



Forward planning to maintain the attractiveness of coastal areas: Choosing between seawalls and managed retreat



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ARTICLE INFO

Article history:

Received 19 July 2016

Received in revised form 30 January 2017

Accepted 30 January 2017

Available online xxx

Keywords:

Adaptation

Climate change

Seawalls

Survey

Relocation

Marine inundation

ABSTRACT

This paper aims to inform forward-planning policies in the face of sea-level rise due to climate change, focussing on the choice of reducing the vulnerability of property at risk through managed retreat or protection behind seawalls. This adaptation is important not only to reduce the cost of future damage but also to maintain the beaches which are an attractive feature for tourism, of vital importance for coastal areas. Some 421 residents with main and secondary homes were surveyed in Hyères-les-palmiers in the Var department (Southeast France). The survey sought to compare the willingness of residents to contribute financially to building a seawall or to relocating sea-front property. Preferences depend both on common variables and variables specific to the proposed arrangement. They reveal common concerns focused on effectiveness and the determining factor of property ownership. The results also show some awareness of the long-term advantages of managed retreat, despite some opposition from older people, who are also more sceptical about the reality of the risk incurred.

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1. Introduction

In France, storm Xynthia which caused the destruction of some 1200 dwellings in risk-prone locations (Cour des comptes, 2012), was a turning point in the policy to manage marine inundation risks. In particular, the implementation of “Natural Risk Prevention Plans (NRPP)”¹ was speeded up, and a national inundation plan was rapidly established together with a plan to strengthen seawalls. An inventory of priority coastal NRPPs was compiled; 303 were identified and, by March 2015, 273 had been implemented (Hubert and Leclerc, 2015).

The prospect of increased marine inundation due to sea-level rise is a concern for insurance companies which are considering modifying their insurance and compensation criteria. Gopalakrishnan (2013) estimates that worldwide there were 4241 natural disasters over the period 2000–2010 with 2.5 billion people

affected and damages totalling some US\$1002 billion, of which only 26% was insured. In France, although there have only been 84 cases of marine inundation in the last thirty years for a total compensation of €1 billion (€800 million of which concerned storm Xynthia alone), there may be a fourfold increase by 2040 (AFA, 2015).

The evolution of insurance policies is a particular issue in countries with solidarity-based systems such as the French natural disaster mechanism (André, 2013; AFA, 2015). This scheme is based on all insured parties contributing financially to the protection against such disasters, regardless of their risk exposure, through a supplementary “Natural Disaster” premium collected on all buildings insurance contracts. This approach is often criticized for not encouraging responsible owner behaviour (Huteau, 2015; Grislain-Letrémy and Villeneuve, 2015). Furthermore, it contributes to maintaining the attractiveness of coastal areas despite their high level of risk. The prospect of increasing compensation is leading some to recommend the diversification of funding sources, particularly through a greater involvement of local government (Cour des comptes, 2012; Grislain-Letrémy and Villeneuve, 2015).

These projections have led to changes in coastline management approaches. Proposed new measures are based on either adaptation – reducing risk exposure through property and activity relocation – or compromise – living with the risk (MEDDE, 2012). However, managed retreat is hindered by the reluctance of both

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¹ The “Natural disaster prevention plan” (“Plan de prévention des risques naturels”) is defined by the State. It regulates land use according to risk, by establishing zones where building is forbidden and others where building must comply with various conditions.

elected representatives, the laypeople, and by funding issues. Hence the French Ministry for Ecology, Sustainable Development and Energy has undertaken an experimental programme on five pilot sites as part of the “National strategy for the integrated management of the coastline” (MEDDE, 2013). These experiments led to two types of recommendation: (i) to increase knowledge and (ii) to implement territorial strategies by tailoring planning documents and promoting broad approaches of spatial recomposition (Comité de suivi, 2015). These recommendations cover the five themes proposed by the *Commissariat Général à l'Égalité des Territoires* [General Commission for Territorial Equality] (2015) to increase territorial resilience in the face of climate change: (i) improve knowledge, (ii) raise awareness, (iii) promote good practices, (iv) adapt planning and governance frameworks and (v) adapt the natural environment.

Against this background, our study focuses on coastal residents' preferences for different climate change adaptation policies. The survey undertaken aims to understand the motivations underlying the choices between the different approaches to anticipate sea-level rise and adapt the coastal areas in consequence. As noted by Eriksen et al. (2015), such policies involve a compromise between individual and collective determining factors. They should, through surveys, take into account subjective perceptions, given the numerous biases inherent in risk representations, in particular long-term risks, which also pose an intergenerational dilemma (Hallegatte, 2009), and the changes in representation of regulatory measures towards progressive approaches emphasizing a “No regrets approach” (Eriksen et al., 2015). Our survey concentrates on the willingness to contribute financially to traditional measures (such as the construction of seawalls) compared with vulnerability reduction measures (such as the relocation of property and activities that are most at risk). This work aims to inform public decision-making under uncertainty. Above and beyond the legal tools and the protection modalities, in order to be efficient, the variation of insurance pricing requires a detailed knowledge of an area's risk exposure and vulnerability as well as a global and progressive management plan (Gibbs et al., 2013; Hurlimann et al., 2014; André et al., 2015). Whether this concerns seawalls or managed retreat, such plans must examine people's perceptions (García de Jalon et al., 2013; Rey-Valette et al., 2012; Lambert, 2013) and their preferences, and include a significant awareness-building component. This means that it is necessary to strengthen people's commitment to anticipatory policies, to create warning and coordination mechanisms and also to generate a risk culture in order to reduce inappropriate behaviour, and therefore damage, during inundation episodes.

The first part of this paper highlights some key points on the issue of climate change adaptation for coastal areas before the methodological protocol is explained in detail in the second part. The third part presents the main results which are then discussed in the fourth and final part.

2. Adaptation and resilience of coastal areas

The expected heightened risk of erosion and marine inundation related to sea-level rise requires forward planning to reduce coastal area vulnerability as recommended by the new doctrine of public intervention towards relocation (Kelly and Adger, 2000; Klein et al., 2001; Boateng et al., 2007; Nicholls et al., 2007; Adger et al., 2008).

However, ideally, an adaptation policy includes measures which aim to (i) reduce risks for people, property and activities in order to avoid future costs and (ii) maintain beaches for both their natural protective and recreational roles in coastal areas. Beaches play a key role in the tourist and residential attractiveness of these areas as shown for example by Cooper and Lemckert (2012).

Consequently, the vulnerability of beaches and coastlines to the impact of climate change leads to the “territorial vulnerability” of coastal zones (d'Ercole and Metzger, 2007). This type of vulnerability results in treating risks on a hierarchical basis depending on the magnitude of their effects in an area, but also to a broader territory because of interdependences. The economics and the management of coastal cities have a determining influence on the neighbouring towns. This is especially true for tourism-related employment, for beach amenities like outdoor recreation or their contribution to a better living environment and for the key-role of some economic or cultural infrastructures. Thus the vulnerability of coastal littoral results in vulnerabilities on a broader scale. In addition to hazard or risk maps, maps of sensitive areas that determine vulnerability at the larger scale are needed (d'Ercole and Metzger, 2007).

Traditionally, adaptation to inundation risk encompasses two visions (Klein et al., 2001)²: (i) “technical” hazard management, based on an engineering vision where man tries to control the risks and (ii) action on vulnerability with the objective of adapting to, and dealing with, the risk. Building seawalls falls within the first approach. It is particularly relevant in heavily-populated or very low-lying areas and this option is still often considered: for example, in France the implementation of the Seawall Plan (Plan Digue) at a national level in 2011 (Huteau, 2015), the Thames barrier, the Oosterscheldekering in the Netherlands or the flood defence projects in New-York. These measures nonetheless have their drawbacks. One condition seems to be to control urbanization behind them (Titus, 2011) because in the case of cracks or openings, damages can be very significant as shown during hurricane Katrina in New-Orleans (2005) or storm Xynthia in France (2010). Current significant vulnerability is due, to a very large extent, to the amount of building and demographic concentration in risk-prone areas. A study undertaken in the Haut-de-France region of France (Caumont and Fasquel, 2012) showed that house prices, which would provide a strong signal for the population, are not affected by the risks related to climate change due to their far-in-the-future nature. Grislain-Létrémy and Villeneuve (2015) point out that maintaining urbanization on “Grand Isle” in Louisiana, despite the very high recurrence of major storms (fifty over 130 years), has cost the federal government some US\$1 million per dwelling in subsidies over the period. Furthermore, in France, unlike England, responsibility for seawall maintenance is not centralized (Hourdeau-Bodin, 2015). Finally, it should be noted that seawalls ultimately cause the disappearance of beaches, which, as discussed, are important both for coastal area tourism (and the numerous jobs this entails) and as natural protective infrastructure (Luisetti et al., 2011). As a result, beach nourishment operations are required but their cost is likely to increase significantly in the future as a result of sediment shortages.

Managed retreat, which is in line with the second approach of Klein et al. (2001), requires a fundamental change in representations, recognising the natural mobility of the coastline and the illusion involved in wanting to control nature. Some projects to relocate roads or diffuse habitats have already been undertaken for example in England on Northey Island (1991) and on the Freiston shore (2001), in France in Criel sur Mer (2011) or in Sète (2011). However the small number of residential dwelling relocations do not provide sufficient insights as to the social constraints concerning these operations, especially if they are carried out in

² Of course, in practice, managers have to reconcile the two approaches depending on the density and the nature of building in their area (Hurlimann et al., 2014; Gibbs, 2015) and on the economic, institutional, legal and socio-cultural context (IPCC, 2014).

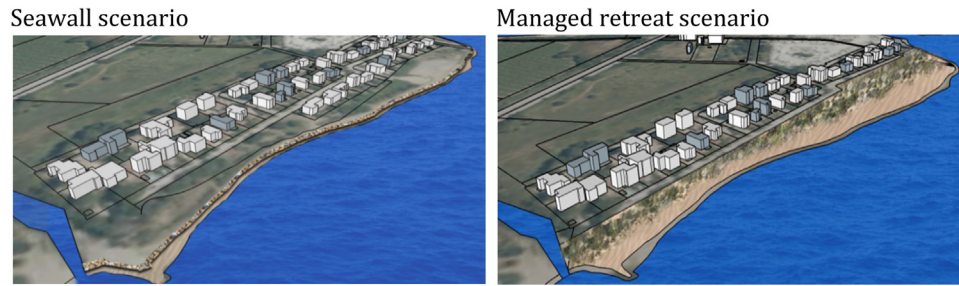


Fig. 1. Urban designs for the two scenarios.

anticipation of future problems. King et al. (2014) testify to the strong resistance of recently-settled owners and inhabitants to move, whilst Myatt et al. (2003) show even stronger opposition from older people. In France, zoning procedures carried out within the framework of NRPPs are usually lengthy and contentious, which undermines their efficacy. Elected representatives are also reluctant to embrace relocation measures as these require funding and involve cumbersome procedures for purchases or, worse, expropriation (Ledoux et al., 2005; French, 2006). With recurring damages, the prospect of losses in real estate value may promote the social acceptability of managed retreat and prompt the implementation of innovative financial mechanisms. Hence, a system to buy back and rent dwellings was experimented in Happisburgh in England (Huteau, 2015), whilst Lambert (2013) and André et al. (2015) suggest new repurchase programmes for risk-prone assets. The generalisation of insurers' actuarial practices might also help to encourage responsible behaviour. Grislain-Letrémy and Villeneuve (2015) give the example of Houston where house prices dropped not as a consequence of the severe 1979 floods but as a result of the subsequent increase in insurance premiums.

3. Survey methodology

3.1. Area of study

Hyères-les-Palmiers is a town of 57,000 inhabitants where the economy is driven by agriculture and above all tourism. The Var department welcomed 10 million tourists and provided 64.2 million overnight tourist stays in 2014. In 2013, 9% of jobs in the Var were directly or indirectly linked with tourism (compared with 3.9% on average in mainland France) and 85% of these jobs were on the coast. The value added by tourism-related enterprises was €2.01 billion (8.4% of the total value added compared with 5.6% on average in France), 49% of which concerned the coast (data from the Var tourist atlas of 2014 and from the Ministry of Economy, Industry and Digital technology).

The town's shoreline stretches for 114 km and comprises the Giens peninsula, and the islands of Porquerolles, Port-Cros and the Levant as well as many small islands and islets. It has significant natural resources with more than 2000 ha of sensitive natural areas purchased by the Coastline Conservation Authority [Conservatoire du Littoral]. Nonetheless, developing coastal urbanization and the creation of a number of marinas have resulted in significant coastal erosion. The beach of Vieux-Salins for example has lost some 50 m in less than 70 years and has almost disappeared in some places where protective seawalls have had to be built. Whilst the historic town situated further inland is largely unconcerned by sea-level rise, the Centurion Plain is at high risk given its low altitude (1–1.5 m above sea level (MEDDE, 2013)). This area was one of the five pilot sites chosen to trial relocation policies in France (MEDDE, 2013). Three types of situation were

identified: (i) a high-risk residential area where relocation policies must be considered in the medium term, (ii) an area where urban planning regulations may allow changes in housing and (iii) a seafront area with a protective role that should be enhanced and could be reinstated as coastal landscape (MEDDE, 2015).

3.2. Questionnaire design and survey protocol

Our questionnaire comprised five parts. The first part sought to understand respondents' attachment to their homes and to the place where they live. The second part aimed to qualify their perception, experience and awareness of the risk of marine inundation and their opinion as to the changes in insurance schemes and house prices on the seafront. The third part focussed on respondents' preferences concerning adaptation policies and the institution they would most trust to implement them. Two evaluation modules were used to estimate their willingness to contribute financially to the building of a seawall or the implementation of a relocation policy for front-line properties. These were accompanied by 3D urban designs to help respondents visualize the impact of seawalls or relocation compared with the current situation (Fig. 1).³

Follow-up questions enabled an understanding of the motivations behind the answers, especially in case of protest or refusal to contribute financially, and an examination of the credibility and the efficacy of the proposed policy. The fourth part aimed to clarify respondents' preferences concerning managed retreat policies (practical implementation, understanding of the impact in terms of beach maintenance and tourist attractiveness, funding process and compensation measures, etc.) Finally, the fifth part of the questionnaire addressed the personal characteristics of respondents.

This questionnaire was tested in April 2014 on some twenty people living on the Mediterranean shore. The final survey was carried out face to face in respondents' homes, over three periods of 15 days in May 2014, July 2014 and March 2015 in order to encompass every type of resident. The questionnaire took about 45 min to complete. In order to take into account the diversity of situations, two zones were identified depending on whether or not they were concerned by a relocation policy: zone 1 comprised seafront properties, at risk of inundation and potentially affected by relocation, zone 2 represented the remainder of the town. In all, 421 people were interviewed, 59 in zone 1 and 362 in zone 2.

3.3. Developing the scenarios

Three scenarios were developed to assess the extent to which

³ These visual designs of the urbanization of the neighbourhood focused the attention of respondents even though some wanted to see the exact location of their home and check that the transcription was a faithful replica of the reality.

property owners in Hyères-les-Palmiers were willing to contribute financially to climate change adaptation policies.

The “reference” scenario presented the scientific predictions of the Intergovernmental Panel on Climate Change (IPCC) relating to a sea-level rise of 60 cm for the region in 2100 (IPCC, 2014). It stated that in fifty years’ time, strong storms would become more frequent and could occur every five to six years with more significant consequences. It then indicated that this situation had to be anticipated straight away and different management options had to be examined (Kelly and Adger, 2000; Boateng et al., 2007), and that if no adaptation policy was implemented, homes and businesses would be regularly flooded, roads cut-off and even destroyed (Nicholls and Lowe, 2004) and insurance premiums would rise (AFA, 2015).

The “seawall” scenario assumed that seawalls were built along the beach to protect homes and infrastructure from marine inundation (Klein et al., 2001). This would prevent reconstruction and damage cost after each storm (IPCC, 2014). However, it specified that (i) beach access would be more difficult and pathways would have to be built above the seawall, (ii) beaches would disappear as the seawall would not make it possible to maintain the sand (Luisetti et al., 2011) and (iii) seafront properties would not necessarily have a view of the beach and the sea (Titus, 2011).

The “managed retreat” scenario involved the relocation of infrastructure or homes situated on the seafront. These would either be spread around the town depending on land availability,⁴ or a new neighbourhood far from the seafront could be created (Klein et al., 2001). This policy would (i) maintain beaches and even in some cases increase their size (Titus, 1998; French, 2006) and therefore maintain the tourist attractiveness of the town (Cooper and Lemckert, 2012) and (ii) avoid reconstruction and damage costs following storms (IPCC, 2014).

The “reference” scenario was presented in the introduction to the fourth part of the questionnaire; the “seawall” and “relocation” scenarios followed randomly according to the respondents together with the 3D urban designs. It was stated that they were two independent options which would not be implemented simultaneously and that there was no reason why they should provide the same level of satisfaction. In both cases, any climate change adaptation policy would be implemented by the institution most trusted by the respondent to avoid refusals due to a lack of trust in the institution (cf. third part of the questionnaire).

Respondents were then asked if they were prepared to contribute financially to each of the two scenarios. A payment card with different various bids was proposed and the valuation question involved three stages: “I am COMPLETELY SURE that I would give at least €X”, “I am COMPLETELY SURE that I would not give more than €X” and finally “I think that I would give €X”. In this article, we only treated the null answers “0€” as opposed to a positive willingness to financially contribute, whatever the value of the latter. Choosing the most appropriate payment method is complex in this case because respondents are not used to paying for environmental goods (Ryan and Wordsworth, 2000) and it must, therefore, be as realistic and plausible as possible (Arrow et al., 1993). Consequently, we used a compulsory payment (Bateman et al., 2002) in the form of an increase in the local property tax, which would be repeated over five years (Boyle, 2003). Cheap talk (Cummins and Taylor, 1999) was introduced in order to mitigate hypothetical biases (Bishop and Heberlein, 1979). The aim of the approach used here was not to assess the value

given to home protection or beach maintenance but to improve our understanding of the motivations behind inhabitants’ choices and preferences for the two scenarios suggested, according to their willingness to contribute financially to each of them (willingness to contribute financially different from zero or equal to zero).

4. Results

4.1. Socio-economic profile of respondents

The survey concerned principally permanent residents (88%), of whom 70% owned their dwelling. Gender distribution was balanced with 54% women, a figure very similar to that observed in Hyères-les-Palmiers’ most recent population census (Insee data). The proportion of pensioners was high which explains the average age of 56 and the prevalence of 1 or 2 person households (70%). The level of education was higher than the average in the Hyères-les-Palmiers area as 46% of respondents had a diploma equivalent to at least two years of higher education. Finally, almost one quarter of the respondents worked or had worked in an area related to our survey (14% in tourism, 9% in the marine sector and 4% in environment). It is also noteworthy that 45% were members of an association, which is the same percentage as in the French population (data from the Ministry of the Town, Youth and Sports), and that 13% were members of an environmental association.

Second-home owners are over-represented among the inhabitants of zone 1 (23.5% compared with 10% in zone 2).⁵ Significantly more of them were retired (59% as opposed to 43% who had their main residence there), older (64 years old on average compared with 54), lived as a couple (80.5% vs. 54.5%), were members of an association (66.5% vs. 42%), and lived in a house rather than in a flat (76.5% vs. 60.5%). They were also better educated with 49% having at least five years of higher education compared with 13.5% in the case of permanent residents.

4.2. Perception of coastal risks and preferences for adaptation policies

59% of respondents thought that the risk of sea-level rise should be considered in the next ten years in their region whilst 9% thought that these forecasts are far from proven and 5.5% felt that sea-level rise will not be significant and is not, therefore, a cause for concern. The majority (89%) pay attention to weather warnings and 47.5% modify their behaviour accordingly whilst 10% admit to feeling very anxious.

As regards the different coastline management strategies, 48% thought that a seawall would be “Quite” or “Very” effective in protecting homes and infrastructure from the effects of climate change. Opinions were split on the probability that it would be built with 39% considering it realistic in twenty years’ time and the same percentage judging it to be unrealistic. The results were different in the case of managed retreat policies with 40.5% believing they could be implemented in twenty years’ time, 24% in fifty years’ time and only 21% feeling that they are unrealistic. Permanent residents and second-home owners gave broadly similar answers to these questions.

If a managed retreat policy were implemented, 47.5% of respondents disagreed that compensation should be less for second-home owners. Of course, this is especially true of main residents (the difference is statistically significant). On the contrary, whatever their status, 63.5% of respondents supported the idea of lower compensation for people who had recently settled in the area and were well informed. Finally, 45% of respondents “Totally disagreed” that compensation should be

⁴ The residual land capacity of Hyères-les-Palmiers is estimated to be 314 ha (data from the territorial diagnosis carried out in May 2015 to establish the Local Urban Plan [Plan local d’urbanisme]).

⁵ Only results where chi-square tests are significant are presented here.

Table 1
Determining variables for binomial logits.

Name	Description
Income	Average monthly household income
Owner	The respondent owns his home in Hyères-les-Palmiers
Age	Age of the respondent
Alone	The respondent lives alone
Seawall 1	The "Seawall" scenario was presented before the "Relocation" scenario
Protection	The respondent thinks that a seawall would very ineffective in protecting homes and infrastructure
Unr. Seawall	The respondent thinks that the building of a seawall is unrealistic
Unr. Relocation	The respondent thinks that the implementation of a relocation policy is unrealistic
Trust	The respondent trusts the local government to implement an adaptation or prevention policy
Int. Relocation	The respondent thinks that one the main interests of a relocation policy would be to prevent damage in case of storms and that it would reduce costs for society.
Compensation	Should seafront homes need to be expropriated, the respondent totally disagrees with the idea that compensation should be capped, regardless of the value of the property
Health	The respondent thinks that public funding should be earmarked for the health sector as a priority

capped and not take into account the value of the dwelling. This figure reaches 71.5% if we add those who "Somewhat disagreed" with this principle (statistically significant difference). A similar view was expressed by 42.5% of the respondents who thought that the fairest compensation criteria is the market price in that all people should be compensated using the same percentage of the market value of their property. There was no significant difference between permanent residents and second-home owners on these two latter questions.

4.3. Econometric modelling

Using two binomial logit models, we explored the probability of willingness to contribute financially to the building of a seawall on the one hand and the implementation of a managed retreat policy on the other.⁶ The variables explaining the model are set out in Table 1 and the model results are shown in Table 2. Apart from income and age, all variables are qualitative.

The results show that preferences for building a seawall or implementing a relocation policy can be explained by a few common, and some specific, variables.

We note, first of all, that the income coefficient is not significant whatever the model. Therefore the financial resources of the household do not have an impact on the likelihood of financially participating to an adaptation policy. This result certainly contradicts expectations (Bateman et al., 2002) but this may occur in monetary valuation. First of all, in our case, choices relate to long term policies and they imply new vision of climate change adaptation and of policy funding. In addition, our respondents are rather old and wealthier than the average (this is representative of French coastal areas, in particular in PACA). It was important to study their preferences because they are often at the root of many challenges and criticisms (all the more so because they have larger social networks). Lastly, we can note that we asked them to estimate their loss of welfare in the case of a move and in the case of a fall of 20% of their income; results show that they are more sensitive to the move than to a drop in income.

On the other hand, home ownership always has a significant positive impact on this likelihood. In both cases, the respondents

⁶ In other words, the explanatory variable is the agreement to financially contribute to the construction of seawall or to the implementation of a relocation policy (i.e the providing of a positive amount to the third valuation question "I think that I would give €X"). The explained variables are given in Table 1.

Table 2
Results from binomial logits.

Variables	"Seawall" logit	"Relocation" logit
Constant	0.20 (0.56)	2.27*** (0.55)
Income	-1.36e ⁻⁰⁶ (5.42e ⁻⁰⁵)	-1.28e ⁻⁰⁵ (5.33e ⁻⁰⁵)
Owner	1.01*** (0.32)	0.81*** (0.29)
Age	-4.19e ⁻⁰³ (8.03e ⁻⁰³)	-0.01** (7.41e ⁻⁰³)
Alone	-0.14 (0.29)	-0.66** (0.27)
Seawall 1	0.78** (0.30)	-0.37 (0.27)
Protection	-1.50*** (0.48)	-0.36 (0.38)
Unr. Seawall	-2.31*** (0.32)	-0.93*** (0.33)
Unr. Relocation	0.11 (0.34)	-1.68*** (0.36)
Trust	-0.58** (0.25)	-0.52** (0.26)
Int. Relocation	0.74*** (0.26)	0.07 (0.25)
Compensation	-0.06 (0.27)	-0.51** (0.25)
Health	-0.72*** (0.26)	-0.06 (0.24)
Number of observations	421	362
Log-likelihood	-197.19	-207.23
Pseudo R ²	0.32	0.16
Proba $\chi^2(12)$	93.45***	63.03***

Note: *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level. Standard-errors are in brackets.

The number of observations is lower for the "Relocation" scenario because people living in Zone 1 were not asked this question.

who trust local government to establish a managed retreat policy or build a seawall are less likely to contribute. It would appear, therefore, that people prefer that the adaptation policy be implemented at a larger scale. This conclusion is supported by the fact that the institution most cited (44.5%) to play this role is the Coastline Conservation Authority [Conservatoire du littoral] which depends on the State. Finally, the respondents who think that building a seawall is unrealistic, whatever the time scale proposed, are less likely to contribute financially. This result appears to make sense as regards contributing to build a seawall. In the case of implementing a managed retreat policy, it may be that those who feel that building a seawall is unrealistic do not really believe in current or future coastal risks and thus, do not wish to contribute to an adaptation policy of any kind.

As regards the "Seawall" scenario, it is also noteworthy that, quite logically, those who felt that a seawall would be very ineffective in protecting homes and infrastructure were less likely to want to contribute financially. We also note that viewing the benefits of relocation as reduced costs for society affects the willingness to contribute financially to a seawall. This is a very utilitarian and limited view of relocation benefits.⁷ It is possible

that for these respondents, who favour a financial approach, there is greater interest in a seawall as they are less sensitive to the impacts and benefits of the two types of measure. Finally, respondents who believe that public funding should prioritise the health sector⁸ have a lower probability of contributing financially to the building of a seawall. This result is more difficult to interpret. A more detailed profile of these individuals shows that they usually have higher incomes (>5000 €), are less educated (<Bachelor degree) and less likely to be members of environmental associations. These characteristics suggest more individualistic personalities focused on economic arguments.

The significant variables are very different for the “Managed retreat” scenario. Older respondents and those who live alone are less inclined to contribute financially towards this type of measure. Moreover, respondents who believe that both a seawall and a managed retreat policy would be very ineffective in protecting homes and infrastructure are less likely to pay. This result was expected insofar as these questions were designed to check the credibility of the proposed scenarios. Finally, those who totally disagreed with capping compensation for relocated people regardless of their property value had a lower probability of contributing financially to a managed retreat policy. This variable may reveal in this case the concern of respondents over compensation levels in case of repurchase or expropriation and drives them to reject this type of policy.

5. Discussion

First, it is interesting to note that the willingness to financially contribute explanatory variables demonstrate quite rational behaviour on the part of people who do not wish to contribute if they think that the scenario, that is the type of policy suggested, is ineffective or unrealistic. This result confirms the search for efficiency coming from a utilitarian approach (Clément et al., 2015) and is in line with various studies linking the acceptability of adaptation policies with risk perception (Myatt et al., 2003; Eiser et al., 2012; Rey-Valette et al., 2012; Hellequin et al., 2013; King et al., 2014).

There is also a growing awareness of the long-term benefits of relocation with 48.5% of those who refuse to financially contribute to the “Seawall” scenario not wishing to see this policy implemented whereas 47% of those who refuse to financially contribute to the “Managed retreat” scenario believe that it is the financial responsibility of the State or of the local authorities (only 13% reject this policy altogether). These differences show a preference for managed retreat and hence a realistic approach to the most appropriate long-term adaptation measures.

Furthermore, age (which reduces support for managed retreat in our model) is often found to be a factor in sea-level rise denial (Hellequin et al., 2013; King et al., 2014). It reflects a stronger attachment to the home and/or the area, reduced mobility, lower levels of education and reduced risk awareness. A significantly greater number of those directly concerned by managed retreat (Zone 1) consider it to be unrealistic and they are usually older (64 on average compared with 54 for the whole sample). The same applies to people with a lower educational level (<Bachelor degree). These factors must be taken into account when

implementing these policies through awareness-raising measures and especially (as it is a long-term risk) through deferred purchase arrangements. One possibility would be to postpone interventions until the moment of property transfer for elderly people or after a lapse of time which would facilitate detachment for others. In France, several research studies are exploring these possibilities (Lambert 2013; André et al., 2015; Huteau 2015) and this approach has been adopted by the commission responsible for monitoring the experiments and for supporting the development of State practice in this area (Comité de suivi, 2015).

The absence of a link with income must be stressed as this is often an explanatory variable for the willingness and amount to pay (Bateman et al., 2002). On the other hand, owning the property is a determining factor regardless of the approach and the type of residence i.e. main or second home. It may increase vulnerability and therefore promote more interest in territorial adaptation measures that have a direct impact on preserving real estate values.

Finally, whilst the analysis of refusals highlights the importance of personal interests, the analysis of willingness to contribute financially shows that respondents derive some moral satisfaction, which is more pronounced in the case of relocation, from their behaviour (Kahneman and Knetsch, 1992) relating to their altruism and/or ethical considerations (Nunes and Schokkaert, 2003; Carlsson et al., 2007). Thus, 51.5% of respondents consider that “It is our duty” to build a seawall, or that “Everyone must contribute” compared with 59% for the “Managed retreat” scenario. The 19% who think that it is important to maintain the beaches can be added to this figure.

6. Conclusion

Our study aimed at providing public decision-makers information about inhabitants' perceptions and preferences regarding the evolution of coastal flooding risk management in the face of climate change. The originality of our approach consists in proposing two successive valuations in order to compare the determinant variables for each type of adaptation measure and the willingness to financially contribute to their implementation; this in an identical (and thus comparable) context. Thus, our survey compared the willingness of residents (from main and second homes, owners and tenants) in Hyères-les-Palmiers to financially contribute to two adaptation scenarios: the building of a seawall and the relocation of seafront property. Taking into account people's perceptions is a crucial factor in adaptation policies (Eriksen et al., 2015). It is important to identify and better understand barriers and resistances to relocation since they may relate to a preference for current policies (i.e. technical hazard management that results in the construction of seawalls) and the low level of awareness about their drawbacks.

Regarding perceptions, our results show a low level of scepticism among respondents towards the impacts of climate change and a desire to preserve the current compensation methods (i.e. compensation using the market value of the property). Whether it concerns a seawall or a relocation policy, the willingness to financially contribute is influenced by the confidence in institutions, by the fact that owners do feel particularly concerned; responses are not affected by the respondents' income. In both case also, respondent's judgement on the effectiveness and the feasibility of the policy is determinant. This result is not necessarily obvious. It shows that preferences rely on a rational reasoning that integrates the need for change in the face of climate change and a degree of consciousness about the limits of the current approaches. If the preferences regarding seawalls exhibit economic and individualistic motivations, moral satisfaction plays an important role in preferences for relocation.

⁷ Respondents had to choose two of the following options: “The beach could be maintained or enlarged and the seafront could be natural”, “The town would no longer have to assure the safety of people in the case of marine inundation”, “The newly built neighbourhood would be more modern and more ecological”, “There would be no more damage in the case of storms and it would cost less to the society” and “Tourist activity would be maintained”.

⁸ Compared with the other possible options which were: education, environment, employment and safety.

Relocation is less endorsed by the oldest respondents, which requires thinking and proposing specific arrangements for its implementation.

The results reveal a predominant utilitarian concern in particular from owners worried about preserving the value of their real estate. However the interest shown in relocation reveals a certain awareness of inhabitants concerning the need for long-term changes in the kind of measures that will be implemented.

However the implementation of such managed retreat measures is hindered by opposition from the owners concerned. This relates to economic inequalities and in particular to the NIMBY (Not In My BackYard) principle. It shows the need for thinking to go beyond the coastal towns to take account of the broader public interest, in particular beach users who live in the hinterland and tourist operators who also depend on beach maintenance. Consideration must also be given to the capacity of towns to redesign their coastal area to keep it attractive. Several authors stress the need to evaluate all gains and losses (Eiser et al., 2012) and to switch scale in order to understand the whole community concerned in an approach that would go beyond independent utilitarian motivation and favour common good regulation (Cooper and McKenna, 2008; Pelletier, 2010; Hampicke, 2011; Clément et al., 2015). In addition to the need to go beyond cost-benefit approaches, that do not adequately value future gains, this discussion highlights the need for adapted governance arrangements (Rupp-Armstrong and Nicholls, 2007; Abel et al., 2011) that would allow improved coordination between actors in an integrated territorial approach and a dialogue with the populace consistent with a participatory governance approach and stronger information and awareness measures. These latter are vital to increase commitment to long-term forward planning (Hurlimann et al., 2014; Gibbs, 2015) which may call into question some current acquired rights. In order to achieve this, Falaleeva et al. (2011) suggest drawing on progress in integrated coastal zone management (ICZM), in particular in terms of governance, to implement climate change adaptation policies which require an integrated approach at a territorial level.

Acknowledgements

This work was funded by the “Fondation de France” tender “Quels littoraux pour demain?” [“What coastlines for tomorrow?”] as part of the project “Alternatives Littoral Vulnérable - Élévation du niveau marin (AlternALIVE)” [“Alternatives Vulnerable Coastlines – Sea-level Rise”]. The authors thank Camille André, Sophie Cornet, Nicole Lautredou-Audouy, Alexis Perlade and Gisèle Vianey who carried out the survey as well as Farah Benkirane who developed the urban design to illustrate the scenarios.

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