Shifting Shores

Quantitative Assessment of the Acceptance of Nature-based Coastal Protection Approaches - A Case Study on the Coastal Zones of the Province of Groningen, The Netherlands

Lea Meyer
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Shifting Shores: Quantitative Assessment of the Acceptance of Nature-based Coastal Protection Approaches

A Case Study on the Coastal Zones of the Province of Groningen, The Netherlands

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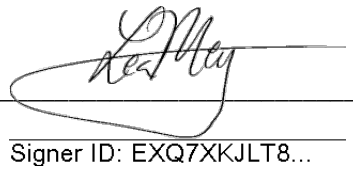
Declaration

This thesis is the result of my own work and includes nothing, which is the outcome of work done in collaboration except where specifically indicated in the text. It has not been previously submitted, in part or whole, to any university of institution for any degree, diploma, or other qualification.

In accordance with the Faculty of Spatial Science guidelines, this thesis does not exceed 20.000 ± 10% words.

Signed: 

Date: 14.08.2022

Lea Meyer (B.Sc. Maritime Technologies)

Abstract

In the last two decades, the concept of nature-based solutions (NbS) has emerged in the field of coastal flood risk management, where natural structures are used to attenuate the physical effects of waves. While the physical reach of this concept has been explored, there is still a gap in knowledge regarding its public perception and acceptance. Due to the importance of water in Dutch history and the change in water management in the 1980s, it is hypothesised that the Dutch perspective reflects this in the form of values and norms and thus a positive tendency for NbS can be observed. Thus, a case study approach was applied to the coastal regions of the province of Groningen, aiming at finding societal proof (values and norms) for the transition from 'keeping the water out' to 'living with water'. Further organizations on the international, national, and regional levels were investigated based on their influence in shaping public opinion. Data collection consisted of a literature review, participation in a symposium and a questionnaire (n=67) completed in six municipalities in the province of Groningen. In line with the expectation, high biospheric values and awareness of climate stressors and low risk and cost evaluation appeared to be significantly related to NbS acceptance. A quantifiable determination of the level of acceptance on site can guide spatial planners in designing and modifying the design of NbS as a sole or additional method of flood protection. Based upon the socio-cultural background, acceptance can be raised through addressing perceived risks and costs, as well as broadening the educational capacity of coastal actors.

Key words

Nature-based Solutions, Flood Risk Management, Formal and Informal Institutions, Public Perception

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I am also grateful to my fellow students from the WCM/EIP program for their companionship, interdisciplinary exchange and moral support throughout the two years spent together. Despite meeting for the first time after one year of pandemic-related online teaching, we were able to close this chapter together in real life.

Further, I would be remiss in not mentioning my family, who kept my spirits and motivation high during this process. Lastly, special thanks go out to Simon for every late-night feedback and reflection session, advice, and moral support.

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List of Abbreviations

AC	Awareness of consequences
AP	Awareness of problem
AR.	Awareness/ Ascription of Responsibility
av.	Average
BE SAFE	Bio-Engineering for safety using vegetated foreshores
BwN	Building with Nature
CBD	Convention on Biological Diversity
cf.	confer
CFRM	Coastal Flood Risk Management
Cont.	Continued
DWS	Dutch Water Sector
D[number]	Data source [number]
e.g.	for example
E-SVS	Environmental Schwartz Value Survey
EZK	Dutch Ministry of Economic Affairs and Climate Policy
f.	and the following page
ff.	and the following pages
FAST	Foreshore Assessment using Space Technology
FCM	Fuzzy Cognitive Maps
FRM	Flood Risk Management
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GET	Good Ecological Status
GIS	Geographic Information System
GMSST	Global Mean Sea Surface Temperature
GMT	Global Mean Temperature
GSLR	Global Sea Level Rise
HWBP	Hoogwaterbeschermingsprogramma/ Dutch Flood Protection Program
H[number]	Hypothesis [number]

ibid.	ibidem
i.e.	id est/ that is
IenW	Dutch Ministry of Infrastructure and Water Management
ISCO-08	International Standard Classification of Occupation 2008
ILT	Inspectie Leefomgeving Transport/ Dutch Human Environment and Transport Inspectorate
I[number]	Image Source [number]
JenV	Dutch Ministry of Justice and Security
LNV	Dutch Ministry of Agriculture, Nature, and Food
NAP	Normaal Amsterdams Peil/ Amsterdam Ordnance Datum
NAT	Norm Activation Theory
NbS	Nature-based Solutions
NCC	National Crisis Centrum
NFM	Natural Flood Management
NGO	Non-Governmental Organization
NL	The Netherlands
NWO	Netherlands Organization for Scientific Research
NWP	Netherlands Water Partnership
OECD	Organisation for Economic Co-operation and Development
p.	page
P-REF	Potential Reference
QR	Quick Response
RCB	Risks, Costs, Benefits
RCP	Representative Concentration Pathway
RQ [number]	Research Question [number]
RWS	Rijkswaterstaat
s.	see
SLR	sea level rise
SAMFET	Saltmarsh Flood defence Evaluation Tool
SARF	Social Amplification of Risk Framework
SVS	Schwartz-Value-Survey

UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-IHE	UNESCO Institute for Water Education
UNFCCC	United Nations Framework Convention on Climate Change
URL	Uniform Resource Locator
UVW	Unie van Waterschappen/ Dutch Union of Water Boards
WFD	Water Framework Directive
WUR	Wageningen University and Research
WWF	World Wildlife Fund

Chapter 1: Introduction

Nature-based solutions (NbS) play a key role in future-proofing coasts against increasing socio-environmental demands and stressors. A constant threat is the natural processes of coastal shift, meaning either the accumulation of material to the existing shoreline, leading to an increased land mass; or the excavation of material resulting in a coastal loss. While such processes occurred for thousands of years, it is expected that the rate of shift is accelerated by rising sea levels, increased precipitation, and storms. As far as land loss is concerned, coastal conditions and land use, in particular, play an important role in the rate of erosion and thus in increasing the risk. The need to re-evaluate existing flood defences to protect local communities is pressing.

In the 19th century, the logical response of the Dutch to coastal erosion was to develop fortified infrastructure, i.e., concrete buildings or sheet piling along the coastline. With ongoing years this infrastructure is now coming into age, opening the window of opportunity for reassessing the current way of securing shorelines. At the same time, the renewal and increase of existing protection structures for a likely range of sea level rises (SLR) represent a major cost factor. With an expected Global Sea Level Rise (GSLR) of 0.24 in the Representative Concentration Pathway (RCP) 2.6 and 0.32m under RCP8.5 (medium confidence) until 2050 and expected further rise until 2100 (Oppenheimer et al., 2019, p. 327).

Regarding flood protection, alternatives to fixed concrete structures have been identified in the literature and coastal zone management practice. These green solutions, in the literature named NbS, Living Shorelines, or Building with Nature (BwN), became increasingly popular across a variety of countries and feature a wide range of natural landscapes e.g., salt marshes, dunes, mangroves, oyster reefs, and seagrass meadows. Through increasing natural vegetation and redeveloping coastlines high in biodiversity, not only carbon sinks are generated but also the coastlines get more resilient towards extreme weather events e.g., flash floods.

According to M. De Groot (2012), a paradigm shift from controlling nature to living with nature can be observed regarding climate adaptations through the arising terminology of Nature-based Solutions in water governance (M. De Groot, 2012). While the ecological influence of such shorelines has been intensively studied over the past 20 years, there remains a knowledge gap regarding its socio-economic extent (Smith et al., 2020). Degrees of climate change differ geographically widely, in that sense Anderson and Renaud (2021) state that "public acceptance varies contextually" - but this does not lessen the importance of understanding its extent and reasoning (Anderson & Renaud, 2021; Cohen-Shacham et al., 2016).

While physical attributes of a site, selected for a coastal zone protection program, are easy to assess, evaluating the acceptance of the public is a much more complicated task, yet crucial to ensure project success. The societal context shall be explored in the face of a shift in coastal defence systems, rising climate uncertainty, and urgency for adaptation instead of mitigation. For the development of public acceptance of NbS, the perception of flood defences is of academic interest (Anderson & Renaud, 2021; Han & Kuhlicke, 2019). Especially the interrelationship between subjective perception, societal values, and the role of institutions in influencing those values crystalizes (Cause, 2016). Following this the design of a quantitative

approach that relates perceptions and institutions to each other is crucial for improving existing and future Costal Flood Risk Management (CFRM) projects on the uptake of NbS.

1.1 Goal and Scope of this Thesis

The key aim of this study is to explore the public acceptance of NbS approaches in coastal zones. To achieve this, a focus will be laid on the public perception of NbS, personal values and norms. As outlined in the previous section, it is assumed that the acceptance of NbS approaches depends on the cultural and environmental context in which they are embedded. Consequently, a quantifiable determination of public acceptance can provide spatial planners with guidance in this difficult terrain.

A case study approach is applied to the coastal regions of the province of Groningen, the Netherlands, s. figure 1. This scope is justified by the Netherlands being a frontrunner in water management and applying the mentality of 'living with water'. As a geographical limitation of the thesis, the regional boundaries of the province of Groningen were chosen, as NbS are present from past land accretion endeavours as well as recent research projects. This spatial scope will be used in the determination of public perception. For the general analysis of the paradigm shift from defending to accepting the water, the national water management and governance development will be regarded.

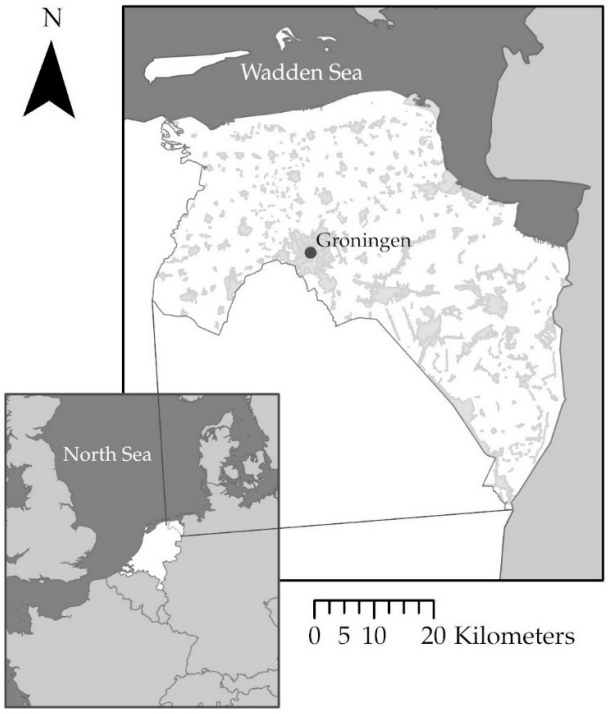

Figure 1 Geographical research scope of the province of Groningen (D1)

Understanding the drivers and barriers within water management and governance (formal institutions) and societal position (informal institutions) relating to NbS is essential before implementing high-cost projects, which then might face limited continuous maintenance. Thus, the descriptive aspects (past and status quo) of the institutional setup prevalent in the

case study area needs to be examined closely beforehand. As presented before, public acceptance and underlying values are highly contextual, nevertheless, this study aims to crystallise common denominators.

Present work covers the period from November 2021 to July 2022. Of these, three months were spent on the research proposal and the remaining five on the data collection, analysis, and discussion. The thesis was written alongside the regular courses of the Environmental and Infrastructure Planning master programme at the University of Groningen.

1.2 Presentation of Research Question

Based on the elaborated background in section 1.1 the following main research question was developed, aimed at guiding through the presented thesis:

> **How can public perception be quantified to determine the acceptance of NbS in coastal flood risk management?**

To answer this question, a segmentation into five sub-research questions that provide the necessary foundation and depth was performed.

- **RQ1** How is risk perception connected to institutions?
- **RQ2** How did coastal governance and management practices develop in the Netherlands?
- **RQ3** Which institutional barriers to NbS implementation are existent in the Netherlands?
- **RQ4** Which public values, norms, and perceptions are connected to the acceptance of NbS approaches?
- **RQ5** Which public values, norms, and perceptions are prevalent in the case study areas regarding NbS in coastal flood risk management?

1.3 Framework and Outline of Thesis

Following the introduction to the thesis, secluded by this subsection, the theoretical background is elaborated in section 2, by starting off with the environmental context in section 2.1. The concept of NbS in a coastal setting will be presented, alongside pointing towards its role in CFRM and associated benefits and constraints, s. section 2.2. Following this, section 2.3 will lay out the literature findings from social perception towards acceptance by explaining the importance of informal institutions (norms and values). Lastly, the summarizing conceptual model is presented. In section 3, the research methodology, based on Gagnon (2010), Yin (2003, 2009) and Khaldi (2017) is presented. In this scope, special emphasis is placed upon the data collection framework and techniques, by elaborating in depth on the qualitative and quantitative data collection and analysis in section 3.3 and 3.4. Hereafter, in section 4, the results of the data analysis are presented. In section 4.1 the coastal system under investigation is described with a primary focus on the shoreline characteristics. This is followed by the presentation of coastal governance and management in the Netherlands, section 4.2, including the transition from 'keep the water out' to 'living with water' and actor influences in the province. Lastly, the quantitative results from the public questionnaire will be presented in section 4.3. In section 5 the findings are discussed critically, and the research questions are

answered. Finally, in section 6, the thesis is concluded, while reflecting critically on the underlying bias and questionnaire performance in section 7.

Chapter 2: Theoretical Background

This chapter aims to develop the boundary condition of public acceptance of NbS in coastal zones. To achieve this, section 2.1 will explain the environmental context of coastal zones by focusing on natural and anthropogenic stressors. Section 2.2 continues with defining coastal NbS and stating its position in CFRM as well as its benefits and constraints. Hereinafter, section 2.3 will develop the societal context through the three categories of perception, norms, and values. Alongside this the conceptual model guiding this research is developed incrementally. A combination of these preliminary elements will then lead to an overall representation which can be found in section 2.4.

The two core elements from which the conceptual model takes off are the spatial planning approach itself and the context, s. figure 2. The former aims to resolve, or improve conditions developed through the interplay of environment, human usage, and societal goals (Stead & Nadin, 2008). While the approach can be either traditional or innovative to achieve the goal, it requires a thorough knowledge of the context in which it is embedded to ensure its effectiveness. As presented in section 1, the principle of NbS for CFRM will serve as an innovative approach, that still requires knowledge accumulation regarding the context's interaction and widespread acceptance. The context itself includes a variety of elements and can be of different scales e.g., local, regional, national, or international. Within the scope of this research, the focus is placed upon the local and national context hampering or facilitating NbS.

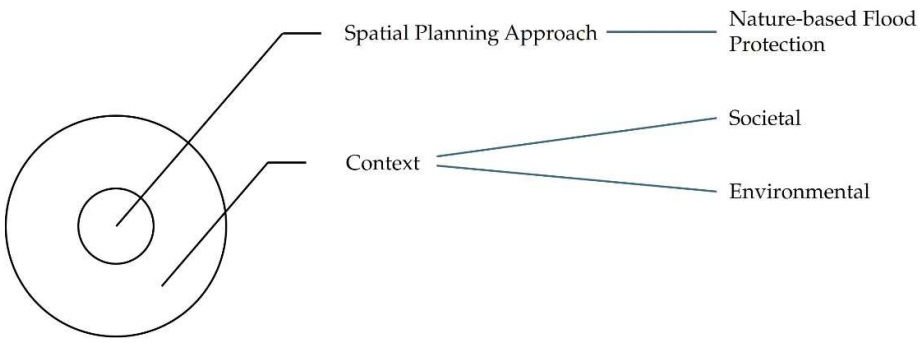

Figure 2 Schematic of the embedment of an approach into its country-specific context

Following figure 2 the context is now assigned a specific scale and therefore allows the allocation of a tangible environment and society. On the one side, the environment sets the physical preconditions of NbS, such as bathymetry, flow velocity, climatic conditions, or water quality. On the other side, society sets NbS in relation to its benefits towards reaching a specified goal. As such NbS are perceived and evaluated highly subjective based on established values, past events, and personal preferences. Environmental characteristics can be assessed more accurately with the help of comprehensive data collection and technical innovation. Social parameters, on the other hand, are volatile, sometimes irrational, influenced by fear or limited knowledge, and difficult to change. Thus, societies pose a large uncertainty of implementation success, when underlying values, norms, perceptions, and interrelations are left unstudied.

2.1 Environmental Context - Stressors on Coastal Zones

Coastal systems are influenced by multiple anthropogenic and natural stressors (Dolan & Walker, 2006; Fischer, 2018; Moser et al., 2012; Räsänen et al., 2016). A stressor is defined as an event or condition that has detrimental effects on the function of a system. The cause of such stress can be of natural origin, such as volcanic eruptions or earthquakes, but can also be linked with human intervention. Within this research, a clear link between human action and the resulting alteration of the climate is based on extensive research by the scientific community (IPCC, 2021).

Anthropogenic stressors consist of increased settlement patterns along coastlines, which lead to land-sealing, biodiversity loss and pollution as a product of intensified economic activity to fulfil societal needs. Firstly, the trend towards increased settlement of coastal residents in northern European countries is less related to economic opportunities and more to leisure (Giulietti et al., 2018) or medical tourism to alleviate respiratory problems such as asthma and lung diseases (Kruizinga, 2016).While aesthetics and romanticism of the coast and sea, play an important role, the harshness of a coastal climate, especially in the winter months, is often disregarded. Consequently, seasonal tourism increases the need for vacation homes along the coast. This development puts stress on the natural coastal zone in three ways. When housing is built too close to the coastline, the natural buffer zone is reduced, and thus higher erosion can occur. Secondly, land-sealing caused by increased building measures, lead to reduced infiltration capacity of the soil and thus provides extra stress of higher run-off and thus pluvial flood risk. Finally, through the provision of goods and services within coastal districts, such as intensified agriculture and industrial development, a higher amount of pollution is entering coastal waters and affects its ecosystem.

Anthropogenic climate change manifests itself in GSLR, changes in the frequency and intensity of precipitation and storms, increase in global mean temperature (GMT) and global mean sea surface temperature (GMSST), with consecutive effects on local biodiversity and coastal communities (Oppenheimer et al., 2019). According to the 2021 IPCC report, coastal flooding in the winter months is likely to increase throughout Europe, due to increasing storminess and sea-level rise (IPCC, 2021). This rise of the mean water line is likely to cause an inward migration of the coastline, threatening especially coastal wetlands and connected biodiversity. Further, the annual precipitation is expected to increase in the North, leading to flash floods. Estimations that flood damages, due to more intense and frequent extreme sea level events, lacking adaptation measures and coastal development trends, will increase by 2-3-fold by 2100 are an urgent call for action to prepare coastal zones and communities (Oppenheimer et al., 2019, p. 324).

While the previous paragraphs have elaborated on the global aspects of a changing climate with a consecutive long time horizon, it is important to note that coastal changes are on a local, "highly episodic short-term" scale (Masselink et al., 2020, p. 161). Furthermore, the coastal system is not a closed system, i.e., sediment transport takes place from one place to another. Thus, coastal erosion and accumulation are relatively in balance globally (Mentaschi et al., 2018). For the development of natural coastal defences, such as saltmarshes, barrier islands, beaches, and dunes, this cycle of sediment is essential for their development (Hanley et al., 2014; Masselink et al., 2020).

2.2 NbS Approaches within Coastal Context

NbS comprise approaches working with nature toward enhancing nature's capacities to counteract undesirable developments (Cohen-Shacham et al., 2016; Seddon et al., 2020). In the case of coastal NbS, the main aim is to harness natural processes to reduce coastal flooding, reduce erosion, increase biodiversity, and adapt to a changing climate. According to Pontee et al. (2016), a differentiation can be made between (1) fully natural solutions (e.g., naturally existent salt marshes, coral reefs, mangroves, sea grass meadows, kelp forests), (2) managed natural solutions (e.g., an artificial form of (1), renourished beaches, regreened dunes), (3) hybrid solutions (e.g. combination of salt marshes and dykes) and (4) 'environment-friendly' structural engineering (e.g. greened dyke, groynes). Figure 3 provides an exemplary overview of these four differentiations.

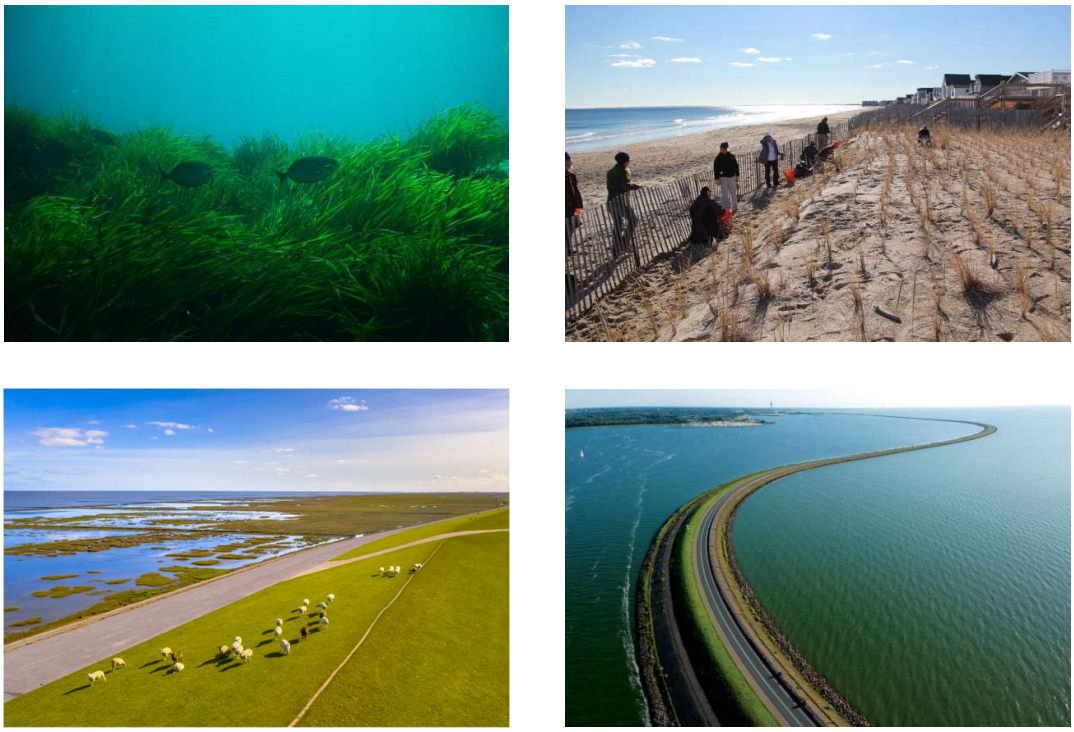

Figure 3 Nature-based Solutions; top left type (1) sea grass meadow (I1), top right type (2) restored dune (I2), bottom left type (3) marsh and dike combination (I3), bottom right type (4) greened engineered dike (I4)

According to De Groot (2012), a paradigm shift from controlling nature to living with nature can be observed regarding climate adaptations through the arising terminology of NbS in water governance since the beginning of the 21st century (de Groot, 2012). Whereas in the European and Asian literature the terminology of NbS or BwN arises in the early 2000s (Anderson & Renaud, 2021; Nesshöver et al., 2017), the American scholars rather used the term living shoreline (Smith et al., 2020). All three concepts act as an umbrella term for coastal ecosystem management and a consistent shift from hard, grey defences to natural, green solutions that loosen up defence thinking in the face of increasing climatic uncertainty in the coastal zone.

For defining the coastal context, it is first necessary to define the term coastal zone for this research, s. figure 4. As pointed out by various scholars there is no coherent definition of a coastal zone (Cohen & Small, 1998; Crossland et al., 2005). Crossland et al. (2005) refer to the

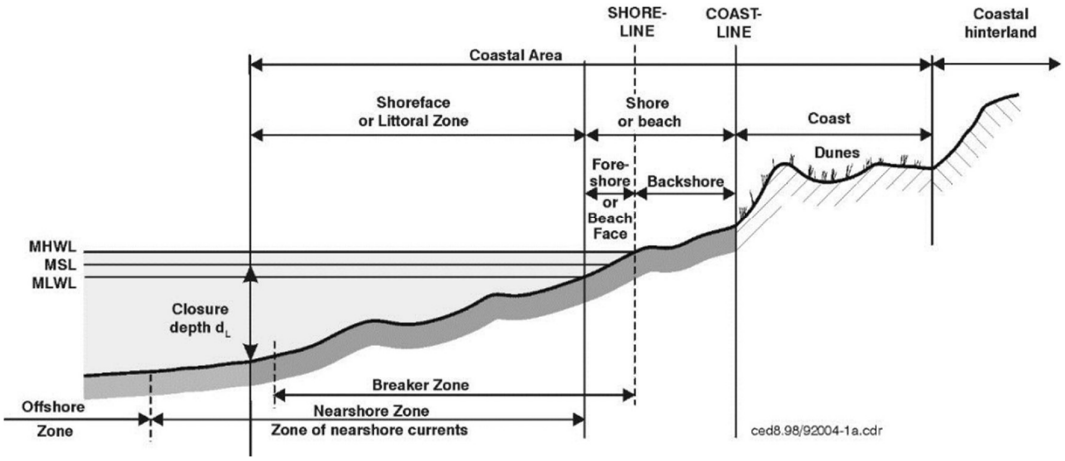

Figure 4 Definition of coastal terms by Mangor et al. (2004) on the basis of Coastal Engineering Research Center (1984)

approach defined by the Organisation for Economic Co-operation and Development (OECD) Environment Directorates, according to which the definition of a coastal zone is dependent upon the problem to be addressed. This consideration is also found earlier in the work of Cohen and Small (1998), where the kind of hazard implicates both direct and indirect exposure. Therefore, in addition to the pure distance from the shore, the altitude must also be considered. As such they define areas within 100km from the shoreline and within 100m of elevation (100-m/100-km), which is referred to as the "near-coastal zone" (Nicholls & Small, 2002, p. 301). Based on the geographical boundaries of the province of Groningen, which lies within the 100 km zone from the sea, and below the 100 m elevation line (between -2.9 m and 14 m (PDOK, 2018)), the entire province is included in the scope of the study. However, an area with a smaller distance to the sea is chosen for capturing the perception of NbS.

2.1.1 Role of NbS in Coastal Flood Risk Management

Flood Risk Management (FRM) deals with the recognition of vulnerable areas to flooding and respective pre-flood and post-flood management to reduce the flood hazard (the probability of occurrence of a damaging flood). Overall the damage by floods is connected to a place's socio-cultural, economic, and ecological vulnerability (Schanze, 2006). As Schanze (2006) demands, FRM should be defined as a "holistic and continuous societal analysis, assessment, and reduction of flood risk" (p. 4), whose elements can be taken from figure 5.

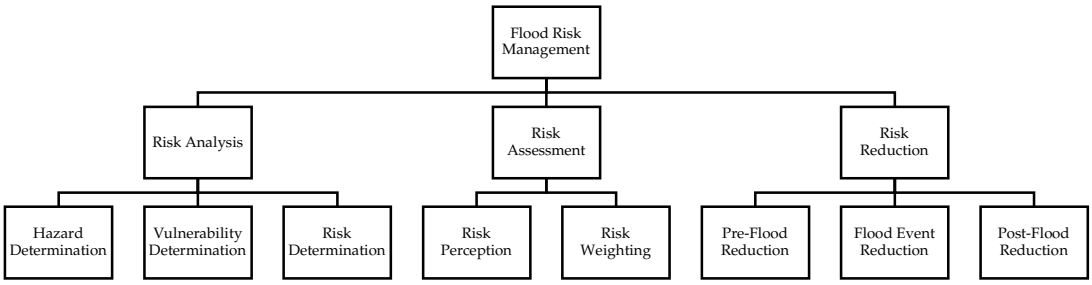

Figure 5 Tasks and components of flood risk management according to Schanze (2006)

Under the concept of natural flood management (NFM), which focuses on measures aimed at restoring or adapting landscapes to flood risks, NbS opened up a new field of research (Lane, 2017). Further, a transition from sole flood control to flood resilience can be observed, which includes the aspects of persistence, adaptability, and transformability. According to Restemeyer et al. (2015; 2018), three steps belong to the operationalization of flood resilience (1) robustness through reducing flooding probability, (2) adaptability by reducing the consequences of flooding, and (3) transforming society through risk communication and awareness and thus speaks of socio-ecological or evolutionary resilience. In the frame of NbS, persistence can translate to a reduction of wave energy to be concomitant with the erosion of shore and coastline. This can be linked to mitigation, which aims at reducing climate change effects through carbon sequestration by a greened coastal area. Adaptation focuses rather on the question of how-to better deal with the consequences of climate change and is at the core of NbS. Lastly, the degree of transformation achieved by NbS is still under investigation and requires prior a thorough understanding of the public.

In the transition of coastal protection from traditional hard defences to NFM, a deep-rooted viewpoint on protection is being challenged. Not only do perceptions of risk, costs and benefits differ but also do values and norms of CFRM planning officials and residents in coastal zones. Further, the degree of protection is often reflected in rules and regulations, decided at a time when technical and rational planning was at its peak. With an increasing network of stakeholders to be included, NFM must overcome many informal (norms and values) and formal (rules and regulations) institutions (North, 1991) that are embedded in coastal governance.

2.1.2 Benefits and Constraints of coastal NbS

Natural coasts developed and maintained under the scope of NbS flood protection, offer the possibility to merge climate mitigation, adaptation as well as flood persistence into one approach. By enabling the integration of different disciplines and scales in planning, the coastal zone is presented in a larger framework that goes beyond the singular goal of flood protection. Table 1 presents the findings of reported benefits connected to coastal NbS.

Table 1 Benefits of NbS across academic literature

Domain	Benefit
Physical	Reduction in erosion (Gittman et al., 2014; Morris et al., 2018; Narayan et al., 2016)
	Tackle climate change adaptation (Morris et al., 2018) and mitigation (Seddon et al., 2020)
	Creation of carbon sinks/ sequestration (Davis et al., 2015; Seddon et al., 2020)
	Reduction of wave height (Morris et al., 2018; Narayan et al., 2016)
	Improved protection from storm events (Narayan et al., 2016) and self-repair (Gittman et al., 2014; Morris et al., 2018)
Ecological	Increase in biodiversity & habitat restoration (Davis et al., 2015; Narayan et al., 2016; Seddon et al., 2020)
Social	Aesthetic values (Davis et al., 2015)
	Public health (Davis et al., 2015)
	Ecosystem services (Tourism & Recreation (Davis et al., 2015)) Wild food (salt marsh (Rendón et al., 2019))
Economical	Relatively low cost (Narayan et al., 2016; Seddon et al., 2020)

While table 1 provides an extensive overview of the benefits that NbS implementation in coastal protection schemes could provide, constraints or limits also do arise regarding the assessment of effectiveness. For example, Seddon et al. (2020) point out five major limitations, s. table 2.

Table 2 Limitations of NbS based upon Seddon et al. (2020)

1	The individuality of social context refutes uniform scales
2	The monetary valuation system is inadequate to rank NbS performance
3	Trade-offs are not considered
4	The time delay between implementation and effectiveness
5	Circumstantial effect on NbS effectiveness in CFRM

As can be seen from these limitations, a differentiated consideration and evaluation of NbS are particularly necessary. This includes the socio-political and socio-ecological orientations of society, i.e., values and norms that condition a non-monetary assessment of effectiveness.

2.3 Societal Context

As already touched upon in the previous sections, the context in which NbS is embedded exceeds the sole environmental dimension. The implementation of NbS in CFRM includes societal components such as culture, institutionalization, and governance (Birkholz et al., 2014; Samuels et al., 2006). This dimension of context clarifies the implementation of approaches and leads to the more complex visualization seen in figure 6 below.

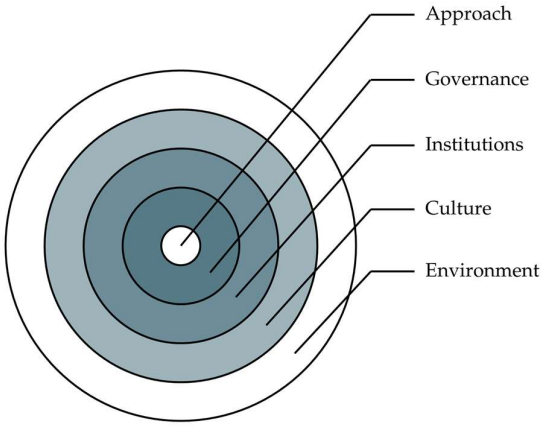

Figure 6 Extension of figure 2 – Societal context more specific

Current defences ensure a high level of security but, unlike NbS, are not able to adapt to changing environmental conditions. The consistent expansion of hard defences leads to intensive use of the hinterland, including the accumulation of assets. Seeking a high level of centrally organised security implies at the same time a lower awareness and adaptation of societies and leads to high losses in case of a severe storm surge, also known as the vulnerability paradox.

The question now arises about how the positive perception and acceptance of new, innovative approaches are achieved within society. Acceptance is defined here as behaviour or position that supports NbS being implemented in the scheme of CFRM. Based on the previous model the environment, culture, institutions, and governance allow not only the implementation of an approach but also shape the society that is living within the presented system. A decision-maker can only exert limited influence on the environment and its changes, e.g., proposing climate change mitigation measures. However, the cultural and institutional interplay with the public towards a societal acceptance of the approach can be addressed through media presentation, research work, and visions for the future.

> *"Understanding the context of flood risk management is essential in terms of governance and institutional structures together with the predominant culture, societal values and national regulation for the use of land." Samuels et al. (2006, p. 148)*

In the following the interplay between culture, institutions, and coastal governance in their position shaping public perception, values, and norms, which then lead to pro-NbS attitude and acceptance of implementation will be explored. Reaching acceptance of NbS by the public is dependent upon underlying, shared social norms. These are influenced by personal values and the subjective perception of the planning approach itself. All three elements are influenced

by the cultural and socio-political layout of the country and strongly coupled with the remembrance of past CFRM. These accumulated norms, then determine the public attitude towards an NbS and decide upon its acceptance or rejection. In the following three elements perception, norms and values will be defined and differentiated.

2.3.1 Perception

Perceiving NbS is about consciously understanding and evaluating its impact. Based on personal preferences and values, the evaluation of risks, costs and benefits is subordinate to this subjective context including history and culture. Besides these institutions, the degree of governance shapes the perception of NbS and trust in CFRM. In the following the three aspects of risk, cost and benefit perception shall be explained further.

Risk Perception

Risk itself assumes uncertainty about the outcome of action but is mostly associated with the probability of negative consequences. In the technical risk analysis, this translates into the probability of events and the magnitude of consequences (Freudenburg, 1989; Renn et al., 1992, p. 138). In social analysis, the risk is based more on perception, which is influenced by values, attitudes, socio-political influences, and cultural identity (Renn et al., 1992). Within social sciences, the individual judgement about events that could turn out negatively denoted as 'risk perception' has gained much interest (Renn, 2017). There are three schools of thought on risk perception (1) the psychological approach, (2) the cultural approach and (3) the interdisciplinary social amplification of risk framework.

The psychological approach is subject-oriented and can be differentiated between the research scopes of heuristics and bias, cognitive psychology, and the psychometric paradigm. Heuristics and bias focus on the first impression people have and their limitations in thinking objectively. Cognitive psychology aims at understanding people's decisions through their thought processes. Lastly, the psychometric paradigm, developed by Slovic (1992) and assumes that risk is inherently subjective, and is influenced by a variety of "psychological, social, institutional and cultural factors" (p. 6).

The cultural theory presents risk perception as socially constructed by institutions, cultural background, and "ways of life" (Oltedal et al., 2004, p. 5). Risk is seen as the product of both knowing about the future and agreeing on the most desired goals. Despite the cultural bias, which means the worldviews consisting of values and beliefs, are strong, the individual self chooses what to fear. A key element of cultural theory regarding risk perception is the clarification of societal conflicts concerning risks (ibid.). Assessing social norms and the resulting expectations and behaviour of society makes it possible to foresee potential conflicts.

Lastly, the interdisciplinary social amplification of risk framework (SARF), most prominently presented by Kasperson et al. (1988) extends the cultural perspective and focuses on the amplification or weakening of social risk perception through interaction with social, institutional, and cultural processes. Additionally, to the primary risk, secondary social or economic consequences, enabled by behavioural patterns, extend the harm towards indirect impacts such as monetary loss, loss of trust in institutions, or "alienation of community affairs" (Renn et al., 1992, p. 140). Key findings are that risk experience is stronger related to exposure than actual hazards, which strongly differs from the technical risk assessment, and the number

of people affected. If few people experience strong hazards, this seems to be less influential on the general risk perception and amplification, than the experience of light hazards by many people (Renn et al., 1992). In this frame, trust between the public and decision-makers, achieved through communication and transparent CFRM is a key element in the perception and rational understanding of risks. Risk perception, when decoupled from rational facts or limited information, is of importance for the acceptance of NbS. Going alongside the SARF it can be summarized that if a large proportion of society feels at risk through NbS (e.g., in the living place, workplace, recreation, or transportation), an amplification of this perception could lead to reduced interest in investment and implementation, even though the objective hazard is low. To face this subjective and culturally influenced perception of risk, actors in coastal governance must educate and advocate NbS as well as address people's risk perception through scientific research on the objective risks to be expected.

Cost Perception

Costs are perceived either in monetary (price) or non-monetary (time, energy/effort, psychological (anger, stress)) terms. The lower the cost is perceived, the more NbS are perceived favourable. While balancing between monetary and non-monetary costs is possible, especially monetary considerations often do play a major role in the determination of NbS implementation in contrast to existing flood defence measures. Residents are here only affected secondarily as CFRM measures are usually paid not by individuals but by central or regional governments. However, disagreeing with spending high amounts can lead to disapproval of NbS implementation. Following this, transparent and reliable information is necessary to create trust in government and institutions (Grimmelikhuijsen, 2012).

Benefit Perception

As mentioned earlier, benefits are highly subjective and depend on the individual's definition of "beneficial", which in turn depends on the context in which the individual finds himself. Social and environmental aspects, such as increased recreational opportunities, water quality and biodiversity, as well as economic benefits, e.g., cost efficiency and reduction in comparison to traditional approaches, play a role in the renewal of the CFRM. The perception of the benefits of NbS is strongly connected to the underlying values. While individuals, highly conscious of social and environmental needs, may strongly endorse the concept of natural coasts and connected benefits of increased biodiversity or adaptability to climate change, self-centred individuals may only accept NbS implementation, when serving their personal goals. Thus, offering a wide range of benefits can heighten the general acceptance of NbS.

The identification of an acceptable risk/cost-benefit ratio for the implementation of NbS is difficult to assess. Not only does the identification require trained and experienced personnel, but also demands a degree of rationality, which is hardly achievable as individuals are a product of their environment (Teuber, 1990). Further, according to Leonard (1983), “some social values will never fit in a cost-benefit framework and will have to be treated as ‘additional consideration’ in coming to a final decision” (p. 42).

2.3.2 Norms

As Hechter and Opp (2001) lay out, norms can be determined as rules, however, require a degree of internalisation and independent choice and thus are "cultural phenomena that prescribe and proscribe behaviour in specific circumstances" (Hechter & Opp, 2001, p. xi). In essence, norms are established through a combination of learning and the desire to belong to a social group (Perry et al., 2021). In spatial science, the connection of norms is most prominently known through the definition of institutions by North (1991) as "the humanely devised constraints that structure political, economic and social interaction" (North, 1991, p. 97). These institutions consist of "formal rules" and informal constraints (norms of behaviour, conventions, and self-imposed codes of conduct)" (North, 1993, p. 62) and obtain the ability to affect the perception of individuals and vice versa. But how do norms establish and how do they influence the perception and acceptance of NbS? To answer this question, the norm activation theory (NAT) developed by Schwartz and Howard (1981) is used to unravel the development from norm to behaviour.

The NAT lays out that an individual's behaviour is influenced by personal norms, which in turn develop through the awareness of the problem (AP) and consequences (AC), as well as an ascription of personal responsibility (AR). While previously applied to determine pro-societal behaviour, in the last decade also pro-environmental behaviour (e.g., household energy use (Poortinga et al., 2004), energy-saving policy acceptance (J. I. De Groot & Steg, 2009), sustainable travel modes (Lind et al., 2015) could be proven by an extended version of the Value-Belief-Norm theory of environmentalism (VBN), s. figure 7.

Figure 7 Norm activation model as a mediator model with VBN adapted from Steg et al. (2017)

AC requires a prerequisite understanding of the underlying problem and its urgency (Blamey, 1998). Correlating this with socio-economic variables, possible reasons for a low level of AC in society can be detected. Examples such as restricted official information from government and media, but also age or educational level could reduce the general AP and thus also its consequences. AR reflects the ability and determination of individuals to counteract less social or environmental behaviour (ibid.). If the problem itself is not reducible on the individual level, the responsibility is usually shifted from the personal to higher decision-makers within the state and market.

Awareness of why a change from traditional flood protection to NFM or NbS in CFRM might be favourable is a key element for acceptance. This comprises the awareness of climate change and its effects on the local coastal system such as expected SLR or changing weather patterns, but also the effect of anthropogenic coastal use e.g., building houses, tourism, and recreational usage. When the maladaptation of existing flood protection to the mentioned stressors is not evident or plausible to individuals, they will rank low on awareness and thus do not see the

urgency in reacting or changing the current CFRM scheme. Further, AP and AC are also important indicators to determine where communication or education may need improvement (Burningham et al., 2008). Lastly, lack of responsibility awareness is likely to connect to limited interest in coastal zones and negation that own actions result in negative effects on flood protection measures (e.g., unrestricted recreational activities).

2.3.3 Values

Schwartz (1992) defined values as "desirable transsituational goals varying in importance, which serve as a guiding principle in the life of a person or other social entity" (p. 21). They define unwritten guidelines that help to differentiate between right and wrong actions and thus directly link to norms, which guide behaviour. Values are stable in time (Stern, 2000) and shared across cultures (Steg et al., 2014). These characteristics make them valuable in comparing the acceptance of approaches within different contexts and further enable the assessment of societal tendencies regarding the valuation system. In that sense, approaches can be altered to fit into the current social system and create opportunities to rethink the planning endeavour.

Schwartz's value theory (Schwartz, 1992) identifies ten basic values and arranges them on a circular wheel, showing their relations of "conflict and congruency" (Schwartz, 2012, p. 8). Values closer to one another share similar underlying motivations, than more distant ones. The determination of the by Schwartz defined values is known as the Schwartz-Value-Survey (SVS). Following Schwartz et al. (2017) and the depiction of the refined theory with 19 values in figure 8, a circumplex is surrounded by three rings with different amounts of elements, called dimension. The first ring differentiates the values between the dimension of self-protection (bottom) versus growth (top), and the second ring of social focus (left) versus the personal focus (right). The third ring encompasses two dimensions: from 'self-enhancement' (bottom-right) to 'self-transcendence' (top-left) and from 'openness to change' (top-right) to 'conservation' (bottom-left). The inner circumplex then contains 19 basic values, from which, according to Bouman et al. (2018), especially values from the self-transcendence and self-enhancement dimension proven to be related to pro-environmental beliefs, attitudes and behaviours.

Steg et al. (2014) and Bouman et al. (2018) showed that four values are connected to environmental action: egoistic, altruistic, biospheric and hedonistic values. In the depiction in figure 8 altruistic and biospheric values can be subordinated under the basic value 'universalism' and egoistic values between the basic values of 'power' and 'dominance' (Conte et al., 2021). According to the findings of the adapted and shortened SVS by Bouman et al. (2018), called Environmental-SVS (E-SVS), individuals high in favour of biospheric and altruistic values act usually more pro-environmental than those who are in favour of egoistic and hedonic values.

In the following, these four values will be explained in more detail.

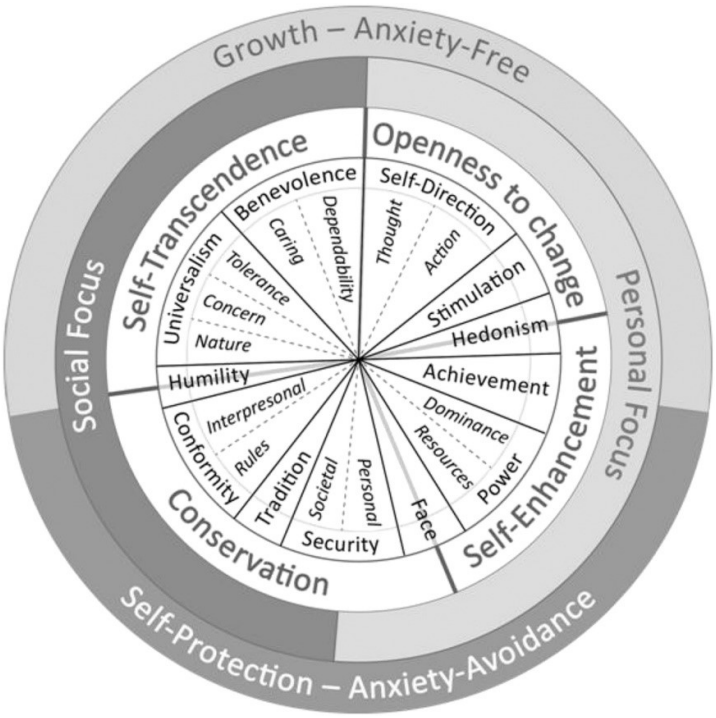

Figure 8 Refined value circumplex by Schwartz et al. (2017)

Situated within the personal focus dimension, *hedonism* has the motivation of pleasure and personal gratification. Common elements are pleasure in satisfying 'organismic needs' (Schwartz, 1992, p. 8), 'sensuous gratification' (Schwartz et al., 2017, p. 242) and enjoyment of life. Hedonism differs from other egoistic values, meaning personal-focused values, in three ways (Schwartz, 1992). Firstly, hedonism is not driven by the same competitive motivation, as the egoistic values of achievement and power. Secondly, hedonism does not strive to manage uncertainty and lastly, it comprises a higher motivation for experiencing challenges which is commonly found in higher openness to change (see adjacence of hedonism to the dimension of openness in figure 8). Lastly, regarding pro-environmental behaviour, hedonism is found to be more negatively related to egoistic values and may inhibit environmentally friendly action (Steg & De Groot, 2012; Steg et al., 2014).

Egoistic values, such as achievement and power, aim at the fulfilment of personal benefits. Both subordinated power values (e.g., wealth, authority) and achievement values (ambition, success) require functioning social institutions to enable status differentiation (Schwartz, 1992). Whereas achievement values rely on an active presentation of status and competence, power values emphasise the general representation of dominance in the social system (Schwartz, 1992). Steg and De Groot (2012) point out that pro-environmental action is only pursued by individuals strongly influenced by egoistic values when the perceived benefits are higher than the perceived costs. Overall an alignment with the individual goals must be guaranteed to enable environmental friendly behaviour (Steg et al., 2014).

The basic value of universalism has the goal of "understanding, appreciation, tolerance, and protection for the welfare of all people and for nature" (Schwartz, 1992, p. 12). Under this *altruistic* (prioritising the well-being of people) and *biospheric* (prioritising the well-being of nature) *values* can be subordinated. When it comes to evaluating costs and benefits, people with strong altruistic values focus on the impact on other people, while people with strong

biospheric values focus on the impact on the environment (Steg & De Groot, 2012). In turn, NbS both offer benefits for people (health, recreation, and aesthetics), and the environment (biodiversity, nature conservation).

As explained earlier, people with a focus on universal values (altruistic and biospheric) are more prone to pro-environmental behaviour. Since NbS offers a variety of environmental benefits, this speaks for the acceptance of the concept by people with high biospheric values. Other social benefits (health, recreation) and the long-term increased ability of the coast to cope with climate change stressors also argue for the acceptance of people with high altruistic values. Rejection of NbS would most likely occur if the promised benefits do not materialise or exacerbate the coastal zone's vulnerability to flooding or erosion, thus threatening the coastal zone's quality of life. In contrast, people with strong personal-focused values (hedonic and egoistic) are most likely to be in favour of NbS in coastal areas only if their individual preferences are met. An alignment between these and the to-be-implemented form of NbS can result in many conflicts. For example, the creation of salt marshes and the simultaneous cessation of use of the area may conflict with the required recreational use.

2.4 Conceptual Model

By combining the elements from the previous sections, a comprehensive conceptual model can now be created, s. figure 9. On the left is the NbS for coastal flood protection, which is embedded in the country-specific context consisting of a unique ecological, cultural, institutional and governance environment. Formal and informal institutions shape the public's perception of NbS and ultimately lead to their attitude or active behaviour towards NbS (accepting or rejecting). First, formal institutions and governance inspire confidence in NBS and legitimise its implementation. The public's perception of NbS is thus dependent upon the trust towards these two entities, but also on the transparency and availability of information on the subject matter of CFRM. Past events, decision-makers and media representation are key elements influencing this perception. Secondly, informal institutions are closely linked to the personal attitude of NbS. By considering personal-focused and universal values (hedonic, egoistic, altruistic and biospheric) and the awareness of the problem, consequences, and responsibility to act, the perception is influenced. If this perception is in favour of NbS, it leads to a positive attitude among the public.

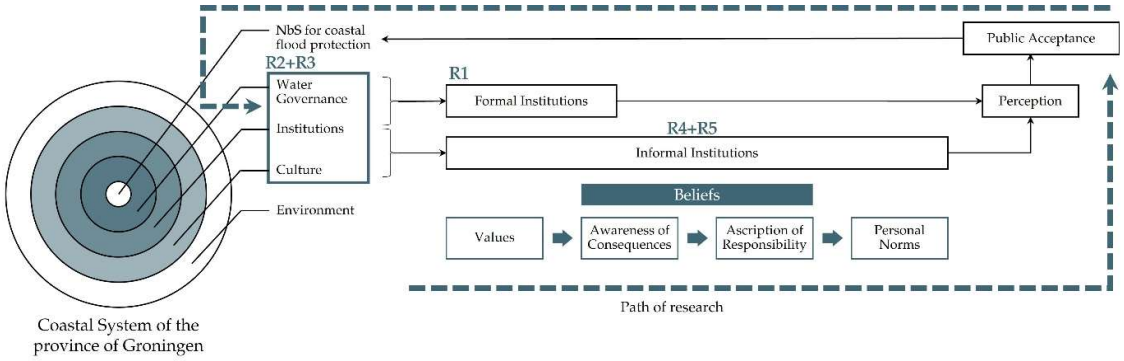

Figure 9 Complete conceptual model with implemented research questions and pathway guiding through thesis

Chapter 3: Methodology

This chapter aims at explaining the applied case study methodology in section 3.1 and the overall research design in section 3.2. In section 3.3 and 3.4 applied data collection and analysis tools will be presented.

Underlying the thesis is the approach of a case study. While the case study approach is traditionally thought of only in terms of qualitative research (Yin, 1994), adding quantitative elements, enables answering how the public perception regarding NbS is distributed spatially and differs based on socio-economic variables. To enable the accuracy of the study and comprehensibility of the results, it must be ensured that information on the type of data collection, methodology and evaluation is made available (Gagnon, 2010). Looking at the case under study from different perspectives and choosing more than two research methods, also known as method triangulation, can improve the consistency of the research and allow for the generalisation of the findings (Hussein, 2009).

Triangulation, introduced from the natural to social sciences by scholars such as Webb et al. (1969), is used to bridge the gap between qualitative and quantitative methods. While Blaikie (1991) has been especially critical of triangulations' capacity to deal with ontological and epistemological differences between the used methods, methodological triangulation is now widely used in social sciences (Hussein, 2009). Despite that Oppermann (2000) points out that interlinkages between both collection methods and systematic planning is fundamental to avoid a simple multi-methodological approach with limited validity between the results. Subsequently, section 3.3 presents the methods used and their linkage.

3.1 Case Study as Research Methodology

A case study aims at capturing the complexity emerging from the interrelations within society and its environmental context. According to Gagnon (2010) a case study can help describe and provide a deep understanding of situations, events, and actor-interrelations within the case boundaries. In contrast to purely statistical methods, the case study thus allows understanding of causes and effects linking both together and thus enabling in-depth knowledge instead of broadness (Flyvbjerg, 2011). Thus, a case study can help determine the public's perception of coastal NbS calls for a thorough understanding of the underlying environmental, culture, institutions, and actors within coastal governance, including the historical development of the existent water or security paradigm.

According to Yin (2009), it can be differentiated between a single case and multiple-case design, elaborated by either having a single (holistic) or multiple (embedded) units of analysis. Using the single-case design allows for dissecting the manifested water paradigm in the province of Groningen. As units of analysis, the public perception of NbS (informal institutions), formal institutions, and coastal governance actors are chosen. The case and its underlying unit of analysis should be elements of the real world and defined by "spatial, temporal and other concrete boundaries" (Yin, 2009, p. 32).

Table 3 Case and unit of analysis criteria

Category		Description
Environment	Coastline length	~100km
	Elevation	-3 to 28m
	Climate	Cfb – oceanic climate, mild winter, absence of dry season/ constant precipitation, moderate temperatures
	Sea facing coast	Wadden Sea/ North Sea/Dollard-Ems estuary
	Area	2.960 km2
Socio-political	Political order at state level	Constitutional monarchy and parliamentary democracy
	Political order at the province level	Elected provincial council (legislative) and provincial executive with a King's Commissioner as chairman of both branches
	Population	590.234 (2022) (Alle Cijfers, 2022)
	Av. age	42,15 (2020) (DSvG, 2022)

The spatial boundary of the case study comprises the coastal part of the province of Groningen, s. table 3 for background information. The area of investigation, as defined in section 2.1, covers the area within 100km from the coast and within 100m elevation. The quantitative data collection however only comprises the coastline facing municipalities, as well as the municipality of Groningen.

The temporal extent of the case study on the one hand comprises the long-term development of coastal institutions mainly within the last 50 years that capture the shift towards more adaptive ways of dealing with flood protection in the Netherlands. On the other the status of current public perception of coastal NbS, meaning the survey period between April and June 2022. The corresponding research period took place from November 2021 to July 2022.

A systematic procedure for conducting a case study is fundamental to allow internal and external validity and reliability of the results Gagnon (2010). Following, the proposed structure of Yin (2009) according to which the research methods of a case study "have not been codified", however, need a thorough research design (p. 25).

3.2 Research Design

The research design of a case study aims at logically connecting research questions with empirical findings. Based on the definition of (Yin, 2009) components are the development of research questions, their propositions, units of analysis, the logic linking data to propositions and criteria for interpreting the data (cf. p. 27). A proposition is a declarative statement that must be either true or false or can be tested empirically. In the latter case, a proposition can be defined as a hypothesis.

The guiding and secondary research questions have been stated in section 1.3. Further, the theoretical background in section 2, developed the path for developing the hypotheses why

the interplay between culture, institutions, and governance leading to perception, values, and norms can be used to determine public acceptance of coastal NbS.

The logic of the research design uses the mixed approach of deductive and inductive logic, s. figure 10, by Khaldi (2017). Deductive elements of this research comprise the literature review, presented in section 2, as well as case-specific findings, s. section 4. The inductive part of the research comprises the questionnaire survey, s. section 3.4, which then can provide conclusions about the validity of the presented theoretical claims by examining emerging patterns.

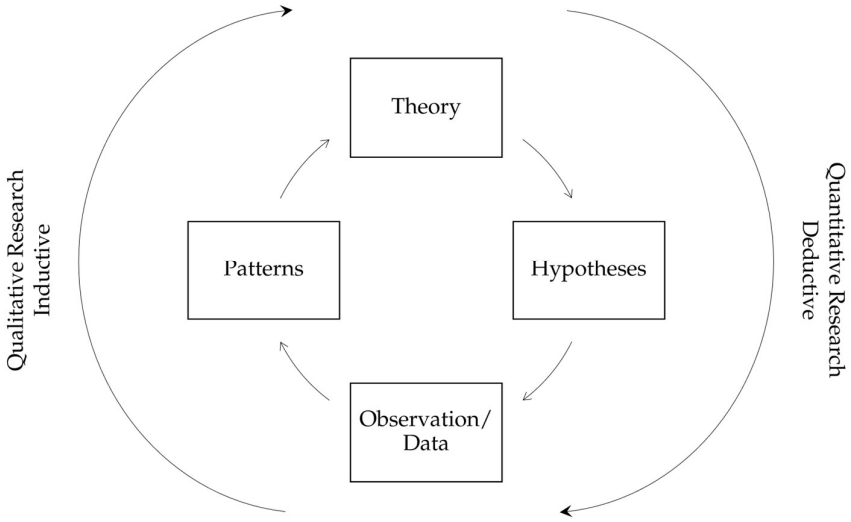

Figure 10 Research wheel based on Khaldi (2017)

3.3. Data collection framework and techniques

Following the deductive and inductive research outline by Khaldi (2017), elaborated in section 3.2, a combination of methods enriches the case study and can improve validity and reliability. This section will describe the qualitative and quantitative data collection methods used in this research. While the qualitative methods aim at descriptively explaining the conditions and developments experienced in the case study sites, quantitative methods elaborate further on the explorative perspective on NbS perception in a coastal context. As a qualitative method, standard literature research (s. section 3.3.1) was chosen. For the quantitative method, a questionnaire survey among coastal residents (public) was selected (s. section 3.3.2). Additionally, geographical representation through Geographic Information System (GIS) complements the visualization of the case study area. In the following, the individual data collection techniques will be presented.

3.3.1 Literature Research

Literature research aims at gathering written evidence to answer the research question or proposed hypotheses. The type of literature used for the theoretical background consisted of academic papers in the fields of NbS, climate change as well as (environmental) psychology to lay out the basis of this research (inductive). For the case research, mainly governmental policy documents and evidence reports have been consulted, primarily in English and if not otherwise available also in Dutch (deductive). The literature research has been performed from December 2021 throughout the whole thesis timeline, with the main peak period from January to April. Further, an NbS symposium (Kweldersymposium) by Ecoshape, a consortium of private parties, government organisations, and research institutes, was visited online on the 27th of January 2022 (NCK, 2022). Case relevant notes were taken during the event, based upon the held presentations.

3.3.2 Questionnaire

A questionnaire targets the quantitative data collection from the real-life world, without the intervention of the researcher (Kumar, 2018). Despite the numerous advantages, such as a uniform approach and concrete answers to the questions, this research method should be carefully examined for its generalisability. This could be achieved by determining the proper sample size for the case area, s. section 3.4 eq. (1). In addition, questionnaires do not consider the subtle differences in how and why participants rate something. For this purpose, qualitative interviews would be better suited, but with large sample size, they require a considerable amount of time.

The method of a questionnaire has been chosen to reflect the perception of NbS, personal values and norms (AP, AC and AR)) within the case study area and correlate those variables with the general acceptance/ negation of NbS, as well as socio-economic variables. The goal was to test the following hypotheses:

- **H1** Positive relation between norm constructs and benefits.
- **H2** Positive relation between norm constructs (awareness and responsibility) biospheric and altruistic values, as well as a negative relation between hedonic and egoistic values.
- **H3** Positive relation between NbS position and benefits and negative with costs and risks.
- **H4** Positive relation between NbS position and altruistic and biospheric values.
- **H5** Positive relation between NbS position and norm constructs.
- **H6** Positive relation between NbS position and age, sex, and education, as well as a negative relation between NbS and the participant's distance to the sea.

The questionnaire was developed, based on the findings presented in the theoretical background, s. section 2.3, and was provided in Dutch, to facilitate data collection within the province of Groningen. Qualtrics, software for online surveys, has been chosen to implement

the questionnaire digitally as being included within the university license (Qualtrics, 2020). Table 4 presents the targeted sample population, distribution method and resulting bias.

Table 4 Clarification of targeted sample population, distribution method and bias

What is the sample population?

The sample population are the residents of the seaward facing municipalities, as well as the municipality of Groningen. This choice is based upon the expectation that closer to sea living participants are familiar with the flood protection measures and thus are capable to express their opinion. The municipality of Groningen was chosen additionally, even though it does not face the sea, due to its central function and variety of residents. Lastly, remaining municipalities of the province were excluded due to their higher elevation and lowered exposure to flood risk, s. figure 24.
Based upon eq. (1) a sample size of 399 (sample population: $N = 364.741$; error rate: $e = 0.05$) should be targeted.

How was the questionnaire distributed?

Distribution of the printed invitation flyer took place by bike and foot, randomly selecting residents letterboxes in the respective villages. In total 1500 invitations were distributed over four days in the municipalities of Het Hogeland, Eemsdelta, Oldambt and Groningen, s. appendix 1 table 21 and figure 11 light blue circles.

The digital invitation was sent by email to 34 village groups (Dutch: dorpsbelangen), in the province of Groningen, with the request to answer and/or redistribute among the village citizens, s. figure 11 dark blue circles. The village groups were chosen because they consist only of villagers and in this sense offer an insight into the local perception of NbS.

What bias results from these choices?

From the physical distribution a tendency towards capturing the perception of house owners is expected, especially in the rural areas. From this a bias regarding awareness of floods and value of security could be deduced. The online distribution could hold a bias of capturing the perception of highly community-active individuals, which then could show tilted results regarding universal values.

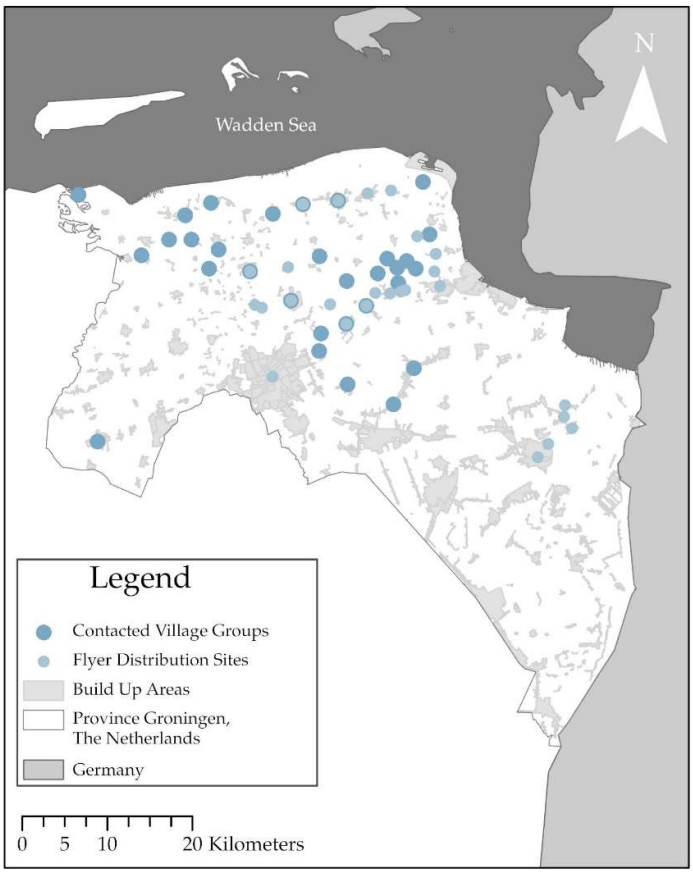

Figure 11 Distribution sites and contacted village groups within the province of Groningen (D1)

In total 81 people completed the questionnaire, of these 15 people did not fully complete the questionnaire, leading to a total of 67 replies being continued to use in the data analysis. The English version of the questionnaire will be used in the following parts, the translated Dutch version of the public questionnaire can be found in appendix 1 table 20.

The questionnaire consisted of four parts additionally to the introduction and reason for the questionnaire. The first part asked the participant about socio-economic variables. In the second part, they were asked about the perceived risks, costs, and benefits of coastal NbS. In the next part, the participant was asked to rank personal values, and the final part asked for their awareness and ascription of responsibility to be active in coastal resilience. These four parts shall be elaborated on further below.

Variables Part 1: Socio-Economic

The first part aimed at creating a background profile of the pool of respondents by asking various socio-economic questions, s. table 5. These questions comprised age, gender, occupation, as well as the highest level of education. For the selection of occupation, the sub-major group of the International Standard Classification of Occupation 2008 (ISCO-08) has been used (Ganzeboom, 2010). Further, to spatially identify patterns between different counties within the province, the respondents were asked to select the municipality (Dutch: gemeente) they are living in. They should also indicate how far they live from the coast and which method of coastal protection is closest to them. For distance to the coast, discrete rather

than nominal data options were used on a scale of 0 km to 100 km in 5-km increments with a slider. This decision is based on the visual overcrowded representation in the mobile version of the questionnaire using Qualtrics, as well as protection of privacy and facilitated data handling. Finally, participants were asked if they were for or against coastal NbS, based on their current knowledge (yes/no/no opinion).

Table 5 Socio-economic data (part 1 public questionnaire)

Data category	Questions
Continuous	-
Discrete	Age, Distance
Ordinal	Acceptance with NbS, risks, costs, benefits, norms, values
Nominal	Sex, Occupation, Education, Municipality, coastal protection method

Variables Part 2: Perception of Risks, Costs and Benefits (RCB)

The following three sub-questions, s. table 6, could be answered by assigning a value on a scale from 1 (very low/do not agree) to 5 (very high/strongly agree). As such all responses can be counted as discrete data.

Table 6 Variables of Perception of Risks, Costs, and Benefits (part 2 in the public questionnaire)

Category	Questions		Code
Perception of Risks	…being restricted in my recreational usage of the coast		R_recrea
	…being restricted in my occupation		R_job
	…being affected at my living location		R_house
	…being affected in my use of infrastructure (road, rail)		R_transp
Perception of Costs	*monetary*	… *costs* to be higher than traditional flood protection regarding implementation	C_Mimpl
		… *costs* to be higher than traditional flood protection regarding maintenance	C_Mmaint
		… *costs* to be higher than traditional flood protection in case of flooding	C_Mflood
		… *costs* will be lower in the long run regarding NbS.	C_Mlongt
	psychological	… *costs* (stress, anger) to be higher than traditional flood protection	C_psych
	time	…*costs* of developing a new flood protection method to be higher than implementing traditional methods	C_time
Perception of Benefits	…recreational activities		B_recrea
	…the provision of resources (e.g., fish, oysters)		B_resour

Cont. Table 6 Variables of Perception of Risks, Costs, and Benefits (part 2 in the public questionnaire)

Category	Questions	Code
Perception of Benefits	…reducing the impact of climate change	B_redCC
	…enhanced biodiversity	B_biodiv
	…enhanced liveability of the area	B_liveabi
	…enhanced aesthetics of the area	B_aesthet

Variables Part 3: Values

The value questions in part 3 are based on a short version of the Schwartz value scale (Schwartz, 1992) developed by De Groot and Steg (2008), which has been tested and validated by multiple studies (De Groot & Steg, 2008; Steg & De Groot, 2012; Steg et al., 2014). The four main values (hedonic, egoistic, altruistic and biospheric) were assigned to a subset of values, which must be ranked on a scale from -1 (opposed to principle of life) to 7 (supreme importance), s. table 7.

Table 7 Main and subset values (part 3 of the public questionnaire)

Main Value	Subset Value
Hedonic	Pleasure, Enjoyment of Life, Self-Indulgence
Egoistic	Social Power, Wealth, Authority, Influential, Ambitious
Altruistic	Equality, A world at Peace, Social Justice, Helpful
Biospheric	Respecting the Earth, Unity with Nature, Protecting the Environment, Preventing Pollution

Variables Part 4: Norms

To determine the underlying motives for norms, acting towards behaviour, part four of the questionnaire focused on the determination of the awareness of the underlying problem in current CFRM and resulting consequences, s. table 8. These variables were determined by letting the respondents agree on statements on a scale from 1 (not agree) to 5 (strongly agree).

Table 8 Norm variables (part 4 public questionnaire)

Category	Question	Code
Problem awareness	…climate change is causing stronger storms, heavy precipitation, and rising sea level.	AP_CLIMA
	…sealing coastal zones reduces biodiversity and thus its carbon capture capability.	AP_COSEAL

Cont. Table 8 Norm variables (part 4 public questionnaire)

Category	Question	Code
Consequences awareness	…that traditional defence techniques cannot be improved indefinitely.	AC_TradE
	…that a higher potential of and vulnerability to flooding will affect my life and that of following generations.	AC_VUL_LT
Ascription of responsibility	…increasing the resilience of my community towards coastal flooding.	AR_ComRes
	…informing myself about how to take care of or behave along coasts.	AR_info

3.3.3 Ethical Considerations

When performing qualitative research involving the capturing of expertise and perception from people, special care must be devoted to moral and ethical operationalization and data handling. Considerations are especially prominent within data collection methods such as interviews and surveys. As the latter has been chosen as one of the research methods performed within this thesis, consequently ethical considerations were part of methodological development.

According to Klopper (2008), ethical considerations deal with the protection of personal rights by the participants in the study and their informed consent to participate. The former includes "the right to self-determination, right to privacy, right to autonomy and confidentiality, right to fair treatment, and the right to protection from discomfort and harm" (Klopper, 2008, p. 71). The meaning of this shall be explained using the explicit example of the performed questionnaire.

Before starting the actual data collection, the potential participants are informed about the research procedure, including their rights. Participants in the questionnaire can participate according to their own free will and have the right to withdraw from the research or participation without giving any reason. They are informed in advance about the reason, scope, time frame, and topics covered in the questionnaire to have an impression of what can be expected. Further, they have the right to stay anonymous, which is achieved through posing questions in an unidentifiable manner. For example, instead of asking for the explicit age, job, or place of living, broader categories are offered.

Data handling and security of the questionnaire follow the seven principles of the General Data Protection Regulation (GDPR), s. table 9 (EU, 2016). The data is protected in a digital password-protected environment of the used software, during the collection phase. Afterwards, the data is extracted and solely stored on a local drive, which can be only accessed by the researcher and thesis supervisors.

Finally, the participants must consent to the laid-out procedure to start the questionnaire process. If the consent is negated, the questionnaire will be terminated immediately.

Table 9 General Data Protection Regulation Principles (EU, 2016)

Principle	Explanation
1. Lawfulness, fairness, and transparency	Any processing of data should be lawful, fair, and transparent.
2. Purpose limitation	The processing of data must be legitimized through the specification of one or more purposes.
3. Data minimization	The collection and processing of data should be limited to the specified purpose.
4. Accuracy	Personal data must be kept accurate and up to date.[1]
5. Storage limitation	Data storage is bound to the fulfilment of the specified purpose and should not exceed.
6. Integrity and confidentiality	Processing must ensure data security, integrity, and confidentiality (e.g., using encryption).
7. Accountability	The researcher is responsible to demonstrate GDPR compliance.

3.4 Data Analysis and Discussion

The data analysis performed in this thesis can be differentiated between qualitative (literature and case research) and quantitative data (questionnaire) analysis. The word analysis means to dissect a topic in its parts to investigate these closely. The following step of discussion then allows for interpretation and gives meaning to not only the single pieces but also the whole picture. Both steps are performed in separate sections, respective section 4 for the analysis and section 5 discussions.

The case data analysis has been analysed using computer-based coding using computer-based directories alongside a literature database for quick access to documents and respective codes. A list of the utilized broader and more detailed code categories can be found in appendix 4. Quantitative data, derived from the public questionnaire consists of reliability and a Pearson correlation analysis. The research validity is tested using the Slovens Formular, with N – population, e – acceptable sampling error, and n the sample size, s. eq. (1).

$$n = \frac{N}{1 + N * e^2} \quad (1)$$

Firstly, the quantitative data analysis has been performed using MS Excel (Microsoft Corporation, 2018) and IBM SPSS Statistics (IBM Corp., 2020) by performing a reliability analysis and calculating Cronbach's alpha, s. eq. (2), for the internal consistency reliability with N – the number of items and $\bar{r}$ – the average correlation between the items. Reliability of the data determines the degree to which the collected data is error-free in representing the concept under investigation, here NbS acceptance. As multiple variables (values, norms) are tested to test connections between NbS acceptance internal consistency reliability is necessary to show the degree to which these measures agree with one another. This step was performed on the

[1] Not applicable in this research, as no personal data (identification) is recorded.

variable sets two to four. If the value for reliability, the Cronbach's alpha has a value of ≥ .60 a construct of the tested variables can be used in the following analysis instead of the single variable itself.

$$\alpha_{st} = \frac{N * \bar{r}}{1 + (N-1) * \bar{r}} \quad (2)$$

Secondly, a Pearson-correlation analysis has been performed between all variable sets, with a focus on the correlation between NbS acceptance and explaining variables, s. eq. (3) with data vectors x and y as well as mx and my as corresponding means of x and y. Respective applicability of this parametric test to ordinal data can be found in Jacobson Jr (1972), O'Brien (1979), Norman (2010), Awan and Dako (2018) and (Hossen et al., 2020). Awan and Dako (2018, p. 318) agree with Norman (2010) that "parametric tests are generally more robust than nonparametric tests when analysing ordinal data such as seen in Likert scales, even when statistical assumptions (such as normal distribution of data) are violated.". Since a normal distribution could not be achieved given the small sample size, the Pearson correlation was considered to have an additional advantage over a non-parametric test such as the Spearman correlation.

The correlation coefficient presents not only the strength of the linear correlation between two variables but also gives information about its direction, which can be either positive or negative. Interpretation of the magnitude of the correlation follows the three categories 'Lower third' for $r < .20$, 'Middle third' for $0.20 \geq r < .30$ and 'Upper third' for $r > .30$ following Hemphill (2003).

$$r = \frac{\sum(x-m_x)(y-m_y)}{(x-m_x)^2(y-m_y)^2} \quad (3)$$

Certain variables were able to be transformed into new dichotomous variables to enable processing through the Pearson r, s. table 10.

Table 10 Assigned dichotomous variables to queried variables

Variable	0	1
Sex	Male	Female
Education	Primary Education, Secondary education, Secondary vocational education (MBO)	Higher Professional Education (HBO), University degree, PhD
NbS Position	No, No opinion	Yes

Chapter 4: Case Study of the Province of Groningen, the Netherlands

Chapter 4 now presents the findings of the explorative part of the presented research and deals with answering research questions three, four, and five. In the beginning, the characteristics of the individual environmental coastal system will be described to set the stage for the following presentation of the development of coastal governance (RQ3). Within the same subsection also excerpts of the facilitators and barriers experienced by officials in the respective areas will be presented (RQ4). This is then followed by the presentation of the findings for the public perception, norms, and values in the respective area (RQ5). The coastal system characteristics, as well as current threats, will be presented in section 4.1, in section 4.2 the acceleration of NbS integration and expansion into the Netherlands institutions, as well as governance networks in the province of Groningen will be presented. In the following section 4.3, the findings from the public questionnaire will be presented.

4.1 Coastal System

Situated in the northern part of the Netherlands, the province of Groningen features approximately 100km of coastline to the Wadden Sea and its typical intertidal habitat. Given its proximity to the sea, the climate in the Netherlands is typically described as a maritime climate according to the Köppen-Geiger climate classification (Kottek et al., 2006). This type shows warm temperatures in the main climate, with precipitation all year long and warm summers (classification: cfb) (ibid.).

Given the low elevation in the province of Groningen, s. appendix 2 figure 24 coastal protection has been a concern since the Middle Ages, which manifested through the development of dikes to ensure protection from flooding by storm tides (Henkens et al., 2014). From the 16th century onwards land reclamation efforts by local farmers led to a decrease in the Wadden Sea area and an increase in salt marshes (Bakker et al., 2002). Sedimentation fields surrounded by brushwood groynes (cf. appendix 2 figure 23) were erected in the pioneer zone and intertidal flats, which were later embanked by seawalls and transformed into arable land (ibid.). With this method, the 'boerenmethode', land reclamation was managed until 1925, when litigation regarding land ownership led to a reduction in maintenance efforts (Van Duin et al., 2016, p. 19). From then onwards, the responsibility of the accretion works shifted from farmers to the government as the erosion of salt marshes threatened the sea dikes (Bakker et al., 2002; Van Duin et al., 2016).

Today, the coastal system of the province consists of a greened sea dike (formerly known as Ommelanderzeedijk; most seaward dike line in figure 12), last flooded in 1826 (Koops, 2020), with foreshore intertidal mudflats or saltmarshes. Besides its flood protection goal, the dike is agriculturally used for grazing sheep. The height of the dike changed throughout the past, based on updated safety standards. Currently, the sea dike is equipped to withstand a probability of failure per dike section (per year) between 1/4.000 and 1/10.000 (Vergouwe, 2014, p. 58). Based on the latest safety standards of withstanding an event with a probability of 1/100.000 (0,001%) a 12km section between Delfzijl and Eemshaven was raised by approximately 2m, and ranges now from +8.5 to +10.6 NAP (dike crest hight differs spatially,

due to higher water levels in case of a storm surge inward the Eems estuary) (Vranken & Sinoo, 2016).

All salt marshes in the province, s. figure 12, can be defined as artificial, as human intervention in the hydro morphological sand accretion process played a major contribution in their development and continues in their maintenance (Bakker et al., 2002; Bakker et al., 2007). This maintenance does not only include the onsite management of brushwood groynes and drainage but also enhances the sand deposit in the Wadden Sea through nourishments along the North-Frisian islands and on the southern Dutch coast, known as "dynamic preservation" (Roeland & Piet, 1995, p. 18).

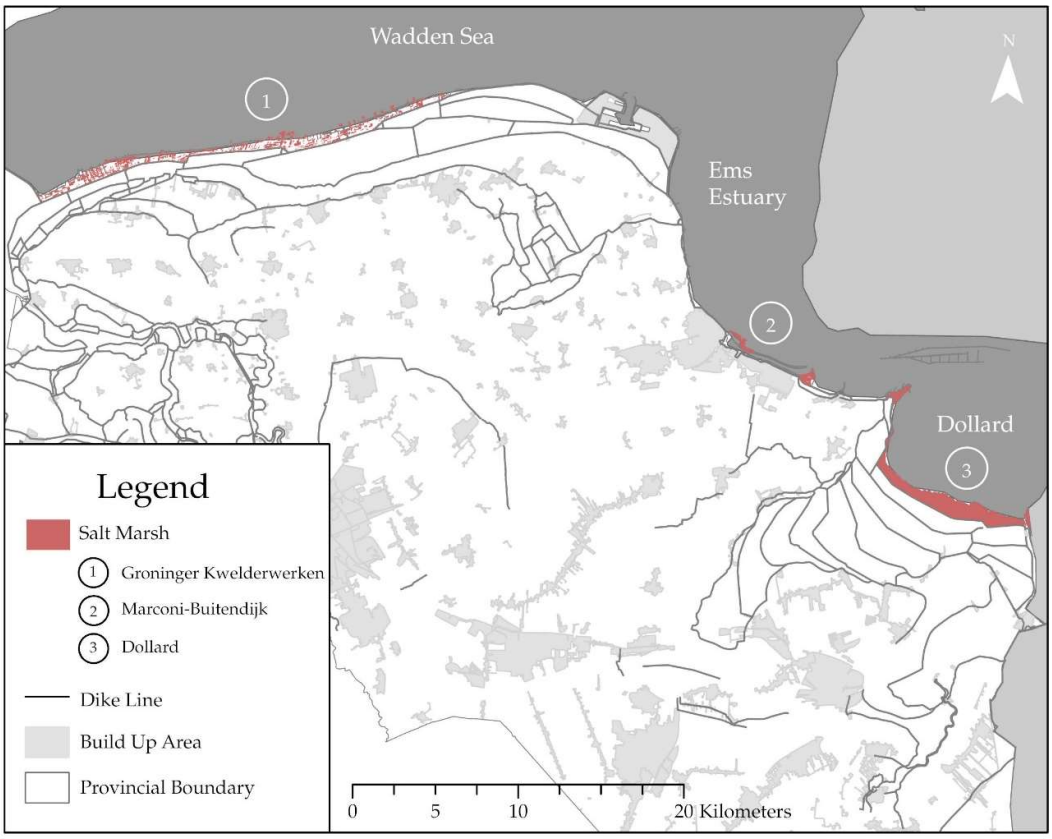

Figure 12 Salt Marshes Areas in the Province of Groningen based upon (D2; D3); (1) Groninger Kwelderwerken, (2) Marconi Buitendijk and (3) Dollard Salt Marshes

In total three larger salt marshes can be found in the province of Groningen: the Groninger Kwelderwerken, Marconi-Buitendijk and the Ems-Dollard, s. figure 12 and appendix 2 figure 22.

1. The Groninger Kwelderwerken, being connected to the municipality of Het Hogeland, comprise 497ha of pioneer zone and 918ha of salt marsh (state 2008) (Van Duin et al., 2016, p. 21). The typical underlying pattern of settling fields from the sea dike to the mud flats, which is used to facilitate sediment accumulation can be found in appendix 2 figure 23.
2. The Marconi Buitendijk consists of a 15ha pilot salt marsh and 13ha bird breeding and (accessible/education) salt marsh bordering the waterfront of the city of Delfzijl. In the

pilot salt marsh, different percentages of mud (silt and clay; 5, 20, and 50%) were tested upon their impact on salt marsh development by mixing it into the top 1.0m layer (B. De Vries et al., 2021), sowing of glasswort plants (lat. *Salicornia procumbens*) in three of the six test plots (ibid.). While the feasibility of newly created salt marshes with backfilled material has been contested, s. Bakker et al. (2002, p. 48) "Creation of new marshes by the dumping of dredging material from elsewhere is no option because a salt marsh is the outcome of the interactions of physical and biological processes and not a dumping site.", this project proves that new pioneering salt marshes can be established on artificially mixed materials.

3. The Dollard saltmarsh, being situated in the brackish water of the Eems estuary and east of the Wadden Sea, is 741ha large and struggles under erosion on the seaward side (Dijkema et al., 2005).

The main stressors on the coastal system of the province of Groningen are the gradual sea-level rise, as well as increased storm surges. Whereas a common method to combat flooding is to continuously raise the dike crest, salt marshes respond by retreating inland. Since this is prevented, due to the rigid mainland coast (dike), "coastal squeezing" occurs. (Dijkema et al., 2005, p. 14). An additional result of the straightened coastline is that sand accretion is reduced which in turn impedes sand accretion and natural salt marsh growth (ibid.). Lastly, as the impact of flooding can be far-reaching due to the generally low altitude of the area, the elevation of an area thus has been the limiting factor in risk assessment for coastal systems in the Netherlands.

4.2 Coastal Governance and Institutional Shift to NbS

In the following section, the formal and informal institutional layout of Dutch coastal governance will be illuminated by first presenting the historical development from the 1950s to the status quo in section 4.2.1. This is then followed by a detailed elaboration on the individual actors in coastal governance and their ability to display or influence public perception in section 4.3.2. Facilitators of NbS in CFRM will be presented in section 4.2.3, followed by barriers in section 4.2.4

4.2.1 Development of Coastal Management

Masters of the Floods

Like the province of Groningen, the rest of the Netherlands is situated at a low altitude, which is associated with a high vulnerability to flooding. The dependence on dikes, but also the tendency to shape the land according to ideals, such as the development of Marker Wadden and Ijsselmeer (Dekker et al., 2014), is therefore historically conditioned. Traditionally, flood protection was the task of farmers, monasteries, and nobles, combined with the expansion of their farmland, until it was taken over by dike masters in the late Middle Ages. Over the centuries, the task was then transferred to more cooperative institutions, the local water boards (Dutch: waterschappen), and later to the Rijkswaterstaat (RWS) at the end of the 18th century (Disco, 2002, p. 208). In this context Mostert (2020), refers to the theory that the common goal

of defending against water promoted the development of an egalitarian society and democratic institutions such as the water boards (p. 320).

Throughout the past, the Netherlands was troubled by many catastrophic flooding events, during wintertime, when storms are most likely. The latest event was the North Sea flood of 1953, which led to more than 100 dike breaches in the province of Zeeland and caused 1835 deaths, property and livestock loss, as well as the salinisation of 150.000ha arable land (Disco, 2002; Watersnoodmuseum, 2018). While the reconstruction and adaptation of dikes have been started immediately, earlier made plans were finalized to close the estuaries by a storm surge barrier, the Delta Works (Dutch: Deltawerken). The project was planned by a subdivision of RWS solely employing technical engineers from the Delft Engineering School, which expresses the technical planning rationale of the 50s and 60s. Further, as Disco portrays it, the Delta Works were celebrated in the 60s as an "expression of Dutch national vitality" (Disco, 2002, p. 216).

Masters of the Ecosystem

Just one decade later, internationally the consciousness of a degrading environmental status, due to increased human intervention and connected dependency on intact eco-systems arose (Jackson, 2012). In the Netherlands, ecological degradation in the water sector was quickly associated with risking economic wealth and a high living standard (Disco, 2002). Consequently, large planning measures, such as the Delta Works, were viewed more critically regarding their impact on the estuary (ibid.).

> *"A new regime in water management would require a dramatic turnaround in attitudes, personnel, knowledge, and institutions."*
> *(Disco, 2002, p. 208)*

Especially RWS, part of the Ministry for Infrastructure and Water Management, responsible for the planning and implementation of the Delta Works, was disgraced by the public as their expertise did not hold up to the newly emerging biospheric values. Bridging the gap between fulfilling their responsibility of defending against the water, acknowledging the necessity to reconsider, and developing a more environmentally friendly plan for the last closure (the Oosterschelder dam) was not achieved by following their traditional regime.

As the engineers employed until then were not sufficiently trained in environmental impact assessment and thus lacked the necessary expertise, the first biologist, H.L.F. Saeijs, was hired by RWS in 1971 (Disco, 2002, p. 222). A further independent evaluation was appointed by prime minister den Uyl, to weigh the safety, feasibility, and environmental compatibility of the planned Oosterschelder dam. The Oosterschelde Committee, which consisted of experts from various disciplines, only one of whom had hydraulic engineering knowledge, reported shortly afterwards that the original plan was ecologically and economically unfeasible. This in turn led to a new permeable hybrid design combining the elements of safety, economy, and environment.

Integration across water sectors

Within 30 years this shift in awareness and values had a major impact on FRM and policy making in the Netherlands, which started to spread also to fluvial (river floods) and pluvial flood (flash flood) management. The 'Plan Ooievaar' in 1986, aiming at connecting spatial planning with the entire biotic river system, or the 'Third National Memorandum on Water

Management' in 1989 began to integrate environmental concerns and values into actual policies (Van der Brugge et al., 2005).

Changed management approaches for the Wadden Sea coast were first presented under the Coastal Erosion Management Policy 1990 – Dynamic preservation of the Dutch Coast (Lodder et al., 2019). While the main aim of the policy was the dynamic preservation of the coastline based on its position in 1990 along the North Sea coast (Dutch islands and dunes), also the Wadden Sea would profit from the additional sediment transport through the sand nourishments along the southern Dutch coast. Due to SLR and static coastal protection along the Groninger main land coast, saltmarshes were and still are being pressured with erosion at the most seaward areas as receding landwards is not possible due to the static dike barrier.

Through the adoption of the European Water Framework Directive (WFD) in 2000 and translation to artificial foreshore salt marshes also the ecological status of foreshore saltmarshes could be described through the parameters of a potential reference (P-REF) (Dutch: Potentiële Referentie) and a potential Good Ecological Status (GET) (Dutch: Potentiële Goede Ecologische Toestand) (Dijkema et al., 2005).

Currently, the effort to give more space to water through adaptive spatial planning is more pronounced in the context of river management, e.g. through the experiments of the "Room for the River" programme (Van der Brugge et al., 2005). While first proposals to develop more dynamic coastlines were present before the 2000s (s. Klein et al. (1998)) only recently the still very technical planning method for coastal protection through dikes in the northern Netherlands has started to review current practices. Apart from SLR and an increased risk of storm surges, a higher risk of earthquakes, due to gas extraction in the region, requires higher and wider dikes (IenW, 2016). This will lead to huge financial investments to upgrade the approximately 100km of dike line along the coast of the province.

Envisioning new, green coastal flood protection

In 2018 the first experimental salt marsh site has been implemented in a joint attempt to restore the maritime character of the city of Delfzijl and connect it to the Eems-Dollard nature reserve. The Marconi Buitendijk is an innovative project to research soil compositions in the Wadden Sea to create new salt marshes. While withdrawing from hard defences such as a dike is no option in areas of low elevation, such as the province of Groningen, the reduction of wave impact could develop as a suitable addition to existing flood protection among many other benefits.

4.2.2 Actors in Coastal Governance

In the following actors, strategies, and policy documents influencing the establishment of natural FRM in the Province of Groningen will be presented. While the scope of influence exceeds the borders of the province also national, European, and international actors and agreements will be considered. Working from broad to narrow scope, each level will be presented individually and concluded by its impact on shaping public awareness and perception.

International

On the international stage, the awareness of climate change and the importance of an intact ecosystem is reflected in many frameworks and conventions from the 1980s onwards. Mentionable here is the United Nations Framework Convention on Climate Change (UNFCCC) signed in 1992 and the Convention on Biological Diversity (CBD) under the United Nations Environmental Program (UNEP) in 1992/93 to which the Netherlands as part of the UN agreed upon. While the UNFCCC is only regarded as a recommendation the CBD is legally binding and requires active strategic development and goal setting. In this regard, the Netherlands strongly focuses on the development of a nature network, which shall be implemented through decentralized provincial governments. Wetlands and terrestrial reserves shall amount up to 668.000ha by 2027, of which 620.000ha have been already converted in 2017 (EZK, 2015, p. 60). Further, the importance of restored natural systems and disaster risk reduction is displayed in the country's efforts in participating in respective programs such as the Disaster Risk Reduction Program (act. no. 4000000768) and the Blue Deal 2018-2030 program (act. no. 4000001624). The latter especially aims at combining capacity building, institutional strengthening, and NbS as a basis for Integrated Water Resource Management (IWRM) (Bos, 2021).

Additionally, the United Nations Educational, Scientific and Cultural Organization (UNESCO) declared the Wadden Sea as a biosphere reserve in 1986 and was added to the world heritage list in 2009 for the Dutch and German areas (the Danish part followed in 2014). Hans C. Wesseling functions as the permanent UNESCO representative from the Netherlands, whose main expertise lies in establishing diplomatic relations, foreign policy, and peace building. Main media communication takes place through the official accounts (Twitter: 'Netherlands at UNESCO'), instead of personal ones. Further, water topics sand beside a wide array of topics discussed and thus only consume a small portion of the total amount of information given to the public (e.g., outlook to UN-Water Conference on 22-24 March 2023 in New York regarding water security in a changing environment posted on the 25th of April 2022). Further, the OECD Principles on Water Governance from 2015 were adopted by its 34 member states, including the Netherlands. Despite the water governance of the Netherlands being rated as far advanced, local translation of these guidelines still needs to be done (Keller & Hartmann, 2020). Besides water governance, the OECD also focuses on raising public awareness and produces recommendations such as in their Policy Brief No. 35 "Building Public Awareness of Development: Communicators, Educators, and Evaluation" in 2008.

The agreement to these frameworks, conventions, and recommendations by the Dutch government, elected democratically by the citizens also reflects a consensus on the political importance of this matter. While specifics are not laid out and left to the national government, disagreement with individual measures could still be experienced. The presence of internationally agreed-upon policies can point out the urgency and severity of the existing problems of biodiversity loss and climate change. However, it must be noted that the level of influence on the local level is rather limited.

EU-Level

On the European level, here represented by the membership of the Netherlands to the European Union, several frameworks regarding biodiversity and water management are agreed on and need to be integrated into national legislation. The most prominent ones are the Water Framework Directive from 2000, the Natura 2000, the Birds Directive first adopted in

1979 and appended in 2009 (Directive 2009/147/EC) as well as the Habitats Directive from 1992 (Directive 92/43/EEC). Further, in the frame of the North Sea INTERREG programs such as the Building with Nature 2017-2021, or the Trilateral Wadden Sea Cooperation collaboration between neighbouring states is fostered. Besides the UNESCO Institute for Water Education (UNESCO-IHE) operating from Delft, further Dutch partners with this program are the Rijkswaterstaat, EcoShape, and the Waterschap Noorderzijlvest which will be explained in the following sections.

As the international organizations mentioned, the EU council and parliament offer transparent policy access and operate various communication channels. Regrading Dutch representation in the Committee of Deputy Permanent Representatives I, which deals with dossiers such as climate and energy, employment, agriculture, and education, Michael Stibbe is Deputy Permanent Representative since 2021. However, due to his low media presence, he is not regarded as being influential on public perception (Kingdom of the Netherlands, n.d.).

National

On the national level Rijksoverheid, the Government of the Netherlands, formed by ministries and executing organizations, is responsible for determining the general direction of the state's development, also including the development of coastal protection, management, and future vision. Relevant ministries for coastal affairs in the Netherlands are the Ministry of Infrastructure and Water Management (Dutch: Ministerie van Infrastructuur en Waterstaat (IenW)) and the Ministry of Justice and Security (Dutch: Ministerie van Justitie en Veiligheid (JenV)).

Especially under the cabinet Balkenende IV (2007-2010), the IenW firstly combined climate adaptation and flood protection, which was continued under prime minister Mark Rutte. From the 1st to 4th Rutte cabinet (2010-now) water management in the Netherlands has undergone an area-oriented and environmental orientation. In 2009/2010 established Water Act (Dutch: Waterwet) formed the basis for the modernization of Dutch water management. In §1a-b it is stated that the Water Act shall both prevent or limit flooding while at the same time "protecting and improving the chemical and ecological status of water systems; and allowing water systems to fulfil societal functions" (IenW, 2010, p. 11).

The National Water Plan 2009 is the follow-up of the Fourth National Policy Memorandum on Water Management of 1998 and lays out the policy strategies for sustainable water management to be implemented in the period from 2009 to 2015 (IenW, 2009). Regarding areas outside the dikes, the ministry announced that a potential reassessment will be developed in the frame of the Delta Programme and will be completed by 2011. NbS, BwN, or ecological engineering were not mentioned at that stage, however, it has been realized that the coastal protection zone must be widened instead of just heightening the dikes (IenW, 2009). In the following National Water Plan in the period 2010 to 2021, IenW links flood protection efforts to the national nature vision Moving on Naturally (Dutch: Natuurlijk verder) 2014 in which the shift from "protecting nature from society to reinforcing nature with society" is displayed (IenW, 2016, p. 60). Regarding public influence, the representative of the IenW is present on the platforms LinkedIn, Twitter (18220 followers, 723 tweets), and Instagram (1418 followers and 8 posts (02.07.2022)).

The Flood Protection Program (Dutch: Hoogwaterbeschermingsprogramma (HWBP)) is a joint effort between the executive government agency, subordinate to IenW, RWS, and the union of water boards (Dutch: unie van waterschappen (UVW)) to implement the safety

standards and ensure flood protection of the hinterland. The supervision of primary water defences has been a statutory duty of the Human Environment and Transport Inspectorate (Dutch: Inspectie Leefomgeving Transport (ILT)) since 1 January 2017 and is performed together with RWS and the UVW. Especially RWS has a strong presence in water management being involved across regional borders, hosting an extensive website that features both easily accessible information as well as policy documents. Both, RWS and ILT have a social media presence for example Twitter, Instagram, and YouTube, besides their webpage. RWS itself has a followership of 27.8k on Instagram and 151k on Twitter, having posted respective 1235 posts and 92.6k tweets (02.07.2022). From RWS especially the director-general Michèle Blom informs from the informal side about RWS projects via Twitter (2962 followers, 569 tweets (02.07.2022)). Based upon previous research by Voogd et al. (2021) the trust in RWS, as well as the waterboards, is perceived as high, between 7.2-7.8 (scale 1-10) by the representative sample population of 2262 respondents.

The JenV and especially the National Crisis Centrum (NCC) are relevant for the interdepartmental coordination and information, network, and expertise management in crises for example extreme weather events and connected flooding on a larger scale. The JenV's social media presence is limited to Twitter (17 followers, 0 tweets) and LinkedIn (753 followers, 0 posts). The NCC holds only a website.

Lastly, the Ministry of Economic Affairs and Climate Policy (Dutch: Ministerie van Economische Zaken en Klimaat (EZK)) is responsible for sustainable economic development under consideration of the current climate goals. Especially for the development of the Wadden Sea region the EZK issued in 2013 the 'Ambitable Policy Reference to establish a big waters Nature Ambition 2050-2100' (Dutch: Ambtelijke Beleidsverkenning om te komen tot een Natuurambitie Grote Wateren 2050-2100) (EZK, 2013). Within this document, especially the cyclic saltmarsh management including the creation of new salt marshes, tidal flats, and floodplains will be promoted until 2050 to create a synergy with existing flood protection (ibid., p. 59). Rob Jetten, the first minister of climate and energy of the EZK is besides official information channels a public figure with a broad and active social media presence on LinkedIn (39.9k followers; daily posts), Twitter (70k followers, 20.1k tweets), Instagram (82k followers, 1440 posts), Facebook (15.6k follower, weekly posts) and TikTok (40.3k followers, 0 posts), for which he also won 'The Best Social Award' in 2021 (Scholten, 2021).

Under the category of NGOs, however not necessarily connected to NbS in the province of Groningen, the Netherlands Water Partnership (NWP), as well as the connected Dutch Water Sector (DWS), represent Dutch water knowledge across its national borders. With their work they not only provide insights into other societies but also their own, reflecting current flood protection methods at home and aiming at translation to other contexts. Following this international representation, the Netherlands appointed its first water envoy, Henk Ovink in March 2015. Being a strong opinion leader on climate awareness and resilience also within-country awareness can be influenced. Being active on many social media platforms (Twitter: 14.5k followers, 33k tweets; LinkedIn: 13.7k followers, daily activities; Instagram: 13.7k followers, 0 posts), as well as being regularly invited as a guest lecturer at schools and universities young people are brought into contact with water awareness. Further Ecoshape, being a consortium between governmental, business, and research institutes reflects the joint goal of more natural flood protection methods, by providing a detailed overview of many concepts on its website, and hosting events and symposia.

Regarding research on the national level, the BE SAFE ("Bio-Engineering for safety using vegetated foreshores," 2019) and Foreshore Assessment using Space Technology (FAST) (M. de Vries, n.d.) can be mentioned as a joint attempt to tackle new challenges in CFRM. Further research is conducted on the integrability and evaluation of saltmarsh performance within the narrower costs-risks-analysis of flood protection layout, such as the Saltmarsh Flood defence Evaluation Tool (SAMFET) developed by Merry et al. (2022). This research and media presence increases the material available for building a NbS perception among the public.

Regional

On the regional side, the province of Groningen is responsible for the establishment of a provincial water plan, as well as spatial planning (Dutch: ruimtelijke inrichting). The two water boards Noorderzijlvest and Hunze en Aa's, together with RWS and ILT, work on the execution of flood protection. Groninger Landschap, as a cultural and environmental foundation, is preserving the regional landscape, protecting biodiversity, and providing nature-oriented learning and recreation opportunities. The foundation is not only active online through its website and several social media platforms, but also provides incentives for volunteering positions, youth, and family events. Groninger Landschap fosters biospheric values and facilitates awareness and especially the responsibility to preserve distinctive Groninger coastal features. Waddenfonds, a cooperation between the province of Groningen and Friesland aims to subsidise sustainable development in the Wadden Sea region. It is not specifically targeted solely at nature restoration, but also covers sustainable economic development (fishery, ports) or cultural history restoration, such as cinematic documentaries featuring the distinct Wadden Sea landscape (de Kroon, 2020). Regarding salt marsh development, Waddenfonds provided ~10Mio. € of the total Marconi Buitendijk project cost of ~11Mio. € to the municipality of Delfzijl. With this cooperation across regions, the larger aim for sustainable development is shared and creates a larger meaning to the public.

Local

Locally, as already mentioned primarily the municipalities are the closest representatives of the local spatial and coastal development to the public. As mentioned in the previous section, municipalities can attract outer funding for reshaping existing coastal areas and creating and representing different values. For example, the Marconi Buitendijk Project did bridge the gap between resurrecting the maritime connection of the city Delfzijl, while at the same time proving recreational, as well as research areas together with the Wageningen University and Research (WUR). Following this, the integration of NbS in land-use planning (Dutch: bestemmingsplan) is a key element for representing local values. Further, collaborations between the municipality, regional water boards and the nationally operating RWS broaden the impact of NbS in CFRM by joining different levels of influence and thus addressing a variety of people. Lastly, on the local scale in the north of the province in Groningen, dorpsbelangen represents the interest of local communities. Offering contact points to local opinion, but also to mobilize climate adaptation and resilience thinking in smaller communities, dorpsbelangen can not only reflect but shape the public perception within their sphere of influence.

Regarding research activities and cooperation between different organizations, especially the two projects of Marconi Buitendijk and the Dutch Research Agenda (Dutch: Nationale Wetenschapsagenda (NWA))/ Netherlands Organization for Scientific Research (NWO)

Living Dikes project (NWO, 2022) must be mentioned. Both projects include a variety of stakeholders governmental and non-governmental in the research and planning process.

Two research institutes are performing increased knowledge acquisition regarding alternative or additional flood protection methods utilizing nature in the province. In total 18 research institutions are active within the scope of the project, as well as the provinces of Groningen and Friesland, smaller municipalities, Natuurmonumenten, the World Wildlife Fund Groningen office (WWF) and spatial planning offices (NIOZ, 2020). Regarding nature conservation especially the WWF and Natuurmonumenten are highly present and active on social media platforms and offer activities regarding biodiversity, climate adaptation, and natural heritage on the local level. The potential to influence public perception is regarded as high due to the informal character of both organizations and making science and nature more accessible to the public.

Figure 13 aims at presenting the potential for public influence in a graphical manner. Abbreviations of organizations are situated at the outer frame of the circle, with their influential tools ranging in five categories from the inner to the outer frame. A dark blue marking indicates the categorization of positive findings e.g., active on media platforms, while grey indicates no findings for this category.

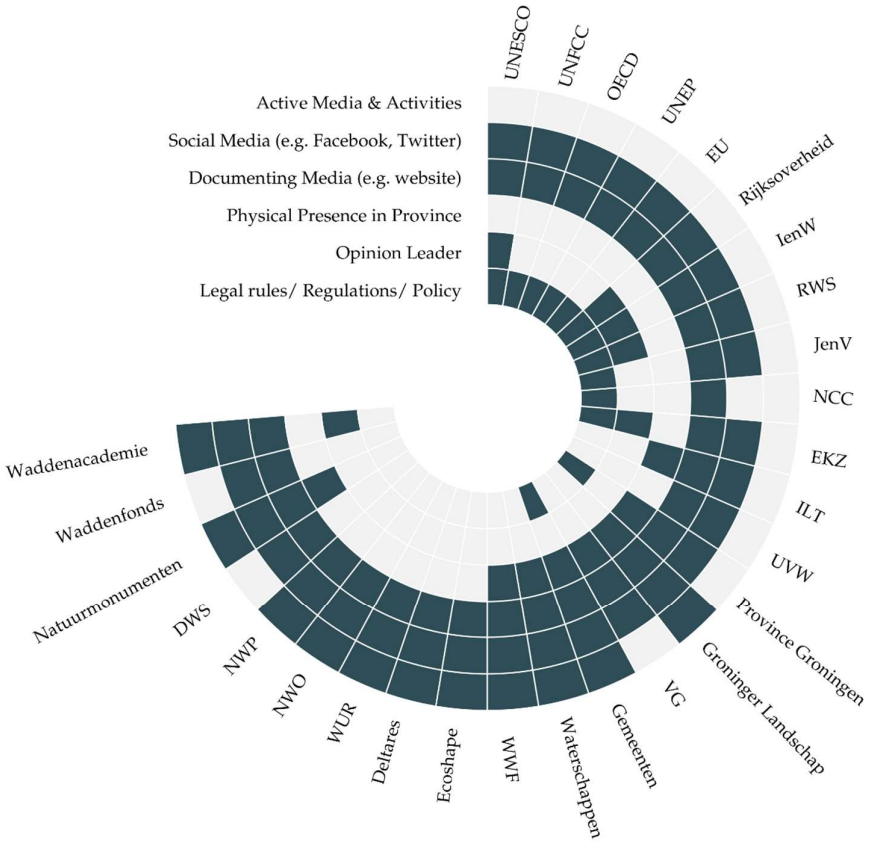

Figure 13 Potential for public influence through organizations displaying formal and informal institutions

4.2.3 Facilitators

Easing the implementation into CFRM practices does require a subsequent realization of importance as well as an ambitious organizational and societal mindset, eager to invest in research and experimentation. As shown, the Netherlands holds a long-standing knowledge base regarding flood protection, 'keeping the water out', and shaping the coastal landscape according to their visions. Throughout history this joint effort proved to be a fundamental aspect of the Dutch identity, solidifying into an egalitarian society and establishing democratic institutions (Mostert, 2020). Awareness of environmental circumstances leading to the necessity of flood protection is constantly present, through a dense network of waterways with a plethora of slightly different designations (e.g., Dutch: canal, gracht, slot, and vaart), the embodiment in architectural style as well as the presence of many dike lines being part of the Dutch landscape. Further, coastal water management transformed into expanding beyond the scope of practical sciences (hydro-mechanical engineering, mathematics) and nowadays also entails environmental science as well as tourism, economic development, spatial design, and arts (sculptures, paintings, poems, and film). Lastly, experimentation regarding new modes of CFRM happened in the 20th and 21st centuries, such as the Delta Works, the Afsluitdijk, or the Room for the River program. Given the shift in societal values towards the inclusion of environmental concerns in politics, it can be assumed that there is a strong internal determination to address flood protection, climate stressors, and environmental health jointly. This assumption can be validated through the increased NbS research activities from universities and independent institutes, as well as RWS itself. Regarding salt marsh experimentation especially projects such as Marconi Buitendijk, BE SAFE, FAST and NWA Living Dikes or SAMFET show the gained momentum of NbS and BwN aspirations. Further, the EZK drawing a clear vision for the environmental status of the Wadden Sea for 2050 shows the increased awareness and determination for altering current practices on a long time horizon (EZK, 2013).

4.2.4 Barriers

While organizations and society appear to acknowledge pressuring demands on the coastal system and increasing difficulties CFRM is facing, there are three barriers to be overcome for wider NbS implementation and ensuring its acceptance.

1. **Integration across disciplines and scales**

   Traditionally CFRM is the responsibility of the ministries IenW and JenV, however, stressors on coastal zones go beyond the scope of flood protection and require a holistic approach including joint efforts with the EKZ, the Ministry of Agriculture, Nature, and Food Quality (Dutch: Ministerie van Landbouw, Natuur en Voedselkwaliteit (LNV)) and provincial spatial planning policies.
   Further, being restricted only to the interface between water and land in current FRM, important subaqueous or aeolian coastal dynamics are not covered in their entirety.

2. **New actor coalitions** — Bringing together parties representing different disciplines, such as NGOs (e.g., Natuurmonomenten) and RWS, is crucial in the joint attempt to connect benefits regarding flood protection, nature conservation, biodiversity, and other societal benefits. Borsje et al. (2017) also point toward the collaboration between different scales, such as local stakeholders, scientists, and representatives of the decision-making organizations (regional and national).

3. **Bridging the data gap** — The quantification of NbS behaviour in case of extreme weather events, but also towards rising sea levels and their fundamental protective value is yet to be researched extensively.
Regarding salt marsh characteristics, Borsje et al. (2017) express the need for an extensive reliability assessment to assess their qualities based upon engineering standards for probability and failure, and empirical or process-based knowledge such as "surge and wave attenuation and shoreline stabilization, such as cliff erosion, seasonal biomass variations, uprooting, and stem breakage attributed to wave impact" (p. 150). Additionally, the long-term resilience of coastal areas is still in its academic infancy (Bouma et al., 2014), requiring in-depth research across spatial planning domains.

4.3 Public Variables

In the following section, the results of the quantitative data collection using the questionnaire methodology from section 3.3.2 will be presented. After presenting the socio-economic descriptive results, the sections 4.3.1 to 4.3.3 will present the results of the public's perception of NbS (RCB), values and norms. Section 4.3.4 will combine these variables in presenting the results of the Pearson correlation.

In total 81 people participated in the survey until the collection was cut off on the 10th of June 2022. After data clearing 67 of these completed the full survey. The response rate lies thus approximately at 4.37% (1534 questionnaires distributed) and, following eq. (1), a 12% margin of error can be expected. Most of the responses came from the municipality Het Hogeland (40%), followed by Groningen (24%) and Eemsdelta (21%). The remaining 15% distributed among the municipalities of Midden-Groningen, Oldambt and Westerkwartier, s. figure 14.

As shown no data has been recorded from the remaining municipalities Veendam, Pekela, Stadskanaal and Westerwolde of the province Groningen.

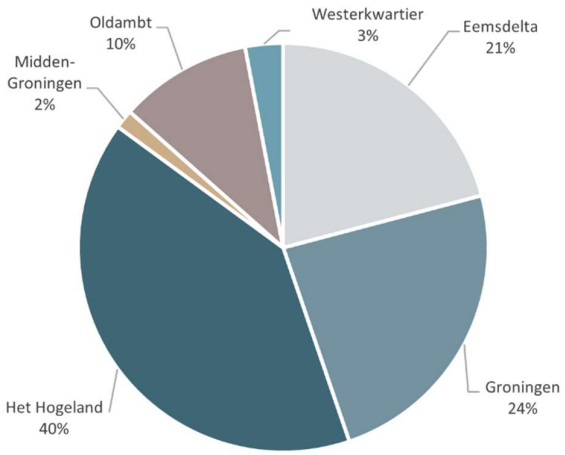

Figure 14 Distribution of Participants based on Municipality in %

For a two-tailed 0.05% significance level and medium effect size (r = 0.3), the sample of 67 respondents translates to an ~70% ($1 - \beta = 0.69626$; with β − type II error probability) chance that the study is producing a significant correlation. This lies below the commonly used power of 80%.

The participants (43% female, 57% male) represented all age groups from 20 to 65+years, except for the group from 0 to 19 years, s. figure 15. Most of the replies can be associated with the age group 50-65 (45% of total participants), followed by the group 65+ (22% of total participants). 6% of the respondents chose not to state their age, s. figure 15 right.

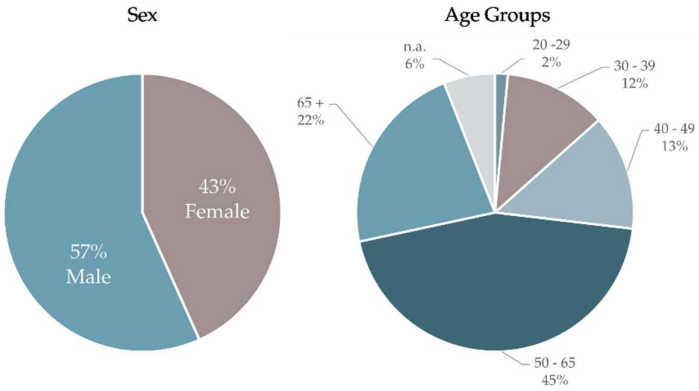

Figure 15 Distribution of participants according to sex (left) and age groups (right)

The highest education of the respondents was higher vocational education (Dutch: hoger beroepsonderwijs (HBO)) (46% of total participants) followed by secondary vocational education (Dutch: middelbar beroepsonderwijs (MBO)) (22% of total participants) and a university degree (21% of total participants), s. figure 16 left. The residential distance of the participants to the sea shows a gradual decrease in participants the greater the distance figure 16 right.

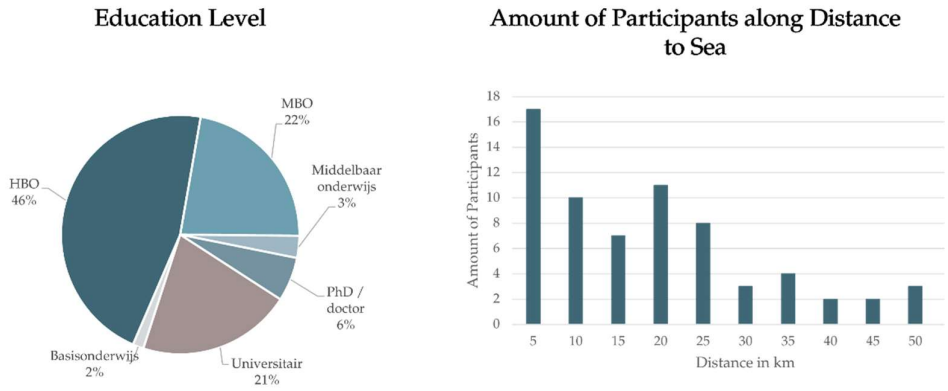

Figure 16 Educational level and residential distance to the sea in kilometres

Regarding their knowledge of the closest flood protection method, 53 participants chose 'yes', 13 participants had no knowledge, and 1 participant was not sure and chose the opinion 'no opinion'. Of the 53 participants knowing, 39 named the dike, followed by 13 participants choosing a combination of dike and saltmarsh, dike and other hard defence (sheet pile wall (Dutch: damwand) or concrete barrier (Dutch: betonnen kering), or saltmarsh and beach (1 participant). 1 participant just acknowledged the salt marsh as single flood protection, s. figure 17.

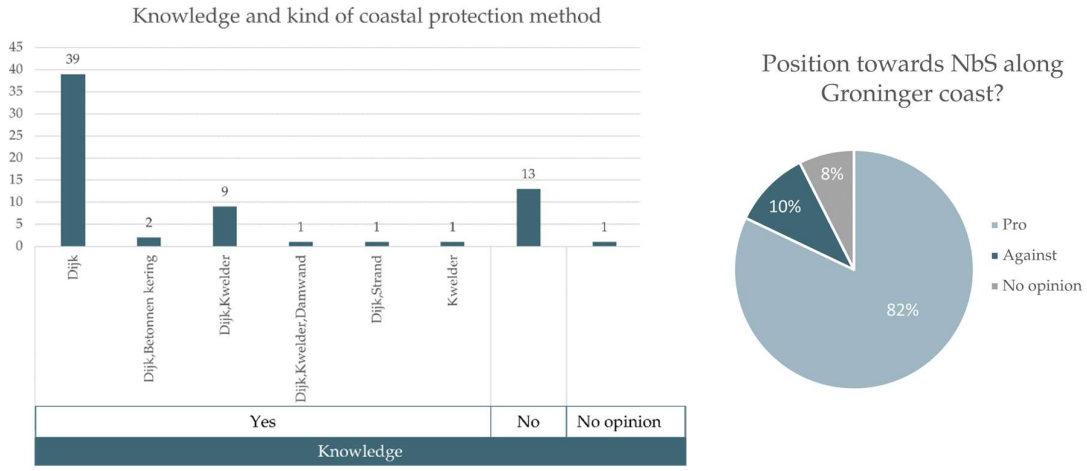

Figure 17 Knowledge about the closest exist and kind of flood protection method (left) and NbS position (right)

Collected occupational data was disregarded in the following analysis, as many people were not able to select a fitting job description from the provided list and tended to choose 'something else' (Dutch: 'iets anders').

4.3.1 Results of Public Risk, Cost, Benefit Perception

The perception of risks, s. figure 18 left, showed that among the sample only a small group of people regarded evaluated all four questions as high or very high. The majority answered the questions out of the risk group with very low to neutral, while especially the risk of their job being affected was evaluated as very low by 66% of the respondents. The cost perception of the sample showed a strong, centralized, neutral opinion for all six questions, s. figure 18. As outliers especially the questions 'time costs for development' can be identified with 43% of respondents choosing 'Agree'. The benefit perception, s. figure 19, remarked overall a high to very high association of the questioned six items. Very high evaluation can be especially seen in the item 'biodiversity' (57% of respondents) and 'aesthetics' (46% of respondents).

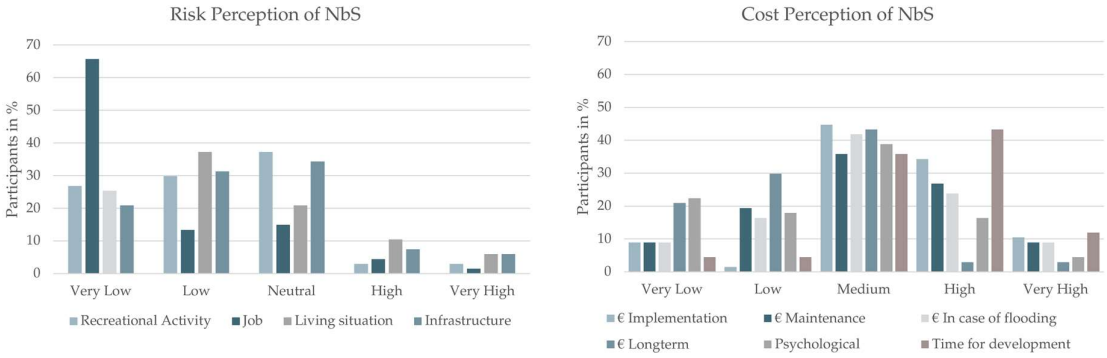

Figure 18 Risk (left) and cost (right) perception

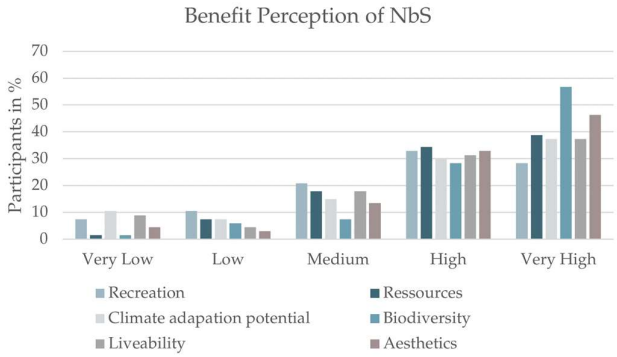

Figure 19 Benefit perception of NbS

The outcome of the reliability analysis regarding risks, costs, and benefits can be found in table 11 to table 13. All three show a relatively high Cronbach's alpha of (risks: .804, costs: .711, benefits: .848) equalling strong reliability. Following this the three constructs risks, costs and benefits will be used in the following analysis.

Table 11 Perceived risks reliability

	Item total correlation	Alpha if item deleted	Cronbach's alpha
Perception of Risks Item			**0,804**
Risk of Recreational Usage Restriction	0,524	0,798	
Risk of Occupational Restriction	0,594	0,767	
Risk of Residential Restriction	0,756	0,682	
Risk of Infrastructure Restriction	0,613	0,758	

Table 12 Perceived costs reliability

	Item total correlation	Alpha if item deleted	Cronbach's alpha
Perception of Costs Item			**0,711**
Monetary costs for Implementation	0,528	0,645	
Monetary costs for Maintenance	0,530	0,643	
Monetary costs in case of Flooding	0,543	0,639	
Monetary costs long term	0,393	0,686	
Psychological costs	0,326	0,712	
Time costs for development	0,349	0,698	

Table 13 Perceived benefits reliability

	Item total correlation	Alpha if item deleted	Cronbach's alpha
Perception of Benefits Item			**0,848**
Recreational Activities	0,370	0,874	
Resource provision	0,710	0,810	
Climate change reduction	0,770	0,793	
Biodiversity	0,587	0,832	
Liveability	0,804	0,786	
Aesthetics	0,598	0,829	

4.3.2 Results of Values

The results from the reliability analysis of the tested value constructs (hedonistic, egoistic, altruistic, and biospheric) can be seen in table 14. A strong relationship within these constructs can be noted, as expressed by the corresponding Cronbach's alpha of .818 hedonistic values, .704 egoistic values, .689 altruistic values, and .845 biospheric values. While in the altruistic construct especially the items 'Equality' and 'A World at Peace' showed lower correlations, it was decided to keep these two values in the cluster, as the Cronbach's Alpha would still be above the .60 threshold without deletion.

Table 14 Value reliability

	Item total correlation	Cronbach's alpha if item deleted	Cronbach's alpha
Hedonistic values			**0,818**
Pleasure	0,563	0,852	
Self-Indulgent	0,769	0,645	
Enjoying Life	0,704	0,721	
Egoistic values			**0,704**
Social Power	0,558	0,610	
Wealth	0,501	0,642	
Authority	0,593	0,598	
Influential	0,537	0,621	
Ambitious	0,166	0,772	
Altruistic values			**0,689**
Equality	0,385	0,681	
A World at Peace	0,343	0,699	
Social Justice	0,611	0,529	
Helpful	0,569	0,561	
Biospheric values			**0,845**
Respecting the Earth	0,676	0,808	
Unity with Nature	0,696	0,797	
Protecting the Environment	0,821	0,749	
Preventing Pollution	0,578	0,860	

The correlation trend can also be seen graphically in figure 20. The highest evaluated guiding principle of life (score 7) was 'A world at peace' (W_PEACE) selected 31 times, followed by 'Respecting the Earth' (RESP; 22) and 'Preventing Pollution' (PREV_POLL; 22). As opposed to their values especially the subitems from the egoistic value set were selected, most commonly 'Social power' (SOCIA_P; 27) and 'Authority' (AUTHOR; 23).

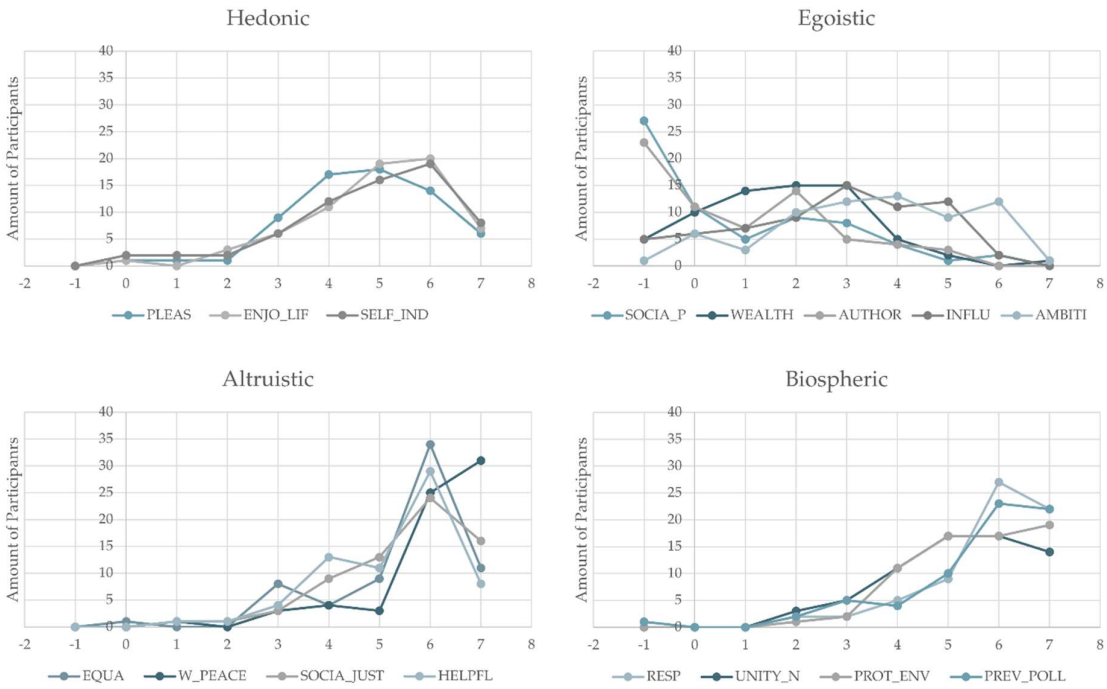

Figure 20 Evaluation of value cluster subitems

4.3.3 Results of Norms

The results from the reliability analysis of the tested norm constructs can be seen in table 15. Except for the construct 'Ascription of responsibility' with a Cronbach's alpha of .810, no strong relationship can be noted. In the following the individual items of the categories 'Awareness of problem/consequence' will be used in the following analysis steps. The column of Cronbach's alpha holds no entries as each category consists only of two subitems, which then makes the calculation obsolete.

Table 15 Norm reliability

	Item total correlation	Alpha if item deleted	Cronbach's alpha
Awareness of Problem Item			**0,507**
Climate change	0,352	-	
Coastal Sealing	0,352	-	
Awareness of Consequences Item			**0,594**
Limitation of traditional defences	0,425	-	
Vulnerability	0,425	-	

Cont. Table 15 Norm reliability

	Item total correlation	Alpha if item deleted	Cronbach's alpha
Ascription of Responsibility		-	**0,810**
Item			
Community resilience	0,681	-	
Information of coast	0,681	-	

This missing relationship between AP and AC can also be taken from figure 21. In contrast to that both items of the construct AR, creating community resilience (AR_ComRes) and Responsibility of self-information (AR_info) show a similar distribution across the five categories, s. dark blue marking.

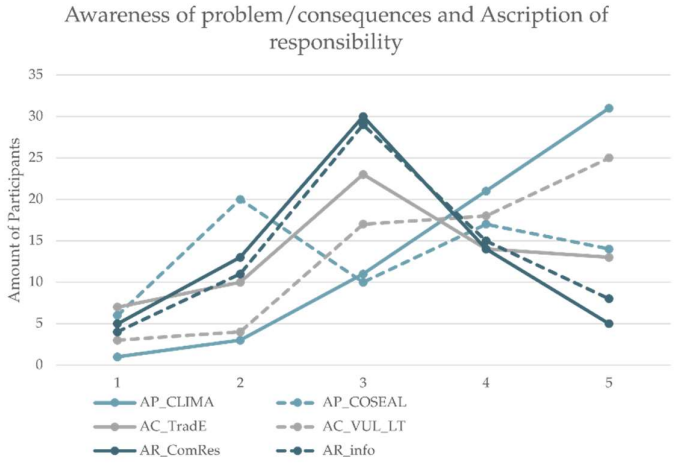

Figure 21 Norm items to the number of participants

4.3.4 Combined Analysis

This section presents the results of the Pearson correlations between the constructs and the socio-economic variables that will be used to test the formulated hypotheses **H1** to **H6**. Firstly, the norm constructs will be correlated with values and perception items, which is then followed by correlating all previous items with the socio-economic derived variables. Lastly, the variability in NbS position is presented, followed by showing the correlation results between NbS position and socio-economic variables.

In table 16 the results of the Pearson correlation of the norm activation with the value clusters (hedonic, egoistic, altruistic, and biospheric) and perception of risks, costs, and benefits, are shown. A significant correlation between awareness of climate change stressors (AP_CLIMA) and risks ($r = -.436, p \leq 0.001$) and costs ($r = .591, p \leq 0.001$) can be noted. Those with high awareness climate change stressors (AP_CLIMA) perceived the risks of NbS as low, whereas benefits were perceived as high. The latter was also true for the awareness of the stressor of coastal sealing (AP_COSEAL) and long-term coastal vulnerability (AC_VUL_LT)

as well as the construct of the ascription of responsibility (AR), whereas no significant correlation with risks could be determined. Biospheric values correlated significantly positively with all items of problem/consequence awareness and ascription of responsibility, while altruistic values only showed a significant relation to AP_CLIMA. The hedonistic and egoistic values sets did not correlate significantly with any items of the norm activation. However, a slightly negative r-coefficient for the egoistic values showed that people with higher hedonic values chose lower values in norm activation. For the hedonic value set except for the correlation between AP_CLIMA, all r-coefficients are positive, meaning high importance of hedonic values appears to relate to high awareness of problems and consequences. This goes against the expectation of a negative correlation between hedonic values and norm activation.

Following this, hypothesis H1 can be agreed upon for all norm constructs, except AC_VUL_LT which does not show a significant relation. Hypothesis H2 can be agreed upon regarding the relation to biospheric values, showing strong relations through all norm constructs. For altruistic values, H2 only shows a significant relation to AP_CLIMA.

Table 16 Correlation values, risks, costs, benefits, and norm activation

	Risks r	Costs r	Benefits r	Hedonistic r	Egoistic r	Altruistic r	Biospheric r
AP_CLIMA	**-.436****	-.399	**.591****	-.074	-.101	**.307***	**.454****
AP_COSEAL	-.250	-.029	**.365****	.178	-.109	.207	**.437****
AC_TradE	-.139	-.015	.125	.143	-.234	.211	**.342****
AC_VUL_LT	-.090	-.125	**.442****	.100	-.205	.131	**.435****
AR	-.180	.088	**.326****	.089	-.201	.189	**.431****

Significance:
**The correlation is significant at the 0.01 level (2-sided).
*The correlation is significant at the 0.05 level (2-sided).

Results from the correlation between socio-economic variables and RCB, values, as well as the norm activation to test the hypotheses H3 to H5, can be taken from table 17. Age correlates significantly positively with altruistic $r = .453, p \leq 0.001$ and biospheric values $r = .320, p \leq 0.005$, meaning that older participants rated value items from these two clusters with higher importance than younger participants. Further age correlated significantly positively with the awareness of AC_TradE, that traditional food defences cannot be indefinitely raised. Interestingly a negative (not significant and weak) correlation was noted regarding benefit perception.

Sex correlated significantly negative with the perception of costs ($r = .251, p \leq 0.005$), showing that female respondents regarded the costs as slightly lower than male respondents. The education level did not significantly correlate with any of the items, however, a negative relation to risks and hedonistic values can be noted. Further females perceived risks of NbS as

lower, as well as benefits as higher as compared to male participants. Also, male participants endorsed slightly less altruistic and biospheric values and showed slightly lower awareness of problems and consequences.

The type of education (higher, lower) did not significantly correlate with any of the tested variables. Slight positive relations could be detected regarding altruistic values ($r = .123, p = .322$), AC_VUL_LT ($r = .108, p = .385$), and slightly higher also AR ($r = .213, p = .083$). Negative weak relations were found regarding risks ($r = -.123, p = .320$) and hedonistic values ($r = -.139, p = .262$).

The item distance to sea correlated negatively with the norm activation items, meaning that the further a participant lived from the sea, the lower the awareness of the problem and consequences, as well as the attribution of responsibility. However, the as r-coefficients are so small, that this correlation strength can be considered very weak to not existent. No further meaningful correlations could be observed regarding this item.

The position toward NbS in the province correlated significantly negatively with the costs of the perceived risks ($r = -.562, p \leq 0.001$) and costs ($r = -.299, p \leq 0.005$), s. table 17. A significantly positive correlation could be observed regarding benefits ($r = -.462, p \leq 0.001$). Hypothesis H3 can thus be regarded as proved true. Biospheric values correlated with $r = .250, p \leq 0.005$ and climate change problem awareness $r = .454, p \leq 0.001$. A slight, non-significant negative correlation could be observed regarding hedonistic values. Following this hypothesis H4 is only true for half of the values, with only biospheric values significantly impacting NbS position. A positive, however insignificant relation between NbS acceptance and the norm constructs can be noted, with the highest correlation of $r = .153, p = .217$ for AC_VUL_LT and $r = .112, p = .366$ for AR. Regarding this hypothesis H5 cannot be agreed upon with high certainty.

Table 17 Correlation socio-economic variables, RCB, values, and norm activation

	Age	Sex	Education	Distance to Sea	NbS Position
	r	*r*	*r*	*r*	*r*
Risks	.039	-.134	-.123	-.006	**-.562****
Costs	.178	**-.251***	.004	.101	**-.299***
Benefits	-.092	.159	.068	-.074	**.462****
Hedonistic values	.056	.078	-.139	.083	-.107
Egoistic values	.044	-.044	.026	-.016	.037
Altruistic values	**.453****	.096	.123	-.163	.081
Biospheric values	**.320***	.098	.038	.047	**.250***
AP_CLIMA	.030	.109	.056	-.124	**.454****
AP_COSEAL	.107	.147	.090	-.048	.099
AC_TradE	**.270***	.084	.081	-.187	.083
AC_VUL_LT	.126	.051	.108	-.011	.153
AR	.155	.002	.213	-.024	.112

Significance:
**The correlation is significant at the 0.01 level (2-sided).
*The correlation is significant at the 0.05 level (2-sided).

Except for the four tested value clusters, neither the RCB nor the norm activation model showed characteristics of a normal distribution, s. appendix 3. Following this, the analysis of the variance test could only be performed using these variables to determine the determination coefficient R^2 of the regression between value cluster and NbS position. As a result, the four values explained 15% of the variance of the NbS position, meaning 85% of the variance is dependent on unknown parameters and thus cannot be explained. The model was significant with $F(4,62) = 2.731, p = .037$, and consequently the null hypothesis of all variances being equal is rejected, due to $F < F_{critical}$ with $F_{critical} = 3.3425$. As expected biospheric values contributed significantly with $\beta = .173, p = .004$, however no contribution of altruistic values could be determined, s. table 18. Further hedonic values contributed with $\beta = -.090, p = .026$ slightly. Summarizing the larger biospheric values and smaller hedonistic values of participants, the more often a respondent had a positive position towards NbS.

Table 18 Regression coefficient β of NbS position towards values

	NbS Position	
Values	β	p
Hedonistic	-.090	.482
Egoistic	.094	.450
Altruistic	.156	.208
Biospheric	-.089	.474

Between NbS position and socio-economic variables (age, sex, education, or distance to sea) no significant correlation could be detected, s. table 19. Aside from the significance of the correlation, a slight positive tendency of higher academically trained to be more favourable towards NbS than those who are not. Remaining correlations, all between $-.1 > r < .1$ with $.2 > p < .5$ can be regarded as having no relation to the position of NbS in the province. Following these weak results, **H6** cannot be agreed upon.

Table 19 Correlation between Socio-economic variables and NbS position

	NbS Position	
	r	p
Age	-.090	.482
Sex	.094	.450
Education	.156	.208
Distance to Sea	-.089	.474

Chapter 5: Discussion

In this chapter, the results from chapter 4 are discussed by elaborating on interpretations, implications as well as limitations and closing off with recommendations for future research. Based on the primary research question regarding the quantification of public perception of NbS as a flood protection method, the first part of the discussion will deal with the quantitative data derived through the questionnaire by considering the historical and cultural context. Following this, the potential for influencing public opinion through coastal governance actors and connected formal institutions will be elaborated.

Public Perception of NbS in the Province of Groningen, The Netherlands

In line with the development in the Dutch water management from 'Masters of the Floods' towards an accepting position of water, the study showed that a large proportion of the sample population in the province holds a positive attitude towards NbS. While no correlation between the participant's distance to the sea, and thus corresponding low elevation, and the position towards NbS could be confirmed, the underlying cultural and historical influences can be attributed a higher weight in the development of this attitude. A baseline awareness of the necessity of CFRM is facilitated through the 'typical Dutch landscape' with a dense network of dikes as well as the ever-present visibility of water networks. The long history of innovative CFRM, present within the province by RWS, ILT, and municipalities, as well as the existence of old saltmarsh areas, such as the Dollard marshes, could also indicate a higher familiarization with the topic of natural coastlines. Additionally, with the increase of biodiversity integration into policy documents since the 80s this higher evaluation could be reasoned through the 'natural' character of NbS.

The study demonstrates a strong relationship between a positive attitude towards NbS and a high perception of benefits, high evaluation of biospheric values, and high awareness of climate change stressors on coastal zones. Especially the specific items of biodiversity and aesthetics, being evaluated as highly beneficial, appeared to align with the findings of Davis et al. (2015) and Seddon et al. (2020). The general risk and cost perception was rated low in the context of NbS. This could be based upon, also in line with findings from Voogd et al. (2021), the high trust in the centrally organized FRM by RWS and the waterboards, as well as the successful protection of coastal flooding since 1826 in the province of Groningen and since 1953 in the Netherlands. Further, the democratically elected water boards allow the public to be involved in the FRM process and thus create a sense of transparency, and steering capacity.

Against part of hypothesis **H4,** no significant correlation to altruistic values was present in the sample. This finding is contrasting with other research in environmental psychology, where biospheric and altruistic values correlated significantly with the behaviour (e.g., heating habits organic versus non-organic) under study (Bouman et al., 2018; Steg et al., 2011; Steg et al., 2014). Looking closer at the specifically questioned value items of the altruistic cluster, s. table 7 'A World at Peace' and 'Social Justice', might be influenced by the politically tense situation on the eastern border to Europe through the Russian-Ukrainian war. Following this regardless of their NbS position the sample population evaluated these items especially high, which could suggest a temporary shift in value importance. Regarding these results, it can be noted that the survey captured the perception, values, and norms from a specific period being also highly dependent on the shifting mood of the participants. The different results cannot be

ruled out with certainty if the experiment is repeated at a later point in time. To rule out temporary occurrences a larger n-study might clarify these circumstances.

Further, based upon the pro-environmental assumption and the NAP, high awareness of underlying problems correlated with NbS acceptance. Contrastingly, the personal responsibility of participants was considered as low and thus again reflected the notion of a centrally organized CFRM through RWS and the water boards. This could be extended by the expectation that as long as the CFRM ensures the quality of life in the province, no individual action will be taken by the sample population to learn about the coasts or to intervene in the coastal planning process. This could in turn affect the effectiveness of informal information channels by the actors in coastal governance.

Despite these limitations, the research showed a new insight into the perception of NbS in the province of Groningen and indicated aspects that could be more emphasized in future projects (benefits), but also showed which risks or costs should be addressed to guarantee continued trust in CFRM practices. Further, the data contributed to a clearer understanding of NbS categorization in four value clusters and showed a clear connection to biospheric values. Further studies regarding the perception of NbS as a CFRM approach should consider aiming at capturing a larger sample size. Further, it would be interesting to determine if the distance to sea correlation changes at a distance larger than the one captured during this study (< 100km).

Results Actors Coastal Governance and Public Influence

The study showed that Dutch water management obtains a plethora of actors from the governmental, but also the private sector, with the capacity to shape public perception and acceptance of NbS. RWS together with the local water boards as the main responsibility holder covers all three branches of FRM (Risk analysis, management, and reduction). Given this centrality of management and risk assessment, a clear vision of CFRM is drawn for the Netherlands, meaning that new concepts such as NbS under the impression of 'living with the water' can be integrated on a larger scale. Experts from research institutions, as well as nature organizations, have a limited say in the final decision of CFRM, however, they do have the ability to influence the public evaluation of nature, green spaces, and their benefits for society, which in turn poses social requirements upon CFRM practices (development in the 80s as an example of change). Further, based upon recent projects, environmental organizations are included early in the research and implementation process. The potential to influence the public to be more open to NbS to provide additional protection to the coast in case of storm events, but also to make the coast more adaptable in the long term to cope with climate change stressors, could take place through different channels and media at different levels (international, European, national, regional, local).

Based on a decreasing formal political interest and increasing informal activities, showed by Van Wessel (2008), the rising importance of informal information through media channels additional to traditional print media and policy documents is expected. Following this, many actors in coastal management and governance have invested in establishing a social media presence. However, only a small proportion of these is using their media outlets consistently. Further active involvement in CFRM can only be provided by municipalities involved in the redesign of the coastline, such as in the case of the Marconi Buitendijk as part of re-establishing the maritime connection in the city of Delfzijl. Other public involvement is only reserved for

NGOs focusing on nature conservation and having an active member base, such as Natuurmonumenten or Groninger Landschap.

The most effective level of influence has not been determined and could be further researched by extending the public questionnaire. However, a strong local connection is estimated to be most efficient to target the local and regional populations. As with the capture of public perception, also these research results have their limitations. Collected data reflects the activities of the respective organizations until July 2022. Further, the research methodology of literature and, in case of their activities to reach the public, online research, lacks detailed knowledge of the individual organization's future strategies regarding NbS, as well as specific plans for influencing or communicating with the public. This gap should be regarded in future research, as it is expected to provide valuable insight into the explicit opinions of organizations, but also the socio-organizational interactions.

Chapter 6: Conclusion

This research set out to determine a methodology to capture the public attitude towards NbS by utilizing secondary elements such as perceived risks, costs, and benefits, as well as personal values and norms. The topic has been chosen to gain a better understanding of the perception of NbS in the setting of CFRM, thus reducing the research gap. Using the province of Groningen in the Netherlands as a case study area is justified through several country and water management specific characteristics. Firstly, regarding the environmental conditions, the province of Groningen requires constantly revised flood protection, due to its low elevation and expected SLR through climate change. Secondly, water management in the Netherlands experienced an environmental turn in the 70s and 80s, leading to a position of defending against towards living with the water and subsequent integration into national policies. Finally, the first experiments regarding foreshore protection using NbS have started in the province, yielding a surveyable population with a formed perception of the topic. Following this, it is considered important to gain knowledge of social variables indicating the acceptance or resistance of NbS to protect coastlines. To capture this quantitative information a questionnaire was performed (n=67, response rate 4.37%). In the data analysis, the secondary elements were correlated with the attitudes of participants towards NbS using Pearson correlation to identify common denominators.

Tying together the presented results and discussing secondary data proved to be a viable surveying tool for the quantification of NbS acceptance. Especially the perception of risks, costs, and benefits showed significant correlations with NbS acceptance. In detail, the data indicated that a lower evaluation of risks and costs, as well as a high evaluation of elements such as biodiversity, aesthetics, and liveability, related to a positive attitude towards NbS. While cost elements showed a negative correlation with NbS acceptance, they indicated no comparable difference to existing flood protection measures in the province. A possible explanation for this could be that an uninformed public participant has difficulties quantifying cost differences between NbS and traditional FRM. Without this information participants of the survey might have resorted to guessing leading to inconclusive evidence. Additional research could focus on reframing especially the questions regarding the monetary costs to enable more precise data. A contrasting approach would be to provide the participants with more data on which to base their decisions. Further, future questionnaires could gather data on individual estimates of the total CFRM budget allocation rather than focusing on individual steps, such as implementation or maintenance.

Not significantly correlated variables such as age, education, or geographic distance of the participant to sea could be found. However, due to the small sample size and partially inconclusive evidence future work should confirm these findings to move forwards with issued recommendations. The collected occupation data did not proof beneficial in determining NbS acceptance, as the ISCO-08 classification brought too much variability into the research. One solution for simplification would be to distinguish between outdoor and indoor occupations.

Regarding questioned value items, as part of informal institutions, only biospheric values showed a strong correlation. This suggests that future research could eliminate questioning the other three utilized value clusters comprising hedonistic, egoistic, and altruistic values. However, this should be confirmed with larger sample size. Furthermore, if one considers the vulnerability paradox and uncertainty associated with climate change, adaptability to a

changing environment proves to be a fundamental necessity for the Netherlands as an extremely low-lying country. Considering this, as well as the low perceived risk of NbS in CFRM, the question arises of how adaptable the Dutch could and would be to rising water levels. In detail, what measures would be acceptable, e.g., moving to higher ground or changing the form of housing (floating houses), or adapting the means of transport? Undoubtedly, these questions are very sensitive and require a safe environment as a space for experimentation and the exchange of ideas. In this case, it is not recommended to use the questionnaire methodology presented in this research, after a participant pointed out that people might be unsettled when asked about risk perception concerning NbS and their living situation. However, extending the questionnaire by including values from the third ring of Schwartz's value circumplex "conservation" and "openness to change" in an abstract way could provide insights into the degree of adaptability and flexibility of the Dutch towards far-reaching environmental and landscape changes.

Of the questioned norm elements, only one item of the awareness of climate change stressors showed a significant positive correlation with NbS acceptance. Elements of the norm subcategory ascription of responsibility showed, keeping in mind the socio-political context of the case study area, no significant correlation with NbS acceptance. Subsequently, future work could aim to highlight this part of the questionnaire to find out why taking responsibility is not considered by the public and how water policy actors can overcome this avoidance of engagement.

Overall, it must be noted that the quantitative collected data included various limitations. The limited sample size and low variety of participants result in nonsufficient generalizability through a weak power of the overall study and adds an error rate of 12% to the results (transformed eq. (1)). Following this, the data cannot predict with certainty if the citizens of the province in Groningen are in favour of NbS as a method used in CFRM. Further, the correlation between RCB, value items, and norms could hold a strong bias with the respective age group (>50) that most dominantly participated in the survey. Further research is needed to determine the relationship, especially among younger people to new approaches in CFRM. For this, larger sample size is advisable, which could be reached by either addressing specific groups such as students or youth initiatives. Lastly, besides the mentioned literature on the applicability of the parametric Pearson correlation, also a non-parametric Spearman correlation should be tested to compare results in depth.

Chapter 7: Reflection

Looking back, not only on the here presented findings, but also on the research period as a time of constant learning, experimenting, and adapting to changes alongside my studies and the RUG, there are two topics that I would like to address specifically.

Original Research Scope and Flexibility of the Research Process

Undoubtedly one of the hot topics in spatial planning practices and theory is the discourse of being adaptive towards changes, figuring out alternative routes to reach the goal, and questioning whether this goal is the right thing to achieve. At the beginning of my thesis, the original plan was to perform a multi-case study to directly compare the existing perceptions, ranking of values, and norms and get to know two contexts to answer the question of NbS transfer and the social implications this transfer would need to meet. However, at a rather late stage in the research progress, the intended collaboration with the case, which is not presented in this research, had to be discarded, as the timelines of my work and the related project did not coincide. The resulting switch to only considering the Dutch perspective on NbS at the end allowed for a deeper understanding of the matter, which my original proposal would have potentially lacked.

Method and Data Collection Techniques

Based on the social nature of the presented research, the methodology of performing a questionnaire survey did fit the overall concept. Despite this, the low response rate might be a consequence of unwillingness to sacrifice time without incentive, the general disinterest in the topic of NbS and flood protection, or the unfeasibility due to technical aversion or unproficiency in using a website link or QR-code. The latter might especially be connected to a higher mean age in the rural areas of the province. However, this could be refuted by the high number of older participants, allowing for the assumption of a high technical proficiency despite high age. Further, given the dropout rate of 18% (15 of 82 participants), it can be assumed that the questionnaire was perceived as either too long or too complicated. In future research, it is advised to consult with a larger number of locals before officially collecting data to rule out reoccurring problems.

Further, given the high participation of the age group above 50 years and the mean age of the province of Groningen at 41.9, the survey lacked the perspective of younger citizens. This could have resulted in a shift in perception across the three survey branches of RCB, values, and norms. Additionally, the low variety of participants, especially based on their position regarding NbS showed a stronger link to obvious relations to biospheric values, high awareness, and high evaluation of benefits, however, no conclusion about the general perspective of the people in Groningen should be drawn given the additional error rate of 12%.

It has been noticed that despite the instruction in the value section of the questionnaire to choose approximately two guiding values of life only (based on the instruction given by L. Steg), many participants exceeded this number by far stating up to 11 values of life (score 7). This limited differentiation regarding the evaluation of values could have played a significant role in influencing the results. Further research might be advised to set a warning for the participants when exceeding the suggested (normal) number of guiding principles in the chosen questionnaire tool.

In the retrospective the postal door-to-door invitation delivery to the questionnaire, while ensuring a random and diverse pool of potential participants, also encompassed the disadvantage of being too passive being reflected by the low response rate. A more personal establishment of contact through doing the questionnaire on-site together with the participants could have further reduced the dropout rate, by clarification of questions in case of unsureness. Furthermore, neutrality in the questionnaire form could have been targeted more to also attract people not accepting NbS. For this especially the socio-economic questions could have been shifted towards the end of the questionnaire.

Despite this, many questionnaire participants expressed positive views about the distribution method by bicycle in the comment section. In some face-to-face encounters along the distribution routes, especially in the areas closer to the sea, people were surprised to be asked to give an opinion on an issue that, from their point of view, is so spatially distant. However, many also expressed the view that the research objective was relevant to the overarching theme of climate change and flood protection challenges.

References

Alle Cijfers. (2022). Groningen. Retrieved from https://allecijfers.nl/provincie/groningen/ on 15th May 2022

Anderson, C. C., & Renaud, F. G. (2021). A review of public acceptance of nature-based solutions: The 'why','when', and 'how'of success for disaster risk reduction measures. *Ambio*, 1-22.

Awan, O., & Dako, F. (2018). Reply: Use of parametric tests to analyze ordinal data. *Journal of nuclear medicine technology, 46*(3), 318-318.

Bakker, J., Esselink, P., Dijkema, K., Van Duin, W., & De Jong, D. (2002). Restoration of salt marshes in the Netherlands. *Hydrobiologia, 478*(1), 29-51.

Bakker, J., Wolters, M., Smith, M., de Vries, S., & de Vries, Y. (2007). Vestiging van binnendijkse brakwater vegetatie langs de Groninger kust. *De Levende Natuur, 108*(4), 170-175.

Bio-Engineering for safety using vegetated foreshores. (2019). TU Delft. Retrieved from https://www.tudelft.nl/en/ceg/about-faculty/departments/hydraulic-engineering/sections/hydraulic-structures-and-flood-risk/research/be-safe on 4th July 2022

Birkholz, S., Muro, M., Jeffrey, P., & Smith, H. M. (2014). Rethinking the relationship between flood risk perception and flood management. *Science of the total environment, 478*, 12-20.

Bitly. (2022). Bitly - Short links, big results. Retrieved from https://bitly.com on 19th May 2022

Blaikie, N. (1991). A critique of the use of triangulation in social research. *Quality & Quantity: International Journal of Methodology, 25*(2), 115-136.

Blamey, R. (1998). The activation of environmental norms: Extending Schwartz's model. *Environment and behavior, 30*(5), 676-708.

Borsje, B. W., de Vries, S., Janssen, S. K., Luijendijk, A. P., & Vuik, V. (2017). Building with nature as coastal protection strategy in the Netherlands. In *Living Shorelines* (pp. 137-156): CRC Press.

Bos, J. (2021). Blue Deal and Nature Based Solutions. World Waternet.

Bouma, T. J., Van Belzen, J., Balke, T., Zhu, Z., Airoldi, L., Blight, A. J., . . . Hoggart, S. P. (2014). Identifying knowledge gaps hampering application of intertidal habitats in coastal protection: Opportunities & steps to take. *Coastal Engineering, 87*, 147-157.

Bouman, T., Steg, L., & Kiers, H. A. (2018). Measuring values in environmental research: a test of an environmental portrait value questionnaire. *Frontiers in psychology, 9*, 564.

Burningham, K., Fielding, J., & Thrush, D. (2008). 'It'll never happen to me': understanding public awareness of local flood risk. *Disasters, 32*(2), 216-238.

Cause, C. (2016). Perceptions matter: The common cause UK values survey. In: London, UK: Common Cause Foundation.

Coastal Engineering Research Center. (1984). *Shore protection manual* (Vol. 1): Department of the Army, Waterways Experiment Station, Corps of Engineers ….

Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). Nature-based solutions to address global societal challenges. *IUCN: Gland, Switzerland, 97*.

Cohen, J. E., & Small, C. (1998). Hypsographic demography: the distribution of human population by altitude. *Proceedings of the National Academy of Sciences, 95*(24), 14009-14014.

Conte, B., Hahnel, U. J., & Brosch, T. (2021). The dynamics of humanistic and biospheric altruism in conflicting choice environments. *Personality and Individual Differences, 173*, 110599.

Crossland, C. J., Baird, D., Ducrotoy, J.-P., Lindeboom, H., Buddemeier, R. W., Dennison, W. C., . . . Swaney, D. P. (2005). The coastal zone—a domain of global interactions. In *Coastal fluxes in the Anthropocene* (pp. 1-37): Springer.

Davis, M., Krüger, I., & Hinzmann, M. (2015). Coastal Protection and Suds-Nature-Based Solutions. *RECREATE Project Policy Brief*(4).

De Groot, & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and behavior, 40*(3), 330-354.

De Groot, J. I., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. *The Journal of social psychology, 149*(4), 425-449.

De Groot, M. (2012). Exploring the relationship between public environmental ethics and river flood policies in western Europe. *Journal of Environmental Management, 93*(1), 1-9.

de Kroon, P.-R. (2020). Silence of the Tides. Retrieved from https://silenceofthetides.com/film/partners/ on 15th June 2022

De Vries, B., Willemsen, P., Van Puijenbroek, L., MEB, C., Baptist, M., Cleveringa, J., . . . Elschot, K. (2021). Salt marsh pilot Marconi; monitoring results. In.

de Vries, M. (n.d.). FAST bekijkt eigenschappen van een ecosysteem. Deltares. Retrieved from https://www.deltares.nl/nl/projecten/fast/ on 4th July 2022

Dekker, J., Duel, H., Van Der Molen, D., & Van Hees, I. (2014). Markermeer-IJmeer. *Landschap tijdschrift voor landschapsecologie en milieukunde, 31(2014)1*, 4-9.

Dijkema, K., De Jong, D., Vreeken-Buijs, M., & Van Duin, W. (2005). KWELDERS EN SCHORREN in de Kaderrichtlijn Water: Ontwikkeling van Potentiële Referenties en van Potentële Goede Ecologische Toestanden/SALT MARSHES in the Water Framework Directive: Development of Potential Reference Conditions and of Potential Good Ecological Statuses. *Rapportnr.: 2005.020*.

Disco, C. (2002). Remaking "nature": the ecological turn in Dutch water management. *Science, Technology, & Human Values, 27*(2), 206-235.

Dolan, A. H., & Walker, I. J. (2006). Understanding vulnerability of coastal communities to climate change related risks. *Journal of Coastal research*, 1316-1323.

DSvG. (2022). Kerngegevens Regio Provincie Demografie. Retrieved from https://destaatvangroningen.nl/kerngegevens-regio-provincie-demografie.html on 15th May 2022

REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), (2016).

Ambtelijke Beleidingsverkenning Om Te Komen Tot Een Natuurambitie Grote Wateren 2050-2100, (2013).

EZK. (2015). *The Netherlands Fourth Biennial Report Under the United Nations Framework Convention On Climate Change*. Retrieved from https://unfccc.int/sites/default/files/resource/NLD%204th%20Biennial%20Report%20Final%20version%2018dec19.pdf on 5th June 2022

Fischer, A. P. (2018). Pathways of adaptation to external stressors in coastal natural-resource-dependent communities: Implications for climate change. *World Development, 108*, 235-248.

Flyvbjerg, B. (2011). Case study. *The Sage handbook of qualitative research, 4*, 301-316.

Freudenburg, W. (1989). *The organizational attenuation of risk estimates.* Paper presented at the Society for Risk Analysis meeting, San Francisco.

Gagnon, Y.-C. (2010). *The case study as research method: A practical handbook*: PUQ.

Ganzeboom, H. B. (2010). International standard classification of occupations ISCO-08 with ISEI-08 scores. *Version of July, 27*, 2010.

Gittman, R. K., Popowich, A. M., Bruno, J. F., & Peterson, C. H. (2014). Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane. *Ocean & Coastal Management, 102*, 94-102.

Giulietti, S., Romagosa, F., Esteve, F., & Schröder, C. (2018). Tourism and the Environment. *Towards a Reporting Mechanism in Europe*.

Grimmelikhuijsen, S. (2012). Linking transparency, knowledge and citizen trust in government: An experiment. *International Review of Administrative Sciences, 78*(1), 50-73.

Han, S., & Kuhlicke, C. (2019). Reducing hydro-meteorological risk by nature-based solutions: What do we know about people's perceptions? *Water, 11*(12), 2599.

Hanley, M., Hoggart, S., Simmonds, D., Bichot, A., Colangelo, M., Bozzeda, F., . . . Recio, M. (2014). Shifting sands? Coastal protection by sand banks, beaches and dunes. *Coastal Engineering, 87*, 136-146.

Hechter, M., & Opp, K.-D. (2001). Social norms.

Hemphill, J. F. (2003). Interpreting the magnitudes of correlation coefficients.

Henkens, R., van Loon-Steensma, J., Franken, R., Tol, S., & de Knegt, B. (2014). Kustbescherming. In *Graadmeter Diensten van Natuur. Vraag, aanbod, gebruik en trend van goederen en diensten uit ecosystemen in Nederland In: de Knegt, B.(ed).* (pp. 113-121): WOT Natuur & Milieu.

Hossen, S., Sharker, M. R., Ferdous, A., Ghosh, A., Hossain, M. B., Ali, M. M., & Sukhan, Z. P. (2020). Pearson's Correlation and Likert Scale Based Investigation on Socio-Economic Status of Fisher's Community in Kirtankhola River, Southern Bangladesh. *Middle-East Journal of Scientific Research, 28*(3), 160-169.

Hussein, A. (2009). The use of triangulation in social sciences research. *Journal of comparative social work, 4*(1), 106-117.

IBM Corp. (2020). IBM SPSS Statistics for Windows, Version 27.0. Armonk. New York: IBM Corp.

IenW. (2009). National Water Plan 2009-2015.

Water Act, (2010).

IenW. (2016). National Water Plan 2016-2021.

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Jackson, S. E. (2012). Portrait of a slow revolution toward environmental sustainability. *Managing human resources for environmental sustainability*, 3-20.

Jacobson Jr, P. E. (1972). Applying measures of association to nominal-ordinal data. *Pacific Sociological Review, 15*(1), 41-60.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., . . . Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk analysis, 8*(2), 177-187.

Keller, N., & Hartmann, T. (2020). OECD water governance principles on the local scale–an exploration in Dutch water management. *International Journal of River Basin Management, 18*(4), 439-444.

Khaldi, K. (2017). Quantitative, qualitative or mixed research: which research paradigm to use? *Journal of Educational and Social Research, 7*(2), 15-15.

Kingdom of the Netherlands. (n.d.). Bio Heads of Mission. Retrieved from https://www.permanentrepresentations.nl/permanent-representations/pr-eu-brussels/the-mission/division-of-tasks/heads-of-mission/bio-heads-of-mission on 5th June 2022

Klein, R. J., Smit, M. J., Goosen, H., & Hulsbergen, C. H. (1998). Resilience and vulnerability: coastal dynamics or Dutch dikes? *Geographical Journal*, 259-268.

Klopper, H. (2008). The qualitative research proposal. *Curationis, 31*(4), 62-72.

Koops, E. (2020). De Groninger Ziekte (1826). Historiek - Online Geschiedenismagazin Retrieved from https://historiek.net/groninger-ziekte-1826-koorts-malaria/134374/ on 3rd July 2022

Kottek, M., Grieser, J., Beck, C., Rudolf, B., & Rubel, F. (2006). World map of the Köppen-Geiger climate classification updated.
Kruizinga, P. (2016). Health tourism and health promotion at the coast. In *The Routledge handbook of health tourism* (pp. 414-426): Routledge.
Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners*: Sage.
Lane, S. N. (2017). Natural flood management. *Wiley Interdisciplinary Reviews: Water, 4*(3), e1211.
Leonard, H. B. (1983). Cost-benefit analysis defended. *Philosophy and Public Policy Quarterly, 3*(3), 6-9.
Lind, H. B., Nordfjærn, T., Jørgensen, S. H., & Rundmo, T. (2015). The value-belief-norm theory, personal norms and sustainable travel mode choice in urban areas. *Journal of Environmental Psychology, 44*, 119-125.
Lodder, Q. J., Slinger, J. H., Wang, Z. B., & van Gelder, C. (2019). Decision making in Dutch coastal research based on coastal management policy assumptions. *June 2020*.
Mangor, K., Drønen, N. K., Kærgaard, K. H., & Kristensen, S. E. (2004). Shoreline management guidelines.
Masselink, G., Russell, P., Rennie, A., Brooks, S., & Spencer, T. (2020). Impacts of climate change on coastal geomorphology and coastal erosion relevant to the coastal and marine environment around the UK. *MCCIP Science Review, 2020*, 158-189.
Mentaschi, L., Vousdoukas, M. I., Pekel, J.-F., Voukouvalas, E., & Feyen, L. (2018). Global long-term observations of coastal erosion and accretion. *Scientific reports, 8*(1), 1-11.
Merry, J., de Best, J., & van den Hoven, K. (2022). Een beoordelingstool voor de inzet van kwelders als kustbescherming. *H2O online*, 1-8.
Microsoft Corporation. (2018). Microsoft Excel. Retrieved from https://office.microsoft.com/excel on 15th April 2022
Morris, R. L., Konlechner, T. M., Ghisalberti, M., & Swearer, S. E. (2018). From grey to green: Efficacy of eco-engineering solutions for nature-based coastal defence. *Global change biology, 24*(5), 1827-1842.
Moser, S. C., Jeffress Williams, S., & Boesch, D. F. (2012). Wicked challenges at land's end: Managing coastal vulnerability under climate change. *Annual Review of Environment and Resources, 37*, 51-78.
Mostert, E. (2020). Water and national identity in the Netherlands; the history of an idea. *Water History, 12*(3), 311-329.
Narayan, S., Beck, M. W., Reguero, B. G., Losada, I. J., Van Wesenbeeck, B., Pontee, N., . . . Burks-Copes, K. A. (2016). The effectiveness, costs and coastal protection benefits of natural and nature-based defences. *PloS one, 11*(5), e0154735.
NCK. (2022). Kweldersymposium. Retrieved from https://www.nck-web.org/past-events/past-theme-days/105-kweldersymposium on 14th March 2022
Nesshöver, C., Assmuth, T., Irvine, K. N., Rusch, G. M., Waylen, K. A., Delbaere, B., . . . Kovacs, E. (2017). The science, policy and practice of nature-based solutions: An interdisciplinary perspective. *Science of the total environment, 579*, 1215-1227.
Nicholls, R. J., & Small, C. (2002). Improved estimates of coastal population and exposure to hazards released. *Eos, Transactions American Geophysical Union, 83*(28), 301-305.
NIOZ. (2020). Living Dikes project receives NWA-ORC funding. Retrieved from https://www.nioz.nl/en/news/living-dikes-project-receives-nwa-orc-funding on 14th July 2022
Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in health sciences education, 15*(5), 625-632.
North, D. C. (1991). Institutions. *Journal of economic perspectives, 5*(1), 97-112.
North, D. C. (1993). Toward a theory of institutional change. *Political economy: Institutions, competition, and representation, 31*(4), 61-69.

NWO. (2022). Salt marshes for climate-resilient coastal defences. Retrieved from https://www.nwo.nl/en/cases/salt-marshes-climate-resilient-coastal-defences on 4th July 2022

O'Brien, R. M. (1979). The use of Pearson's with ordinal data. *American Sociological Review*, 851-857.

Oltedal, S., Moen, B.-E., Klempe, H., & Rundmo, T. (2004). Explaining risk perception: An evaluation of cultural theory. *Rotunde, 85*, 1-33.

Oppenheimer, M., Glavovic, B., Hinkel, J., van de Wal, R., Magnan, A. K., Abd-Elgawad, A., . . . Ghosh, T. (2019). Sea level rise and implications for low lying islands, coasts and communities.

Oppermann, M. (2000). Triangulation—A methodological discussion. *International Journal of Tourism Research, 2*(2), 141-145.

PDOK. (2018). Dataset: Actueel Hoogtebestand Nederland (AHN3). Publieke Dienstverlening Op de Kaart Retrieved from https://www.pdok.nl/geo-services/-/article/actueel-hoogtebestand-nederland-ahn3- on 22nd June 2022

Perry, G. L. W., Richardson, S. J., Harré, N., Hodges, D., Lyver, P. O. B., Maseyk, F. J. F., . . . Brower, A. (2021). Evaluating the Role of Social Norms in Fostering Pro-Environmental Behaviors. *Frontiers in Environmental Science, 9*. doi:10.3389/fenvs.2021.620125

Pontee, N., Narayan, S., Beck, M. W., & Hosking, A. H. (2016). *Nature-based solutions: lessons from around the world.* Paper presented at the Proceedings of the Institution of Civil Engineers-Maritime Engineering.

Poortinga, W., Steg, L., & Vlek, C. (2004). Values, environmental concern, and environmental behavior: A study into household energy use. *Environment and behavior, 36*(1), 70-93.

Qualtrics. (2020). Qualtrics. 05/22. Retrieved from https://www.qualtrics.com on 8th May 2022

Räsänen, A., Juhola, S., Nygren, A., Käkönen, M., Kallio, M., Monge Monge, A., & Kanninen, M. (2016). Climate change, multiple stressors and human vulnerability: a systematic review. *Regional Environmental Change, 16*(8), 2291-2302.

Rendón, O. R., Garbutt, A., Skov, M., Möller, I., Alexander, M., Ballinger, R., . . . Griffin, J. (2019). A framework linking ecosystem services and human well-being: Saltmarsh as a case study. *People and nature, 1*(4), 486-496.

Renn, O. (2017). *Risk governance: coping with uncertainty in a complex world*: Routledge.

Renn, O., Burns, W. J., Kasperson, J. X., Kasperson, R. E., & Slovic, P. (1992). The social amplification of risk: Theoretical foundations and empirical applications.

Roeland, H., & Piet, R. (1995). Dynamic preservation of the coastline in the Netherlands. *Journal of Coastal Conservation, 1*(1), 17-28.

Samuels, P., Klijn, F., & Dijkman, J. (2006). An analysis of the current practice of policies on river flood risk management in different countries. *Irrigation and Drainage: The Journal of the International Commission on Irrigation and Drainage, 55*(S1), S141-S150.

Schanze, J. (2006). Flood risk management–a basic framework. In *Flood risk management: hazards, vulnerability and mitigation measures* (pp. 1-20): Springer.

Scholten, B. (2021). ROB JETTEN ACTIEVER DAN OOIT OP SOCIAL MEDIA EN SCOORT PUNTEN MET REACTIES. Retrieved from https://www.thebestsocial.media/nl/rob-jetten-social-media-reacties/ on 2nd July 2022

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In *Advances in experimental social psychology* (Vol. 25, pp. 1-65): Elsevier.

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online readings in Psychology and Culture, 2*(1), 2307-0919.1116.

Schwartz, S. H., Cieciuch, J., Vecchione, M., Torres, C., Dirilen-Gumus, O., & Butenko, T. (2017). Value tradeoffs propel and inhibit behavior: Validating the 19 refined values in four countries. *European Journal of Social Psychology, 47*(3), 241-258.

Schwartz, S. H., & Howard, J. A. (1981). A normative decision-making model of altruism. *Altruism and helping behavior*, 189-211.

Seddon, N., Chausson, A., Berry, P., Girardin, C. A., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B, 375*(1794), 20190120.

Slovic, P. (1992). Perception of risk: Reflections on the psychometric paradigm. In.

Smith, C. S., Rudd, M. E., Gittman, R. K., Melvin, E. C., Patterson, V. S., Renzi, J. J., . . . Silliman, B. R. (2020). Coming to terms with living shorelines: A scoping review of novel restoration strategies for shoreline protection. *Frontiers in Marine Science, 7*, 434.

Stead, D., & Nadin, V. (2008). Spatial planning. Key instrument for development and effective governance with special reference to countries in transition.

Steg, L., & De Groot, J. I. (2012). Environmental values. In: Oxford University Press New York, NY.

Steg, L., De Groot, J. I., Dreijerink, L., Abrahamse, W., & Siero, F. (2011). General antecedents of personal norms, policy acceptability, and intentions: The role of values, worldviews, and environmental concern. *Society and Natural Resources, 24*(4), 349-367.

Steg, L., Keizer, K., Buunk, A. P., & Rothengatter, T. (2017). *Applied social psychology*: Cambridge University Press.

Steg, L., Perlaviciute, G., Van der Werff, E., & Lurvink, J. (2014). The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. *Environment and behavior, 46*(2), 163-192.

Teuber, A. (1990). Justifying risk. *Daedalus*, 235-254.

Van der Brugge, R., Rotmans, J., & Loorbach, D. (2005). The transition in Dutch water management. *Regional Environmental Change, 5*(4), 164-176.

Van Duin, W., Jongerius, H., Nicolai, A., Jongsma, J. J., Hendriks, A., & Sonneveld, C. (2016). Friese en Groninger kwelderwerken: monitoring en beheer 1960-2014.

Van Wessel, M. (2008). How to grasp the Public? Governmental communication in the Netherlands. *Javnost-The Public, 15*(4), 87-105.

Vergouwe, R. (2014). De veiligheid van Nederland in kaart: Eindrapportage VNK. *Eindverslag, Document HB2540621*.

Voogd, R., de Vries, J. R., & Beunen, R. (2021). Understanding public trust in water managers: Findings from the Netherlands. *Journal of Environmental Management, 300*, 113749.

Vranken, L., & Sinoo, F. (2016). *Inpassingsplan Dijkverbetering Eemshaven-Delfzijl*. Retrieved from https://www.planviewer.nl/imro/files/NL.IMRO.9920.IPDijkEemsDelf-VA01/t_NL.IMRO.9920.IPDijkEemsDelf-VA01.pdf on 24 May 2022

Watersnoodmuseum. (2018). Delta Works. Retrieved from https://watersnoodmuseum.nl/en/knowledgecentre/delta-works/ on 31st May 2022

Webb, E. J., Campbell, D. T., Schwartz, R. D., & Sechrest, L. (1969). *Unobtrusive measures: Nonreactive research in the social sciences*: Rand McNally Chicago.

Yin, R. K. (1994). Discovering the future of the case study. Method in evaluation research. *Evaluation practice, 15*(3), 283-290.

Yin, R. K. (2003). Design and methods. *Case study research, 3*(9.2).

Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5): sage.

Image Sources

I1 Ecoshape. (n.d.) Restoring Seagrass Meadows. Retrieved from https://www.ecoshape.org/en/concepts/restoring-seagrass-meadows/ on 7th April 2022

I2 Pie Riviers. (n.d.) Native Plantings and Sand Fencing Help Beach Dune Restoration. Retrieved from https://pie-rivers.org/native-plantings-and-sand-fencing-help-beach-dune-restoration/ on 7th April 2022

I3 NWO. (n.d.). Research Living Dikes Grow Rising Sea Level. Retrieved from https://www.nwo.nl/en/news/research-living-dikes-grow-rising-sea-level on 7th April 2022

I4 Earth Magazine (n.d.). Dutch Masters – Netherlands Export Flood Control Expertise. Retrieved from https://www.earthmagazine.org/article/dutch-masters-netherlands-exports-flood-control-expertise/ on 7th April 2022

I5 Natuurgebied in Beeld. (n.d.). Kwelders Emmapolder. Retrieved from https://www.natuurgebiedinbeeld.nl/natuurgebied/groningen/uithuizerwad/kwelders-emmapolder/#!enviragallery9808-16552 on 13th May 2022

I6 Eemsdollard2050. (n.d.). Marconi. Retrieved from https://eemsdollard2050.nl/project/marconi/ on 13th May 2022

I7 Suedliches Ostfriesland. (n.d.). Bunde. Retrieved from https://www.suedliches-ostfriesland.de/ferienorte/bunde on 13th May 2022

Data Sources

D1 Geodienst. (n.d.). Basic Data Portal. Retrieved from https://geodienst.xyz/data/gdf.php on 20.06.2022

D2 RWS. (2022). Bescherming Tegen Overstroming. Retrieved from https://data.overheid.nl/dataset/25360-bescherming-tegen-overstroming#webservices on 12.05.2022

D3 RWS. (2007). Vegetatiekartering VEGVAD Flakken. Retrieved from https://maps.rijkswaterstaat.nl/dataregister/srv/dut/catalog.search#/metadata/0bb7f390-7761-41da-b341-828c1bc74b5c on 22.05.2022

Appendix

1. Public Questionnaire – Dutch

This section of the appendix serves as additional documentation of the data collection process. The Dutch translation of the questionnaire survey can be found in table 20, which was created by the author and audited by Dr. F. Niekerk. Access to the questionnaire was enabled by either using a Quick Response (QR)-Code or by using a shortened Uniform Resource Locator (URL), created using Bitly (Bitly, 2022). The distribution details of the flyer can be taken from table 21.

Table 20 Dutch version of the online questionnaire implemented in Qualtrics (Qualtrics, 2020)

Toestemming en Inleiding De volgende vragenlijst maakt deel uit van mijn afstudeeronderzoek voor de master 'Environment and Infrastructure Planning', aan de Rijksuniversiteit Groningen. Het onderwerp van mijn onderzoek is 'Publieksprofielanalyse als meetinstrument voor de acceptatie van - op natuur-gebaseerde -kustbeschermingsbenaderingen'. Het doel van het onderzoek is het inzichtelijk maken van de perceptie en het standpunt ten opzichte van op de natuur gebaseerde oplossingen ter bescherming tegen overstromingen van de kust. Op natuur-gebaseerde oplossingen zijn diepgeworteld in het milieu en hebben ook tot doel de biodiversiteit te vergroten. Er kan een onderscheid worden gemaakt tussen (1) volledig natuurlijke oplossingen (b.v. natuurlijk bestaande kwelders, koraalriffen, mangroves, zeegras weiden, kelpwouden), (2) beheerde natuurlijke oplossingen (b.v. kunstmatige vorm van (1), heraangelegd stranden, begroeide duinen), (3) hybride oplossingen (b.v. combinatie van kwelders en dijken) en (4) "milieuvriendelijke" bouwtechnieken (b.v. groendijken, strandhoofden). Niet op de natuur gebaseerde oplossingen daarentegen zijn verdedigingswerken die zijn losgekoppeld van het ecosysteem waarin zij zijn ingebed en die als enig doel hebben overstromingen te voorkomen. Op natuur-gebaseerde oplossingen kunnen een groter aanpassingsvermogen bieden bij heftige weersomstandigheden, klimaatverandering en andere voordelen bieden. Daarom is het van wetenschappelijk belang om het perspectief van de burger in kaart te brengen. U wordt uitgenodigd om op vrijwillige basis deel te nemen aan dit onderzoek. Een voorwaarde voor deelname is dat u in de provincie van Groningen woont. U kunt er vanzelfsprekend voor kiezen niet deel te nemen, zonder opgaaf van reden. Als u ervoor kiest aan dit onderzoek deel te nemen, kunt u zich op elk moment terugtrekken. De volgende vragenlijst zal ongeveer 15 min duren. Uw antwoorden zullen vertrouwelijk zijn en persoonlijke informatie (bv. naam, e-mailadres, IP-adres) zal niet worden verzameld. De vragenlijst bestaat uit vier delen. Het eerste deel bestaat uit inleidende vragen, bv. uw leeftijd, beroep, opleiding, en uw mening over op de natuur-gebaseerde oplossingen voor het beheer van overstromingsrisico's aan de kust. In het tweede deel wordt gevraagd naar uw perceptie van op de natuur-gebaseerde oplossingen voor het beheer van overstromingsrisico's in kustgebieden. In het derde deel wordt gevraagd naar uw persoonlijke waarden in uw leven. En in het laatste deel wordt gevraagd naar uw probleem- en gevolgbewustzijn en verantwoordelijkheid in het beheer van overstromingsrisico's aan de kust. Alle gegevens worden opgeslagen in een met een wachtwoord beveiligd elektronisch formaat. Om uw privacy te beschermen, zal de enquête geen informatie bevatten die u persoonlijk kan identificeren. De resultaten van dit onderzoek zullen uitsluitend voor onderzoeksdoeleinden worden gebruikt en kunnen worden gedeeld met vertegenwoordigers van de universiteit.

Als u vragen heeft over het onderzoek, neem dan contact op met l.meyer.9@student.rug.nl. Dit onderzoek volgt de richtlijnen van de Rijksuniversiteit Groningen met betrekking tot de General Data Protection Regulation (GDPR) procedures.

- ☐ Ik geef toestemming en ben bereid deel te nemen aan dit onderzoek.
- ☐ Ik geef geen toestemming en wens niet deel te nemen aan dit onderzoek.

Deel 1: Sociaaleconomische Vragen

- *Hoe oud bent u in jaren?*
- *Wat is uw geslacht?*
  Man, vrouw, divers
- *Wat doet u voor werk?* (ISCO-08 standaard: sub hoofdgroep)
- *Wat is uw hoogst genoten opleiding?*
  Basisonderwijs
  Middelbaar onderwijs
  MBO
  HBO
  Universitair
  PhD/ doctor
- *In welke provincie woont u?*
  Provincie Groningen: Midden-Groningen, Groningen Stad, Westerkwartier, Het Hogeland, Appingedam, Delfzijl, Oldambt, Veenkoloniën, Westerwolde
- *Wat is bij benadering uw woonafstand tot zee in kilometer?*
  XXX km
- *Weet u wat de dichtstbijzijnde kustbeschermingsmaatregel is?*
  Ja, Nee
  In geval ja (meerkeuze): dijk, duin, strand, damwand, betonnen kering, kwelder
- *Zou u voorstander zijn van natuurgerichte kustoplossingen in uw provincie?*
  Ja/ Nee/ geen mening

Deel 2: Perceptie

Geef uw mening van de volgende stellingen op een schaal van 1 (laag) tot 5 (zeer hoog).
Als op natuur-gebaseerde oplossingen worden gebruikt als kustbeschermingsmaatregel, zie ik risico's...

- ... beperkt te worden in mijn recreatief gebruik van de kust...
- ... beperkt te worden in mijn beroep om...
- ... dat mijn woonplek onveilig wordt…
- ... voor de transport infrastructuur (weg, spoor) …

Score de volgend stellingen op een schaal van 1 (niet akkoord) tot 5 (volledig akkoord).
Als op natuur-gebaseerde oplossingen worden gebruikt als kustbeschermingsmethode, verwacht ik dat de…

- ... uitvoeringskosten hoger zijn in vergelijking met de kosten van traditionele beschermingsmaatregelen tegen overstromingen
- ... onderhoudskosten hoger zijn dan de kosten van traditionele beschermingsmaatregelen tegen overstromingen
- ...financiële kosten hoger zijn dan traditionele beschermingskosten tegen overstromingen in geval van een overstroming.
- ...de kosten op de lange termijn lager zijn wat *natuur-gebaseerde oplossingen* betreft.
- ...psychologische gevolgen (stress, woede) groter zijn dan bij traditionele overstromingsbeschermingsmaatregelen.

- ...het meer tijd kost om nieuwe methodes voor hoogwaterbescherming te ontwikkelen in vergelijking met het implementeren van traditionele methoden.

Geef uw perceptie van de volgende stellingen op een schaal van 1 (laag) tot 5 (zeer hoog).
Als op de natuur gebaseerde oplossingen worden gebruikt als kustbeschermingsmethode, zie ik de voordelen van...

- ...recreatieve activiteiten...
- ... hulpbronnen (b.v. vis, oesters) ...
- ...het verminderen van de gevolgen van klimaatverandering...
- ... een grotere biodiversiteit...
- ...verbeterde leefbaarheid van het gebied...
- ...verbetering van de esthetiek van het gebied

Deel 3: Waarden

Hieronder vindt u 16 waarden. Achter elke waarde staat een korte uitleg over de betekenis ervan. Kunt u aangeven hoe belangrijk elke waarde voor u is ALS RICHTLIJN IN UW LEVEN?
De beoordelingsschaal is als volgt:

-1 betekent dat de waarde in strijd is met de principes die je leiden
0 betekent dat de waarde helemaal niet belangrijk is; ze is niet relevant als richtinggevend principe in uw leven
3 betekent dat de waarde belangrijk is
6 betekent dat de waarde zeer belangrijk is
7 betekent dat de waarde van het allergrootste belang is als leidend beginsel in je leven; gewoonlijk zijn er niet meer dan twee van zulke waarden

Uw scores kunnen variëren van -1 tot 7. Hoe hoger het cijfer (-1, 0, 1, 2, 3, 4, 5, 6, 7), hoe belangrijker de waarde is als leidend beginsel in uw leven. Probeer zo veel mogelijk onderscheid te maken tussen de waarden door verschillende cijfers te gebruiken.

	Tegengesteld aan mijn waarden	Niet belangrijk	Belangrijk (oplopende belang)					Zeer belangrijk	Van het allergrootste belang
GELIJKHEID: gelijke kansen voor iedereen	-1	0	1	2	3	4	5	6	7
RESPECT VOOR DE AARDE: harmonie met andere soorten	-1	0	1	2	3	4	5	6	7
SOCIALE MACHT: controle over anderen, dominantie	-1	0	1	2	3	4	5	6	7
PLEZIER: vreugde, voldoen van verlangens	-1	0	1	2	3	4	5	6	7

EENHEID MET DE NATUUR: passen in de natuur	-1	0	1	2	3	4	5	6	7	
EEN WERELD IN VREDE: vrij van oorlog en conflicten	-1	0	1	2	3	4	5	6	7	
RIJKDOM: materiële bezittingen, geld	-1	0	1	2	3	4	5	6	7	
AUTORITEIT: het recht om te leiden of te bevelen	-1	0	1	2	3	4	5	6	7	
SOCIALE JUSTITIE: onrechtvaardigheid corrigeren, zorgen voor kwetsbare mensen	-1	0	1	2	3	4	5	6	7	
GENIETEN VAN HET LEVEN: genieten van eten, seks, vrije tijd, enz.	-1	0	1	2	3	4	5	6	7	
HET MILIEU BESCHERMEN: de natuur beschermen	-1	0	1	2	3	4	5	6	7	
STUREND: invloed hebben op mensen en gebeurtenissen	-1	0	1	2	3	4	5	6	7	
HULPVAARDIG: zich inzetten voor het welzijn van anderen	-1	0	1	2	3	4	5	6	7	
VERVUILING VOORKOMEN: natuurlijke hulpbronnen beschermen	-1	0	1	2	3	4	5	6	7	
GENIETEN VAN HET LEVEN: leuke dingen doen	-1	0	1	2	3	4	5	6	7	
AMBITIEUS: hard werken, ambitieus	-1	0	1	2	3	4	5	6	7	

Deel 4: Normen

In de volgende vragen wordt u gevraagd naar uw bewustzijn van problemen en gevolgen, en naar de toewijzing van verantwoordelijkheid. Geef aan in welke mate de volgende stellingen va toepassing zijn op een schaal van 1 (niet van toepassing) tot 5 (volledig van toepassing).

Ik ben me bewust van het probleem dat...

- ...de klimaatverandering sterkere stormen, hevige neerslag en een stijgende zeespiegel veroorzaakt.
- ...het afsluiten van kustgebieden vermindert de biodiversiteit en daarmee het vermogen om koolstof op te vangen.

Ik ben me bewust van het gevolg...

- ...dat traditionele beschermingstechnieken (zoals de aanleg van dijken) niet oneindig verbeterd kunnen worden.
- ...dat een grotere kans op - en kwetsbaarheid voor - overstromingen mijn leven en dat van de volgende generaties zal beïnvloeden.

Ik voel me medeverantwoordelijk voor...

- ...het vergroten van de weerbaarheid van mijn gemeenschap tegen overstroming van de kust.
- ...het informeren van mezelf over hoe ik kan anticiperen op het risico op deze overstromingen.

Aanvullende opmerkingen

Wilt u de onderzoeker nog iets anders laten weten? U kunt dat hier doen!

Table 21 Distribution of flyer among the province of Groningen

Location	Municipality	Date	Amount
Bedum	Het Hogeland	19.05.2022	30
Zisterzienserinnenabtei Sint Annen	Het Hogeland	19.05.2022	24
Ten Boer	Groningen	19.05.2022	30
Ten Post	Groningen	19.05.2022	30
Winneweer	Eemsdelta	19.05.2022	18
Garrelsweer	Eemsdelta	19.05.2022	30
Wirdumerdraai	Eemsdelta	19.05.2022	14
Eekwerderdraai	Eemsdelta	19.05.2022	14
Appingedam	Eemsdelta	19.05.2022	50
Jukwerd	Eemsdelta	19.05.2022	3
Arwerd	Eemsdelta	19.05.2022	3
Krewerd	Eemsdelta	19.05.2022	12
Godlinze	Eemsdelta	19.05.2022	30
Oostereinde	Eemsdelta	19.05.2022	3
Roodeshol	Eemsdelta	19.05.2022	40
Uithuizermeeden	Het Hogeland	19.05.2022	30
Uithuizen	Het Hogeland	19.05.2022	20
Along the way (farms)	-	19.05.2022	47
Sauwerd	Het Hogeland	31.05.2022	50
Winsum	Het Hogeland	31.05.2022	100
Onderdendam	Het Hogeland	31.05.2022	50
Groningen	Groningen	02.06.2022	222
Hardenberg	Oldambt	02.06.2022	50
Finsterwolde	Oldambt	02.06.2022	50
Beerta	Oldambt	02.06.2022	50

Winschoten	Oldambt	02.06.2022	100
Uithuizen	Het Hogeland	03.06.2022	100
Usquert	Het Hogeland	03.06.2022	75
Bedum	Het Hogeland	03.06.2022	100
Groningen	Groningen	06.06.2022	125

2. Coastal System Province of Groningen

Figure 22 shows the three distinct salt marshes in the province of Groningen. While the Groninger Kwelderwerken obtain a structured layout (s. figure 23), the Dollard Marsh has more organic forms.

Figure 22 Saltmarshes and Reed Grass Marsh (top left: Groninger Kwelderwerken (Emmapolder) (I5); top right: Marconi Buitendijk; (I6) bottom: Dollard Marsh (I7))

Figure 23 shows the layout of the Groninger Kwelderwerken. From the sea dike (bottom of the image) three settling fields span towards the sea with an in the middle separating earth dam. The first and second settling field hold each four subdivisions with trenches and cross ditches. Brushwood dams are implemented horizontally every 400m to the sea dike. The third settling field holds the main water drainage channels.

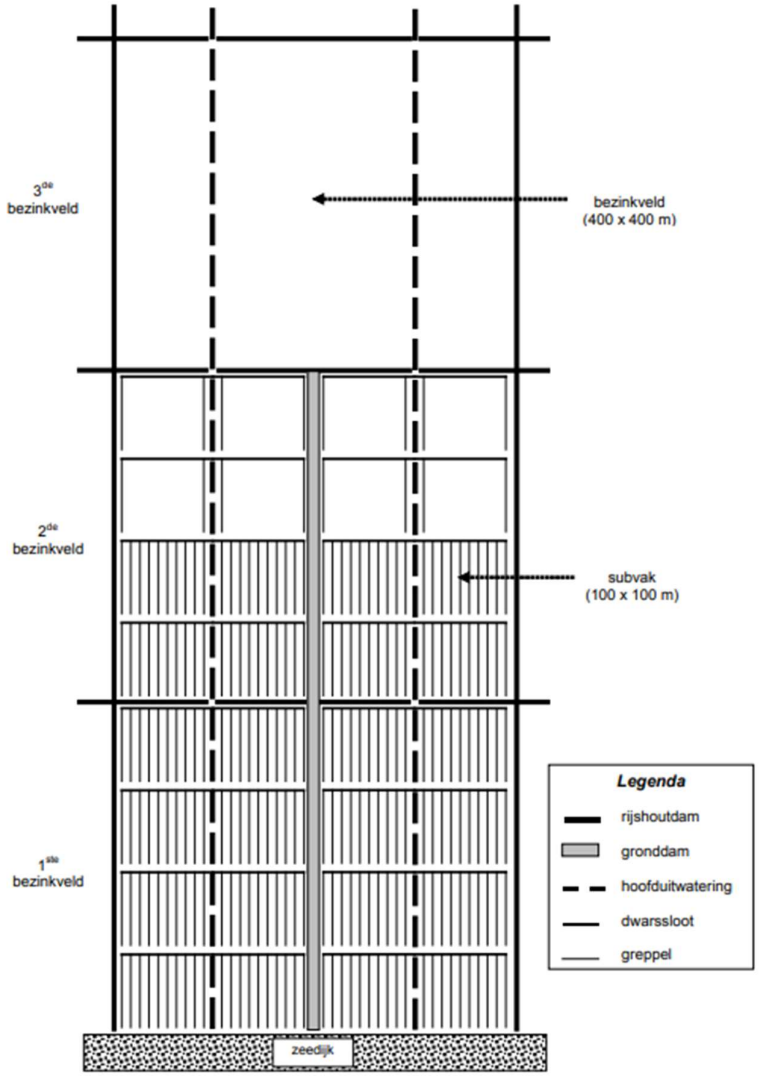

Figure 23 Schematic layout of one series of settling fields from the sea dike to the mud flats present at the Groninger Kwelderwerken, taken from (Van Duin et al., 2016, p. 18)

Figure 24 shows the elevation in the province of Groningen.

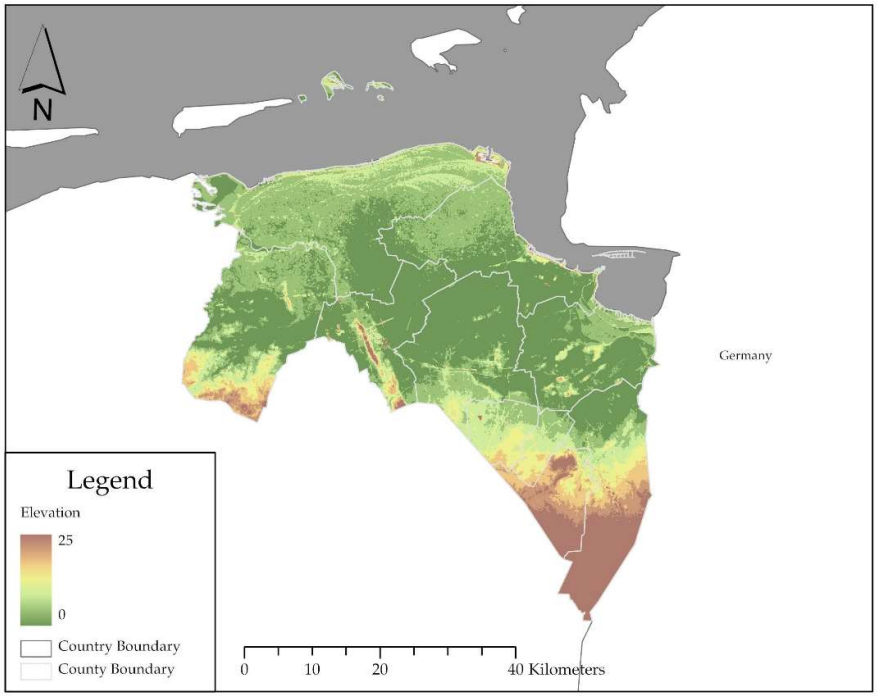

Figure 24 Elevation profile of the province of Groningen with indication of municipalities ('gemeente') (D1)

3. Additional Analysis Results from SPSS

Koeffizienten[a]

Modell		Nicht standardisierte Koeffizienten		Standardisierte Koeffizienten		
		Regressionskoeffizient B	Std.-Fehler	Beta	T	Sig.
1	(Konstante)	,601	,318		1,887	,064
	HEDO	-,090	,040	-,302	-2,276	,026
	EGO	,046	,038	,149	1,199	,235
	ALTRU	-,071	,064	-,173	-1,112	,270
	BIOS	,173	,058	,505	2,989	,004

a. Abhängige Variable: NbS_Pos

4. Literature Coding

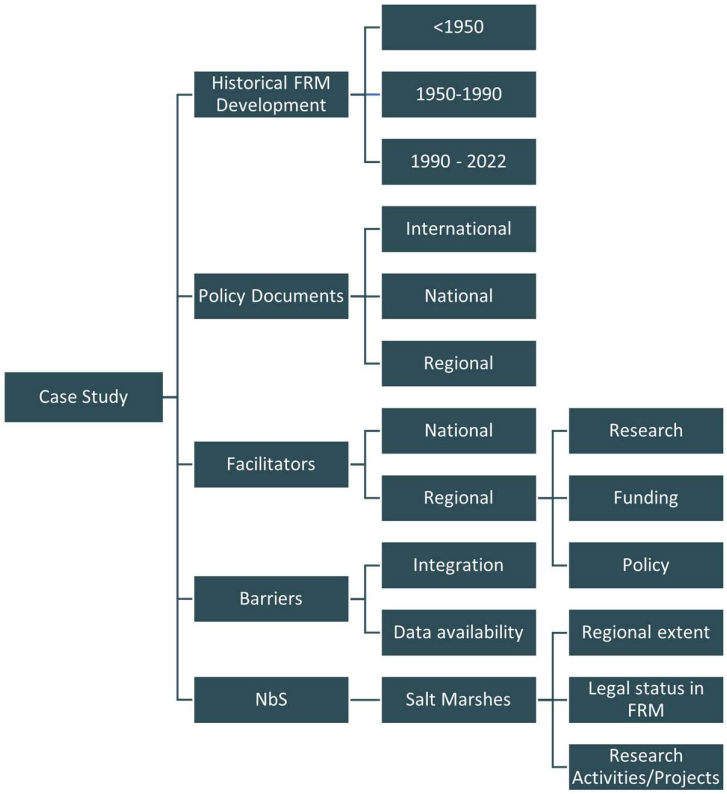

Figure 25 Coding Tree used during the Literature Research and Case Study