


## Residents' attitude towards possible adaptation measures to the sea coast erosion in Latvia

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### Abstract

#### **Purpose –**

In addition to climate changes, human activities in the sea coast area are also important in the context of coastal erosion. There is a need to consider possible measures of adaptation at a national level to solve this issue. The purpose of this paper is to analyze the findings of the interviews made by the author and come to conclusions about residents' attitude towards possible measures of adaptation to the coastal erosion in Latvia.

#### **Design/methodology/approach –**

The research was made by interviewing those seashore residents whose households are most influenced by sea coast erosion along the entire coastline of Latvia in the areas where erosion rate is projected to be at least 6 m until the year of 2025.

#### **Findings –**

Half of the interviewees consider hard coast defense structures as an effective adaptation measure to the sea coast erosion in households concerned. The other half would not support that because of either long-term ineffectiveness or other unwilling consequences. Retreat as a strategy is acceptable only for quite a small part of interviewees.

#### **Originality/value –**

The results of the research can be taken into consideration when making political decisions concerning adaptation to climate change.

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### Full Text

#### **Introduction**

Coastline erosion in today's circumstances, when climate change becomes ever more visible and pronounced, has become a burning issue throughout the world, as one of the manifestations of climate change is an increase of storm frequency and intensity, shortening the period of ice in the seas, ice loads and the moisture-saturated rock permafrost decline in shallow water and the sea water level rises. These climate change effects contribute to coastal erosion, flooding of lowly located land areas during the storms (Kļaviņš *et al.*, 2008). In Latvia, without climate change, human disturbance is also significant in coastal zones – impact of ports, coastal dune building, and construction of reservoirs on the rivers, over-load of vacationers (Eberhards, 2003).

The aim of this article is to display the overall situation of coastal erosion in Latvia, to consider possible adaptation measures as solutions, analyze the findings of the interviews made by author and come to conclusions about residents' attitude towards possible measures of adaptation to the coastal erosion in Latvia.

In Latvia, along current sea coast, 5-10 km wide zone is home to more than one million people and in the next half century more than 60 percent from the Latvian coastline during the storms will be more or less washed off (Eberhards, 2004). Recently, in Latvia, in elevated coastal erosion risk zone, there are about 20 settlements and approximately in 4 km total length; there is a necessity to limit coastal erosion. In circumstances of climate change, rising of sea water levels, growing storm surge levels and prolonging active operational period of storms, in the next 30-50 years coastal erosion will have to be limited in total length of 8-10 km (Eberhards and Lapinskis, 2008). Since during the period from year 2008 to 2023 in Latvia is expected elongation of total coastal erosion affected coastline until at least 258 km or 51.5 percent of the total length and 310 ha of land area to be washed off (Eberhards *et al.*, 2008), at a national level, there is a necessity for a development of adaptation to coastal erosion strategy.

However, in Latvia, compared with other countries, there are not many rather valuable objects and households that are actually endangered, because of the geopolitical conditions during the last 50 years in the previous century, when the housing and economic activities in the Baltic Sea coastal zone and in the Gulf of Riga Kurzeme coast starting from Engure was severely restricted or banned. Only approximately one-tenth of the sea coast is directly affected by port infrastructure, coastal defense structures and residential proximity (Eberhards, 2003). However, the households, who suffer from coastal erosion, and every year loses land, is completely vulnerable, because legislation in Latvia does not determine any assistance in such cases.

Timely adapting to the situation enables saving costs in the future, which would arise while eliminating consequences or managing emergency measures. For an adaptation that enhances the situation, especially for one that calls for a radical action quite a long pre-preparation is needed, to allow sufficient time for public participation, discussion, integrated planning and implementation. To enhance national adaptive capacity, to successfully implement necessary adaptation measures and avoid public resistance public support is an important factor, so it is worthwhile to clarify perception and attitude towards possible adaptation measures of those who are most directly affected by coastal erosion.

Nowadays, the role of human activity in coastal zones that promotes seashore erosion is increased as anthropogenic load on vulnerable ecosystems in coastal zones is building up. The most representative anthropogenic factors include ports (moles), depletion of unpolluted soil from the ports aquatorium and ship access channels and dumping it in distant sea landfill sites, removing large boulders, sandy and gritty sediments and pebbles from the shallow water and beaches, coastal dune building, construction of reservoirs on the rivers, over-load of vacationers. In Latvia annual with port activities-related losses of sediments in shallow water, which consists of 1-3 million m<sup>3</sup>, in volume are similar to those, which waves wash off during powerful storms from the zones of mainland coast and foredunes (Eberhards and Purgalis, 2008). Human actions, for instance, have led to the degradation of natural buffers from storms and waves, such as salt marshes, mangroves, coral reefs and dunes, the world over. Till now much less human effort has been put trying to reduce vulnerability through strategies such as beach and dune nourishment, and the adoption of insurance policies that discourage construction in low-lying areas (Turner *et al.*, 1996).

Concerning human induced coastal erosion Protection Zone Law is the most important regulation in Latvia. It prevents coastal erosion, if the question is, for example, about mineral deposit extraction, movement of vehicles or campfire burning and tent-building in unexpected places. By contrast, if the question is about the implementation of new building or expansion of existing one, law issue is not sufficiently rigid and provides various exemptions, forms, how to realize the measure anyway, which counteract the purposes of Protection Zone Law.

Adaptation strategies can be relatively divided as defense, adjustment and retreat strategies. Strategy – defense against erosion and flooding – includes engineering approved coastal defenses, which are in a high maintenance need (Eberhards, 2003), for instance, hard coast defense structures – groynes, seawalls, revetments, gabions, offshore breakwater, etc. non-construction solutions – special wooden fence for accumulation of sand, branches put in a direct place to stop cliff from eroding away, beach nourishment (KALME, VPP, 2009). The defense strategy also includes “green solutions” as a degraded dune planting with osier and/or grasses (Bijlsma *et al.*, 1996) and wood-track introduction at sandy dunes, which prevents the destruction of vegetation, when vacationers are moving (Cambers, 1998).

Adjustment strategy includes various measures to cope with regular flooding, for example, providing extensive security against flooding or elevation of property, modifications of the city sewage system, elevation of roads and restoration of wash-outs, providing shallow water sand swaths balanced distribution, which is achieved by dumping uncontaminated soil that is exhausted from the port aquatorium and ship access channels into the washed-out beach or shallow water zone. Also, sand pumping through pipelines along the coast, bypassing ports and other hydraulic structures that block longshore sediment transport and beach drainage are among the adjustment strategies (Eberhards, 2003), as well as the payment of compensation for damages and insurance, to some extent fall into this category.

Retreat strategy implies major changes in land use and housing relocation away from the erosion and/or flooding exposed coasts, possibly by public authority buying back the land and property in the planned retreat area or giving grants to coastal residents, to move deeper into the mainland (Bijlsma *et al.*, 1996).

Active adaptation to climate change means complying long-term strategy. Usually in coastal planning decision making, there is not enough long-term analysis. Choosing a suitable time horizon, in response to climate change is a crucial aspect (Few *et al.*, 2004). Short-term planning approach can be implemented only until much more coordinated action is feasible and necessary, then difficult compromises should be assessed between short- and long-term benefits (Kay and Alder, 1999).

The situation of threatened coastal areas is very different both in urbanization and nature conservation terms, therefore by choosing a suitable adaptation strategy for a specific location at first its significance has to be assessed: whether area at risk has an important economic role; whether it has a significant role in preserving biodiversity; in nature conservation; in cultural and historical heritage; whether it is urbanized (to what extent) (Klein *et al.*, 1999). When introducing certain hard coastal defenses, beach area is becoming constantly narrower between the approaching sea and structures, which often have nowhere to depart because of urbanization, thus the biodiversity of coastal areas, as well as recreational features and unique landscapes are threatened (Klein *et al.*, 1999).

If adaptation measures include a radical change, such as large-scale security operations, changes in infrastructure and gradual abandonment of housing, the implementation is quite controversial. The potential effects of different adaptation to climate change impacts are, for instance, property and amenity loss, negative changes in biodiversity and landscape and even threats to human identity as well as sense of ownership, which is based on specific site. In such cases, in the process of implementing adaptive strategies, decision makers may have to face strong public protests, and local government representatives, who are elected for a certain period and is dependent on voters' support, may be uninterested in making unpopular, but necessary decisions in order not to lose their position (Leafe *et al.*, 1998).

In Latvia, compared to other countries, the extent and seriousness of coastal erosion problem is relatively less significant as population density of the threatened coastal zones is much lower. So in Latvia, hard coastal defense structures with regular financial contributions of a large-scale would not be an adequate solution.

Currently, there are no laws or plans that determine adaptation to coastal erosion in Latvia. In the near future the government will have to make decisions regarding adaptation measures – determination and assessment of measures to be taken for the specific location, order, in which different types of support are delivered for threatened households.

## **Methodology**

Initially households of interest were selected – those, which are located in those Latvian coastal zones where till 2023rd mainland cost retreat is predicted of six or more meters and which are located at 100-150 m wide zone from the coastline. This process was done by using digital maps of coastal erosion developed by G. Eberhards and J. Lapinskis within national research program "Climate change impact on water environment in Latvia" project (Eberhards *et al.*, 2008) and 2007th coastal aerial maps of "Metrum" Ltd.

The interview occurred in two steps, for three days. During these days, all the chosen households were visited and the following information form respondents was obtained:

Information about household residents – family/worker or lone pensioner/s.

Function of household – the main place of residence or a summer cottage.

Lifetime of specific household (when the house was built or purchased), use of coastal erosion threatened land, dwellings and other buildings distance from the upper erosion slope.

Observed and experienced coastal erosion by respondent – whether something else, other than land is lost due to coastal erosion.

Characterization of coastal erosion observed in the household in the past and present.

Already ongoing or planned adaption actions, if any. Dwellers attitude and assessment for certain situation.

Attitude towards possible adaptation measures to the coastal erosion – which of the adaptive strategies are more acceptable for them.

The interview was conducted in a way that some of the information would be handled quantitatively, some qualitatively – during the conversation gaining an insight on the respondents' attitudes towards the study subject, as well as various additional information useful in the interpretation of results and allowing to see other aspects of the study problem was gained. Questions of the interview were open.

Research was made on May 30-31, 2009 (Saturday and Sunday) and on June 27, 2009 (Saturday). Overall, across the coast of Latvia, from about 115 households that meet criteria, residents of 61 households were interviewed. Out of all households interviewed, 18 were summer cottages. Approximately judged that, overall, from all the 115 households that meet criteria ~55 are summer cottages. Part of owners of appropriate houses were not interviewed for various reasons – either inhabitants were not at home at the time the household was visited, some cottages were in the building stage, so the owners were not at a place, some refused to respond. There were quite many summer cottages whose owners visit their households very rarely (information, given by neighbors). Few households were not found, even asking for assistance to local people. Moreover, it is not certainly known whether the household meets the criteria because the occupants were not met. The representativeness of this survey could be

evaluated as reasonably good, as residents from around 53 percent of the households that meet criteria were interviewed. The variation of such indications as households' age, function, rate of erosion, threat and residents' gender, age was enough to represent the whole situation.

That part of results, which could be quantitatively processed, was classified by a program MS Excel, correlative factors were distinguished, and graphs were established. Qualitative information was reflected in a describing manner, linking with the previously distinguished correlations.

## **Results and discussion**

As preferred strategies for adapting to coastal erosion in the results it appeared that almost all the interviewees generally do not believe in the possibility of compensation, especially in circumstances such as those currently in the state, but, of course, would not refuse from it, although they could think about it only theoretically, not practically.

On the question, whether the state should generally do something to help somehow in this situation, almost all responded that they do not believe in such an eventuality in general, but during the rest of the conversation it came in sight that a large proportion of them would like to be helped.

By contrast, 11 interviewees replied that the state should not do anything in this situation. Between them there were owners whose property was not yet affected by coastal erosion at all, or the land was lost only in a small amount and residential house was located more than 30 m from the upper erosion slope and also lonely pensioners, who said that for their life time there would be enough land, and also those who already have their own defense structures ensured.

Similarly in a study of shoreline residents' response to coastal erosion of Lake Superior made by Dilley and Rasid (1990) a majority of shoreline residents would like the federal or provincial governments to pay some of the cost, but are generally willing to share the expense.

A total of 13 interviewees claimed that due to coastal erosion they have lost not only land, but also sheds, other auxiliary buildings, fences, and all of them believed that the state has to assist somehow in this situation, most of them hard coast defense structures considered as good adaptation measure.

Half of the interviewees hard coastal defenses deemed to be a good adaptation option, while the other half indicated that there would be no use of them, because the sea "will take its own" anyway, it would be only short-term solution, waste of money. A comparative surveys of property owners of European descent shows that while beaches are appreciated for their natural setting, most people prefer artificial structures to preserve the status quo, rather than the idea of allowing natural processes to do their work at the coast (Dahm and Economos, 2002).

A total of 19 interviewees had themselves some sort of defense structures (stone piles, pales, clay embankments) already formed. Those in favor of hard coastal defenses would like that state would provide it. There were three interviewees who believed that the state should pay for those expenses that resulted from implementation of their defense structures.

Among those interviewees who live in the place relatively recently (until 20 years) or whose house is located, in comparison to others, closer to the upper erosion slope, proportionally bigger was the part of those who consider hard cost defense structures a good adaptive strategy (Figure 1). This demonstrates that the situation, because of different experiences, is viewed differently. Those residents, who have experienced more storms, their strength and destruction, and for a longer period of time, are more conscious about sea activities. They see it as something that human cannot stop or that is difficult to control in long term period. Perhaps, if all the affected people were adequately informed about the adverse conditions and prospects of the various adaptive strategies, the study's results would be different. Most likely, it would result in decrease of the number of those who deemed hard coastal defenses as acceptable adaptation strategy.

Most of those interviewees who were retired, claimed that hard coastal defenses would not make sense, and there will be enough land for their lifetime. Therefore, when making the choice of adaptation measures, view of time scales of the household occupants should be taken into account, since, for example, residents who claimed that the greening method can prevent the erosion processes in their desired term (remaining lifetime), would not want to accept any more radical measures such as a retreat, though, scientifically assessing the situation, planting of osiers or grasses would make little sense in the long term. By contrast, most of those interviewees, who were of working age, supported hard coastal defenses. They found it an effective adaptation measure.

The question of differing need to adapt for summer cottages and houses that are main place of residence should be assessed, because the significance of situation and problem varies. However, in the study results appeared a fact that those are the summer cottage occupants who more confidently support the introduction of hard coastal defenses – 11 from total of 18 residences whose occupants were interviewed, commented positively on this adaptation strategy. By contrast, most of those interviewed whose household is the main place of residence for them, hard coast defenses did not consider as an effective adaptation measure.

However, prevalence is low. Such a difference is observed, possibly because those who reside at a certain location all the time, not just during the summer, see coastal changes, including autumn and winter storms, much more clearly and thus are aware of the real processes of nature.

On the retreat possibility – the state would allocate land deeper into the mainland and would compensate losses related to household transfers – positive feedback was only from six interviewees (and only for one of them its household had chalets function). The remaining interviewees possibility of retreat perceived as too unrealistic, citing as reasons – either there would not be any space to retreat due to dense housing in the village, or simply would not want to. Also other comparative surveys of property owners of European descent shows that in general, property owners are not deterred by erosion and there is an emphasis on decreasing or preventing erosion rather than relocating (Dahm and Economos, 2002). Of course, the people who own property very close to the sea, descry in the place also such additional values as beauty of the landscape, for part of them their property, house is the family legacy, so in that case there may be also a strong mental attachment to the specific location. Thus, the retreat strategy counteracts with such aspect as one's consciousness of identity. At some locations interviewees said if a land fitting to their property, deeper in mainland were granted for them, then retreat would be more realistic option, but it would be possible only in places, where there is a free state or municipality-owned land.

However, if it was more frequently spoken about the possibility of housing relocation and if the seriousness of the situation increased due to development of coastal erosion processes, as well as if state or local government allocated land resources for such purposes, then it is likely that over time some part of society would begin to accept this idea. Thus, in this case as one of adaptation measures the inclusion of public into planning process can be implemented, thereby increasing public support and reducing its resistance.

Managed realignment is a complex issue, and the public needs to be involved more, with the benefits of it clearly explained. However, it may take several decades for people to appreciate fully the potential benefits. Involving stakeholders is not easy, as it is time-consuming, intensive in management resources, and can lead to outcomes biased towards local interests, and inconsistent with a strategic approach at a national level (Ledoux *et al.*, 2004). Besides, what may be regarded as a retreat option in ten to 20 years time is a real blight on property value. It can severely reduce the value of the property asset for investment and insurance cover in the immediate future (O'Riordan and Ward, 1997).

The situation of desirable strategies is similar in other case studies, for instance, in New Zealand, where a national survey in 2003 where made, residents of coastal communities noted that 55 percent of those surveyed believed sea walls or large rocks are the most appropriate form of defense, 12 percent wanted accommodation policies such as selective beach re-nourishment, 12 percent were satisfied with strategy “to do nothing”, but very very few agreed with managed retreat (Hayward, 2008).

Most of the 13 interviewees who due to coastal erosion have lost not only land, but also sheds, other auxiliary buildings, fences, as good adaptation measure considered hard coastal defense structures (Figure 2). However, only four of them would accept retreat strategy, though, as in total only six out of all the interviewees were those who would be willing to retreat, then apparent is a connection – more unpleasant experience means that a relatively radical strategy could be more likely adopted. There were few who both adaptive strategies found acceptable. Surveys of beach property owners of European descent also shows that experience is a significant influence on people's choice of adjustment alternatives. Individuals at risk may not be aware of all strategies for dealing with a hazard (Dahm and Economos, 2002).

Almost half (26) of the interviewees had planted osier, shrubs or trees to strengthen the coast. Most of them claim that without such activities coastal erosion would have been stronger. However, during storms the plants are destroyed anyway and everything has to be planted again. Some of them want government assistance in strengthening the dune by planting greenery.

During the research it was observed that wealthier household owners either had already built hard coastal defenses by themselves, or was about to do that. As a desirable adaptive strategy they mentioned not to be disturbed and legally allowed to protect their property by themselves without special allowances. In some cases, this indicates a lack of knowledge or experience about coastal erosion as phenomena, as many examples are known that introduction of hard coastal defenses at one place furthers stronger erosion in other areas alongside. However, this does not apply to all cases – for instance, in sparsely populated areas, where there is no adjacent neighbor's property, a situation, in which every individual himself protects its coast, unless it is not degrading landscape or otherwise the environment, may also be permitted.

Thus, in Latvia in sparsely populated areas for those without any close neighboring household or any significant infrastructure facility or building, acceptable option of adaptation might be implementation and maintenance of defense structures, financed by property owners. However, it might be permitted only, when taking into account various regulations, obtaining a permit after expert evaluation and development of recommendations for each case. Such rules could include, for example, a condition that the proposed construction or modification must not adversely affect the adjacent areas, if there is something important (protected natural areas, habitats). The construction as far as possible should fit in the landscape as well. Specific laws, regulations on how such measures should be done in order not to cause more damage should also be implemented.

One of adaptation measures for coastal erosion could also be a creation of legislation, which provides that those who buy property or start the construction in the zone of elevated coastal erosion risk, starting from a moment, when a legislation is adopted, are not entitled to compensations or other forms of state support, as well as to introduce any hard defenses by himself. In this case, any buyer before the contract will be interested to ascertain the coastal erosion risk in a particular case, and there will be a need for a creation and maintenance of publicly accessible database about situation of coastal erosion around all seashore of Latvia. In result building would be reduced in coastal protection zone.

In most cases the lack of coordinated policies and ineffective coastal management has merely served to compound value and land use conflicts among the various interested parties (Turner *et al.*, 1996). Approximately one-sixth of interviewees as one of preferable adaptation strategies mentioned that a treating out of dunes by unorganized flows of people and driving with quadricycles has to be restricted at last, because, although there is an according law, no one seems to care. Some interviewees mentioned that they had taken photos of offenders, written letters to the authorities, but there had been no reaction, even though all the locals knew who the offender was.

It would be useful if before the actual implementation of certain strategy the dumping of depleted soil from the ports aquatorium and ship access channels into distant sea landfill sites were prevented, since returning this exhausted soil to longshore sediment flow, would change the situation of coastal erosion in impact zones of ports. However, addressing this should not delay adapting to coastal erosion in general.

When taking into account economic and usefulness principles, it is clear that it would be worthwhile to implement hard coastal defense structures only in areas, where there is a socially significant object and where there is dense housing or village and it should be done only by community approach – the adaptation should be done by everyone together in a coordinated manner, not separately, due to both financial and practical reasons.

The state or local government, when helping the erosion-affected households, should provide various support mechanisms. Local authority with each owner, involving specialists, should coordinate, which measure in a particular case is convenient, economically assess benefits/losses, and then agree on measures to be applied, also depending on the owners' will. Compensation, land re-purchases or a retreat should be considered if it is concluded that hard coastal defenses and non-construction solutions in certain case are not economically justified. The different solutions can be also combined.

Looking from community perspective, difficult is the question of implementation of hard coastal defenses in villages, because those land owners whose property is already located in the beach due to erosion, might want hard defenses to be in place, even if in this case the beach disappeared in the long run due to defenses, while other villagers is likely to oppose such a solution, because beach as a public-interest object has too large public and recreational value, compared with one or few land properties. Thus, decisions must be balanced so that society as a whole benefits more than loses – so that everyone would not have to pay for expensive maintenance of defense structures and besides that perhaps have to lose the beach.

Three principles for governance of the coastal zone should be taken into consideration:

1. sustainability – coastal development should be carefully planned;
2. adaptive management – policies concerning built capital need to be flexible enough to ensure that the region does not increase its vulnerability to coastal hazards; and
3. stakeholder participation – decisions made by all the stakeholders who will be affected (Duxbury and Dickinson, 2007).

In Latvia the issue of legal status of coastline zone and beaches and its management is still not aligned. Although legally the ownership of beach holds state, it does not manage and governs it. The issue of land belonging at seacoast is unclear in cases, where part of land is located on the beach or even at sea. There is also an unanswered question about cases, when the land owner secures his property with some sort of defenses even when it locates already on the beach – does then this part of the beach still belong to the landowner? The situation and understanding of the land belonging in coastal erosion cases, where local government/state and private property “overlap” in various local governments is different. Legislative alignment of the matter is necessary to prevent legal uncertainty to disturb implementing adaptation measures.

Eberhards (2004) argues that:

Apparently in long-term view most sensible would be gradual retreat inland. One should be aware that coastal erosion is a natural process, which cannot be completely stopped. The expressions and intensity of this process can be appropriately directed, thus keeping the current coastal zone. Also, one has to be aware that by constructing massive continuous coastal defenses against a settlement place for several hundred meters in length, partly the processes of erosion will continue. In the long run beach will disappear there.

A more extensive research with improved methodology in future would be useful, conducting a survey with closed questions, spending more time for each of the respondents, perhaps informing them about different aspects of each adaptation strategy. Furthermore, it would be important to ascertain the views of local authorities of the preferred adaptive strategies.

## **Conclusions**

Although every one of them showed disbelief for that to happen, the vast majority of interviewees would want state to support them by implementing some measures to adapt to the sea coast erosion. Half of the interviewees consider hard coast defense structures as an effective adaptation measure to the sea coast erosion in household concerned. Other half would not support that either because of long-term ineffectiveness or other unwilling consequences and divide in those, who as a best solution sees monetary compensations and/or organized retreat. Among those interviewees who are residents at a certain location for comparatively long period of time proportionally bigger was the part of those who considered hard cost defense structures as ineffective adaptation strategy and vice versa. Those, who had experienced storms, their strength and ravage more and for a longer period of time, realize sea activities as something that for human is unstoppable or hard to control in long term.

Retreat as a strategy is acceptable only for quite small part of interviewees. Majority possibility of retreat perceived as too unrealistic, as reasons for that mentioning that either there would not be any space for that, as there is too thick building in the village, or they just would not be ready for such a radical change. To accept comparatively more radical strategy there has to be more unpleasant experience.

When making the choice of adaptation measures, view of time scales of the household occupants should be taken into account, as views and intentions regarding land use and future development differs, for example, interviewees of the retirement age evaluated the situation according to their remaining lifespan, and would not want any fundamental measures to be taken, such as the retreat.

Within the strategy of adaptation to coastal erosion in Latvia there is a necessity for working out such a legislation, which, first, would identify public and private responsibilities for the consequences of coastal erosion, and second, would identify the order of implementation of adaptive measures providing a variety of mechanisms, approaches in different situations also involving specialists in analyzing the situation and developing recommendations. One of adaptation measures for coastal erosion should not only be a creation of corresponding legislation, but also introduction of more effective enforcement mechanism, which would ensure realization of such laws as Protection Zone Law.

#### **Figure 1**

Residents' attitude whether hard coast defense structures are effective adaptation strategy

[Figure omitted. See PDF]

#### **Figure 2**

Coastal erosion most influenced residents' attitude towards adaptation measures

[Figure omitted. See PDF]

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## Details

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