionnaire addressing perception of causes and seriousness of coastal erosion, knowledge of the phenomenon, potential coping strategies, etc. The survey was applied through personal interviews between August and September 2016, to an area that has over time been subject to coastal erosion, Amorosa, a coastal area just south of Viana do Castelo in Northern Portugal close to the Spanish border.

### **4 PRELIMINARY DATA ANALYSIS**

In total 184 surveys were conducted, however only 124 have complete information for the purpose of this study. Concerning the distribution by type of user according to the subject relationship to the site

we observe that: 27,4% are residents; more than half are non-resident, 13,7% of which are frequent visitors of the area throughout the year.

Table 1 presents summary statistics concerning the sample. Roughly 55% of respondents are women and the average age is 46 years. As a control to explain risk perception, we also asked respondents to state on a scale from 0 to 100 (whereby 0 means risk averse and 100 risk loving) how risky they judge their decisions regarding financial matters. The sample is on average risk averse, whereby the mean response of self-perception of risk aversion is 33,4.

Table 1: Risk and socio-demographic variables

	Mean/ frequency	StDev	Min	Max
Financial risk attitude (0 risk averse -100 risk loving)	33,4	25,3	0	100
Monthly income	1715,7	1229,0	250	5000
Age	46,1	16,1	18	83
Gender: woman	54,8%			

Respondents' general views on environmental problems and coastal erosion are also considered for control and descriptive purposes. The most significant environmental problem in Portugal, according to respondents' opinion, was climate change, followed by coastal erosion and water pollution. Specifically concerning coastal erosion, it is clear that considering coastal erosion an environmental problem that significantly affects the Portugal, most believe that the population in general might adopt behaviors that can significantly reduce the seriousness of the problem. In addition, they reveal a significant degree of concern with future generations. Regarding the costs, the vast majority agree that local taxes should be applied, followed by national taxes, and only very few attribute the financial responsibility to local property owners. On the causes of coastal erosion, the most frequently indicated cause was sea level rise, closely followed by human occupation. Extraction of sand and deforestation and reduced vegetation on sand dunes are the third and fourth most frequently. On the other hand, on the effects of coastal erosion (classified on a scale from no effect to very serious), the most significant were destruction of sand dunes, flooding and weakening of coastal defence structures. The destruction of manmade constructions, local economic activity and loss of fishing stock were not considered as significant.

When focusing on coastal erosion in the area of Amorosa, 87% consider it serious or very serious, from those that identify erosion as a problem. In addition to how serious they considered coastal erosion in Amorosa, respondents were also asked for how many years they had noticed it. Most respondents selected the interval of 5 to 10 years. Interestingly, when asked about the causes of coastal erosion in Amorosa, in addition to the ones identified for coastal erosion, in general, wind was also frequently referred. Regarding the erosion effects in Amorosa they are similar to those identified for the national territory, except for floods that are considered not serious or inexistent by almost 32% of respondents, compared to about 6% for the continent.

The literature reviewed identifies familiarity and vulnerability as possible determinants of risk perception. To analyze these effects, subjects were asked to indicate on a map where they lived, or usually stayed when visiting. One third of respondents are located at 300 meters or less from the coastline, and two thirds are located less than 450 meters.

To elicit respondents' perception of the seriousness of coastal erosion, we also asked them to report four probabilities on a scale from 0 to 100. We asked (i) the probability that the beach (sand) would disappear in 10 years; or (ii) in 20 years; and (iii) the probability that property would be destroyed in 30 years, and (iv) in 40 years (Table 2).

Table 2: Probability of destruction

	All		Non-Permanent users		Permanent users	
	Mean	Stdev	Mean	Stdev	Mean	Stdev
Destruction sandy beach in 10 years	40,4	27,5	40,3	27,7	40,5	27,6
Destruction sandy beach in 20 years	55,3	29,6	54,2	29,0	56,9	30,8
Destruction of property in 30 years	49,1	32,9	43,4	33,2	57,2	30,9
Destruction of property in 40 years	59,7	33,2	54,0	33,3	67,8	31,7

As expected, mean probabilities generally increase as we increase the temporal scope, as reported in Table 2. Although risk perceptions are similar between permanent users and non-permanent users, elicited probabilities are on average higher for permanent users. Permanent users include residents and non-residents that frequent the area throughout the year, non-permanent users include all other visitors.

In addition, we are interested in analyzing the variability of risk perception in terms of those two groups of users: permanent and non-permanent users. The hypothesis is that: if controlling for individual characteristics, namely risk attitudes, being part of a group influences risk perception, social and cultural factors affect risk perception. Table 3 report a multivariable regression model for risk perception. We report four specifications differing on the dependent variable being the perception of probability of destruction of sandy beach in 10 years, in 20 years, or destruction of property in 30 and 40 years. Given the censored nature of the dependent variable in the interval [0; 100], a Tobit model was used.

Table 3: Tobit regression results

VARIABLES	(1) 10 years	(2) 20 years	(3) 30 years	(4) 40 years
2. distance_coast	-26,07*** (8,822)	-39,05*** (9,906)	-18,14 (11,72)	-16,56 (12,39)
3. distance_coast	-12,26 (8,445)	-21,55** (9,497)	-19,40* (11,25)	-17,17 (11,88)
4. distance_coast	-22,33** (8,892)	-24,98** (9,980)	-20,79* (11,81)	-19,36 (12,47)
5. distance_coast	-35,37*** (9,666)	-50,51*** (10,81)	-37,83*** (12,75)	-40,13*** (13,53)
Erosion_cause_sealevel	11,86** (5,294)	15,55*** (5,812)	14,61** (7,035)	14,59* (7,389)
Permanent_users	-21,08** (8,606)	-27,21*** (9,465)	-11,05 (11,27)	-18,47 (11,92)
0.permanent_users#financial_risk	0,016 (0,138)	-0,160 (0,152)	-0,058 (0,187)	-0,028 (0,193)
1.permanent_users #financial_risk	0,541*** (0,147)	0,604*** (0,160)	0,637*** (0,193)	0,872*** (0,215)
Income	-0,006*** (0,002)	-0,006*** (0,002)	-0,005* (0,003)	-0,006** (0,003)
Age	-0,236 (0,158)	-0,284 (0,173)	-0,547*** (0,208)	-0,704*** (0,219)
Gender	11,30** (4,919)	12,09** (5,424)	11,08* (6,519)	10,49 (6,843)
Constant	66,43*** (12,66)	95,97*** (14,10)	82,42*** (16,76)	105,3*** (17,67)
Sigma	26,21 (1,857)	28,64 (2,155)	34,35 (2,590)	35,68 (2,849)
Observations	124	124	124	124

Notes: significance level \*\*\* p<0.01, \*\* p<0.05, \* p<0.10; permanent\_users and Erosion\_cause\_sealevel (belief that coastal erosion is caused by increased sea level rise) are dummy variables; financial\_risk (financial risk attitude measured on a scale from 1 to 10); Distance\_coast (distance of users location from the coast, 1: less than 150 m, 2: 150 to 300 m, 3: 300 to 450 m, 4: 450 to 600 m, 5: more than 600 m).

Results are similar across the four different specifications (significant at 1%). The independent variables that are statistically significantly at explaining the risk perception are mostly the same across regressions. Distance to the coast is statistically significant and has a negative effect, meaning that people who live or usually stay further away from the coast have a lower perception of the risk, than those living closer. The effect is particularly strong between the first line (< 150 meters from the coast line), and the last (>600 meters). The variable that reflects the belief that coastal erosion is caused by increased sea level rise has a positive effect, compared with those respondents that do not identify this as a relevant cause. Socio-demographic variables (income, age, sex) are generally statistically significant. Finally, the variable included to capture the effect of risk attitudes is statistically significant. Interestingly, permanent users have lower risk perceptions than non-permanent in shorter time horizons, but are indistinguishable for longer time horizons. In addition, less risk averse individuals have higher

risk perception of coastal erosion, than more risk averse, if they are permanent users. However, individual risk measures have no effect on non-permanent users.

In sum, the results show stated preference methods consistently elicit respondents risk perceptions as they evaluate cumulative risks with higher risk perceptions. Moreover, the results are consistent with expectations based on previous literature. In addition, the novel inclusion of risk attitudes as a control variable was found to be positive and statistically significant for permanent users.

## 5 CONCLUSION

The literature is abundant in justifying the difference between risk perception and objective measures of risk. Rooted in the observed discrepancies, some policy makers and interest groups push for dismissal of lay people's perception of risk in decision-making. However, there is growing evidence that risk perception is a social construct, depending on personal characteristics, but also on the cultural context, past experience, relation to the territory, among other determinants. The present paper adds to the evidence that risk perception regarding coastal erosion depends on personal characteristics (age, sex and income), on familiarity with the phenomena and expected losses in case of accident (proxied by distance to coast), on the causes of coastal erosion, and most importantly, on risk attitudes. To our knowledge this is the first attempt to include risk attitudes as determinants of risk perception concerning coastal erosion. The results show that in fact it is statistically important for respondents with higher connection to the place (namely permanent users).

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