The awareness of Terschellingers of their coastal defense

Research focused on sea-level rise and gas extraction

Bachelor thesis Human Geography & Urban and Regional Planning
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Colophon

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Abstract

Sea-level rise is a much-discussed topic nowadays. In the case of the Netherlands there are negative consequences to sea-level rise. For example, the Dutch Wadden Islands, home to a lot of Dutch people, are surrounded by the sea. Those areas of the Netherlands could be endangered if the sea level rises. Literature shows that many people continue to live in risk areas, because the place attachment is high and often those regions have very fertile soil conditions. The aim of this research is to find out how aware Terschellingers are of their coastal defense. The level of awareness of inhabitants has a relation with how often hazards occur. In this case it would mean that the level of coastal defense awareness of Terschellingers is relatively low. The main research question to investigate this is: How aware are residents of Terschelling of their coastal defense? By using quantitative and qualitative data in the form of; literature, a survey and mental maps an answer to this question will be presented in this research. It can be deduced from the results that the inhabitants do not directly notice the sea-level rise. They do not see the sea as a threat and do not feel like they are living in a risk area. The place attachment overall is very high. This is an expected outcome because living on an island is often a well-considered choice. The people are emotional connected with the island. The awareness of coastal defense is relatively low, most participants did not know how their island was protected.

Central concepts: Sea-level rise, place attachment, coastal defense, Terschelling.

Introduction

Background

The Wadden region is the coastal area between Den Helder in the Netherlands and Esbjerg in Denmark (figure 1).

Figure 1: The Wadden Sea Area (Common Wadden Sea Secretariat, 2018).

The region is indexed on the UNESCO World Heritage list. It is the largest unbroken system of sand and mud flats worldwide, which makes the region unique, but vulnerable. The temperate-climate sandy barrier coast is facing a rising sea-level (UNESCO, 2009).
In total, around 24000 people live on the Dutch Wadden islands (CBS, 2018). The inhabitants are always threatened by the sea. Flooding and coastal erosion is something they always been confronted with. The villages were built on higher grounds. Dikes and coastal protection works have been built later on (Zijlstra et al., 2017), those needed to protect the hinterland and to stop coastal erosion. A modern form to prevent coastal erosion is sand nourishment (ibid.). The inhabitants living in the Wadden Sea region depend on effective and reliable coastal risk management (Zijlstra et al., 2017). Sea-level rise automatically changes the morphology and the ecology of the Wadden Sea-system. Sooner or later, the sea-level rise will impact the safety of the inhabitants of the region (Markham et al., 2016).

Another threat the Wadden Region faces is soil subsidence. Subsidence is the lowering of land of the land surface (Eggleston and Pope, 2013). Relative sea level can also rise because the land itself sinks (Mount and Twiss, 2005). The natural subsidence of the soil increased the relative sea-level rise by a few of centimeters per century. Man-made subsidence to salt extraction and gas extraction causes an even quicker decline of the soil subsidence and an enlargement of the relative sea level rise (Schuttenhelm, 2017). An example of natural soil subsidence is tectonic movement, created by faulting; the movement of plates an accommodation spaces create subsidence. Another example is natural sediment compaction which causes natural subsidence. The physical characteristics of marine sediments, layers sea sand, make coastal areas prone to subsidence. The extraction of resources like oil, gas, coal, salt and groundwater speeds up the rate of subsidence (Erkens et al., 2015). A modeling study proposed the additional strain placed on dikes as the land surface subsides, together with rising sea levels, are increasing the risk of floods resulting from dike failure (Mount and Twiss, 2005). The surface Terschelling is 674 km² and there are living more than 4.889 inhabitants (CBS, 2019). The island is facing serious issues regarding sea-level rise. The port area needs to be raised because of flooding's, occasionally the ferry port is being submerged by water. As a result, the cars need to be towed away and ferries cannot moor, this causes delays for passengers (Heuff, 2017). Terschelling also has to deal with substantial soil subsidence of 8 to 9 centimeters per century. This decline originates from the extraction of gas and rock salt. The reservoir rock in the soil of Terschelling is relatively close to the earth surface between 2600 and 2200 meters. This is still a form of the so-called upper Rotliegend sandstone, which originated from the early Permian (Schuttenhelm, 2017).
The inhabitants of the island are living in a beautiful landscape, but do they know what the future has in store for them?

Research problem
The aim of the research is to investigate how aware the inhabitants of Terschelling are of their coastal defense, with the main focus on gas extraction and sea-level rise. It is interesting to find out if the inhabitants are occupied with climate change and, therefore, also the consequences for 'their' island.

Main research question:
- How aware are residents of Terschelling of their coastal defense?

Sub-questions:
- What are the consequences of gas extraction and sea-level rise on Terschelling?
- How is the island protected against the sea is?
- How place attached are Terschellingers?

Theoretical framework

Coastal defense of Terschelling

The dunes, the beach, and the foreshore together form a natural, sandy flood defense. Dunes, sea dikes, dams and quays protect the hinterland. Terschelling has one primary water defense which protects the area where most inhabitants live. The natural water defenses are being preserved by sand replenishment. The most important form of coastal defense is the management of the outer row of dunes, the sea whip (Waddenzee school, 2014). The island of Terschelling is mainly protected by the beach and dunes, so-called, soft engineering (Baptist, 2011). The southern part is protected by dikes, so-called, hard engineering. The policy and plans for the Coastal and Wadden Sea policy theme are aimed at the sustainable preservation of a healthy and rich Wadden Sea, in which sustainable co-use and safety of the residents in the area are guaranteed (Meijer, et al. 2016). This supports the realization of the N2000 conservation objectives. The pursuit of natural dynamics in and surround the Wadden Sea, and the dynamic coastal management for the safety of the residents, users also support the natural values on Terschelling, despite the fact that no replenishment takes place on Terschelling. In the case of dynamic coastal management, the basic coastline (baseline 1990) is maintained with suppletions (foreshore and beach replenishment). This form of coastal management has brought more dynamism in the dunes and on the islands over the past 20 years (Ibid). The primary water defense provides safety against flooding from the North Sea and the Wadden Sea. It is the boundary within which the government guarantees the highest water safety level. The coastal defense of Terschelling has been expanded during the last months of 2018. According to new documents of Rijkswaterstaat regarding the primary water defense, more buildings need to be protected within the primary water defense (Rijkswaterstaat, 2018). A risk map of Terschelling is shown in Figure 1. A clear border is shown between the natural defenses and artificial defenses. The part which has the highest risk, most inhabitants and economic center, of drowning is being protected within the primary water defense. Just outside this defense lays West-Terschelling. The harbor in West-Terschelling is being flooded once in a while, the water defense is the weakest in that area (White, 2018).

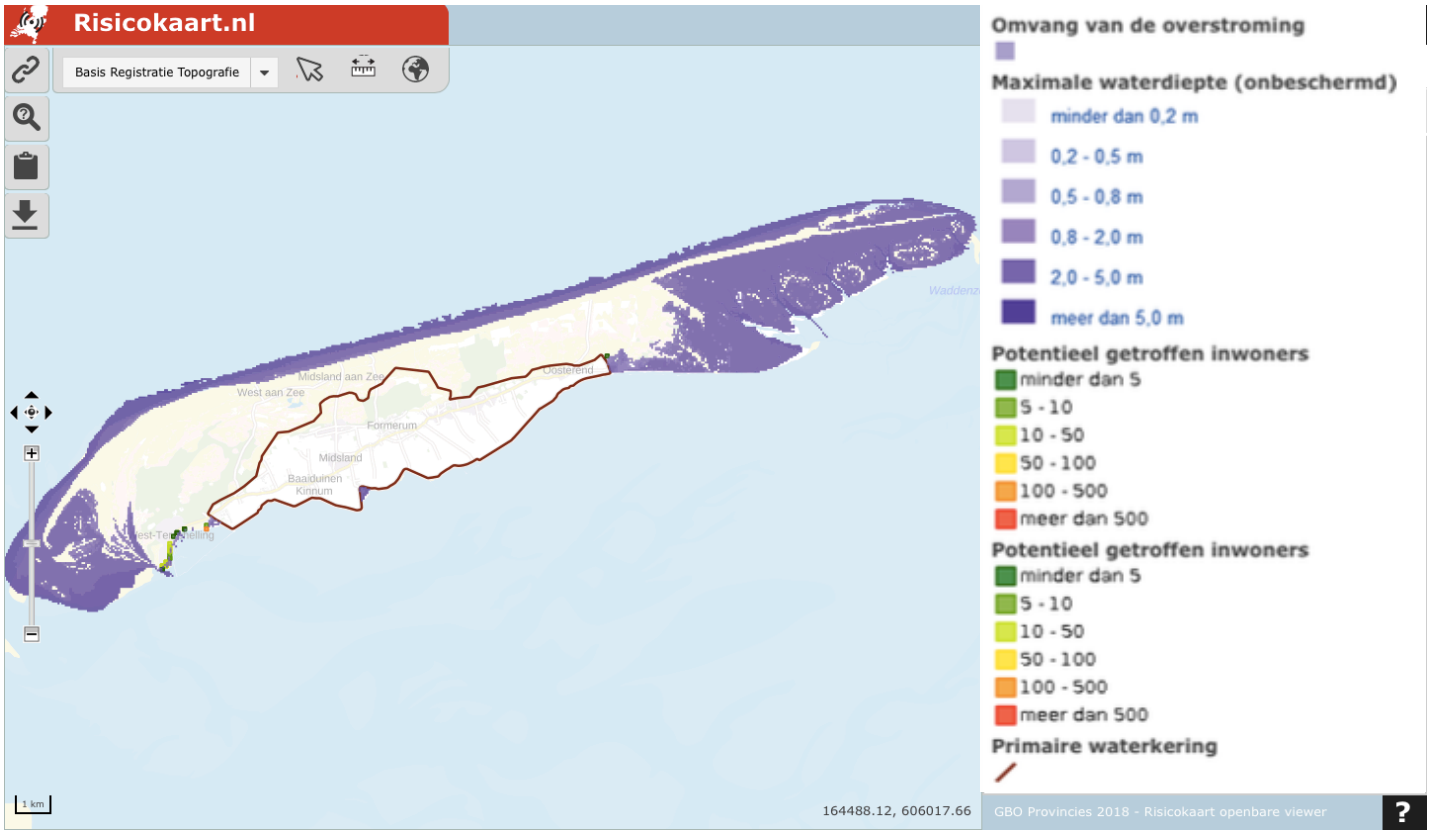

Figure 2. Risk map of Terschelling. With the extent of the flood, maximum water depth (unprotected), potentially affected residents and the primary flood defense (GBO Provincies 2018).

Consequences of gas extraction and sea-level rise on Terschelling

Currently, the largest part of Terschelling is above the main sea level. In the Netherlands this is measured with NAP (Normaal Amsterdams Peil), a NAP height of 0 meters is approximately the same as the average sea level of the North Sea (Rijkswaterstaat, 2019). The NAP is indispensable for flood protection. Dykes and other flood defenses keep our country dry. That is why dikes and dunes are regularly checked if they are still high enough compared to the NAP. The NAP is also used for studying soil movement (Ibid.). Figure 2 shows which parts of Terschelling will be submerged by water in case of a flood (Overstroomik.nl, 2019). According to this map the part that will be drowned also contains the most populated areas of Terschelling. However, this figure does not include the primary water defense and it excludes the risk with soil subsidence. As explained earlier, the natural and artificial soil subsidence increases the relative sea-level rise. The depth of the Wadden Sea is increasing due to sea-level rise and the decline of the seabed. At this moment, sediments have filled this extra space. But the refill of sediments of the extra space cannot be held in the future, as sea level rises faster and faster and sedimentation can no longer keep up (KNMI, 2019). In the report 'Toekomst Waddenzee' is written that this relative sea-level rise could already happen this century. The natural subsidence in the Wadden Sea is a few centimeters per century. The extraction of gas and salt causes part of soil subsidence on the Wadden islands. The sea level rise or fall and the tectonic uplift or subsidence have a relation with changes in marine accommodation space (Olszewski, 2004). This shows that there is a link between sedimentation, subsidence, sea level rise and tectonic movements. Subsidence due to mineral extraction shows two important differences with the natural soil subsidence.

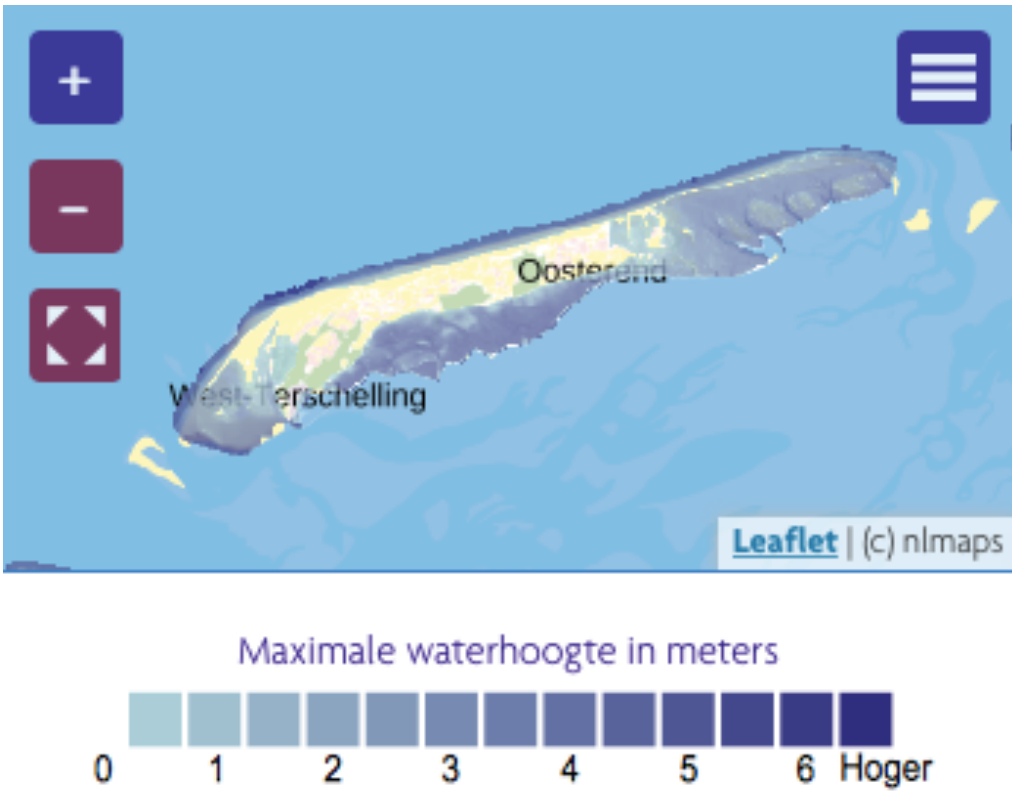

Figure 3. Map of Terschelling, maximum water height in meters (Overstroomik.nl 2019).

On the one hand, soil subsidence is local, round the areas where minerals are extracted, on the other hand, the speed of the anthropogenic soil subsidence is often considerably larger. Since local soil subsidence within the dynamic system must be compensated by sedimentation and thus the available sediment buffer is reduced, anthropogenic subsidence is an important factor that increases both the relative sea level rise and the drowning risk for the Wadden Sea (Schuttenhelm, 2017).
At a depth of three kilometers off the coast of Harlingen, the Ministry of Economic Affairs gave in 2014 permission for the opening of a first cavern to extract salt. Expected is that the rapid and large subsidence which takes places on the Frisian mainland by this salt extraction will also take place under the Wadden Sea. The salt production on the Wadden Sea will take place 300 meters deeper than the salt extraction on the Frisian mainland. Therefore, the soil subsidence caused will occur in a larger area (Urai and Bekendam, 2016).

Another factor that increase the risk of flooding is the sea-level rise. Sea level rise is a big challenge for guaranteeing the safety against flooding (Wang, 2012). Figure 3 is a flooding scenario map. This map is created for the emergency service Fryslân and the Fryslân Water Board. For each potential location, a scenario has been designed. This scenario is based on the worst-case flooding. It results in the arrival of waterfront (above left) and the maximum water depth (below right) (de Jong, 2016).
The primary water defense is protecting the land from floodings from the Wadden Sea. The defense on Terschelling protects areas where the risk of victims and economic damage is high. West-Terschelling, a village on the west side of the island, is not included in the primary water defense. The area is located outside the border of the dikes and is not protected by a wall that rises 3.6 meters above sea level. According to CBS (2011) more than half of the inhabitants of Terschelling live in West-Terschelling.

Another feature of West-Terschelling is that the ferry harbor, passenger terminal, car park, and the Willem Barentzkade are positioned in this part of the island. Occasionally the harbor is submerged during high tide. Rising sea levels form an acute threat to the residents living in this village (White, 2018).

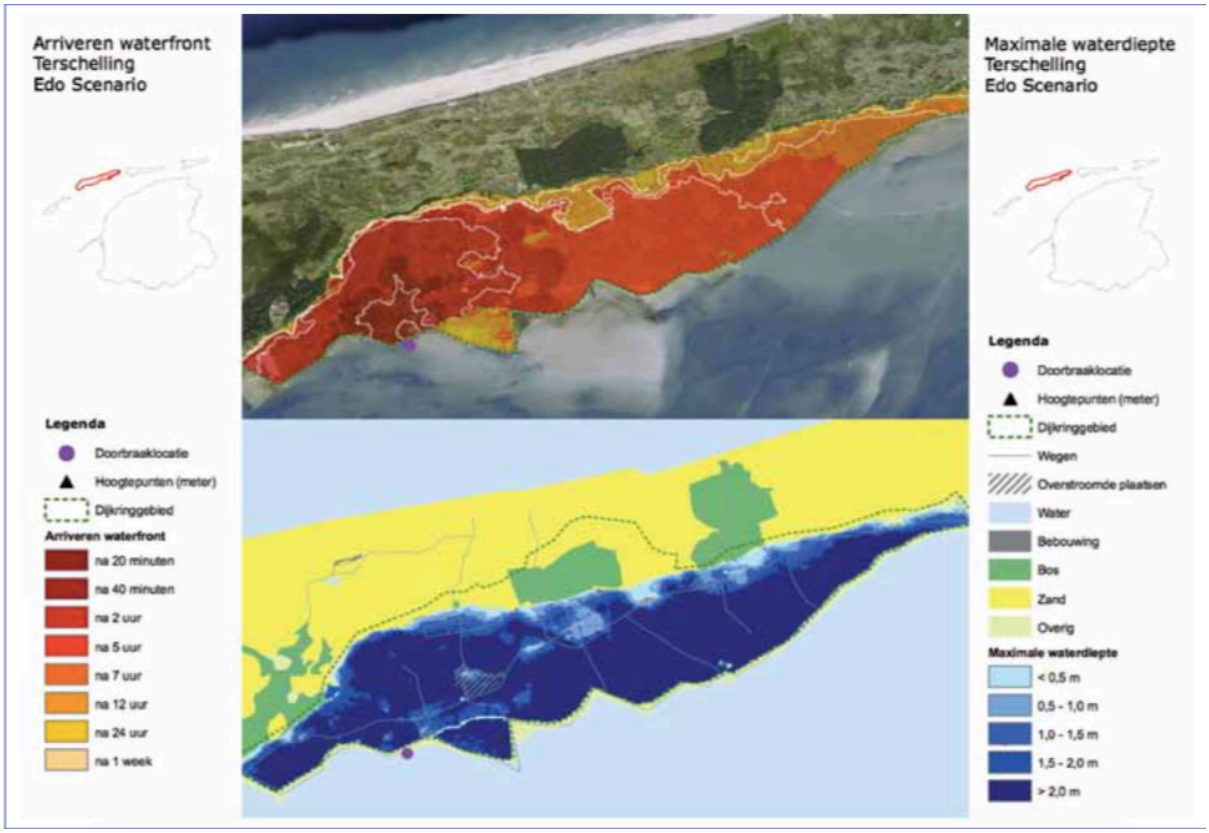

Figure 4. Flooding scenario's Terschelling (de Jong, 2016).

Social impact assessment on hazards

The depth of place attachment is predicted by social and demographic factors, the link between people and places form the basis of this concept. According to Plunkett; 'place attachment occurs at the individual level most commonly when individuals identify with a place, forming a deep personal connection, or develop a functional dependence with a place that another place cannot easily meet' (Plunkett et al., 2018). Place identity, however, has been defined as a measure by which, through interaction with places, people feel themselves more belonging to a place. Research has shown positive correlations between these two variables. Especially in populations that have maintained continuing interactions over longer periods of time. (Qingjiu and Maliki, 2013). A predictor of place attachment and place identity is the investment in local areas. A result is that the elderly are often more attached than younger people. Older people experience an 'insideness' with a place over time which leads to the place becoming an extension of themselves (Anton and Lawrence, 2014).

Studies show that inhabitants of certain risk areas are not aware of the consequences of living there until a disaster happens (Holder et al., 2017). This does not necessarily mean that they do not know how their protection works. The associations and commitments that people have to their home may only become clear in times of loss and danger. This is the case because when there is no danger at that time, people do not take the threats serious. They obviously want to

live there, no matter the risk of being there. This vision is partly created by governments, as the usual approach is to raise the awareness of a problem when it is already happening (Holder et al., 2017). The experiences of danger could strengthen attachment (Anton and Lawrence, 2014). When the time has come and Terschelling is in a critical situation, the inhabitants have two choices: fight or flee. The tourists are on a temporary stay on the island, it is known for a pleasant time of year; a resident must endure all seasons. The residents have to learn to meet the island on its own terms.
Currently, the awareness of the Wadden region inhabitants is relatively low. Flooding risks are considered by most people to be under control. There is a high level of trust in the dikes and coastal protection works. It is a long time ago that Terschelling struggled with flooding, current inhabitants of the island have not experienced it. This fits the following hypotheses; 'The further away and the longer ago a flood disaster, the lower the publicly felt urgency.' It can be stated that the awareness of specific risks among inhabitants depends also on individual experience with the disaster. (Olsthoorn et al., 2008)

Conceptual model
The main reason for this research is to see how well the inhabitants of Terschelling know their coastal defense. Awareness is the dependent variable. The independent variables are; 'Gas and salt extraction', 'Sea level rise' and the 'main protection'. Another variable which might have an influence on the coastal defense awareness is the place attachment. Place attachment of the inhabitants can change variables like the vision on gas extraction and sea level rise. But also, on how well residents know their island and know where the main protection against the sea is. All these factors contribute to the awareness of coastal defense by the inhabitants of the island (Figure 5).

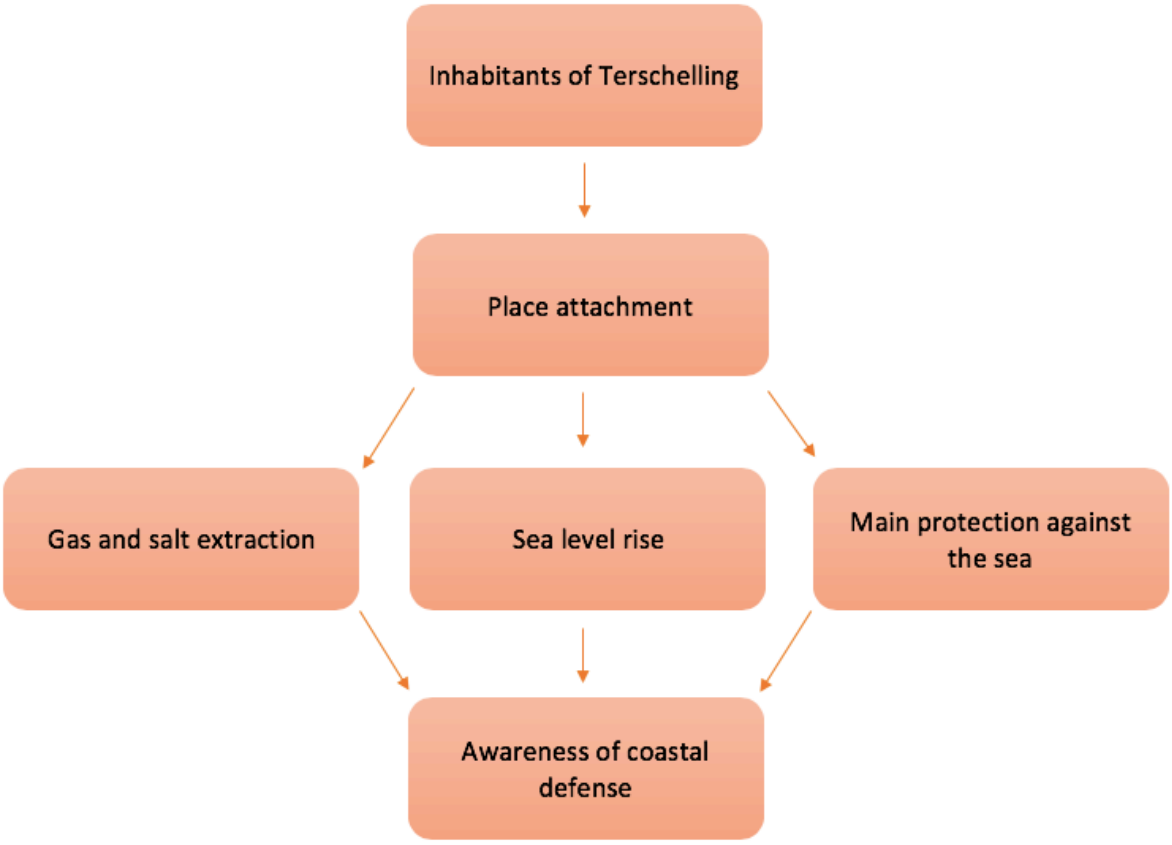

Figure 5. Conceptual model (Minkes, 2019)

Hypothesis

How aware are residents of Terschelling of their coastal defense? Research shows that the level of awareness of inhabitants in risk areas are caused by hazards (Holder et al., 2017). How often do hazards happen and how big is the chance a hazard occurs? Terschelling did not really experience hazards yet. In the upcoming years it is not immediately a high-risk area, but the risks of living on the island does increase in the next years. According to the theory, the level of awareness of coastal protection would than increase as well. This would mean that the inhabitants of Terschelling are, at this moment, not that aware of their coastal protection. Because they don't experience danger yet. If something bad happens, or is going to happen, the inhabitants want to know where they are safe. Only then, it will be important for the inhabitants to how the coastal defense works (Holder et al., 2017)

Another hypothesis is that inhabitants of Terschelling know that they are protected by the dunes. This is the most obvious theory of island protection. The question remains: How well do inhabitants know their coastal defense works, and do they know the protection methods that are used (Waddenzee school, 2014)?

Methodology

Method, population and sample

The best way to get a good analysis for this research is by using mixed methods. Mixed methods is used to get advantages when analyzing complex research questions (Driscoll et al., 2007). The qualitative data provides an understanding of the survey responses. The statistical analysis provides an understanding of particular patterns of responses (Ibid.). The survey contains open, closed and Likert scale questions. Handing out questionnaires to the inhabitants of Terschelling in combination with collection of mental maps.

The population for this research is the inhabitants of Terschelling. There are almost 5.000 residents on the island (CBS, 2019). More than half of this number lives in the village of West-Terschelling. West-Terschelling is, therefore, the base of the research area. Because of the number of people in this part of the island the chance of getting a substantial sample size is high. Other big villages like Midsland, Hoorn, Oosterend, and Formerum will also be visited.

Data collection

With the questionnaire as many inhabitants as possible will be reached. Questionnaires are held in shops, restaurants, and pubs of Terschelling. Most shops/restaurant/pub owners are locals. The questionnaire is a good tool for this research to find out the perception and interaction between the participants.

The questionnaire will result in quantitative and qualitative data. The first questions are descriptive questions; age, gender, place and time of living on Terschelling and educational level of the participants is going to be collected. These characteristics could have an influence on the awareness of the coastal defense. There are four questions which need to be answered through the Likert scale. To get sufficient diversity in the data to enable optimal driver analysis the 0-10 Likert scale is used (McLeod, 2008). With zero meaning low/never and ten meaning high/always. The choice for an 11-point Likert scale instead of for example a 5-point Likert scale is the much broader spread of the results, this will lead to better predictive analysis. This odd-numbered scale provides a mid-point, where five is the median. The options below and above five are therefore given more meaning to.

The awareness of the coastal defense will be asked in an 11-point Likert scale and will be asked again in the mental map section of the survey. Open questions will give answers to if and in what way respondents notice sea level rise and gas extraction. The place attachment is going to be tested through 2 Likert scale questions; the thought of movement due to the increasing threat from the sea and to what extent do you feel connected with Terschelling?

The mental maps provide detailed observation of the locals and form a part of the questionnaire. Research found out that mental maps can be applied to enable deeper understanding of the people – place relationship (Zwiers et al., 2018). With a mental map analysis of the sub-question; 'Do the inhabitants of Terschelling know where the main protector against the sea is?' can be made. The inhabitants can add points, in the map of question 12 of the survey (Appendix 3), where they think the main protector against the sea is. In question 13 they can highlight the weakest points of the island. In this way, it becomes visible if the inhabitants know where they are protected the most. There is a question about the awareness of coastal defense in the survey, but this outcome is rather superficial. It is interesting to see how up to date the inhabitants are and how well they know their island. The mental maps are going to be combined and converted into GIS. By combining all the collected maps in one you can see if the inhabitants really know what the risk areas of their islands are.

Data analysis

Quantitative analysis

The data of the questionnaire can be analyzed through SPSS. The first part of the questionnaire will result in the descriptive statistics and are also used as control variables. These descriptive statistics are helping to get an overview of the population and will increase the value of the analysis, it aims to summarize the sample. 'Age' results in a nominal variable and 'how long respondents live on the island' will result in a ratio variable. These outcomes are being categorized to create a better overview. Gender is a nominal variable. Educational level and the place where respondents live is an ordinal variable. Four statements need to be answered through the Likert Scale, these are ratio variables.

To find out relationships and differences within the coastal awareness of Terschellingers there is chosen for multiple linear regression. With this regression variables like age, gender and place attachment can all have an influence on the outcome of the awareness. The dependent and independent variables will be connected. All results are initially assessed with a significance level of 5%. In some cases, however, a level of 10% is considered. It is a research with a small number of cases, so it is not unusual to use a larger confidence interval. The results can still be assumed to be likely (Troch, 2001).

Qualitative analysis
To get more detailed information about the sea level rise and gas extraction, open questions are used. It is not only important to know if the respondents experience sea-level rise or gas extraction 'yes' or 'no'. But it is also crucial to know how they experience it. The mainly given answers are being analyzed and will give a general overview of the vision of the inhabitants of Terschelling.

The mental maps are all observed one by one and immediately put in GIS by means of points. In the end, a map with all the collected data of the strongest coastal defense and the weakest coastal defense are merged into one. Not all the respondents have used points to make clear where they thought was the strongest/weakest coastal defense, some also drew lines along the coast. In the end, a map with green and red lines along the coastal zones of Terschelling will give an overview of how the Terschellingers think their coastal defense is like.

Ethics
The privacy of the respondents has been considered by leaving out names in the questionnaire. A question is asked where the respondent lives on Terschelling, this is a closed question to make sure respondents do not provide detailed information. The only thing the respondent needs to fill out is the village in which they live. To leave out details like postal codes and street names the privacy is guaranteed.

Results

Descriptive statistics

In table 1 the numerical data of the respondents is visible. The female/male division is not perfect, but the divergence is not big. This increases the validity of the research. The mean age of the respondents is high. The groups are all represented but you can see that the group of 20 years and younger is under-represented (figure 6). This means that we don't have a lot of data about relatively young people.

Characteristics	Frequency	Percentages
Total number of respondents	85	100%
Female	46	54.1%
Male	39	45.9%
Mean age	Between 41 and 50	24.7%
Mean educational level	MBO	48.2%
Meantime of residence	Between 21 and 30 years	25.9%

Table 1: Numerical data about the population (Minkes, 2019).

According to Oozo (2018), the 41-65 age category is the strongest represented on Terschelling with a percentage of 27.5. This corresponds with the results of this research.

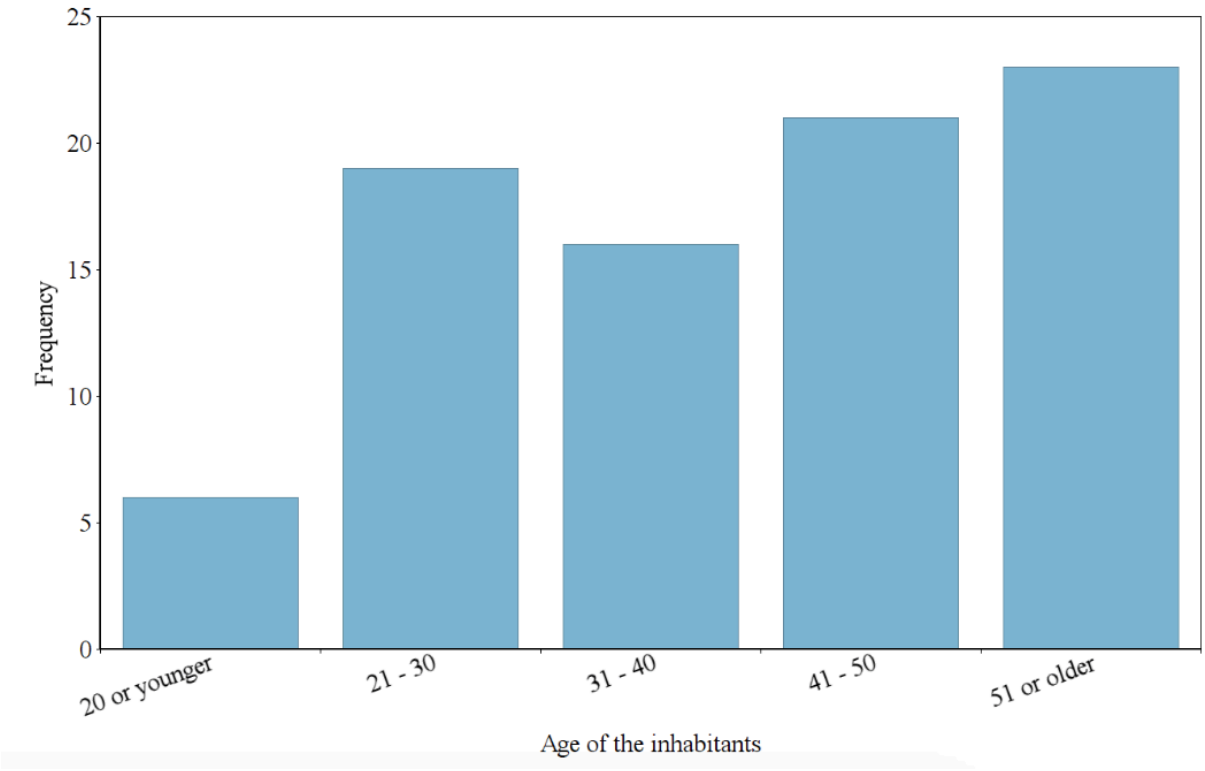

Figure 6: Age of the inhabitants (Minkes, 2019)

The average educational level of the respondents is, far out, MBO. Polling in the shops and restaurants did not only cause this, the overall educational level of Terschelling is MBO or lower (CBS, 2018). According to CBS, in 2018 only 21 – 25% of the inhabitants of Terschelling got an HBO/WO degree. The mean time of residence on the island is relatively

high (figure 7). Over time, emotional and social connections to places become more noticeable. This results in a high place attachment (Smaldone, 2007).

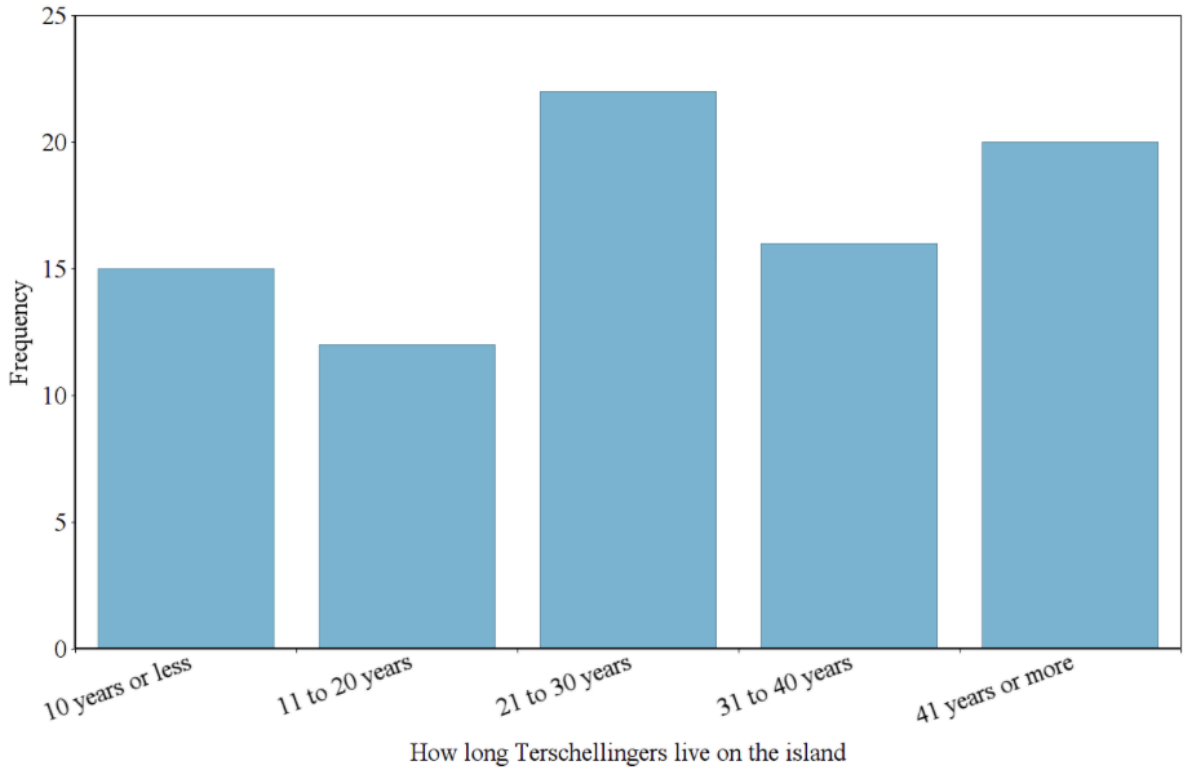

Figure 7: How long Terschellingers live on the island

The statements gave striking results. The place attachment is by 43.5% of the participants labeled with a 10 (Figure 8).

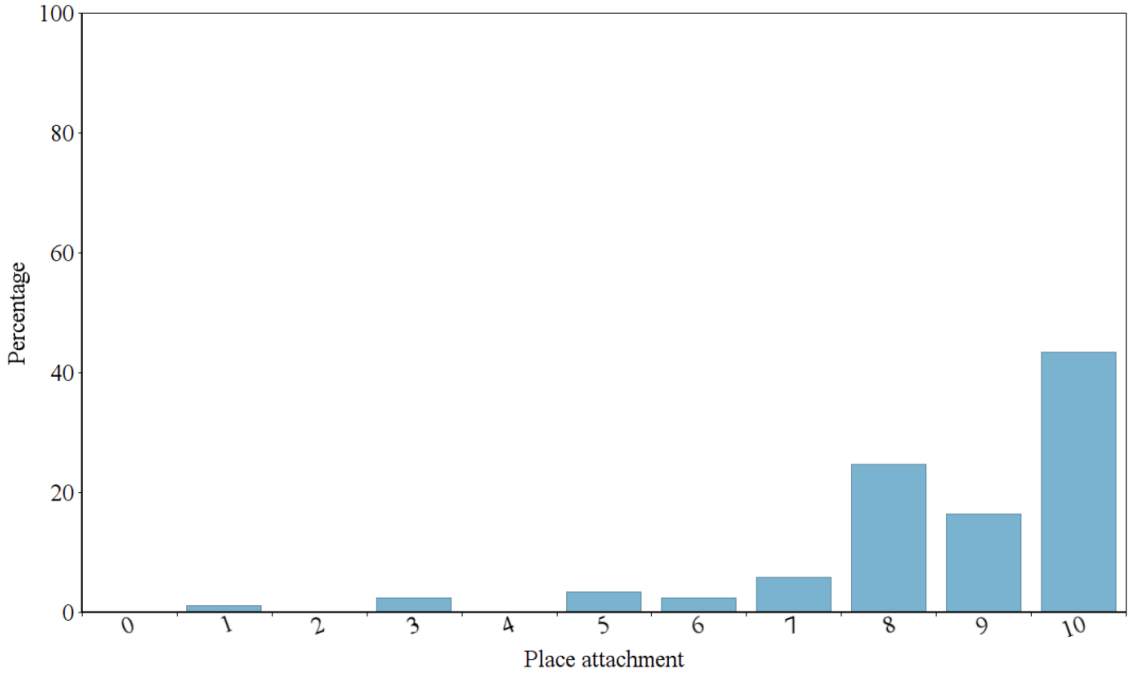

Figure 8: Place attachment (Minkes, 2019)

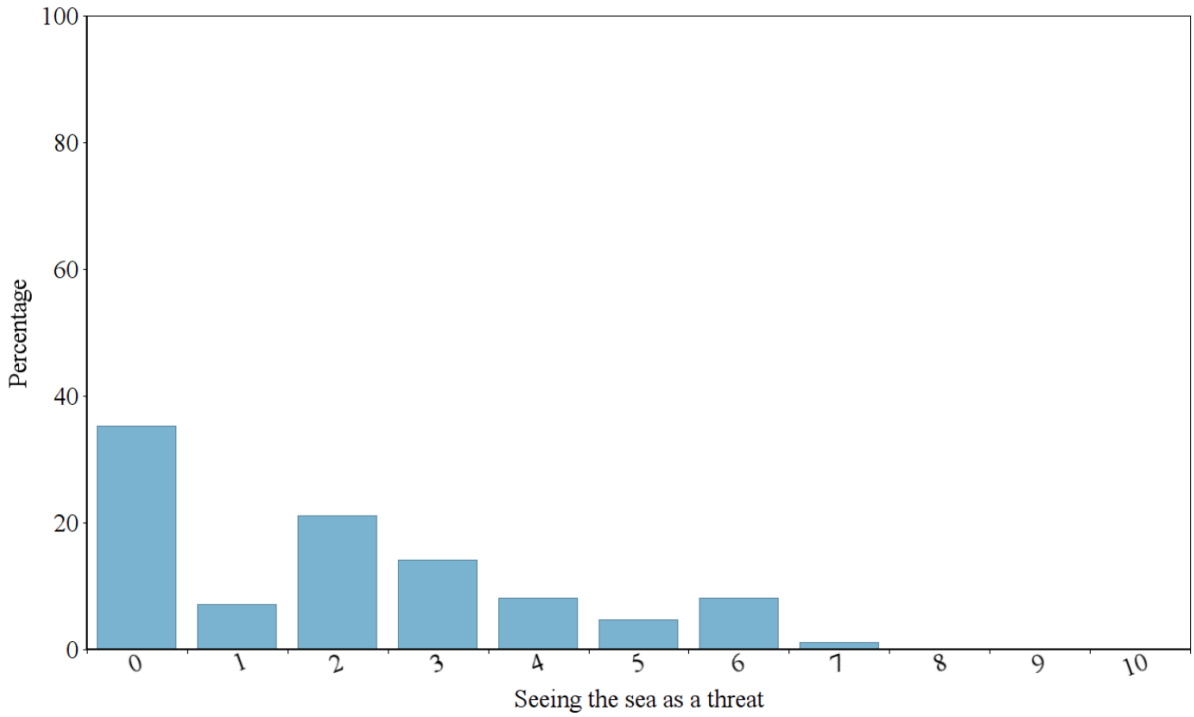

Figure 9: Seeing the sea as a threat

Seeing the sea as a threat is by 35.3% rated with a 0 (Figure 9). The highest score (20%) is a 5 on the awareness of the coastal defense (Figure 10). This would mean that inhabitants may have some knowledge about the coastal defense, but none of the respondents is fully informed. The threat of the sea does not make people want to move, 70.5% of the respondents have never thought about moving (Figure 11). Research has reported that changes in the natural environment can cause behavioral change. However, the severity of a threat has an influence on human mobility. The more severe a natural disaster the higher the mobility rate (Wang and Taylor, 2016).

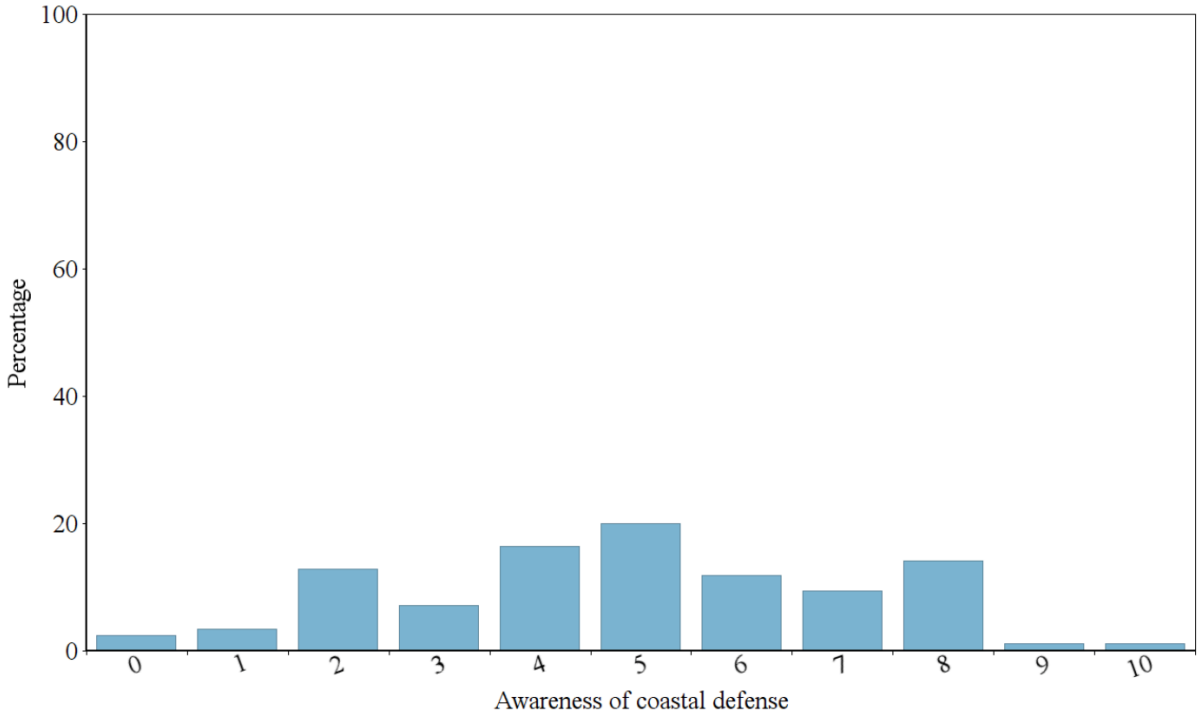

Figure 10: Awareness of coastal defense according to the participants (Minkes, 2019)

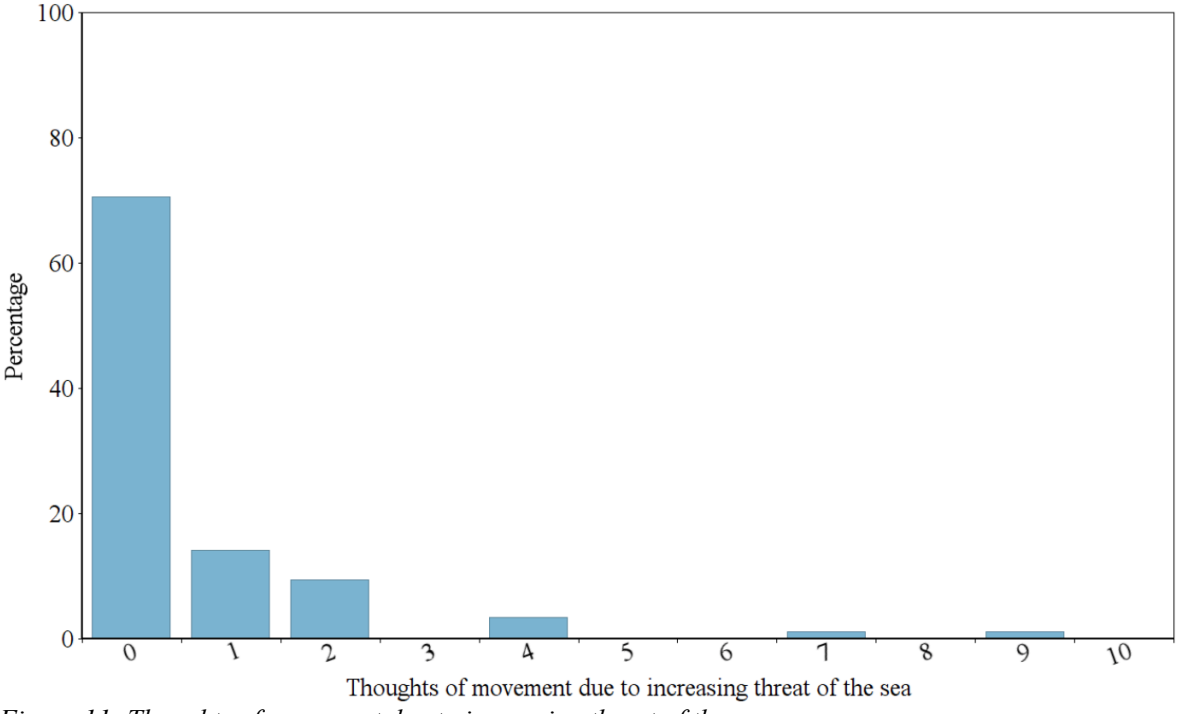

Figure 11: Thoughts of movement due to increasing threat of the sea

The places where the respondents come from is not that divers (Figure 12). Most Terschellingers live in West-Terschelling. Of the respondents, 48.2% live in West-Terschelling.

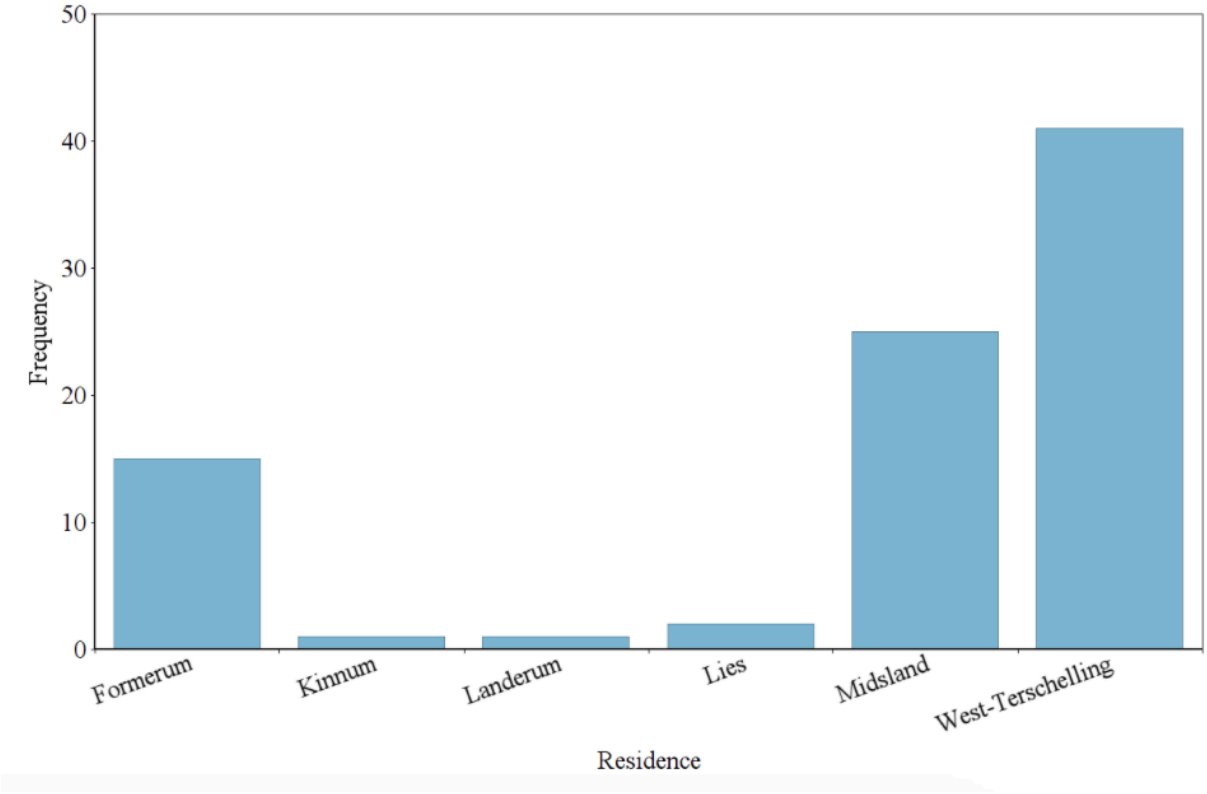

Figure 12: Respondents place of residence (Minkes, 2019).

Quantitative analysis

To analyze the result a multiple linear regression is used. The aim is to predict a value based on two or more independent variables. The independent variables are 'age', 'gender' and 'how long do residents live on Terschelling'. It is interesting to see what influence these variables have on the dependent variables. The dependent variables are; 'place attachment', 'Awareness of coastal defense', 'Seeing the sea as a threat' and 'Thought to move due to an increasing threat of the sea'. Multiple linear regression allows to determine the overall fit of the model, but it also explains total variance through the relative contribution of the predictors individually. We want to see how much of the variation of the dependent variable can be explained by the independent variables as a whole, but also the relative contribution of the independent variables separately.

Dependent Variable: awareness of coastal defense

Model Summary	R	R Square	Adjusted R Square
	0,214	0,046	0,010

Coefficients	Standardized Coefficients	Significance
(Constant)		0,000
Gender	0,034	0,761
Age	0,241	0,066
How long do residents live on Terschelling	-0,187	0,152

Table 5: Model Summary and Coefficients; Awareness of coastal defense (Minkes, 2019).

Table 5 shows the multiple correlations of the dependent variable 'Awareness of coastal defense' with the set of predictors; gender, age and How long do residents live on Terschelling. The square of this correlation (R Square, marked in green) indicates how much of the variance in Y is explained by the set of predictors. The output shows that in the sample only 4.6% of the variance of awareness of coastal defense is explained by the predictors of gender, age and how long residents live on Terschelling. The Adjusted R Square provides a clearer estimate of the population value of R2. The standardized coefficients can be used to determine which predictors the most important are in the prediction of awareness of coastal defense. In the sample, age appears to have the largest standardized regression coefficient (0.241, marked in yellow) and therefore the most important predictor.

Dependent Variable: See the sea as a threat

Model Summary	R	R Square	Adjusted R Square
	0,207	0,043	0,008

Coefficients	Standardized Coefficients	Significance
(Constant)		0,013
Gender	0,034	0,758
Age	-0,104	0,426
How long do residents live on Terschelling	0,237	0,071

Table 6: Model Summary and Coefficients; See the sea as a threat (Minkes, 2019).

Visible in table 6 the predictors explain for 4.3% of the variance of seeing the sea as a threat. The independent variable which has the most influence on the dependent one is; how long do residents live on Terschelling. From this model can be concluded that gender and age do not really have an influence on seeing the sea as a threat. But the time that residents spend on the island does influence the way they see the sea as a threat.

Dependent Variable: Place attachment

Model Summary	R	R Square	Adjusted R Square
	0,216	0,047	0,012

Coefficients	Standardized Coefficients	Significance
(Constant)		0,000
Gender	-0,165	0,138
Age	0,077	0,552
How long do residents live on Terschelling	0,115	0,376

Table 7: Model Summary and Coefficients; Place attachment (Minkes, 2019).

Table 7 summarizes that 4.7% of the variance of place attachment is explained by the three predictors. Not one is significant. Nevertheless, as well as for 'seeing the see as a threat', the 'time of living on the island' is the strongest predictor for place attachment.

Dependent Variable: Thoughts of movement due to the increasing threat of the sea

Model Summary	R	R Square	Adjusted R Square
	0,271	0,073	0,039

Coefficients	Standardized Coefficients	Significance
(Constant)		0,149
Gender	0,252	0,022
Age	-0,138	0,282
How long do residents live on Terschelling	0,073	0,567

Table 8: Model Summary and Coefficients; Thoughts of movement due to the increasing threat of the sea (Minkes, 2019)

In the case of thought of movement due to the sea, the predictors have the highest influence 7.3% of explaining the variance; however, it remains below 10% (Table 8). The variable gender has the strongest correlation with the thought of movement and is significant (marked in blue). This means that gender has an influence on thoughts of movements due to the increasing threat of the sea.

Not one of the regressions is significant which means that no conclusion can be given about the level of significane. However, through these tables, it does become visible which predictors have the most influence on the dependent variables.

Qualitative analysis

The open questions of the survey were about the sea-level rise and gas extraction. In the case of the sea-level rise, the aim was to discover if people noticed sea-level rise on the island and if so, how this was noticeable. 71.8% of the respondents answered ‘no’ to the question if they noticed sea-level rise. The 28.2% which answered ‘yes’ had often the flooding of the port as a reason. They do not notice sea level rise; however, this does not mean that sea-level rise is an issue of which they are not concerned about.

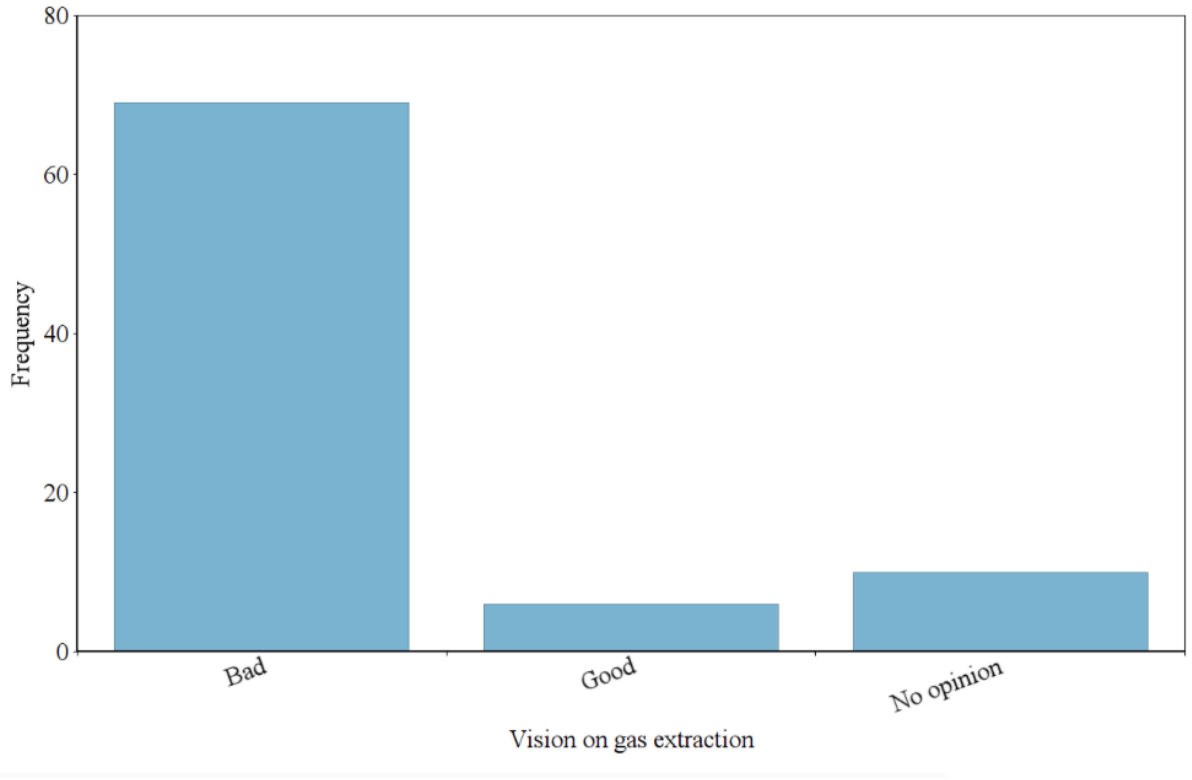

Figure 13: Vision on gas extraction (Minkes, 2019).

The vision on gas extraction (Table 9) was, without a doubt, overrepresented with 'no'. No less than 81.2% thought that gas extraction around the island was a bad idea. The most given reason was that they compared their island with Groningen. Groningen is experiencing a decline of the soil through gas extraction. If that happens on Terschelling, they say, we are going to drown. Only 6 people have voted that they think it is a good idea to extract gas around Terschelling. The reason; 'We have space around our island, it is not so crowded here as on the mainland. So, fewer people will experience the negative aspects.' Another respondent pointed out that he was only open for gas extraction if the inhabitants of Terschelling benefit from it themselves.

The mental maps (Figure 4) provided a direct answer regarding the awareness of the coastal defense. The respondents thought it was a hard question because most of them had never thought about it. It is assumed that it is well arranged, and the people trust the corporation which maintains the coastal defense. What immediately stands out is that everyone recognized the northeast of the island as the part with weak coastal defenses. The place where the primary water defense is located is labeled as strong coastal defense. The beach in the north of Terschelling is both seen as strongest and weakest coastal defense. You can conclude from this that the residents do not really have an idea of how the coastal defense of their island works. Also, West-Terschelling is a crucial point, some people think it belongs within the primary water defense and some people think that it is one of the weakest parts of the island. It is interesting to see what the outcome is of awareness. One respondent answered to this question; 'I'm actually a bit ashamed, I live here all my life, but I really have no clue what the weakest or strongest points of our island are.' The map does give an overview of how the respondents see their island. It is clearly visible which parts all the respondents agree upon and which parts are difficult to label. The overall vision of the locals is that the weakest coastal defense is in the north and east, and the strongest coastal defense is according to them located in the south

near the villages. The north shore and the part around West-Terschelling have provided the most contrasting outcomes.

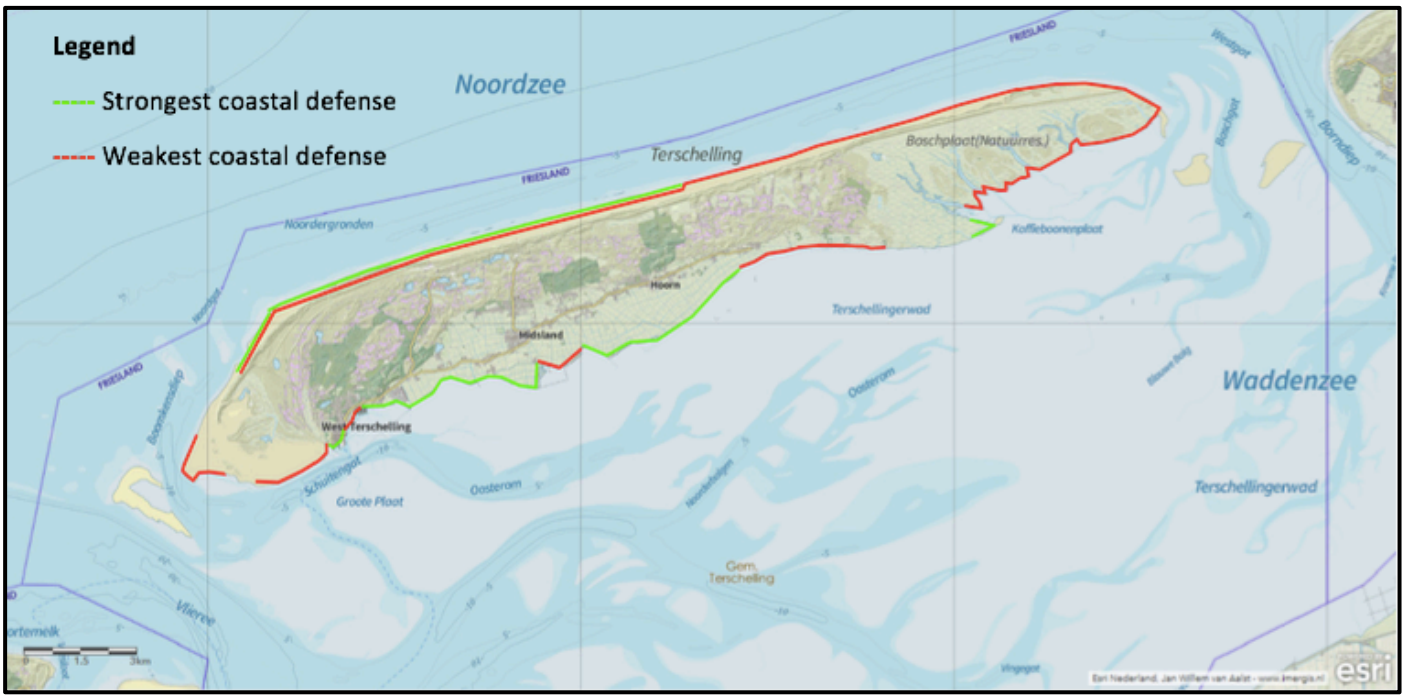

Figure 5: Coastal defense according to the respondents of the survey (Minkes, 2019).

Conclusion and recommendations

Conclusion

The place attachment of the islanders is noticeably high. Most respondents live on Terschelling for a long time and this increases the social and emotional connections to a place (Smaldone, 2007). People choose to live on an island, without direct connection to the mainland. It is often a well-considered choice because you are in some way isolated. The inhabitants really have the feeling that they belong there.

It is hard to say if 'gender', 'age' or 'how long residents live on the island' really have something to do with 'awareness of coastal defense', 'place attachment', 'see the sea as a threat' and 'thought of moving due to the increasing threat of the sea.' The models (Table 5,6,7&8) did show us that the variables have an influence on each other. Age has the strongest influence in awareness of coastal defense. Thus, you can conclude that age depends on how aware the inhabitants are of their coastal defense. Not that striking is the result that the 'time of living on the island' has the biggest influence on the 'place attachment.' The longer you live somewhere the more place attached you become, places become more valuable when time passes (Smaldone, 2007). The 'time of living on the island' also has an influence on 'seeing the see as a threat.' This happens when residents live more than 20 years on the island, they learn to live with the sea. 'Gender' has the most influence on the 'thought of movement due to the increasing threat from the sea.'

Seeing the sea as a threat is relatively low on the island, the place attachment is high. Previous research suggested that those two variables correspond to each other. The feeling of danger would increase the feeling of place attachment (Anton and Lawrence, 2014). This pattern is not the case on Terschelling.

The results from sea level rise and gas extraction are very clear. The locals do not really notice sea-level rise. This conclusion can be combined with 'seeing the sea as a threat', most people did not see the sea as a threat. If the people did notice sea-level rise the changes were bigger that they would also see the sea as a threat.

The majority of the locals are against gas extraction. This is because they are afraid that the situation of Groningen will also happen on their island. This is only more crucial because they are surrounded by the sea and risk the chance of drowning. If the gas extraction would happen 'seeing the sea as a threat' would possibly increase.

The overall awareness of the coastal defense insufficient. This corresponds with research of Holder (2017); the awareness would increase when people feel like they are in danger. That is not the case nowadays. The locals act a bit casual when the subject is brought up, they have all the faith in the corporations which maintain the coastal defense. It is not a subject which they are really concerned about, the focus is more on enjoying living on the island.

Recommendations

For further research, it is important to work with a bigger group of respondents. This will increase the chances of significant results and of representativeness.

Another key point is figuring out why the coastal defense awareness of Terschellingers is what it is. How did this develop and how can awareness be improved? It is important that locals know their island, that they know what their weakest and their strongest parts are. Especially now that sea-level rise is a big issue in the world, people need to know how to interact with the sea and get more detailed information on how they are protected.

For future research, it is important to really sift out the relations between ‘seeing the sea as a threat’ and ‘sea-level rise’ and ‘gas extraction.’ This could lead to some striking results and interesting outcomes.

Reflection

The data collection went prosperous. The inhabitants were benevolent to participate in this research. In the mornings when the shop/restaurant owners were not that busy a lot of questionnaires where completed. In the afternoon it became more complicated because the locals were busier with the tourists.
The researcher discovered that it was quite a hard subject. Lots of respondents said that they did not have a clue about the coastal defense of Terschelling.
The amount of filled in questionnaires was relatively low. Because of this, not one of the regressions was significant. If the group of respondents would be bigger, the changes to get significant outcomes would be bigger as well.
The majority of the respondents filled in the questionnaire themselves. A couple of respondents preferred that the researcher filled it in for them. This could have a slight influence on the anonymity of the respondent and also on the honesty of their answers. However, this will not lead to a severe problem since there are only a few questionnaires filled in through the researcher.

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Appendix

1. Survey

Beste meneer/mevrouw,

Ik ben student Sociale Geografie en Planologie aan de Rijksuniversiteit Groningen en doe onderzoek voor mijn bachelor project. Mijn doel voor dit onderzoek is te bestuderen hoe bewust Terschellingers van hun kustverdediging zijn. Alleen inwoners van Terschelling kunnen respondent zijn voor dit onderzoek. Het invullen van de enquête kost maar een paar minuten. De enquête wordt anoniem ingevuld en de gegevens worden uitsluitend voor dit onderzoek gebruikt.

Algemene informatie

1. Wat is uw geslacht?
   - Man
   - Vrouw

2. Wat is uw leeftijd? _____

3. Waar op Terschelling woont u?
   - West-Terschelling
   - Midsland
   - Formerum
   - Hoorn
   - Oosterend
   - Anders, namelijk _____

4. Hoelang woont u op Terschelling? _____

5. Wat is uw hoogst afgeronde opleidingsniveau?
   - Vmbo of lager
   - Havo/Vwo
   - MBO
   - HBO
   - WO of hoger
   - Anders, namelijk_____

Kustverdediging

6. Merkt u iets van de zeespiegelstijging? Hoe?

_____

_____

_____

7. Wat vindt u van gaswinning op Terschelling?
   - Slecht plan
   - Geen mening

- Goed plan

Waarom vindt u dat?

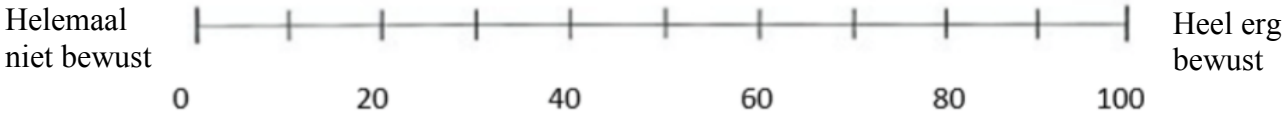
_____

_____

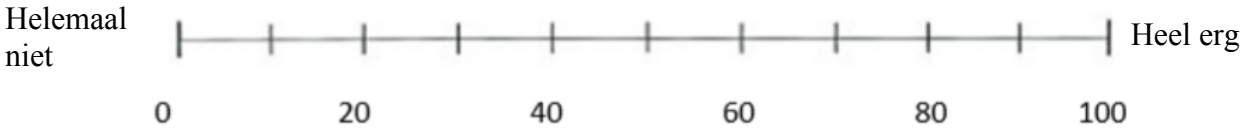
_____

In hoeverre kunt u zich vinden in de volgende vragen? (Zet een kruisje op de schaalbalk)

8. Bent u zich ervan bewust hoe de kustverdediging van Terschelling in elkaar steekt?

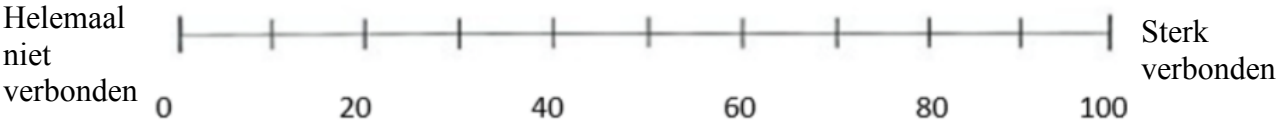


9. Ervaart u de zee als een bedreiging?

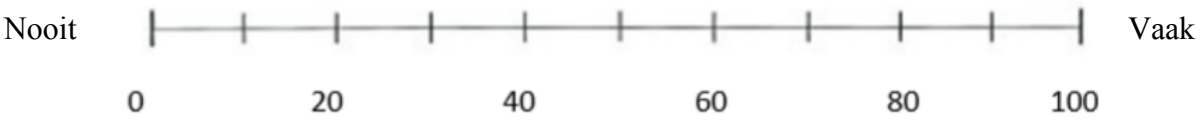


Plaats verbondenheid

10. In hoeverre voelt u zich verbonden met Terschelling?



11. Heeft u er al eens over nagedacht om te verhuizen door de toenemende dreiging van de zee?



12. Kunt u op het onderstaande kaartje aangeven waar volgens u de kustverdediging het sterkst is?

13. Kunt u op het onderstaande kaartje aangeven waar volgens u de kustverdediging het zwakst is?

Hartelijk bedankt voor het invullen van deze enquête.

2. A couple of randomly picked mental maps

12. Kunt u op het onderstaande kaartje aangeven waar volgens u de kustverdediging het sterkst is?

13. Kunt u op het onderstaande kaartje aangeven waar volgens u de kustverdediging het zwakst is?

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