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[Stakeholder perspectives on the effects of beach hut development along the Dutch coast]

A qualitative study to assess scenarios for the preservation of important coastal dune functions

Ethan Tromp, October 2016

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Stakeholder perspectives on the effects of beach hut development along the Dutch coast

A qualitative study to assess scenarios for the preservation of important coastal dune functions

By

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Cover: Photograph showing a row of beach huts near Julianadorp
Retrieved from: http://strandhuisje.be/wp-content/uploads/2015/11/2.jpg

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SUMMARY

The Dutch coastline largely consists of dunes. These dunes offer several important functions to the society. These functions include flood protection, nature, recreation, etc. Recently controversies have emerged due to an increasing trend of beach hut constructions along the coastline. As the construction of new beach huts on a large scale is seen as a new development, it brings uncertainties on what the effects will be on the many dune functions. Furthermore different perceptions may be causing a problem for coastal managers on how to manage beach hut development. Some stakeholders are in it for financial reasons while others expect deterioration of the coastal dune functions. If coastal managers are unable to properly address this problem, the increasing trend of beach hut constructions may lead to increased conflicts between stakeholders and even deterioration of the valued coastal dune functions.

In this thesis, I investigate how the different perspectives regarding beach hut development that are held by the different actors influence the actions taken by the governmental institutions. To this end I elicit the perspectives of relevant stakeholders.

Stakeholders relevant to the development are therefore identified and interviewed to obtain information about their perception of the coastal dune system and this data is used to structure the system with all its complexities. To structure the complexity of the system means that different aspects of the coastal dune system are identified and linked together to understand how the system behaves when certain actions are taken. For this purpose, a mental model construction technique was applied in the form of Causal Loop Diagrams (CLDs). With this CLD I'm able to visualize the links between different aspects within the system and identify the probable causes of dune function deterioration. Ultimately, the CLD is used as a tool to create a scenario in which all of the dune functions remain maintained, which is the goal for coastal managers.

I focus my study in the province of Zeeland, where there are increasing numbers of beach huts being constructed along the coast, with many of them being near nature designated areas and dunes that rely on aeolian sediment transport for growth. This makes it an ideal location as stakeholders are concerned with the effects on nature and dune growth.

My findings showed that Zeeuwse Milieufederatie and water board Scheldestromen have concerns that the nature conservation efforts are inadequately enforced, which contributes to the deterioration of the nature function within the system. To reach a system scenario in which all of the functions are maintained, analysis shows that the season length for the placement of beach hut constructions should be maintained or even shortened, and nature conservation policy requires bolstering. Also capping the financial benefits of developers can lead to a balanced system scenario.

Although the accuracy of this analysis may be limited, due to a lack of involvement of certain stakeholders and a quick validation process, the results of this study gives insight to the coastal managers on how policies and actions influences other aspects of the system.

1 Introduction

This chapter provides an introduction into the topic, followed by the problem definition, objective and research questions. Furthermore, an overview of the research method is given. The chapter ends with an outline of this thesis

1.1 Research motivation

Large sections of the Dutch coast consist of dunes (Figure 1). The dunes were formed over the past centuries through natural processes and nowadays they provide important services (functions) to society. Flood protection, nature and recreation are some of the functions to name a few. Recently there has been an increasing trend of beach hut constructions along the Dutch coastline and this development is raising concerns regarding its potential effects on the dune functions (Kuipers, 2014). Beach hut development on a large scale is a fairly new phenomenon in the Netherlands and thus it is yet unknown what the effects on the dune functions might be. Coastal managers are therefore uncertain on how to best respond to this development in terms of regulations. Although several types of regulations already exist to protect the above mentioned dune functions from beach hut development, many stakeholders are not convinced that these regulations are adequate enough protect all of the dune functions which is causing controversies (Kuipers & Raaijmakers, 2015). In thesis, I examine the problem perception of each relevant stakeholder related to beach hut development to detect the underlying factors that lead to the these controvsies and develop a balanced scenario in which the dune functions are maintained.

Figure 1: Dune locations along the Dutch coast

1.2 Problem definition

The increasing trend of beach hut development along the Dutch coastline is causing social unrest in terms of increased uncertainty of the impacts on the functions of the coastal dune system. Before 2013 there was little development seen in this field, however has been an expansion of these constructions in recent years (Rengers & Smithuijsen, 2016). These constructions also require additional infrastructure to facilitate usage. Concerns have been raised due to observation of a lack of dune growth in areas near these beach constructions (Van der Valk & Van der Meulen, 2013) and deterioration of nature values (Kuipers, 2014). However, besides the report of Hoonhout & van Thiel (2013) in which they analysed the impacts of beah hut constructions on dunes in terms of dune growth, no other research has been done on the effects of beach hut development on coastal dune functions.

Due to this uncertainty of the effects of beach hut development and different perceptions of stakeholders, coastal managers are unsure on how to best respond to beach hut development in order to maintain all of the functions. It is therefore of utmost importance to understand the complexity of the coastal dune system and analyse the actions that leads to social unrest.

For this study, social unrest is expressed as an imbalance within the coastal dune system, meaning that the functions of the system are deteriorating due to beach hut development along the coastline. This study is a qualitative study that will explore the perceptions of relevant stakeholders about ecological socio-economic effects and regulations related to beach hut development. The data to be gathered in this study will be used to make the ecological socio-economic system of the coastal dune system structure visible and analyse the effects of certain actions within this system. This study may provide coastal managers (decision makers) with information on how to bring the coastal dune system in balance, i.e. maintain the functions of the dune system alongside the ongoing beach hut development.

1.3 Objective and research questions

Research objective: to elicit the stakeholder perspectives on the effects of beach house constructions (both positive and negative effects) in order to uncover why imbalance (that leads to social unrest) exist and to develop balanced scenarios for coastline development.

The following research questions (RQ) are formulated to achieve the research objective:

RQ1. Which stakeholders are important to interview in order to gather data that will ultimately be used for the development of optimally supported regulations?

RQ2. Are the stakeholders aware of the effects of beach constructions on the dune environment? If so, which effects are perceived by different stakeholders?

RQ3. What perception do different stakeholders hold in relation to regulations for beach housing?

RQ4. What are the differences and similarities of the mental model of the stakeholders?

RQ5. Based on the construction of the integrated mental model, what mechanisms can be included into the integrated model that can aid the system to reach a balanced state in which all the functions of the coastline are preserved?

The result of this study will help us explore the similarities and differences between stakeholders' understanding of the issue of beach construction along the Dutch coastline and to improve communication between stakeholders (Abel, et al., 1998). Furthermore this study can help integrate the different perspectives of the stakeholders to improve overall understanding of the social-ecological Dutch coastal dune system.

1.4 Research approach

A stakeholder analysis is performed in the initial phase in order to select stakeholders that are relevant to this research. Stakeholders from various backgrounds are used. This will answer the first research question.

The selected stakeholders from the stakeholder analysis are contacted and invited to an interview. From the interviews their perception (mental model) on how they perceive the effects of beach hut development on the beach dune environment is gathered. Both the physical and non-physical related effects are asked for. Furthermore there questions are asked regarding their views on the present regulations. This will answer research question 2 and 3. In order to better compare the stakeholder's mental models, it is worked into Causal Loop Diagrams (CLDs). The CLDs are later on validated through feedback from the interviewed stakeholders. A comparison between the individual CLDs is made which provides an answer to research question 4.

The individual CLDs are later converted into an integrated model in order to get additional insight on how the ecological socio-economic system is working according to the accumulated understanding of the stakeholders. Possible ideal scenarios in which the dune functions of are elaborated and possible interventions/actions which could help reach this ideal scenario are discussed. This answers research question 5.

1.5 Outline of report

The following section of this thesis presents background information.

Section 3 covers the method and procedure used to interview the stakeholders in order to elicit their perspectives on the development of beach hut constructions along the coast. Furthermore the section describes the methodology of analysis on the interview data. It also presents an analysis on the selection of relevant stakeholders which ought to be included for data gathering.

Section 4 builds up on the previous section as the interview results are presented. The perception of each stakeholder is firstly presented and the constructed mental model of the individual stakeholders is presented in the following chapter (5). Subsequently, the ambiguities of the mental models are presented and missing data gets identified after that.

In section 6 the individual mental models are combined into the integrated model and the role of the regulations for this case are explained. The discussion follows in chapter 7.

Section 8 presents the conclusions and recommendations on further research and actions for the decision-makers.

2 Background information

2.1 History

Over the past centuries, the Dutch coastline experienced major changes by both natural dynamics and human intervention. In the following section, an overview is given of the historical developments which have contributed to the current state of the Dutch coastal dunes.

2.1.1 Origin of the dunes

The formation of the dunes along the coast of the Dutch mainland began in the period between 10th and the 12th century. Three phases of dune building have been recognised (Klijn, 1981). The initial phase ended in the 13th century or somewhat later, and consisted mainly of filling-up the pre-existing relief of the coastal barriers. The main phase of dune formation is the second one, when the large parabolic dune systems were produced which determine the geomorphological character of the dune belt. The age of this phase is assigned to the period between 1450 and 1750 AD. The third phase began in the 19th century with the formation of small parabolas on the western fringe, separated from the sea by a narrow strip of fore dunes. These fore dunes came into being after 1850 AD and are for the most part artificial (Klijn, 1981). Since more than a century, man has protected the dunes against further wind action, mainly by afforestation with Pinus, and by planting marram grass (Ammophila arenaria) on exposed sites. From the geomorphological viewpoint this meant that the dunes became fossilized. To save costs and to increase the ecological variety in the dune landscape, the stabilization measures have been relaxed somewhat during the last decades, with the result that deflation and other geomorphological processes are now evident in many places along the coast (van der Meulen & Wanders, 1984). Because of this development the dunes regain their importance for geomorphological research.

2.1.2 Recent developments

In the past century, erosion of the coastline has become a concern. From 1952 till present, more than 170 nourishment projects have been carried out along the Dutch coast. Up until 1990, weak dune sections were strengthened by nourishing the beach and fore dunes (on-shore nourishment) in order to bring the dunes up to the standards laid down under the Delta Act of 1953.

Since 1990, the Dutch government implemented policies with the aim to preserve the position of the coastline as it was in 1990. Nourishment is recommended as the principle measure to counteract erosion (Rijkswaterstaat, 1990). These nourishment plans are based on long term coastal behaviour.

Nourishments compensate for the consequences of the relative rise in sea level and the structural erosion of the coast so the coast can adapt to the rise in sea level. Nourishment also makes it possible to preserve and develop the physical space for functions in the coastal area. Moreover, the continuous management and maintenance of the coast provides opportunities for making the coast more attractive and boosting its economy.

2.1.3 Present functions of the Dutch dune system

The nourishment strategy is of course to safeguard some important functions that the beach-dune environment provides. In this section we give a short description of the functions which the Dutch dunes provide.

2.1.3.1 Safety against flooding

Seventy-five percent of the Dutch coast consists of dunes. The present safety from flooding by the sea is determined by the strength and height of the dunes. Their strength depends on the quantity of sand they contain (the cross width and height of a dune). Other than the dunes, there are also hard and a combination of hard and soft (hybrid) flood defences and civil engineering structures which makes up the other fifteen percent, such as the Brouwersdam (dyke), the Noordwijk promenade (hybrid flood defence) and the Eastern Scheldt Storm Surge Barrier. The overall cross width of the dune is to a great extent determined by the quantity of sand that is blown landward from the beach. Keeping the amount of sand around the waterline at a consistent level or, in other words, maintaining the coastline also keeps the supply of sand at a consistent level. Then, if natural processes are allowed, tides, waves and wind may transport sand into the dunes. In this way, the dune can gradually and naturally adapt to the rising sea level. Maintaining the coastline helps to maintain safety for longer period.

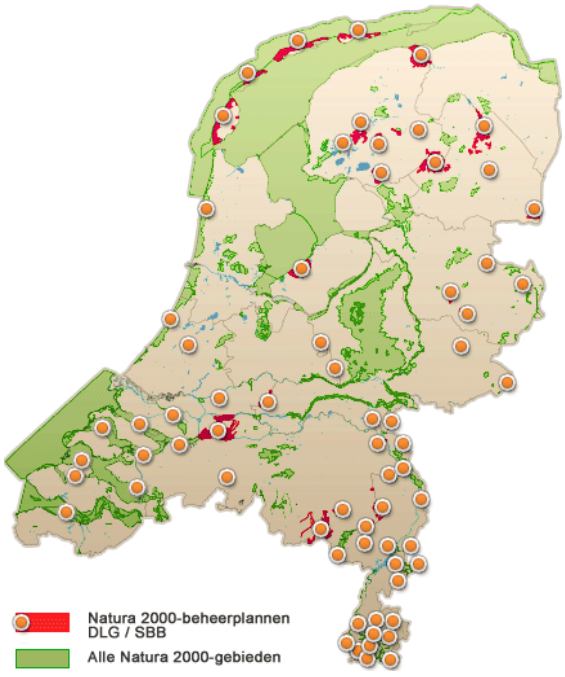

Figure 2: Overview of the Natura 2000 areas in the Netherlands. Notice that nearly the entire Dutch coast is protected by the Natura legislation.

2.1.3.2 Nature values

The nature along the Dutch coast is of international value (Ministerie van LNV, 2005). Large numbers of birds breed, rest or overwinter along the coast. The dune system is also the habitat for many other species. Many of these nature areas are protected by law in order to conserve its landscape and its biodiversity

2.1.3.3 Drinking water extraction

In the Dutch Drinking Water Act (Drinkwaterwet), the sustainable safeguarding of the drinking water supply is described as an "imperative reason of overriding public interest", which means that this public interest should in principle carry more weight than other interests (Ministerie of Transport, Public Works and Water Managment, 2010). Dunes are important for drinking water production. The fact that these unique areas enjoy protected status has ensured that nature reserves of great value and diversity have been created within these drinking water extraction areas. One example is the Amsterdam dune water area. Making coastal management more dynamic in some places can give rise to challenges that may affect the drinking water reservoirs.

2.1.3.4 Recreation and housing

As many Dutch people value the landscape of beaches and dunes, it is important to maintain its quality (Velema, 2014). The coast possesses not only ecological qualities but also a large-scale scenic quality which can be experienced by visitors and locals. The quality of being able to have an uninterrupted view of the horizon in many parts of the coastal zone is almost completely absent elsewhere in the Netherlands, especially in the area of Randstad, where almost every aspect of the living environment has been shaped by human intervention. One example of a complete change of dune landscape due to drastic urbanisation of coastal dune areas can be found along the coastline of Belgium, where tall building blocks dominate the coastal landscape. Nowadays, due to this changed atmosphere of the Belgian coast, many Belgians rather travel to the southern part of Netherlands to experience the natural atmosphere that the Dutch coastline has to offer.

2.1.4 Change in beach utilization: The increasing popularity of beach hut constructions

Recent trends indicate increasing popularity and demand for beach huts and beach pavilions (Stichting Duinbehoud, n.d.; Krommendijk, 2014). These constructions can be seen all along the Dutch coast in the summer months, especially near the coast of Holland and Zeeland. Near Julianadorp aan Zee the number of beach houses increased from 25 in 2011 to 65 in 2014 with another 25 to be added in the future. Another example is at Petten, where there are plans to add 70-100 beach huts in the near future (Krommendijk, 2014). From a short term economic perspective, it is a positive development and if managed correctly, it can improve coastal aesthetics which can also be an attraction element for visitors.

Figure 3: Beach huts

However, continuous introduction of new beach houses in the beach environment requires additional infrastructure for its use, e.g. sewage pipes, electrical wirings, roads for ease of access etc. On top of that, access roads require night lighting which puts additional stress on the nearby ecology (light pollution). With these developments along the Dutch coast, one can state that the beaches are getting urbanized. The natural characteristics which can only be found near these beaches can become lost due to this ongoing trend of beach house construction.

Furthermore, there are concerns about this recent growing trend. Studies have shown a lack of dune growth in areas where there are year-round or seasonal beach constructions (Van der Valk & Van der Meulen, 2013). Such an impact on the dune dynamics can possibly impact the functions that the coastal dunes provide to its users. Next to this, the recreation atmosphere may also undergo some decay in quality. The problems created by beach constructions are summed up below.

Dune growth: Coastal dunes are part of the beach-dune system within sediment is moved by aeolian and marine processes. Beach construction impacts the potential aeolian sediment transport to the dunes. Such hard constructions can keep sediments immobile and also alter the aeolian flow field (Arens, 1996; Arens, et al., 1995; Hoonhout & van Thiel de Vries, 2013). This results in less sediment accretion on the fore dunes. Many of the functions depend on the growth of the dunes. For instance, adequate coastal safety requires a minimum dune volume as described by the Dutch Water Act. Moreover, with the ongoing sea level rise, it only becomes more important to avoid disturbing the sediment accretion process.

Disturbance of nature: By having more beach constructions, the beach area will become more crowded and may become a disturbance to the nature values. Some bird population requires tranquillity for their nesting grounds and the introduction of beach construction near these areas brings increased human activity. These populations might seek other nesting grounds to avoid disturbance.

Recreation and housing: Even though beach constructions leads to increased recreation and economic benefits, the increased activity can lower other recreational characteristics such as the openness and tranquillity of the beach-dune environment which many beach visitors actively seek as these characteristics are largely absent in other parts of the Netherlands. Consequently, tourists/visitors may start to avoid places where the beach is littered with beach constructions. Also the local living atmosphere for the residents may change due to increased human activities near the coastal area.

While having a positive economic benefit for the local community on the short term, beach hut/pavilion construction also brings its share of associated risks. Therefore it necessary to study its impact and to determine to what extent the dune functions is affected in order to manage its development along the Dutch coastline.

2.2 Case study description

2.2.1 Governance of the Dutch coastline

To ensure sufficient protection against flooding, safety standards for all flood defences along the Dutch coast, including the dunes, the government has established certain laws (Delta Acts, 1958; Flood Defence Act. 1996; Water Act, 2009). In addition to these Acts, the Flood Defence Act and the Water Act define the requirement to preserve the Dutch coastline. The Water Act has been a management objective, when the policy of "Dynamic Preservation" has been adopted by the government, in order to stop the erosion of the Dutch coastline (MIN V&W, 2000). Since 1990, coastal erosion management has been translated into a continual nourishment policy.

Preservation of the Dutch coastline, and in this case the Dutch dunes, involves three governance levels. At the nationwide level we have the State or Ministry of Transport, Public Works and Water Management (Rijkswaterstaat). At the regional level there are the coastal Provinces and Water Boards, and at the local level there are the municipalities (fig. 4).The State has several roles: overall supervision, flood defence management at the Wadden islands and of the hard structures of the Delta program, and coastline management.

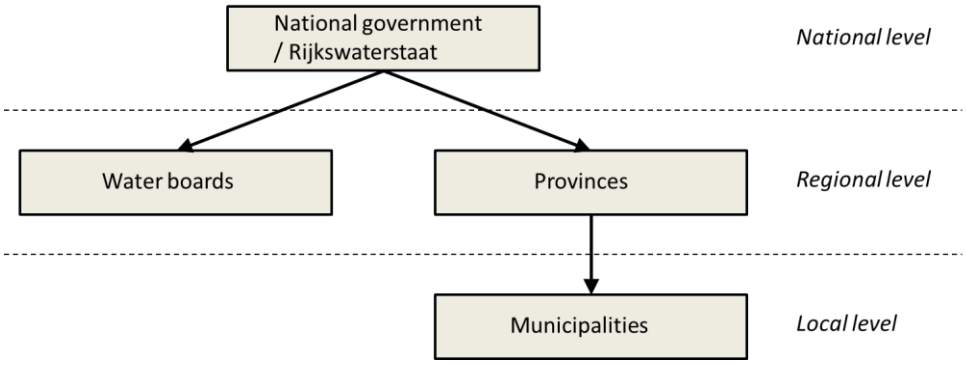

Figure 4: Governance levels related to the Dutch coastline management.

As general supervisor the State holds responsibility for (strategic) policy. The responsibility of Provinces is supervision of the Water Boards and coordination and integration of coastal policy. For the management of the coastline, e.g. the design of nourishment plans, the State looks for advice from the Provinces, Water Boards and municipalities and stakeholder organizations.

Thus, Rijkswaterstaat is responsible for the flood protection of the hinterland against high seas on the nationwide level. It is tasked to maintain the Dutch coastline at the 1990 mark: the basic coastline. This is done by means of beach nourishments. Together with the coastal provinces and municipalities, water boards and nature management organisations, Rijkswaterstaat prepares the annual nourishment programmes. It is up to the coastal provinces for the implementation of these schemes and the water boards to carry out the work (Rijkswaterstaat, 2012).

Provinces have the responsibility to translate national policies from the Ministry into regional context. The provincial governments develop regional policies and draw up regional plans setting out zoning

guidelines for the location and expansion of residential, industrial and commercial areas within cities, towns and villages. However, provinces have less responsibility in policy development for the management of coastal areas. Most of this responsibility is left to Rijkswaterstaat and water boards. But provinces do assume a partner role in the development of policies for combining flood protection functions with other functions such as nature and recreation (Interprovinciaal Overleg, n.d.).

Implementation of national policy and strategy on the environment is decentralised to the municipalities. The municipalities are responsible for preparing regulations, implementing and enforcing the regulations in the national Environmental Management Act and other environmental regulations. The Environmental Management Act covers matters such as separated waste collection, disposal of hazardous waste, air quality, and noise nuisance, and environmental permits for industrial and commercial activity.

Lastly, the coastal water boards are responsible for the management and maintenance of flood defences along the coastline. Regulations for the protection of the dunes are prepared by the water boards. These regulations vary from one water board to another, for instance the exact locations for beach hut constructions.

2.2.2 Permits for beach hut constructions

A couple of permits are required for the construction or placement of beach huts. Firstly, a WABO (All-in-one Permit for Physical Aspects) is required. The municipalities checks if the application for the permit complies with the zoning plans, construction safety guidelines, environmental impact and fire safety. Secondly, a water permit is required if the beach hut construction is to be located in front of a coastal dune. The water permit is issued by the water boards in consultation with Rijkswaterstaat. They set the requirements/guidelines to the construction, such as minimum distance between constructions, permitted construction materials, type of foundation and the exact location on the beach (sufficient distance from the dune foot). These guidelines are set to safeguard the flood protection function of the nearby dunes.

2.3 Uncertainties in managing beach hut constructions along the coast

Managing the beach hut construction development along the Dutch coastline in order to protect the beach and dune functions is a very complex issue. It needs a broad perspective where the technological, environmental, economic and societal aspects of the issues are considered simultaneously. Next to this, it also requires taking into account the views of various stakeholder groups. The uncertainty associated these types of problems makes this issue of beach hut construction a complex problem. Decision-makers (i.e. municipality, water board etc.) have to develop solutions under conditions of conflicting interests, diverse managing goals and lack of predictability. In this section the types of uncertainties related to the management of beach hut constructions along the Dutch coastline are described and explained.

2.3.1 Difference in problem perception

Stakeholders can have conflicting interests regarding the different functions of the dunes. Due to differences of interests in the various functions of the dunes, stakeholders may frame the issue of beach construction in different manners and this leads to ambiguity.

Ambiguity is an unavoidable characteristic of a participatory process where different groups of people are engaged in some sort of collaboration. It refers to a distinct type of uncertainty that emerges from the simultaneous presence of multiple and sometimes conflicting ways of solving a problem (Brugnach & Ingram, 2012). Under the presence of ambiguity it is difficult to objectively frame the problem. Ambiguity implies that a problem can be approached and interpreted in many ways and that there are no clear criteria to distinguish between valid and less valid interpretations.

Weick, (1995) describes ambiguity not as a lack of information, but as multitude possible interpretations of a situation. For instance, Brugnach et al. (2008) gave the following example; situations with water shortage can be framed as a problem of insufficient water supply for one actor or one of excessive water consumption for another actor. The formulation of a problem in a different way will point out distinct preferences and point towards other solutions. In the case of insufficient water supply as the problem frame, actors will look towards dam construction to retain water as a technical solution. On the other hand, if the problem is framed as excessive water consumption, focus would be set on limiting water extraction. For this case, a comparison can be made in terms of the different problem interpretations that come from beach hut development. As there are many stakeholders involved in the development of beach huts along the coast, some may see, or acknowledge different effects than other stakeholders.

2.3.2 Modelling

Besides the uncertainty regarding the different problem perceptions of stakeholders, researchers are still unable to accurately model aeolian sediment transport in a coastal dune environment (Muller, et al., 2012). Due to the inability to accurately model the sediment transport in the coastal environment, it remains difficult to determine dune volume changes over a period of time. Even more so with added structures such as beach huts to the dune environment. This gap in knowledge regarding the physical changes of the dune environment may contribute to less than optimal management practices by the decision makers.

3 Methodology

3.1 Introduction

The case study requires a method that can describe and analyse the differences and overlaps in problem perception between stakeholders. The present chapter gives an overview on the chosen method and elaborates the data gathering and analysis procedures that has in order to answer the objectives stated in chapter 1. And finally, section 3.4

3.2 Research strategy

For this study, the coastal dune environment will be viewed as a social-ecological system, where system knowledge among stakeholders is important. A social-ecological system is defined as a system of both social and biophysical factors that interact in a resilient and sustained manner. Social-ecological systems are defined at multiple spatial and organization levels, and show dynamic complex behaviour with continuous adaptation (Redman, et al., 2004).

The possible variety and conflicting interests of the stakeholders involved with the beach constructions along the Dutch coastal dune environment and the lack of clarity on the long-term effects of policy interventions results in ambiguity among stakeholders. Therefore, improved system understanding can lead to better long-term management by local stakeholders (Brugnach & Ingram, 2012).

In the past, many studies were done in the field of water management regarding the system understanding of stakeholders (Lynam & Brown, 2011). More recently, Giordano & Brugnach (2016) used Causal Loop Diagrams to describe the perceived socio-ecological system dynamics of the relevant stakeholders. This approach is to be used as the basis for this study in order to increase our understanding of the stakeholders' perspectives with respect to the Dutch coastal dune system. Accordingly, a mental model analysis will be applied to increase our understanding of stakeholders' perspectives and to identify overlaps and/or mismatches.

Mental models are not to be confused with conceptual models. A mental model of a person refers to a type of knowledge that is often implicit, incomplete, imprecise, and incoherent with normative knowledge in various domains (Greca & Moreira, 2010). However, it is a useful model to the person (stakeholder), as it results in a powerful explicative and predictive tool for the interaction of subjects with the world, and a dependable source of knowledge, for it comes from the subjects' own perceptive and experience with this world.

The unstructured nature of problems in complex, multifunctional systems, such as the Dutch coastal beach-dune system, may result in the creation of a large range of mental models. When the stakeholders involved in a problem are not adequately participating into sharing each other's mental models early in the problem solution process (i.e. the process of decision-making which can ultimately affect the interests of all stakeholders), implicitly developed mental models could be insufficient to legitimise the preferred solution to a problem (Kolkman, et al., 2005), as the knowledge and assumptions used to reach the solution may not be accepted by all stakeholder involved in the process.

Comparison between the stakeholder's mental models can reveal points of conflict which can later on be addressed for the purpose of creating broadly supported solutions.

As the aim for this study is to create a balanced development scenario with regard to beach hut construction that pays optimal attention to all functions involved, the process of mental model elicitation will contribute in exploring similarities and differences between stakeholders' understanding of an issue in order to improve communication between stakeholders (Abel, et al., 1998) and to develop more socially robust knowledge to support negotiations over unstructured problems in complex multifunctional system (Kolkman, et al., 2005).

For this thesis, mental models of the stakeholders within the Dutch coastal dune environment will be elicited. A stakeholder analysis is performed, in order to assess their values, interests in functions and to assess their system understanding and perspectives of their environment. The study of the ecological and social subsystems requires rich data, which may be found within the mental models of experts and local actors, using a qualitative approach. For this purpose, semi-structured interviews are conducted to gather the information required for mental model construction and validated.

3.3 Research steps

Firstly a stakeholder analysis is preformed to identify stakeholders groups who have a legitimate stake in the issue of beach hut development along the Dutch coast. These stakeholders have influence or are affected by the ongoing trend of beach hut construction. Due to their stake with this issue, they have been selected for an engagement with interviews.

In the beginning of this study, there was little contact information on persons who can represent the selected stakeholder groups, and therefore we relied on a contact at Rijkswaterstaat to provide us with contact information of possible stakeholder representatives who are somewhat involved with the issue of beach construction along the Dutch coastline. Other stakeholder representatives, specifically various beach hut rental business were contacted by phone. Afterwards a formal invitation letter was sent to each stakeholder representative in order to set a date for the interviews.

Besides the selected stakeholders from the stakeholder analysis, it was also possible to include other stakeholders that were overlooked prior to the stakeholder analysis process. This was the case with Stichting Strandexploitatie Veere (SSV). During the interview period, there were multiple stakeholders who suggested approaching SSV to get their "on-site" perspective on beach hut development.

The interviews were formatted in the form of semi-structured interviews where questions are asked to the stakeholder representatives and they have the opportunity to answer the question and build upon their answer. This way the researcher will get a more complete picture of the stakeholder's perception. The interview questions revolve around four topics relevant for the creation of the stakeholder's mental model. The topics are: characteristics and functions, influence of beach huts on functions, role of authorities and their policies, and lastly the knowledge about aeolian sediment transport.

From the interview data (answers from the stakeholders on the interview questions) a comparison is made between the answers on each question. Then specific factors are identified that can capture

information for the specific topics elaborated during the interviews. E.g. for “Characteristics and Functions of Coast”: “Nature”, “Openness”, “Beach Activities”, “Synthesis Nature and Development” etc. These factors are compared and analysed in combination with the interview answers to see on which other factors they depend on or influence. In others words, this analysis will bring up any correlation between the factor if there are any. Thus their mental model of the beach-dune environment is elicited.

These mental models are then visualised in the form of causal loop diagrams (CLDs). A CLD is a causal diagram that aids in visualizing how different variables of the perceived system are interrelated. The diagram is composed of sets of nodes (variables) and links. The links represent a relation between the two variables. A link with a positive mark indicates a positive relation while a link with a negative mark indicates a negative relation between their respective variables. A variable connected with a positive link would increase, if the variable at the other side of the link also increases. Vice versa, a variable connected with a negative link would decrease if the variable at the other side of the link increases.

Closed cycles in diagram are meaningful features of the CLDs. Closed cycles can either work as a reinforcing or balancing loop, i.e. feedback within the system. A reinforcing loop means that if a variable increases within the cycle, the effect through the cycle will return an increase to the same variable and vice versa. A balancing loop on the other hand means that if a variable increases in a balancing loop, the effect through the cycle will return a decrease to the same variable, and conversely a decrease in the initial variable would return an increase.

To validate the results, the individual CLDs were sent to the respective stakeholder. The CLDs were sent via email together with their system’s working description and a description on how to “read” a CLD.

Ultimately, the individual validated CLDs which represent the mental model of the stakeholders are combined into one integrated model. The integration uses common variables from the individual CLDs as the basis for the creation of the integrated model. The problem core variable of each CLD is then also added to the integrated model along with other variables. This integrated model gets to be used for the formulation of scenarios in which mechanisms are incorporated for the realization of an equilibrium system development. An equilibrated system state implies that the quality of the relevant functions of the ecological socio-economic system gets to be preserved.

Besides improving the overall understanding of the system, other potential benefits in mental model mapping are:

- Identification of blind spots in knowledge and solutions produced by regulatory science and group thinking.
- The revealing of experiences, perceptions, assumptions, knowledge that fits into frames of diverse stakeholders, in order that the knowledge can be of use to the stakeholders.
- Better insights into possible and desirable problem solutions.

3.3.1 The study area

As mentioned above, stakeholders within the Dutch coastal dune environment are the source of data and from this data will the mental models of each stakeholder or stakeholder group be constructed. As a first step, a specific location has to be selected, based on the following criteria's:

Natura 2000 and residential areas border the beach areas with beach house construction.

Considered beach areas should be somewhat vulnerable to coastal erosion (in many cases they are relatively small beaches protected by groynes)

From these criteria, Oostkapelle, Zeeland and its general location was selected as the study area.

Figure 5: Satellite photo of the beach huts near Oostkappelle, a town within the municipality of Veere.

Oostakepelle is a village in the Dutch province of Zeeland and is part of the municipality of Veere. It lies about 10 km North of Middelburg. This location was selected due to its proximity to Manteling van Walcheren, a Natura 2000 protected area north of the village. The presence of a Natura 2000 area requires cautious planning and management of nearby development in order to prevent any negative impacts on the Natura 2000 designated zone. Thus, this section of coastline meets the selected criteria's.

3.4 Stakeholder selection

3.4.1 Potential stakeholders

In the literature there are many definitions of what a stakeholder should be; in which cases or under what circumstances can a certain individual or organization be considered a stakeholder to an issue. Because any group or individual can be a stakeholder to a certain issue, there is a need to have a definition of what a stakeholder is in this case in order to narrow down the field of stakeholders. For this research we apply Clarkson's (1994) definition of stakeholder: "a stakeholder bear some form of risk as a result of having invested some form of capital, human, or financial, something of value, in a firm" or "are placed at risk as a result of a firm's activities" (Clarkson, 1994). In this case we are not talking about a firm, but on the issue of the management of the Dutch coastline with respect to beach hut construction.

Before we begin sorting out who are the relevant stakeholders in this case, we must identify all the potential stakeholders who have a stake (invested some form of capital or put in some form of risk) in this ongoing trend of beach hut construction along the Dutch coastline. As already mentioned above, Rijkswaterstaat, the Provinces, Water boards and the Municipalities have important roles in preservation of the Dutch coastline and are bounded by law. Furthermore, the Dutch coastal dune areas are also protected by the Natura2000 legislation, which puts nature managers as stakeholders in this coastal setting. Table 1 provides an overview of all the potential stakeholders related to the case of beach constructions along the Dutch coastline.

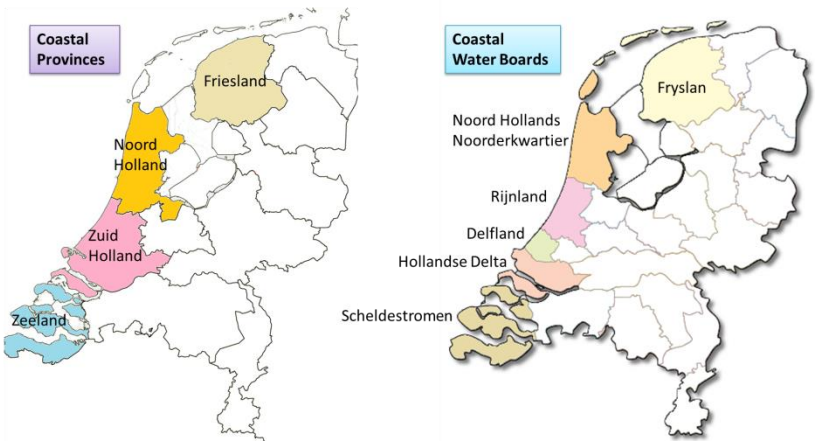

Figure 6: Map of the Dutch coastal provinces on the left and a map with the coastal water boards on the right.

Beach hut owners and renters, local residents, beach visitors, local businesses are examples of stakeholders who are placed in some kind of risk as a result of the decisions made by the governmental authorities with respect to the management of beach hut construction. These entities have little direct influence on the decisions made by the authorities, but at the same time experience first-hand the consequences of these decisions. The amount of beach huts the beach hut owners may place depends on the policies of the Water boards and municipalities, while residents may experience a change in their living environment as the beach-dune environment becomes more 'urbanized' with beach huts. As the

physical beach-dune environment changes, so does its attractiveness as a holiday destination which might influence its recreational appeal to potential visitors.

Stakeholders	Role
Rijkswaterstaat	Overall supervision of coastline management and strategic policy.
Provinces	Supervision of the water boards and coordination and integration of regional policy.
Water boards	Daily management of the flood defence structures and sandy coastlines. Issues water permits for constructions in front of the dunes.
Municipalities	Supervises the local development according to the zoning plans (spatial policy).
Consultants/experts	Provides advice for the management of the coast.
Beach hut owners	Use beach hut for private use
Beach hut rental companies	Rents out to consumers for financial gain
Nature managers	Supervises areas protected by Natura2000
Local residents	Concerned with their living environment
Visitors (beach users)	Recreationists that support the local economy
Local businesses	Service providers to local consumers

Table 1: Potential stakeholders related to the case of beach hut constructions.

Figure 7 shows the hierarchical map of the stakeholders. It illustrates the relationship between each stakeholder within the system. The relationships depend on their role and responsibilities. The governmental authorities are logically at the top as they are the decision makers. Each governmental authority is responsible for different aspects in the decision making process. Ultimately it is up to the water boards and municipalities to prepare the regulations and enforce them. This is done by granting water permits and WABO permits to the beach hut owners. These permits allow beach huts to be constructed following certain guidelines.

Construction of beach huts can impact the functions that the beach-dune environment. As these functions are impacted, so does the society who has vested interests on these different functions.

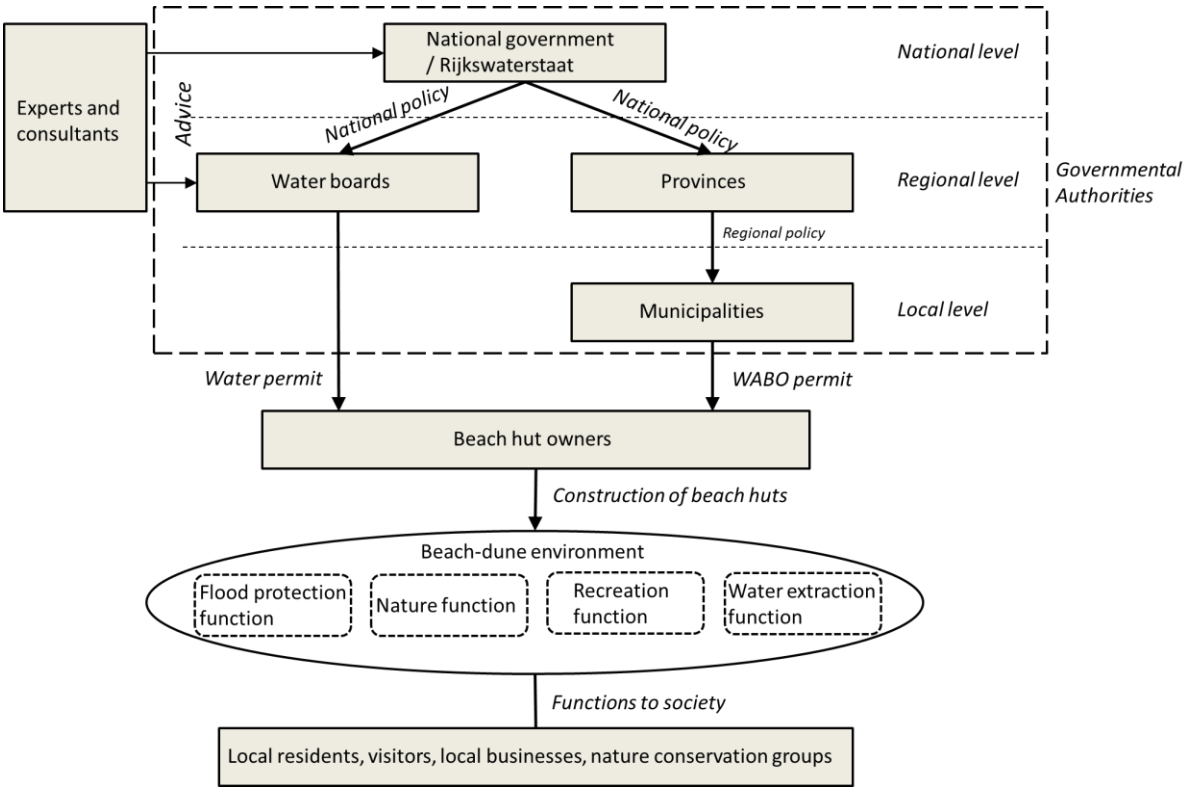

Figure 7: Stakeholder relationships regarding beach hut constructions along the Dutch coastline.

3.4.2 Stakeholder classification

As not all stakeholders are equally important, we can narrow the range of stakeholders within this setting to identify which ones have high salience to the manager. Salience is defined as 'the degree to which managers give priority to competing stakeholder claims'. Each of these stakeholders can have one or more of some sort of attributes (power, legitimacy and urgency) which helps the manager narrow the list down and exclude stakeholders that have no salience in this case to the manager (Mitchell, et al., 1997).

Stakeholders with the power attribute have the ability to bring about the outcomes they desire. In a social setting, where one social actor, A, in possession of this attribute can get another actor, B, to do something that B would not otherwise have done. 'Legitimacy' attribute is defined as "a generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs, definitions" according to Weber, 1947. Urgency is another independent variable in which helps us with stakeholder identification and determine their salience. Urgency can be defined as: the degree to which stakeholder claims call for immediate attention. This attribute can be broken down in two attributes: time sensitivity (the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder), and criticality (the importance of the claim or the relationship to the stakeholder).

		Stakeholder attributes		
#	**Stakeholders**	**Power**	**Legitimacy**	**Urgency**
1	Rijkswaterstaat	x	x	x
2	Provinces	x	x	
3	Water boards	x	x	x
4	Municipalities	x	x	x
5	Consultants/experts		x	x
6	Beach hut owners		x	x
7	Beach hut rental companies		x	x
8	Nature managers		x	x
9	Local residents		x	
10	Visitors (beach users)		x	
11	Local businesses		x	

Table 2: Attributes of the stakeholders.

These attributes help define the perceived salience of each stakeholder from the point of view of the manager (fig. 8). Rijkswaterstaat, the water boards and the municipalities are classed as 'definitive stakeholders' in the issue of beach constructions along the coast, due to their lawful responsibility to safeguard the primary function (flood protection) of the dunes. Their ability and responsibility to develop policies and enforcing them gives them 'power' and 'legitimacy' attributes and at the same time they have an urgent claim in managing the beach hut construction along the Dutch coast. This makes them stakeholders of high salience to the manager/researcher.

Provinces are classified only as 'dominant stakeholder' due to their indirect relation with the management of the coastline. The coastal provinces have power in the decision-making process as these provinces are the governmental authorities that develop the regional zoning plans for commercial, nature, recreation etc. and having this responsibility by law makes them a 'legitimate' stakeholder. But with no critical claim in the decision making process regarding the management of the Dutch coastline gives them a lack of urgency. Thus their influence in the decision-making process is assured since they have both 'legitimacy' and 'power' attributes, but without the sense of urgency, their salience to the manager is slightly less compared to the 'definitive stakeholders'.

The 'dependent' stakeholders class is compromised of the other moderate salient class of stakeholders, which include consultants/experts, the beach hut owners and renters, and nature managers. They are limited in having power as they are not included in the decision-making process for the management of beach hut constructions, thus depend upon others for the power necessary to protect their interests.

Local residents, visitors and local businesses are at risk of the changes beach hut construction might bring to the environment. This perceived risk makes them a legitimate stakeholder in the eyes of a manager. But with little influence in the decision-making process and with relevantly little sense of urgency makes them 'discretionary' stakeholders. These three stakeholders that are in possession of only one attribute have low salience to the manager.

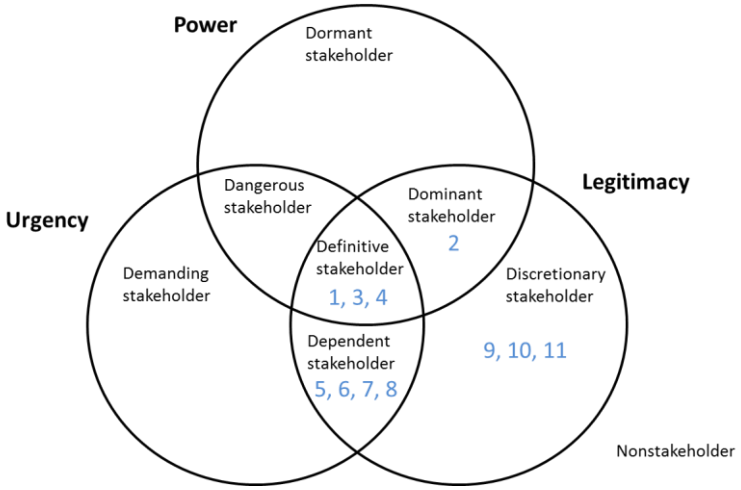

Figure 8: Stakeholder classification according to their attributes.

Figure 8 visualizes the absence of stakeholders that possess either solely the 'power' or 'urgency' attribute, or both. From figure 8 it is clear that all of the stakeholders have a legitimate claim in the issue of management of beach constructions along the Dutch coastline as they all have either a legitimate responsibility in protecting the functions of the dunes or have some kind of risk if these functions are affected. Other than the main governmental authorities, no other stakeholders have the power to influence the decision-making process regarding the management of beach constructions. At the same time it is the consultants/scientists, beach hut owners and renters, and nature managers that depend on the governmental authorities to make decisions which protects their interests in the functions of the dunes. And while the discretionary stakeholders also rely on the decision-makers to keep into account their interests in the dune functions, their urgency to the issue is somewhat less than the dependent stakeholders.

We can further visualize the stakeholder stance regarding the beach hut construction issue along the Dutch coast. Stakeholder power-position and power-interests position is visualised in figure 9. The position of each stakeholder within these matrixes is based on the opinion of the author and might not be the case in reality. These matrixes help the author to prioritize the stakeholders in order to concretize their salience.

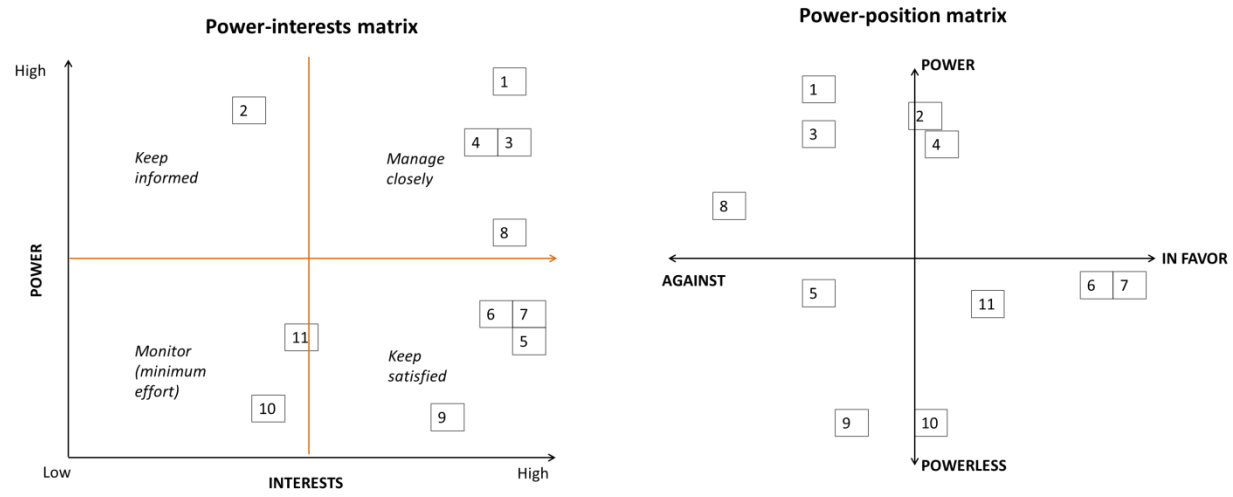

Figure 9: The diagram to the left shows the perceived interest of the stakeholders, and the diagram to the right shows the stance of each stakeholder regarding beach hut constructions.

Most stakeholders presented in this case have high interests (fig. 9) in this issue due to their responsibility and risks. Only the provinces, local businesses and visitors are labelled as stakeholders with somewhat lower interests. In other words, they are not actively involved in the outcomes of the decision-making process. The assumed stance, shown in the left figure shows that only beach hut owners, renters to a lesser extent local businesses have a positive attitude towards beach hut construction along the coast due to their monetary interests of this development. On the other hand, the authorities responsible for protecting the flood protection and nature function of the dunes have a more negative stance on this issue. For a manager it is interesting to get information from stakeholders with high interests and extreme stance.

The stakeholder list can therefore be narrowed down to: *Rijkswaterstaat, provinces, water boards, municipalities, beach hut owners, nature managers, local residents and visitors, consultant/scientists, beach hut developers and local business.*

4 Data gathering and mental model construction

4.1 The interviews

As indicated in chapter 3, interviews were held with relevant stakeholders and it revolved around 4 topics in order to facilitate the creation of the individual mental models. The interviews were conducted in the months of December, January and February 2015-2016. Seven stakeholders were interviewed - officials from the municipality of Veere, province Zeeland, water board Scheldestromen and Rijkswaterstaat. Representatives from Stichting Strandexploitatie Veere and Zeeuwse Milieufederatie along with a visitor were also interviewed. Beach hut owners and local residents were eventually excluded due to lack of interest.

The semi-structured interviews were conducted in the Dutch language, took approximately 1 hour, and were recorded and transcribed. A standardized interview protocol was used (appendix B). During the interview sessions, the interviewees were asked to elaborate on their valued characteristics of the Dutch coast, impacts of beach construction on the beach-dune environment, the roles of authorities on the management of beach hut construction and lastly, the impact on aeolian sediment transport. For this chapter, the different perceptions of effects on the dune environment due to beach development and the perceptions about the regulations related to beach housings are identified and examined.

In the following sections a pre-analysis is firstly given with the aim to elaborate about each stakeholder's position on the research questions 2 and 3, i.e. the perceived impacts on the dune environment and their position on the present regulations on beach hut development (section 4.2 and 4.3). In sections 4.4 the constructed individual mental models are presented and described. Afterwards in section 4.5 the main differences and similarities between the mental models are presented.

4.2 Interview summary: perceived effects on the dune environment due to beach hut development

The questions during the interviews mostly revolved around their perception regarding the impacts of beach hut construction on the functions and characteristics of the dunes, and their perception about the regulations related to beach hut development along the Zeeuwse coast. Table 3 summarizes the perceived physical impacts on the dune environment from the point of view of each stakeholder.

It appears that there is ambiguity regarding the effects of beach hut construction on the beach dune environment in terms of the extent of the physical impact. From the interviews it appears that all of the interviewed stakeholders are aware of certain possible impacts that the construction of beach huts can have on the dune environment, either physical and/or socio-economical.

Regarding the physical impact(s) on the dune and its environment, gemeente Veere, provincie Zeeland, Stichting Strandexploitatie Veere (SSV) and the visitor responded that they are aware of possible physical impacts on the dune and its environment and the importance of aeolian sediment transport for the dunes, however the impacts are perceived to be not so significant. Provincie Zeeland and SSV find the removal of beach huts for the winter month sufficient enough to keep the dunes growing, as it gives enough time for the aeolian sediment transport to strengthen the dunes. As a matter of fact, SSV stated

that even the densely developed beaches along the South West coast of Veere are getting narrower due to dune growth.

Rijkswaterstaat and water board Scheldestromen on the other hand find that the placement of beach huts can have a significant impact on the dunes, in the sense that it negatively affects its flood protection function. As with the other stakeholders, Rijkswaterstaat and water board Scheldestromen argues that the placement of beach huts can impede the aeolian sediment transport process as the beach huts can be seen as a barrier for this process. Furthermore, both of these stakeholders raised concerns regarding beach construction on piles (either beach huts or pavilions) that are too close to the dune foot as they observed the formation of scour holes beneath this type of construction, next to the pile foundations. Close proximity to the dune foot might also weaken the dune in terms of its stability. Therefore the distance between beach huts and the dune foot is of great concern to Rijkswaterstaat and Scheldestromen. These local morphological disturbance observations are also supported by the perspective of the consultant (Hoonhout & van Thiel de Vries, 2013). Other than the above mentioned physical impacts, the consultant and the Zeeuwse Milieufederatie point out that the vegetation growth on the dunes might change due to the interference of aeolian sediment transport, as the vegetation would receive less than average mineral quantity from the blown in sand.

SSV furthermore stated that in their experience from multiple cases, that dune growth can eventually “swallow” the pile foundations of year round beach pavilions which are placed in close proximity to the dune foot. This often leads to the displacement of the beach construction further seawards (minimum distance from construction to dune foot guideline within the water permit), because it is often forbidden to remove sand from to dune foot. The displacement of the beach constructions further seawards also leaves less recreation space for the day visitors. Thus the dune growth combined with the displacement of beach constructions takes beach space away from the day recreationists.

Physical impact on the dune environment due to beach hut construction

Stakeholder	Awareness of physical impact on the dune environment	Perceived physical effects on the dune environment
Gemeente Veere	Yes, but insignificant	Beach huts can form a barrier for the sediment transport, thus sand will accumulate in front of the beach huts. However, the effects on the long term are insignificant as the beach huts are not placed in rows along the coast of Veere.
Provincie Zeeland	Yes, but insignificant	The main effects are a change in the quality/experience of the beach and safety against flooding. In the case of beach pavilions, its year round presence prevents dune foot growth, and the effects are only local. Seasonal beach huts on the other hand allow maximum sediment transport during the winter months.
Rijkswaterstaat	Yes	The placement of beach huts can undermine the stability of the dikes/dunes. Erosion can cause holes in the dikes and dunes. It can also lead to a situation that sand gets deposited in places where it is not wanted. Or that the sand is unable to flow away and keeps accumulating.
Stichting Strandexploitatie Veere	Yes, but insignificant	Nourished sand flows towards the dune and as a result the dune grows. Beach huts have an effect on the sediment transport. However, the dunes keep growing, especially with the nourishment scheme in place. A 6 month open beach is sufficient to guarantee dune growth. There are parts of the beaches that are eroding, but that is due to storms, proximity to the navigation channel, currents etc. However, the dunes aren't negatively impacted by the beach huts.
Visitor	Yes, but insignificant	Aeolian sediment transport is the only process that transports sediment towards the dunes. It is important for the dune growth. Beach huts can form an obstacle for this process, but the effects on the dunes are insignificant.
Waterschap Scheldestromen	Yes	Beach huts can form an obstacle for the sand transport. In one case, scouring holes developed around pile foundations. Sufficient space should be kept between the scour hole and the dune foot.
Zeeuwse Milieufederatie	Yes	The dunes will become less dynamic due to interference of aeolian sediment transport and vegetation might change.
Consultant	Yes	Significant impact on local beach and dune morphology if beach constructions are placed close to each other. Also vegetation growth might be affected.

Table 3: Physical impacts on the dunes due to beach hut development as perceived by stakeholders.

Other perceived impacts that the stakeholders brought forward is the increased vehicle traffic and logistical issues related to the check in and check out dates of beach hut renters, loss of diversity in terms of the different characteristics of the beaches, and less recreational space and nature deterioration. These types of impacts don't directly affect the dune strength, but nevertheless are of importance for the recreational function of the beach-dune environment.

Province Zeeland and SSV pointed out that continuous development of beach hut constructions will lead to a loss in the diversity of the Zeeuwse and Veerse coastline. Zeeland benefits from the divers types of beaches along its coastline and it is this diversity that helps attract the tourists (Kuipers & Raaijmakers, 2015). The province and SSV argued that the placement of beach huts all over the coastline may take away the diversity characteristic off the Zeeuwse coastline. The loss of beach space is another common concern brought up by the province and Rijkswaterstaat. They argued that it leaves less space for the day recreationists.

Other impact(s) on the dune environment

Stakeholder	Perceived effects on the dune environment
Gemeente Veere	Increased vehicle traffic and logistical issues on check in/check out dates of the company rented beach huts. Might change the image of the Veerse coast.
Provincie Zeeland	Diversity and uniqueness of the beaches can be lost in terms of its image. Secondly, locals and visitors might feel that the beach becomes privatized.
Rijkswaterstaat	Continuous development might lead to a situation where beaches become less wide as they take up beach space. Increased number of beach huts might also lead to shorter nourishment periods.
Stichting Strandexploitatie Veere	Diversity of the beaches along the Veerse coast will be lost.
Visitor	May have a small effect on nature.
Waterschap Scheldestromen	Affects nature, new beach huts create a visual quality gap and adds pressure to change the nourishment schemes.
Zeeuwse Milieufederatie	Loss of bird breeding grounds and deterioration of landscape values.
Consulant	*No opinion on non-physical effects*

Table 4: Other mentioned effects of beach hut development on the dune environment as perceived by stakeholders.

While all of the interviewed stakeholders are well aware of possible adverse effects from beach hut constructions on the dune and its environment, only the water board, Rijkswaterstaat and consultants view this development as potentially harmful to the dune stability. Their standpoint on this issue most likely comes from their role as institutions that are responsible for the flood protection function of the coast. Other government institutions see this development in a less negative light. Nonetheless they are also somewhat cautious as continuous addition of beach huts can tarnish the image of the Zeeuwse coastline which can make it less attractive to tourists. For example, recently the municipality of Veere has put a stop to this development. However, they might continue in the future depending on the local political climate and the acceptance of the local population.

4.3 Interview summary: perception of the different stakeholders regarding the regulations for beach housings

Presently, there are many regulations which the authorities use to manage coastal developments, including beach hut constructions. These regulations range from spatial policies, zoning plans, nature protection laws to policy rules for the placement of beach huts (Kuipers & Raaijmakers, 2015). Stakeholders were asked whether they have a strong opinion about any policy which may not be to their liking. Their responses are summarized in table 5.

At the moment, the individual municipalities are able to create their own spatial policies and zoning plans without much oversight from the province. ZMF for instance pointed out the lack of enforcement from the province in conserving the Natura 2000 designated areas, e.g. Sophia strand and Vrouwenpolder (Appendix C). Province Zeeland and water board Scheldestromen suggested that the creation of a common vision, which includes all the governmental bodies and nature organizations, would be more efficient in the management of the coastal developments with regard to spatial development.

Rijkswaterstaat and SSV also raised some concerns regarding the recreational period and nourishment schemes. From the flood safety point of view, Rijkswaterstaat argued that in other parts of the Netherlands, the nourishment season has become shorter due to an extension of the recreational period, which is the period in which beach hut placement is allowed (Arcadis, 2010). Shorter nourishment seasons permit less time for the natural process of aeolian sediment transport to take place. It also complicates the schedule of dredging operators as they become less flexible with their dates. SSV argued from a recreational standpoint, nourished sand often gets blown away when the beach is nourished at the beginning of the winter season. SSV also added that nourishments right before the start of the recreational season can interfere with recreation activities and setup of the beach huts. From their perspective, it is desirable that the dredging operators do the nourishments right before springtime when wave action has subsided and beach recreational activities are still at a minimum.

Another issue that SSV has brought up is the type of nourishment scheme often applied along the Veerse coastline. They observed that beach nourishments makes the beach wider and creates more recreational space, while offshore nourishments barely contribute to the widening of the beaches. While beach nourishments are the most welcomed nourishment scheme for SSV, Rijkswaterstaat often settles for offshore nourishment instead. The “basiskustlijn” is thus kept in place, while seaward dune growth together with beach hut placement results in narrower beaches for recreational use.

With regard to the flood protection function of the dunes, Hoonhout & van Thiel de Vries argued that local morphological disturbances can affect the stability of a dune and suggest to apply a minimum distance of 5 meters between dune foot and beach parcels. Presently, the policy guidelines of water board Scheldestromen requires a minimum distance of only 2 meters between the dune foot and beach parcel (Waterschap Scheldestromen, 2012). Hoonhout & van Thiel de Vries furthermore suggests that year-round beach constructions should be allowed as there is no observable difference regarding impacts on dune growth compared to seasonal beach constructions. Other suggestions are the

introduction of minimum space between beach constructions and limiting their dimension to allow sufficient sediment to flow through.

Stakeholder	Opinion regarding present regulations and policies related to beach hut development.
Gemeente Veere	*No opinion*
Provincie Zeeland	Each Zeeuwse municipality has its own vision and plans for their own beaches. The creation of a common vision between the municipalites, province and water board is essential to better manage the developments along the coastline.
Rijkswaterstaat	The recreational period may not be extended as it gives less time for sand to be blown into the dunes and to keep the risk of flooded beach hut construction low. Have only 1 row of beach huts to leave more room for other beach users.
Stichting Strandexploitatie Veere	The lack of uniformity in the policies of the different water boards. The basiskustlijn is maintained, but the dune foot moves seaward which results in an ever smaller beach. Preference for beach for beach nourishment instead of offshore nourishment.
Visitor	*No opinion*
Waterschap Scheldestromen	There is a lack of a common vision for the Zeeuwse coast.
Zeeuwse Milieufederatie	Nature conservation policies are not enforced (Natura2000)
Consultant	No observed difference regarding dune growth when comparing year-round with seasonal beach constructions. Keep a distance of at least 5 meter between dune foot and beach parcel to promote dune growth. Keep a distance of at least 1 time the beach construction width to minimize the interference of sediment transport by the buildings. Limit the dimensions of the constructions to guarantee sufficient "permeability" for the sediment to flow through. Explicitly advise about the effects of the use of beach constructions within the water permit.

Table 5: Opinions regarding present regulations and policies related to beach hut development as perceived by stakeholders.

5 Mental models of individual stakeholders

As stated in the beginning of this chapter, the interview protocol revolved around the topics regarding the valued characteristics of the Dutch coast, impacts of beach construction on the dune environment, the roles of authorities on the management of beach hut development and lastly, the impact on aeolian sediment transport. The responses on the questions from these topics have aided in the construction of each interviewee's mental model of the perceived socio-ecological system.

5.1 The individual frames

5.1.1 The municipality of Veere

According to the interviewee of the municipality of Veere, the core problem in the issue of beach hut construction along their coastline is the "society's resistance" to beach hut development. The municipality of Veere's standpoint is that it is the society that benefits from the additional economic activities that the beach hut development business brings and with less resistance from the society, will only contribute to the local economy and their livelihoods. During the interview I have learned that the municipality of Veere has put a halt to the beach hut development along their coastline, despite its contribution to the local economy. The main reason for this is to give the residents some time to give their feedback on the present state of their coastline.

According to the constructed mental model of the municipality of Veere, it is the society's acceptance, the political environment (local governing political party) and the financial attractiveness of beach hut development towards entrepreneurs that are important factors within the system. These three variables are influential to the political support which in turn influences the municipality's attitude towards beach hut development. According to the municipality, the political support is the main driving variable which influences the position of municipality on beach hut development. If beach hut development is allowed, the municipality expects three types of effects. Firstly, the available public space according to the municipal zoning plans would decrease. Secondly, human and vehicle traffic on the beach would increase. This is because beach hut renters need to check-in/check-out along with their entire luggage on check in dates. Thirdly, the quality of the unique characteristics of the coast would decrease as the beaches become more built up. These perceived effect depend largely on the municipality's attitude towards beach hut development.

From the three effects, feedbacks within the system can be observed. As the driving force for beach hut development, the municipal attitude towards beach hut development can be influenced by the positive impact on the local economy (1). This feedback loop is a reinforcing loop, where a positive municipal attitude would lead to more development and a stronger local economy which reinforces the municipal attitude towards beach hut development. To counteract this cycle, there is the municipal zoning plan loop (2), which is a balancing loop, where more beach huts would lead to less space for the municipality to give out. Besides the available space cycle, there is a second balancing and third loop which expresses the image of the coastline (human traffic on beach and the unique characteristics of the coastline) which can lead to increased societal resistance when beach hut development is ongoing (3 - 4). Societal resistance decreases political support for beach hut development. This balancing loop is probably the most influential as it entails the core problem for the municipality.

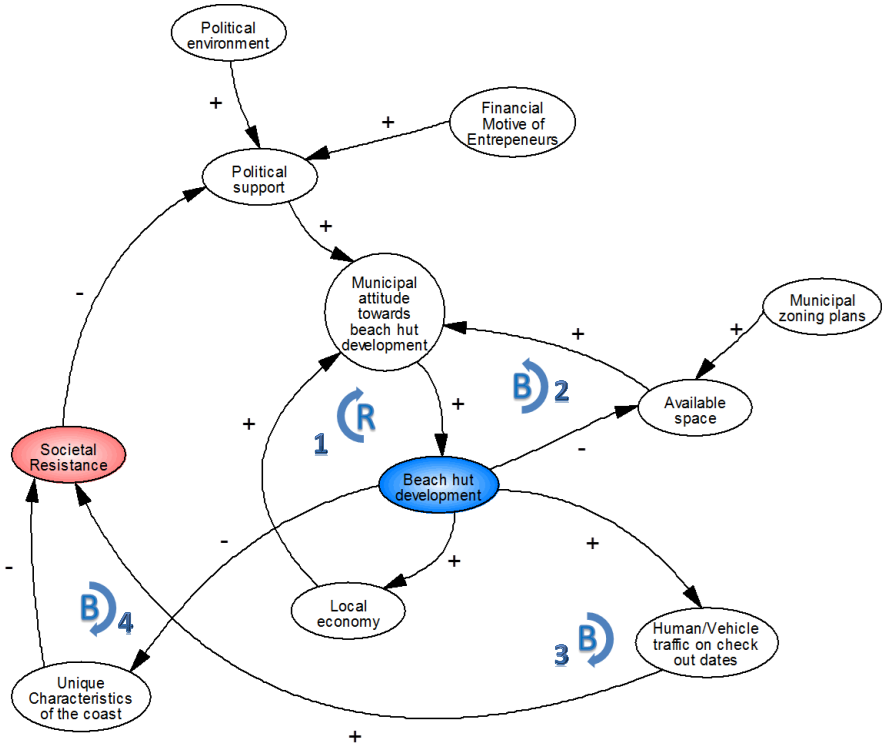

Figure 10: CLD representing gemeente Veere problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

Without the society's resistance balancing loop, it remains doubtful that the spatial planning balancing loop would be sufficient to safeguard the nature function of the coastline, as there is much room for interpretation of the provincial spatial plans. In addition, the society's resistance balancing may have a large delay in comparison to the other loops.

5.1.2 Province Zeeland

During the semi-structured interview with the representatives of Province Zeeland, it became apparent that the Province is mostly concerned with a balance between recreational development, nature conservation and flood protection. This variable is the most important for the province as Zeeland depends largely on recreation to boost tourism and the regional economy, flood protection against high water and nature conservation.

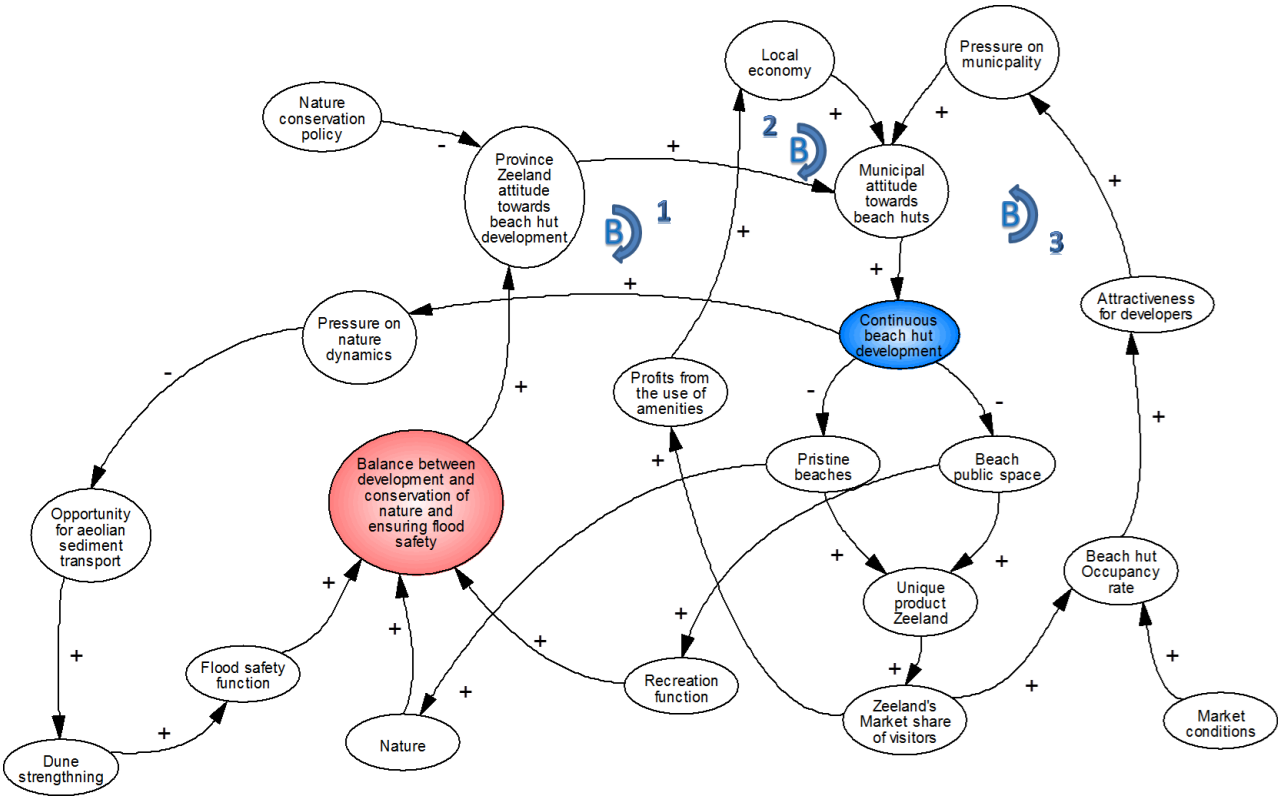

Figure 11: CLD representing provincie Zeeland problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

This variable can be negatively influenced by the development of beach hut constructions along the coastline of Zeeland. On the state of this variable, the province tries to exercise its influence on the municipality through its regional spatial policies. This influence is visualized with the link between "Province Zeeland's attitude towards beach huts" and "Municipal attitude towards beach huts" variables. However, the "Municipal attitude towards beach huts" doesn't depend only on the position of the province on this issue. The municipality also looks at the impact on the local economy from the beach hut development and the pressure it gets from the developers.

The CLD shows two balancing feedback loop, starting from the "municipal attitude towards beach huts" variable. The first balancing loop shows that a positive stance of the "municipal attitude towards beach huts" variable would negatively affect the "public beach space" and "pristine beaches" variables which in turn would decrease the "unique selling product Zeeland". As a consequence, "Zeeland's market share of visitors" would take a drop. Such a drop would negatively impact the local economy, which would make the municipality less likely to continue with the development. This is visualised by the second feedback loop. Theoretically the "Beach hut occupancy rate" should also decrease if the "Zeeland's market share of visitors" variable decreases, however this variable depends also on the market conditions. If the "Beach hut occupancy rate" rate remains high, as it is presently, the developers will keep putting pressure on the municipality to continue with the development. This denotes the third feedback loop.

From the flood protection viewpoint, ongoing beach hut development would put additional pressure on the nature dynamics, as more construction would mean that there will be more interference on the sediment transport on the beach. According to the province, both year-round and seasonal beach constructions have limited effects on dune growth. However, they think it is important that the serried-seasonal beach constructions are removed in order to maintain the natural process of aeolian sediment transport which strengthens the dunes and reinforces the flood protection function.

While all three functions i.e. flood safety, nature and recreation form part of independent balancing loops, it is the "market conditions" variable that ultimately forces the municipality to continue with the beach hut development (dominant forcing). Other than this dominant forcing, the link between the variables "Province Zeeland attitude towards beach hut development" and "municipal attitude towards beach hut development" may be somewhat weak, as the provincial spatial planning policies offers sufficient room for the municipalities to make their own choices on local zoning/development plans.

5.1.3 Rijkswaterstaat

The interviewed representative from Rijkswatersaat stated that the question they would like to answer is: to what extent can development be allowed while being beneficial for the coast with focus on flood protection function.

The constructed CLD shows essentially a single cycle, made up of three feedback loops, where the effects of beach hut development is expressed on different variables. The effects of an increase in the "amount of beach huts" would be increased "interference" and increased "scour holes" (1). Only the "interference" has an effect on the aeolian sediment transport (2), while erosion holes can directly affect the "dune stability" variable. The "beach hut development" variable is also directly linked with "pressure to extend recreation season" (3). Thus, not only will there be more interference of aeolian sediment transport, the duration for uninterrupted sediment transport would also decrease which contributes to lesser "dune growth". While "interference" and "duration of nourishment season" only affects the dune growth, it is the creation of "scour holes" due to beach hut development that is a direct danger to the "dune stability".

Rijkswaterstaat is able to react by issuing less/no water permits to developers, in collaboration with the water board. This will restrain or even halt development.

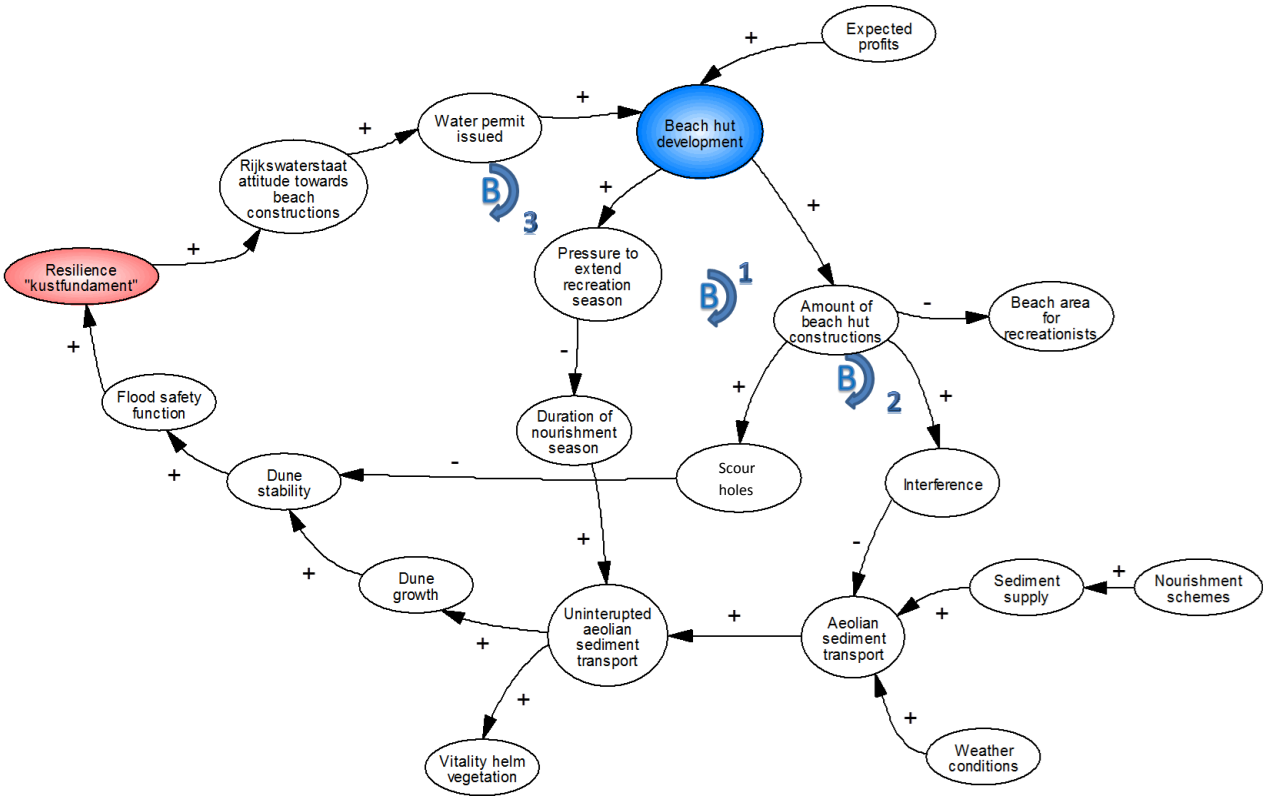

Figure 12: CLD representing Rijkswaterstaat problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

5.1.4 Stichting Strandexploitatie Veere

The interview with the representative of SSV provided additional insights on how the beaches are getting exploited. SSV sees that a problem can arise from overly constructed beaches along its municipal borders. Even though the foundation is partly funded by the profits of beach parcel rent fees, they see an overly developed beach as an undesirable situation which can diminish the value of “recreation product Veere” can offer.

From the created CLD of SSV, it becomes apparent that the “beach recreational product Veere” is an important variable as it serves as the selling point to attract tourists to the municipality. The “attitude of the municipality towards beach huts” is dependent on the “recreational product Veere” variable among others. Also the market conditions and the political environment play a significant role in influencing the municipality’s position on beach hut development.

According to SSV, if beach hut constructions are allowed without restrictions, the “coastline diversity” of Veere and the “exclusivity of product beach huts” would lessen and thus negatively affect the “beach recreational product Veere”. On the other hand, SSV will be able to increase its budget with an increase in the collected beach parcel rent earnings and in turn have better maintenance and monitoring plans to improve the “beach recreational product Veere” variable. Also a significant part of the beach parcel rent earnings gets returned to the municipality.

One issue that SSV stated is that most of the nourishment schemes, i.e. offshore nourishments, are done without taking their recreational interests into account. SSV finds that the offshore nourishment schemes are only able to somewhat mitigate sand erosion from the beaches instead of creating wider beaches which would be beneficial for the beach as a recreational product.

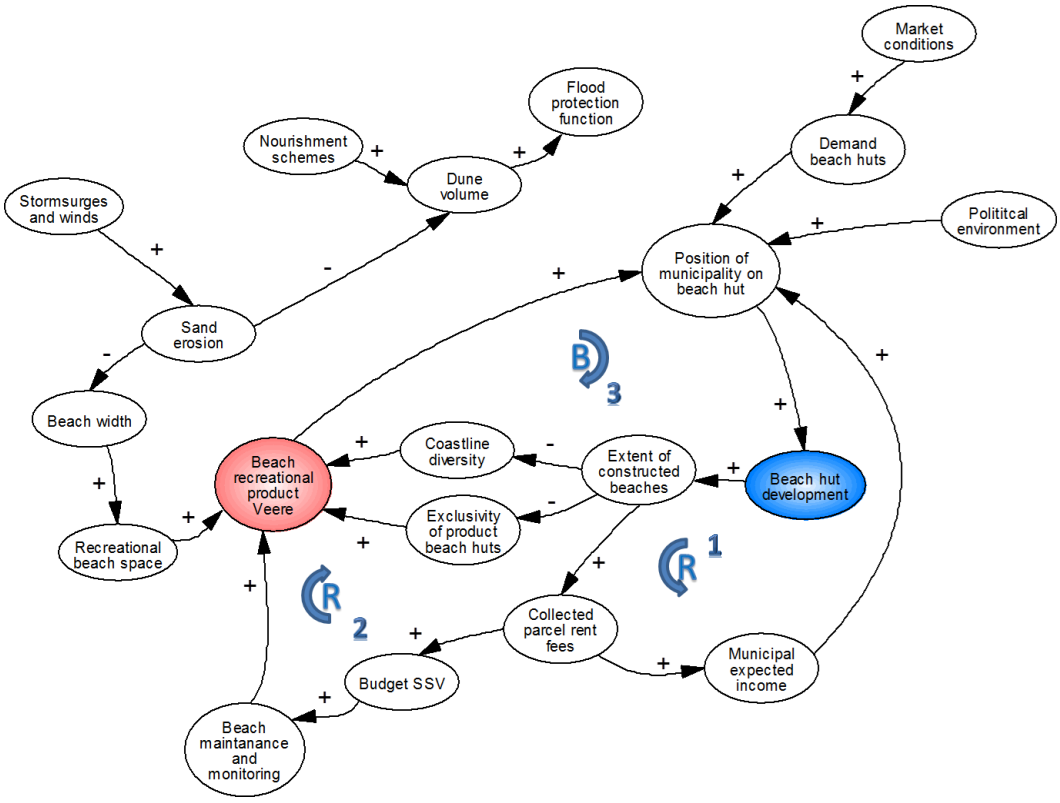

Figure 13: CLD representing Stichting Strandexploitatie Veere problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

The constructed CLD shows three main feedback components. It shows that the "municipality's attitude towards beach hut development" is the main variable within the system as it solely dictates whether beach hut development is to be allowed. From this variable, two reinforcing feedback cycles can be observed, namely the additional funds cycle that the municipality will get back from allowing more beach huts, and the improvement of "beach recreational product Veere" due to a larger budget from SSV (1). Counteracting these two cycles is the negative impact of "coastline diversity" and "exclusivity of beach huts" on the "beach recreational product Veere" variable, which is our balancing loop to the system (3).

5.1.5 Visitor/tourist

According to the interviewed visitor, there should be a balance between continuous development of beach huts and nature conservation. The combination of these two factor would factors would influence the "beach attractiveness" towards the visitor, which is the most important variable within the respective mental model. The interviewed visitor stated that his decision to visit a particular beach depend on how attractive he sees the beach.

This “beach attractiveness” is influenced by five chains of variables, some with positive influence and other with negative influence. Four of these influential chains of variables come from the “beach hut development” variable, while the other chain depends on the “nourishment” variable. The visitor sees that the beach hut development can have a positive impact on the beach attractiveness. Namely, it would increase the number of beach huts and therefore also increase the number of visitors which the visitor likes to see (1). On the other hand, the visitor sees that such an ongoing development might end up in having multiple parallel rows of beach hut constructions on the beach (2), have longer recreation season and dimensions (3), which make the beach less attractive to the visitor. Furthermore the nature would also experience a setback according to the visitor (4) .

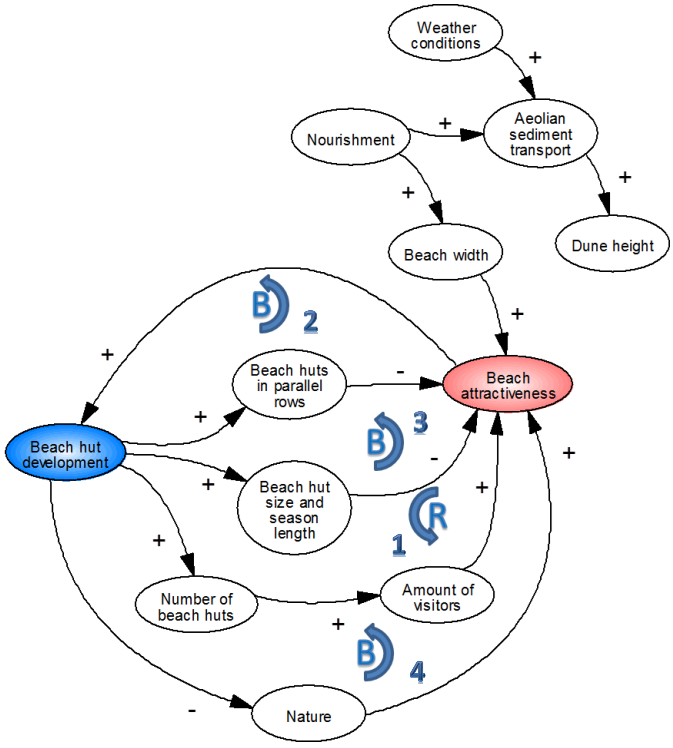

Figure 14: CLD representing visitor problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

Nourishments are also able to influence the visitor’s perspective of an attractive beach, as nourishments can make the beach wider. Other than contributing to the beach’s width, nourishments also contribute to the “dune height” variable, due to its positive contribution to “aeolian sediment transport” variable. Other than nourishments, the “aeolian sediment transport” variable also depend on “weather conditions”

From the interview, it became apparent that there are 4 feedback loops according to the visitor. The visitor sees that an increase in “beach attractiveness” would also attract more beach development, thus the “beach hut development” would also increase. This feedback suggests that the beach attractiveness towards the visitors also attracts the developers.

5.1.6 Water board Scheldestromen

The “risk of flooding” is the core problem according to the interviewed representative of water board Scheldestromen. The representative also stated that the recreation season’s duration is also an important factor in this ongoing beach construction development. The water board sees the effect of this development almost entirely from a flood safety point of view.

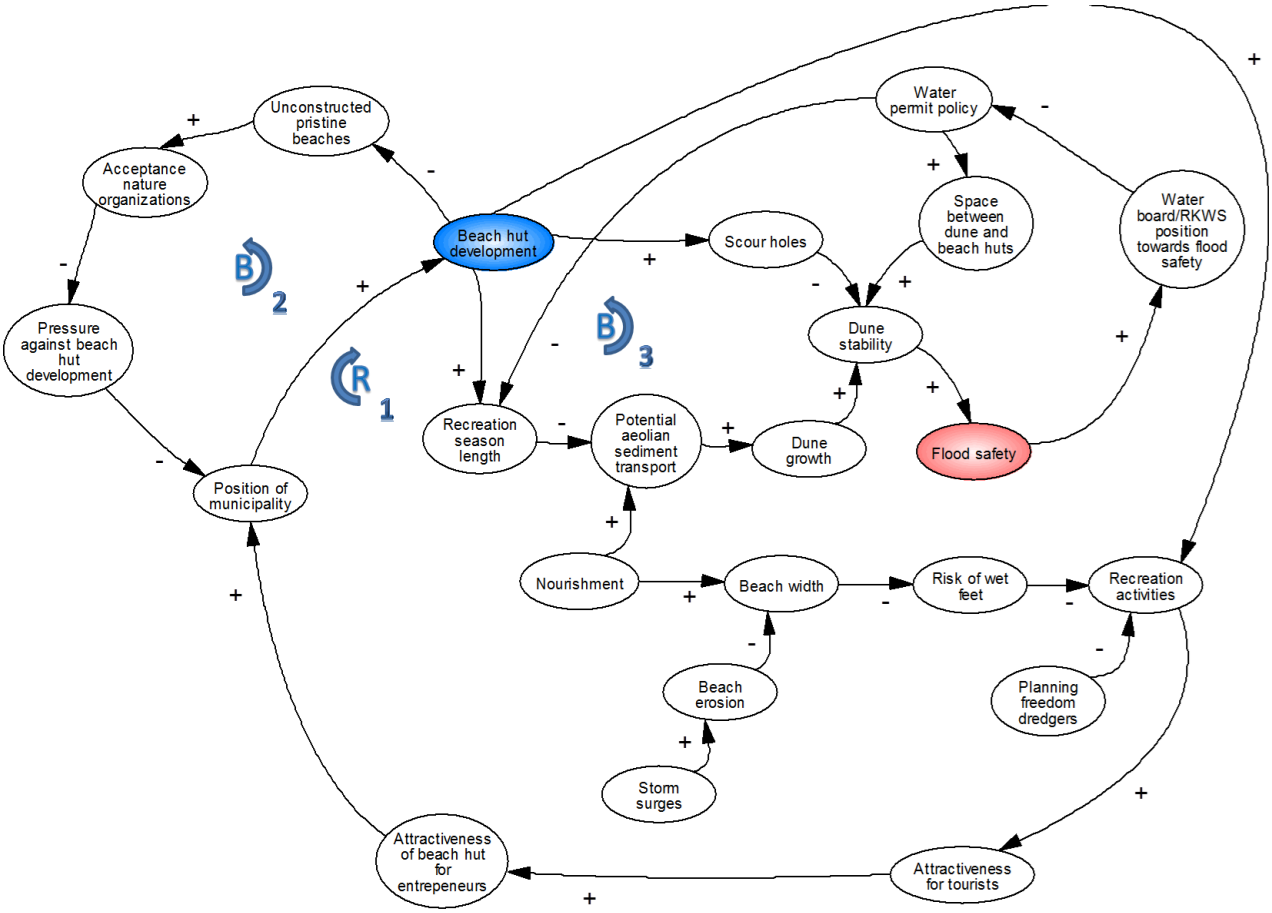

Figure 15: CLD representing water board Scheldestromen problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

According to the representative, the ongoing beach hut development has two main negative effects on flood safety. Firstly, beach huts, especially the ones on pile constructions, can create scour holes beneath the construction due its impact on the wind field. The back lying might become less stable if the scour hole is in close proximity to the dune foot and thus a less stable dune infers a greater risk of flooding. Secondly, ongoing beach hut development might put pressure on the authorities to extend the recreation season. The water board sees an extension in the recreation season in a negative light as such an extension would give less time during the year for the uninterrupted natural process of aeolian sediment transport to replenish the dunes. A dune with less growth increases the risk of flooding. To reduce the risk of flooding, water permit policy (which are formulated by the water board in consultation with Rijskwaterstaat), mitigates the effects of beach hut development through limiting the beach hut season length and providing sufficient space between constructions for sand to flow through.

To keep the dunes growing, nourishments are done which increases the aeolian sediment transport towards the dunes, and thus helps lower the risk of flooding. On top of that, nourishments also increase the beach width which lessen the “risk of wet feet” and thus contribute to the ability for the beach to hold recreational activities. However, the freedom given to the dredgers, in terms of letting the dredgers pick their own dates for executing the nourishments, is not always aligned with the interests of recreationists and municipalities. An example of this is that in some cases the nourishments are being done too early in the storm/winter season, and often the supplied sand gets eroded away before it can be enjoyed by the recreationists.

The “recreation activities” variable is linked with the “attractiveness towards tourists” variable, which in turn is linked with “attractiveness towards beach hut entrepreneurs” and then the “position of the municipality” variable. In this chain, an improvement of the quality of recreation activities would improve the municipal attitude towards beach hut development, and thus approves more plans for the construction of beach huts. This ongoing development adds to the quality of “recreational activities” along the coastline. In other words, a positive feedback loop (1) is created as more beach huts would improve the municipal attitude to approve more development.

On the other side, increases development creates increased resistance from nature organizations which sees the disappearance of pristine beaches along the coast as a major issue. This means that they start to lobby against the development with the hope of stopping it. This denotes the 2nd feedback loop.

Regarding the “flood safety risk”, a feedback is created when the water boards and Rijkswaterstaat step in to make changes to the flood safety permits. This is done every 5-6 years, in which the risk of flooding is determined in order to see whether stricter policy rules to protect the dunes need to be applied within the water permit. This balancing feedback loop (3) is able to safeguard the flood protection function of the dunes, yet the other functions (nature and recreation) are excluded.

5.1.7 Zeeuwse Milieufederatie

The Zeeuwse Milieufederatie (ZMF) is an organization actively campaigning for the protection of the nature values of Zeeland. During the interview, the representative of ZMF made it clear that the ongoing beach hut construction development is due to pressure from project developers on the municipal government and is one of the main core problems within the system. The ZMF representative pointed out that the project developers often use the argument of the requirement of better accommodations for visiting tourists.

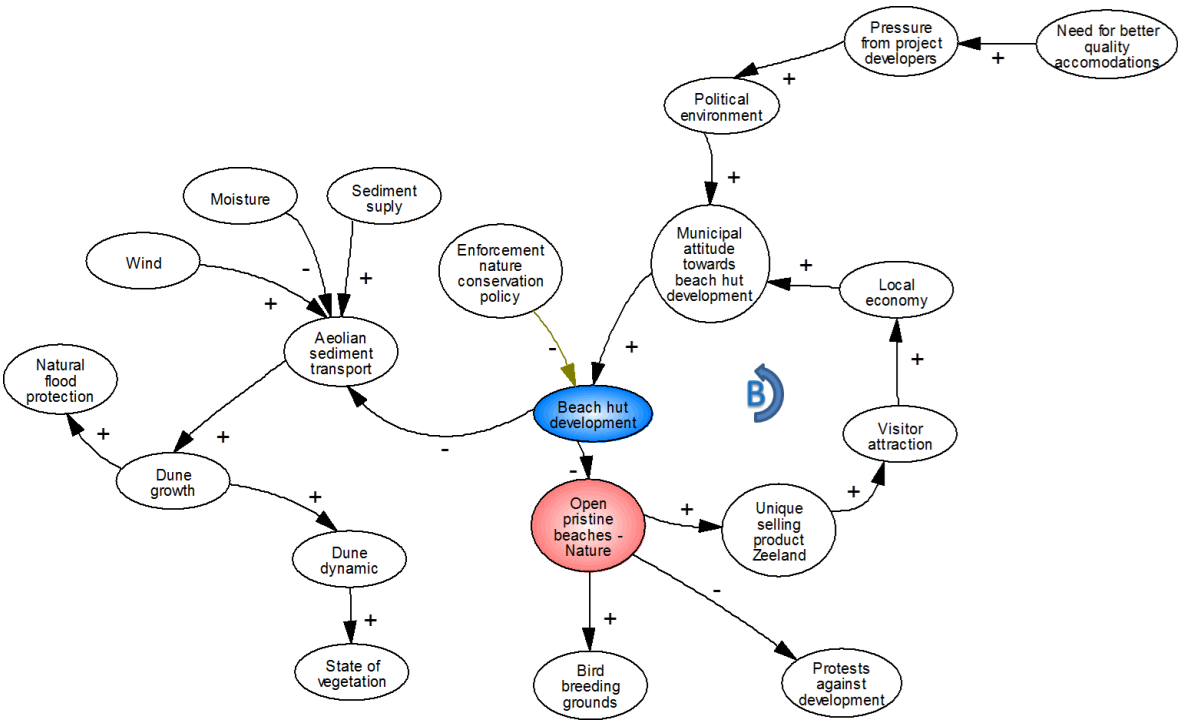

Figure 16: CLD representing Zeeuwse Milieufederatie problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder. The brown link denotes uncertain relation between variables.

With sufficient influence from the municipal political environment (municipal governance), municipalities start to allow beach hut development which has a negative impact on the “open pristine beaches” and “aeolian sediment transport” variable. A decline of the “open pristine beaches” variable would also negatively affect the “unique selling product Zeeland” and thus will attract fewer visitors which support the local economy.

Other than having their unique selling product Zeeland damaged, significant loss of open and pristine beaches would also negatively affect the ability of the coast to support bird population, and more protest from the communities will arise against the ongoing development.

Beach hut constructions can also negatively impact the potential aeolian sediment transport towards the dunes. ZMF sees that a disruption of the aeolian sediment would be detrimental for the dune dynamics, which is also part of the nature value of the coast. The “dune dynamics” variable, together with “bird breeding grounds” and “state of vegetation” form the nature values of ZMF (biotic and abiotic).

During the interview we learned from the representative of ZMF that the enforcement of nature conservation policies, e.g. natura2000, is lacking. One example shown to us was the beach hut development plan on Sophia beach (next to Sophiahaven in Noord-Beveland), where year-round beach huts were placed on a beach that is within a natura2000 protected area. Thus, ZMF points out that the province should do a better job of enforcing the nature protection policies.

The created CLD representing the mental model of ZMF shows a clear balancing loop. Although it is presented as a balancing loop, it may have great delay, as the amount of visitors to Zeeland remain unchanged, while number of beach huts in the province are increasing. ZMF suggests that there is a tipping point within this system, where there will be no pristine beaches left, and visitors will make a choice to go elsewhere. The constant beach hut development is primarily due to the pressure of project developers on the municipal governance (forcing). And due to the delay of the balancing cycle and lack of nature conservation enforcement, the number of beach huts will keep increasing.

5.1.8 Consultant frame

We used the paper of Hoonhout & van Thiel de Vries, 2013 as reference for the "scientist" mental model. The reason only one paper was used for the construction of this mental model is that the effects of beach constructions on flood safety hasn't been studied in detial up untill recently. There are many ongoing studies on this subject along the Dutch coast, but they are yet to be published.

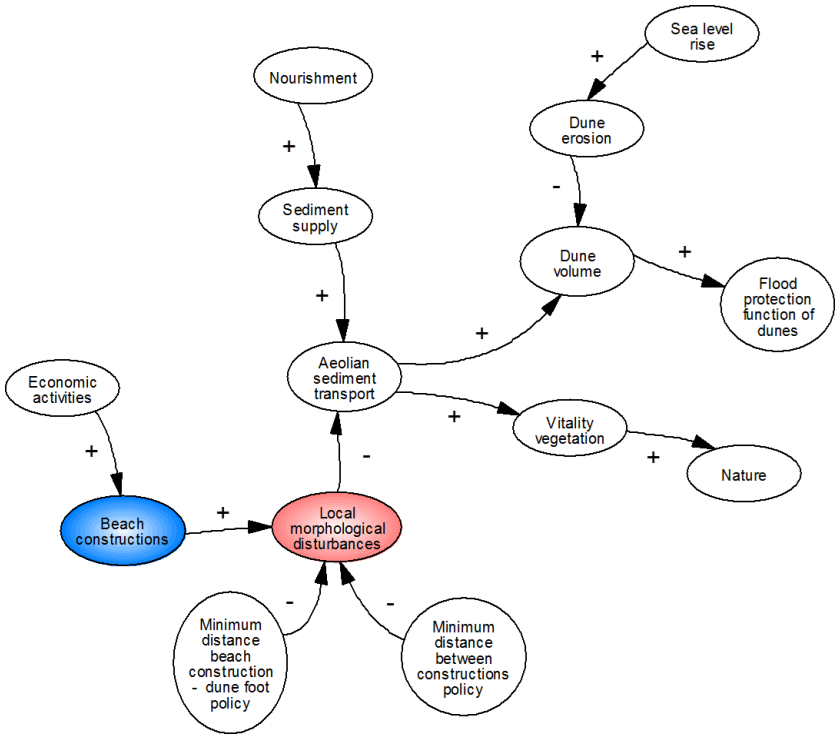

Figure 17: CLD representing the consultant problem frame. Blue circle denotes main topic within the mental model and red circle denotes the problem core of the stakeholder.

The CLD created from the paper shows that only the flood protection function of the dunes were assessed and to some extent nature. The flood protection function of the dunes rely on the available dune volume. The dune volume in turn is influenced by two aspects, namely dune erosion from sea level rise and additional sediment from nourishment schemes. Aoelian sediment transport process is used to get the sediment into th dune volume which contributes to flood protection. However, the aoelian sediment transport process can be negatively effected with the placement of beach constructions on the beach. Parameters which are of importance to the negative contribution on sediment transport are the distance between construction (room for sediment to flow through) and the distance between

beach construction and dune foot. Having policies which ensures a sufficient minimum distance of these parameters will mitigate the negative effects of beach constructions on dune growth. Hoonhout & van Thiel de Vries did note however that the impact of beach constructions is insignificant in comparison to the influence of nourishment schemes on dune volume.

Other than the flood protection function, the nature function of the dunes was also discussed in a limited manner. Disturbances from beach constructions can negatively contribute to vegetation vitality and thus, the nature function. This negative impact on nature can be caused by limited sediment deposition which can starve vegetion from minerals or excess sediment deposition which can bury vegetation within the soil.

From the CLD of the scientist perspective it can be seen that there are no feedback loops which reinforces or balances the system. The authors haven't explicitely discussed possible feedbacks of the system, however advices were given with the to minimize the negative effects of beach constructions on the dunes in regard to flood safety. These advices can be interpreted as a possible way to introduce a feedback loop into the CLD by means of policies. Such policies (e.g. introducing minimum distance between beach constructions, minimum distance between beach construction and dune foot) would bring balance in this system and makes sure that the flood protection function of the dunes are sufficient.

5.2 Ambiguity analysis: comparing the individual frames

Ambiguity analysis aims to identify and investigate the main differences between the stakeholders' mental models. In this sub-section, the mental models are further structured into individual problem cores in order to be able to make a comparison between them. Similarities and differences are thus identified (table 6). The comparison in this section is done by considering the stakeholders' problem core, the perceived system dynamic of the system and the main forcing influencing these dynamics.

Stakeholder	Problem core	System dynamic	Forcing
Gemeente Veere	Societal resistance	Reinforcing cycle of economy boost and balanced by societal resistance and limited space	Combination of political environment and entrepreneur/project developer pressure.
Province Zeeland	Balance between flood protection, recreation and nature	Balancing cycles due to negative impact on economy, beach occupancy rate and the pursue of adequate balance between the functions	Favourable market conditions for beach hut exploitation
Rijkswaterstaat	Extent of beach hut development before negatively affect coastline	Negative impact on dune stability which is compensated by nourishment schemes	Additional sediment supply from nourishments
S.S.V.	Recreational beach product of Veere	Reinforcement cycles of additional income for municipality and operating budget for SSV and a balancing cycle of deterioration of coastline diversity and less exclusiveness of beach huts.	Storm surges which decreases recreational space and a combination of market conditions and present political environment
Visitor	Beach attractiveness	Reinforcing cycle of a more active beach which is balanced by balancing cycles of parallel hut placement, longer hut season and deteriorating nature	Nourishment which increase beach width
Ws. Scheldestromen	Flood safety risk	Reinforcing cycle of continuous beach hut development with two balancing cycle of water permit issuing and pressure from nature organizations	Positive contribution of nourishment on flood safety and recreation
Zeeuwse Milieufed.	Nature values of dune dynamic, state of vegetation and bird breeding grounds	Balancing cycle of decrease in local economy due to beach hut development	Pressure from project developers on political environment, and natural factors influencing aeolian sediment transport
Consultant	Local morphological disturbances due to beach constructions	None. However, feedbacks can be implicitly identified when coupled with given advice towards water boards and Rijkswaterstaat	Economic activities, with sea level rise and nourishment

Table 6: Comparison between the main elements of stakeholders' mental models

5.2.1 Problem core framing of the stakeholders

The information about the problem core helps with the identification of the differences that exist between the stakeholders' problem perception regarding the issue of beach hut constructions and its effects on its environment, i.e. socio-economic, nature and physical impacts.

Within this system, the municipality of Veere considers societal resistance as the bottleneck for the ongoing issue of beach hut constructions. From their standpoint, beach hut development benefits the local economy, yet at the same time it is the society that has to accept the changes within their environment. The province seeks to have an adequate balance between the recreational development, nature conservation and flood protection for the region, and to keep control of this balance they have nature conservation policy in place (i.e. natura2000) which protects certain areas from harmful development towards nature. Rijkswaterstaat considers that beach hut development can be allowed as long as there is no detrimental effect on the coastline as a whole. Stichting Strandexploitatie Veere is concerned with the beaches of Veere as a recreational product to attract visitors while the interviewed visitor focused mostly on the attractiveness of beaches as the key factor in their decision-making on which part of the Dutch coast to visit. Water board Scheldestromen is primarily focused on the potential additional risk to flood safety that beach hut development may bring. The nature organisation Zeeuwse Milieufederatie considers the impacts on various nature aspects as its core problem. Lastly, consultants (the report of Hoonhout & van Thiel de Vries, 2013) perceive the issue at stake as morphological disturbances from beach hut constructions which might impact the flood protection function of the dunes.

5.2.2 System dynamic primary loops

On the issue of the differences regarding the perceived system dynamic of each stakeholder, it is apparent that most stakeholders (i.e. province Zeeland, Stichting Strandexploitatie Veere, visitor and Zeeuwse Milieufederatie) see the beach hut development cycle as a balancing loop due to the fact that they perceive beach hut development having a partially deteriorating effect on pristine and diverse beaches along with its natural characteristics which ultimately would attract less tourists to contribute to the local and regional economy. The perception of these stakeholders is that the municipality will rethink their position on beach huts once the local economy is impacted due to the visitors being less attracted towards the beaches of the region. Besides the "local economy" balancing cycle, the municipality sees that the reduction of public beach space would lead to increased societal resistance that can eventually change the political environment. With sufficient societal resistance on the political environment, the municipality will give out fewer parcels for beach hut developers.

At the same time the municipality sees the beach hut development projects as a somewhat beneficial development to the local economy which can reinforce the positive municipal attitude towards allowing beach hut development. The water board also sees beach hut development as a contributing factor to the recreation potential of the region which in their perspective also reinforces the standpoint of the municipality on the beach hut development issue. Their perspective implies the existence of a reinforcing loop in which allowing beach hut development increases the economic benefits of the region and thus reinforces the municipality's positive standpoint towards beach hut development.

Lastly, Rijkswaterstaat sees the system dynamic solely from a physical perspective, where the negative impacts of beach hut constructions on the dune stability can be compensated by adapting adequate policy regulations.

5.2.3 Deactivation/ balancing loops

From the eight constructed CLD's, four have reinforcing loops. These reinforcing loops require some sort of action to be deactivated or balanced. For gemeente Veere, it is the increasing societal resistance which allows the system to eventually achieve equilibrium (enough resistance stops beach hut construction). The limited amount of space available is also perceived as a contributing factor to reduce the development rate as more beach huts implies that less beach parcels would be left available.

Stichting Strandexploitatie Veere expects a deterioration of the coastline diversity and the loss of beach hut exclusivity as the natural balancing loop on the two reinforcement loops (i.e. the SSV funds loop and expected additional income for municipality loop). The thought process of SSV is that too much development will decrease the beach recreational product of Veere and thus eventually would deactivate the reinforcing loop of continuous beach hut development. In accordance to this line of thinking, the interviewed visitor also sees that a significant increase in beach hut development would make the beach less attractive and force the person to seek a more pristine coastline for his/her recreational needs.

Regarding the water board's CLD, there are two balancing loops, one that affects the position of the municipality as beach hut development would increase pressure on the municipality to put a halt on the development. Secondly, appropriate regulations in the form of water permit are able to offset the perceived negative impacts of beach hut constructions on the dunes. Accordingly to this balancing loop, the flood protection function of the dunes seems to be secured as the water board is able to adapt the regulations within the water permit every 5-6 years.

5.2.4 The role of forcing within the system

Many of the constructed CLDs have some sort of external forcing which are able to contribute to additional reinforcing or balancing on the different cycles. These forcing factors are of great significance, due to their contribution to the system's balance/imbalance, and the exclusion of any feedbacks which is able to influence the respective forcing factor.

The municipality, SSV and ZMF explicitly acknowledges that the political environment plays a significant role in allowing beach hut developments to take place. Much of this political support comes from the project developers as they seek financial gain in the exploitation of the coastline. This type of forcing makes it difficult for the system to reach equilibrium (exploited beaches with adequate nature conservation and flood protection) as the number of beach hut construction has increased. Likewise, the province perceives a similar forcing in the form of market condition, while SSV sees the market condition as a condition to activate the pressure from project developers ("demand beach huts"). For the above mentioned CLDs, either the "political environment" and/or "market condition" are essential factors which positively contribute to the ongoing beach development along the coastline.

Regarding the flood protection function of the dune environment, Rijskwaterstaat, SSV, the visitor, the water board and consultants stated that nourishments positively contribute to the dune volume/stability, i.e. the flood protection function of the dunes. Most stakeholders see this as an external intervention to the system, thus an external forcing that tries to offset the negative impacts on the dune flood protection function due to beach hut constructions.

Lastly, ZMF expressed the concern that the nature conservation policy, the natura2000, isn't being enforced to reduce the rate of beach hut development along the Zeeuwse coastline. From their perspective, an adequate enforcement of the nature conservation policy would prevent deterioration of the natural characteristics of the coastline.

5.3 Identifying missing key environmental and socio-economic data

A benefit of creating these mental models in the form of causal loop diagrams is that the importance of key data can be identified. The collection of data is a costly process in terms of both resources and time. Having constructed the model, it becomes apparent that there is missing data which could have significant impact in the overall functioning of the model, and therefore inclusion of this missing data would improve the model as it would have a better reflection of the dynamics of the system. The mental model construction approach, i.e. system dynamics approach, requires continuous iterations of the methodology to improve its resemblance to the actual system and to adapt it to the evolving reality and new attained knowledge (Tomlinson, et al., 2011). This requires time for the key missing data to be collected, transcribed, collated, and analysed. For this study case, time constraints limited the application of the methodology to only one iteration round, in other words, each selected stakeholder was interviewed once, and thereafter asked for validation for the analysed data.

During the formulation of the mental models for the case study, it became apparent that there is missing information about key external forcing and/or feedbacks to the system, in particular the influence of project developers and political environment on the position of municipalities regarding beach hut development. It is still somewhat unclear how exactly project developers lobby in order to get the required permit from the municipalities for the construction of beach huts. Also, it is unclear whether there is a feedback loop between that links back to the project developers or political environment forcing. An interview with one of the beach hut developer firm might bring some clarity to this issue. However it might be difficult to find one as the nature of this research would probably show results that contradict their financial interests. It must also be said that the interviewer refrained from questioning exact details about the financial workings and financial motives of each stakeholder during the interviews, as it might create unwanted friction during the interview sessions.

A key connection between the environmental and social-economic components of the model is the change in recreational appeal. The regional and local economies in Zeeland depend largely on tourism and thus the recreational appeal of the coastline is of great importance for the municipality, Stichting Strandbehoud Veere and province Zeeland. For this study, only one tourist/visitor was interviewed in order to get the person's perspective on the appeal of beaches in general. To improve the representation of the general visitor's mental model, more visitors should be interviewed due to differing opinions about what characteristics of a beach might be appealing to visitors.

One limitation of the constructed model is that it fails to incorporate temporal scales of the system. It is known that nourishments are performed every 4 years or less, water permits adapted every 5-6 years and beach hut seasons last only 6 months. The time scale for the recreation appeal towards the tourists to change is yet unknown. On the one hand, the municipality of Veere pointed out that the recreation appeal of its coastline will never change due to its name as a tourist destination. The representative made a comparison with Scheveningen as an example of increased recreational appeal from development along the beaches. Contrary to this standpoint, other stakeholders stated that recreational appeal would start to deteriorate at some point if beach hut development is allowed to continue. These standpoints show that there is ambiguity between the stakeholders on this issue.

Another ambiguous subject between the stakeholders is whether periodical removal of beach huts during the winter months would allow sufficient time for the dunes to grow as the aeolian sediment transport stays uninterrupted in this period. The water board and Rijkswaterstaat expressed the importance of keeping the beach clean of any construction that would interrupt the flow of sediment towards the dunes. Contrary to their perception, Hoonhout & van Thiel de Vries (2013) concluded that there is no significant observed difference between seasonal and permanent beach constructions on dune growth. The researchers however did remark that more samples are needed to concretesize their findings. Thus the question whether beach huts should be remove during the winter months for the growth of the dunes remains an ambiguous issue and requires further research for clarification.

6 The integrated model

The individual mental models reflect each stakeholder's perception of the environmental social-economic system. To no surprise, there are overlaps between each individual mental model. These overlaps, i.e. common variables and links are used as the foundation for the formulation of the integrated mental model. Differing variables are added to the integrated model as "add-ons" which further expands the model. The completed integrated model (Figure 18) should reflect the dynamic of the system in reality with all its complexities.

The core variable within the model is the "extent of constructed beaches" (i.e. beaches with beach huts in front of the dunes) variable (blue circle in fig. 18) and it solely depends on the municipal attitude towards beach hut development. There are many existing factors that are able to positively contribute to the "municipal attitude to allow beach hut development" variable. The blue coloured links within the integrated model shows the immediate or short term (short delay) feedback loops on the "municipal attitude towards beach hut constructions" variable, while the orange links have a more restraining influence on the "extent of constructed beaches" variable within the model and is perceived to happen on the longer term. Hence the system is not in equilibrium as the restraining influence from "societal resistance" and reduced profits from fewer visitors would be felt more in the long term in comparison with the pressure from the political environment and developers. It is expected that there will be much more construction of beach huts for the system to reach equilibrium, that is as it stands the beach hut developers will continue to put pressure in order to continue with the development till the beach construction market gets saturated (i.e. the supply outgrows the demand).

The left section of the integrated model shows the importance of the water board and Rijkswaterstaat within the system with regard to the flood protection function of the coast. Their influence primarily affects the flood protection function of the coast and is balanced by a feedback loop which contains the mechanics of the water permit regulations. The water permit regulations are able to influence the extent of the local morphological disturbances due to beach hut development and the length of the beach hut recreation season. From a flood protection perspective, the impact of beach hut construction on the dunes is sufficiently covered due to this feedback loop, as the condition of the dunes (dune volume) are monitored (i.e. the yearly Jarkus profiles survey) and the regulations within the water permit subsequently adjusted in order to maintain or improve the flood protection function of the dunes. Besides the conceivable negative impacts from beach hut constructions, sand erosion due to storm surges also play a role in the weakening of the dunes. This is covered by the nourishment schemes which aim to keep the coastline at the 1990 "basiskustlijn" boundary.

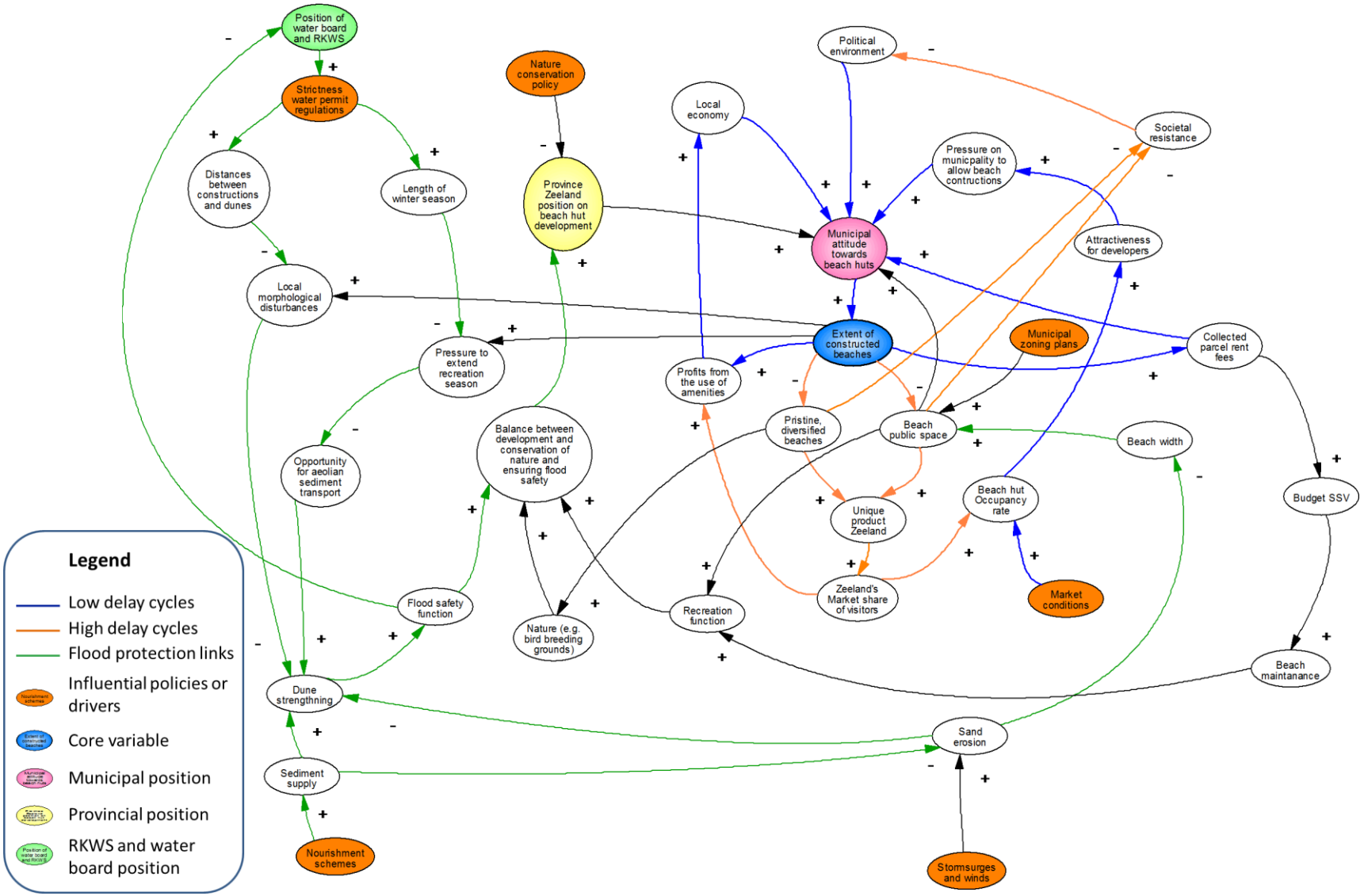

Figure 18: The integrated model.

Regarding the nature function of the coastal beach-dune environment, there is a balanced feedback loop wherein the province has the responsibility to protect nature areas, thus to prevent municipalities making construction plans in areas such as natura2000 designated zones. The “province Zeeland position on beach hut development” is the only variable within the model that has a direct link which is able to restrain the municipalities’ plans on development along the coastline. Any development beach construction development that takes place along the coastline is perceived to alter the natural state of the beaches in terms of diversity and pristine appearance. Such a development is perceived to affect the breeding grounds of bird population for example. Therefore the municipality utilises policies such as the natura2000 framework to protect certain nature areas from development.

The right section of the integrated model appears to be governed by five major feedback loops which directly influence the development rate of beach huts along the Zeeuwse coastline. These are the “local economy” feedback which gets a boost from the beach hut development and leads to the municipality allowing the development to take place. The “political environment” loop is also able to contribute the development rate given the absence of resistance from society. The “pressure from developers” loop also leads to increased beach hut development rate and is largely dependent on favourable market conditions for the rental of beach huts. The “parcel rent fees” loop makes it attractive for the municipality to keep handing out parcels for beach hut development. Lastly, the “nature conservation” loop lets the province to restrain some development in certain nature conservation areas.

6.1 Role of regulations within the integrated model

The integrated model shows two distinct forms of regulations, i.e. the nature conservation policy (natura2000) and regulations to protect the flood defence function of the dunes (water permit).

Regulations within the water permit ensures that the dunes are somewhat protected from the negative effects of beach hut constructions and thus, safeguards the flood protection function. To keep the flood protection function of the dunes checked, the beach-dune profiles (Jarkus profiles) are measured every year and once every 5-6 years the regulations within the water permit can be adapted to guarantee sufficient dune strength. The main components within the water permit are the specified period for beach hut construction and the minimum distances in-between beach constructions and the distance towards the dune foot. Adequate adaption of these regulations within the water permit and yearly monitoring of the beach profile is perceived to be sufficient to mitigate the negative effects of beach hut constructions.

The Natura2000 nature protection policy is aimed to protect the species habitat and bird breeding grounds from development and is enforced by province Zeeland. Within the integrated model it is visualized as a forcing variable linked to the “Province Zeeland position on beach hut development” variable. It should be noted however that nature organisation ZMF believes that the nature conservation policies aren’t properly enforced and thus, this forcing within the integrated model should be removed to better represent ZMF’s point of view (appendix A). Hence, there is some doubt whether the nature conservation variable should be included within the integrated model in order to accurately reflect the dynamics of the system.

The zoning plans is part of the WABO permit which is the necessary permit from the municipality which partially grants the construction of beach huts (the other being the water permit). Within the integrated system, the zoning plans works as e balancing loop, wherein the more beach huts are constructed, the less space remains for additional beach huts. There is however widespread overlaps between recreational destined zoning areas (areas where beach hut development can be allowed) and Natura2000 designated areas. Thus this overlap creates the setting for disputes between municipalities and nature organizations.

Another relevant policy within the system is the “basiskustlijn” policy which argues for the use of nourishment schemes to maintain the 1990 coastline boundary. Although the “nourishment schemes” variable is an important forcing within the integrated model, it is perceived to have little influence on the beach hut development cycle. Similar to the water permit, it only aims to increase the “dune strengthening” variable and thus increases the flood protection function.

6.2 The ideal system scenario

The previous section mentions the regulations that are used in order to maintain the system in equilibrium, or strictly speaking, to protect the various functions of the beach-dune environment. Despite the present regulations, some stakeholders suggested that the coast is experiencing unrestrained beach hut development as result of lax policy enforcement. For this reason the quality of different functions of the beach-dune environment is expected to decline, in particular the nature function.

In an ideal system scenario, some of the existing policies as described within the integrated model might need some revision as some of the stakeholders are discontent with their functioning within the system. Data collected from the interviews show some discontent with the nature conservation enforcement of the province and applied nourishment schemes. Adjustment to these mechanisms within the integrated model (Figure 19) would make the system work more ideally. The adjustments are the following:

- Create a direct link from the “nature” variable to the “nature conservation enforcement” variable (1). Such a link implies that the nature conservation enforcement would be directly proportionate to the actual state of the natural characteristics of the beach-dune environment. Presently the nature conservation policy, specifically the natura2000 is established on a European wide level and it is difficult to adapt it to the regional level for better enforcement.
- Create a link between the “sediment supply” variable to the “beach width” variable (2). SSV argues that the nourishments schemes carried out along its coastline often don’t contribute to the widening of its beaches. Adapting the nourishment schemes, i.e. applying more beach nourishments instead of off-shore nourishment or a balanced combination of the two would create this link and thus improve the recreation function along with the flood protection function.

Inclusion of these points into the integrated model would satisfy the interests of the stakeholders who have issues with the present workings of the nature conservation policy and the recreation function of

beaches and thus would lead to an ideal system scenario for the stakeholders. However, even in this ideal scenario, the beach hut development will continue in non-nature protected areas.

Although strengthening the nature conservation policy and nourishment schemes would improve the quality of nature and recreation function according to the integrated model, it is likely that the development of beach huts would continue which would bring additional pressure on the functions as financial incentives to keep developing remains due to unchanged market condition which influences the expected income for beach hut developers (figure 20). Introduction of mechanisms that help reduce the "expected income" of beach hut developers will slow down the beach hut development cycle within the integrated model. Mechanisms that can solely target the financial incentives can be:

- Introduction of pricing control (1). This mechanism can decrease the expected income of beach hut developers and thus lessens the financial incentives in pursuing additional projects.
- Use the water permit to constrain the length of the beach hut season (2). The beach huts have a weekly rent rate (Strandhuisjes Nederland, n.d.), and limiting the amount of weeks that it gets rented would also cap the expected income.

6.3 Uncertainties that need to be addressed

In order to improve the decision making to arrive to a scenario in which all functions of the dune-beach environment are preserved, it is necessary to minimize certain uncertainties. New knowledge has to be gained to help reduce uncertainties within the system. Here we describe the uncertainties that need to be addressed in order to arrive at a desirable system state in which the functions are covered.

Firstly, the governmental authorities, particularly the municipality and province need to make a decision about in which state the coastline should be in. As the economy of Zeeland depends largely on tourism, it is critical to keep the coastline in a state in which it keeps attracting visitors. As the individual mental model of ZMF and the visitor shows, there is a balance between beach hut development and the beach attractiveness/quality beach recreational product. It remains however uncertain how much beach hut development can be allowed before potential visitors choose an alternative beach destination for their recreational needs. Market research to find the exact relation between the extent coastline development and the preference of visitors is required in order aid in the decision making regarding in which state the system should be in.

On the other side, the extent of the effects of beach hut development on nature (e.g. bird populations, dune dynamics, and state of vegetation) is still unknown. Natura2000 policy requires that the bird habitats and habitats of other threatened species remain unaffected, and yet there are developments in various natura2000 designated sites because of an uncertainty about the effects of beach hut constructions on nature. Two types of uncertainties exist in this regard. First the effect of increased human activity (traffic, lighting, noise etc.) on nature and secondly the interference of aeolian sediment transport by beach huts. Further research in these areas would improve the system understanding and allow decision makers to be more aware of the effects of beach hut constructions on its natural environment.

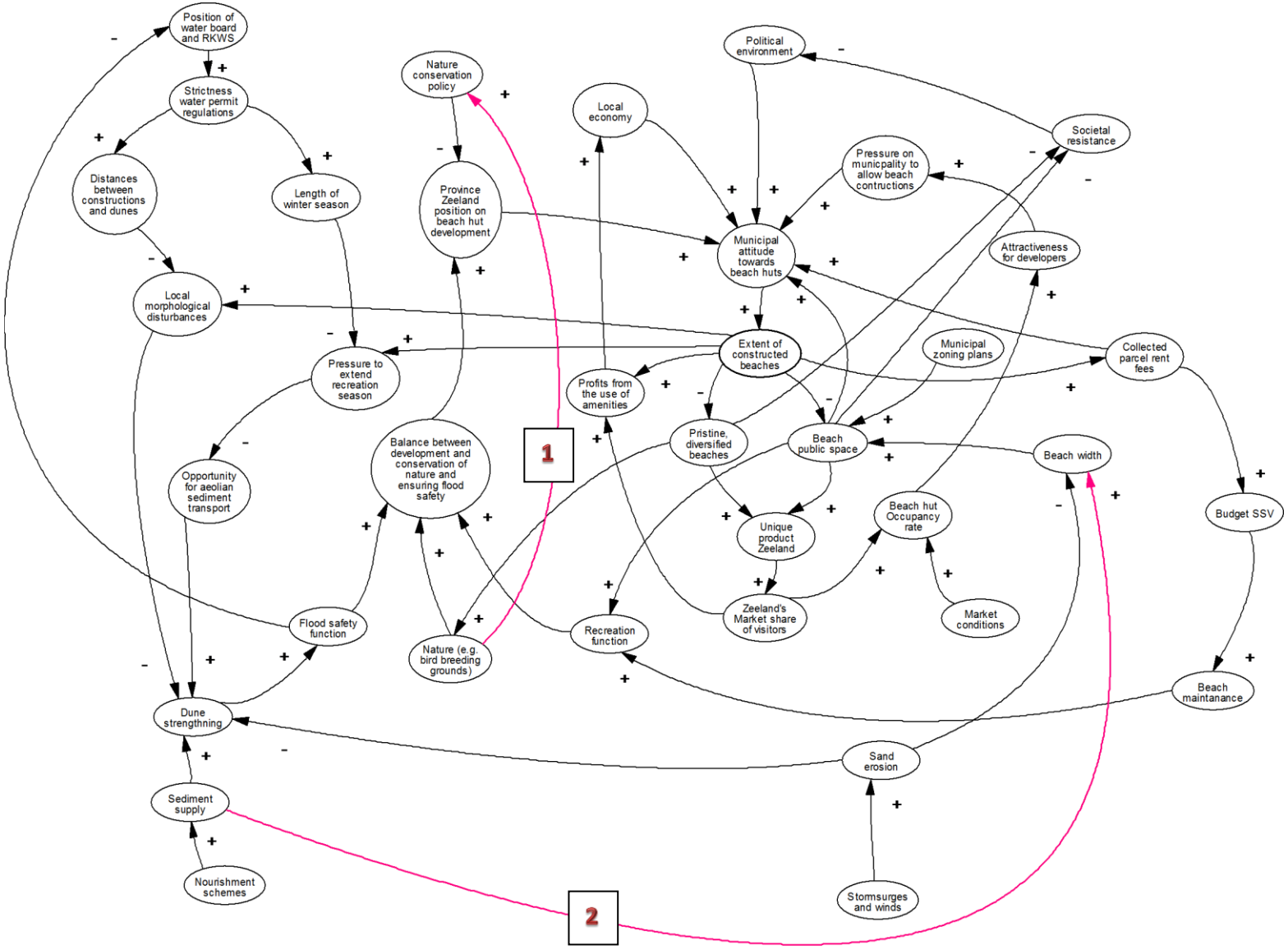

Figure 19: System with optimally working components. 1) Nature conservation policy (e.g. natura2000) gets direct feedback from nature status. 2) Contribution to beach from nourishment schemes.

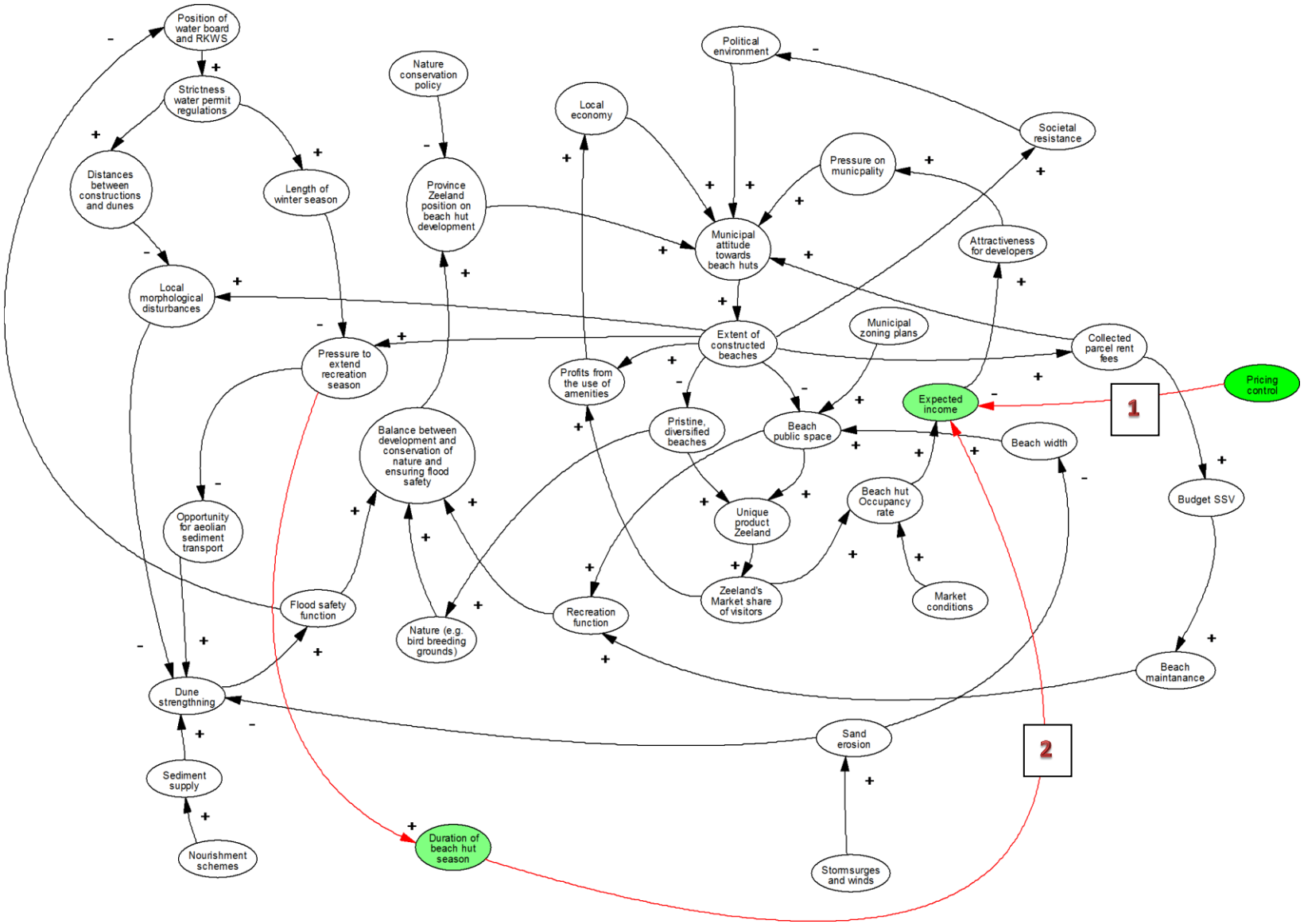

Figure 20: Possible interventions that could slow down development and lead to system equilibrium. 1) Pricing control and 2) limitation on beach hut season length.

7 Discussion

For the discussion the objectives are revisited and a comparison is given between the applied method within this thesis (mental model construction) and adaptive management.

7.1 Revisiting the research questions

RQ1. Which stakeholders are important to interview in order to gather data that will ultimately be used for the development of optimally supported regulations?

The municipality, province, Rijkswaterstaat, water board, SSV, visitors, expert/consultant, nature managers, beach hut rental companies and locals were identified in the stakeholder selection process in order to get the proper data for the creation of an appropriate representation of the system and possible indication of optimally supported regulations. From the beginning of the research period, it became apparent that it would be difficult to convince beach hut rental companies to participate in the interview process. This lack of interest may be attributed to various factors, e.g.:

- Off-season period for beach hut rental companies (winter/nourishment season) coincided with data gathering window.
- Conclusions based on applied methodology may lead to loss of revenue for the private beach hut rental business.
- Lack of time or available personnel.

Both the local residents and local businesses stakeholders were also excluded from this research. In situ consultation proved to be unsuccessful as 1 hour long interview solicitation was frowned upon.

The lack of involvement from the beach hut rental companies, and to some extent local residents and businesses contributed to a more simplified representation of the integrated model. A more simplified model implies that there may be a higher degree of uncertainty, in other words, it may not accurately reflect the system as a whole. In its present form, it may lead to obvious doubts regarding the model's credibility among stakeholders. It is unknown however that the overall conclusions would be different if the model is completed with the missing data from the non-interviewed stakeholders. Despite this setback, the last-minute inclusion of Stichting Strandexploitatie Veere did help with uncovering new links which made the integrated model more complete.

RQ2. Are the stakeholders aware of the effects of beach constructions on the dune environment? If so, which effects are perceived by different stakeholders?

As discussed in sections 4.2 and 4.3, all stakeholders are aware of some possible impact of beach construction on the dune environment. In terms of physical impacts, all stakeholders acknowledge that aeolian sediment transport can be adversely affected, but most of them see this effect as insignificant. This is probably because adverse changes in dune height and position behind beach constructions remain somewhat unnoticeable to the naked eye. Moreover, SSV stated that some of their beaches are experiencing beach loss due to dune growth while the "basiskustlijn" is maintained, even in densely constructed areas. On top of that, other factors, especially

nourishments have been observed to have a greater impact on the dune strength in terms of sediment volume than the presence of beach huts in front of the dunes (Hoonhout & van Thiel de Vries, 2013).

On the socio-economic side of the issue, most stakeholders perceive at least one form of impact from beach hut construction along their coastline, which is reflected in all of the individual mental models with the exception of the consultant's frame. As these stakeholders acknowledge, constant development may lead to deterioration of the natural beach characteristics (e.g. pristineness, diversity, openness etc.) that attract tourists towards the region. Many of the stakeholders are concerned as the hospitality sector is one of the main contributors to Zeeland's economy (Kuipers & Raaijmakers, 2015). Therefore the stakeholders are probably more focused on the socio-economic impacts of beach hut development, for example the possible deterioration of the recreational function than its impact on the flood protection function of the dunes.

RQ3. What perception do different stakeholders hold in relation to regulations for beach housing?

Regulations directly related to beach housings, i.e. the water permit, are broadly accepted. It must be noted however that the guidelines within the water permit of water board Scheldestromen differs somewhat in comparison with the advices presented by Hoonhout & van Thiel de Vries (2013). Replacing the water permit guidelines with the advices given in the report of Hoonhout will increase the minimum distance in between beach constructions and its distance towards the dunes to mitigate the local morphological effects which can destabilize dune sections. Hoonhout & van Thiel de Vries (2013) also concluded that there is no significant difference on dune growth between seasonal and year-round beach constructions, while the present regulations advocates for beach hut removal during the winter months for allowing uninterrupted aeolian sediment transport to strengthen the dunes. This implies that the water permit guidelines are a bit strict, regarding the allowed period for beach hut constructions.

Although there is yet no scientific evidence to support the claim that permanent beach constructions (e.g. pavilions) have great effect on dune volume than seasonal beach constructions (Hoonhout & van Thiel de Vries, 2013), it is sensible to keep the beaches empty from seasonal beach huts during the winter season as recreation activities from beach huts may interfere with beach nourishment activities which is often carried out during the winter season.

The location of beach hut placement is determined by the local municipal zoning plans and the municipality also arbitrarily determines the amount of beach huts that are allowed to be placed within these designated areas. Controversies arise when the zoning plans for beach hut constructions are placed in close proximity or even within nature designated areas.

With regard to the nature conservation policy, there is little evidence that it is being enforced, in particular the protection of natura2000 areas (Kuipers & Raaijmakers, 2015). The integrated model contains the "nature conservation policy" as a restraining variable on the continuous beach hut development cycle, but the interviewed representative of the nature organization has doubts whether it reflects the reality as developments within protected areas are ongoing (Appendix C). It can be argued that the Natura 2000 policy solely aims at the protection of threatened species and habitats (European Commision, 2016), and not the area itself. This policy leads to a difference in policy interpretation between the stakeholders as it is often difficult to precisely quantify the impact

of development on the habitat of threatened species. This case can serve as an example of the conservation failure trend on a larger scale within the Netherlands (Beunen, et al., 2013).

RQ4. What are the differences and similarities of the mental model of the stakeholders?

Most if not all stakeholder mental model contain similar balancing loops that reflect the deterioration of beach characteristics which can result from beach hut development. In other words these stakeholders acknowledge that on the long term, continuous beach construction can lead to a decline in "product Zeeland" in terms of attraction potential for tourism. However, two other stakeholders pointed out that beach hut development may also positively contribute to the recreation function of the coastline, which suggests that there is a reinforcing feedback from additional beach hut construction on the beach hut development trend. Thus to no surprise there are contrasting ideas on how exactly beach hut development will influence the overall beach recreation function of Zeeland.

Regarding the financial incentives for beach hut development, there is wide agreement that beach hut adequate market conditions for the developers and a favourable political environment are the driving forces for the trend. As long as the market conditions (demand for renting beach huts) are high, there will be pressure on the municipality to keep allowing beach hut constructions along the coast. The exact relation between beach hut developer, political environment and municipality however remains somewhat obscured at this point as the beach hut developers weren't interviewed.

Effects on the dunes resulting from beach hut development according to the individual mental models range from insignificant to valid concerns. Both the water board and RKWS perceive that adequate water permit regulations and nourishment schemes as mechanisms that would offset the negative impacts on the dunes. The province sees its overarching hierarchical position on the municipality as another mechanism to protect the flood protection function of the coast. The main difference between these two mechanisms within the integrated model is that water permit mitigates the direct negative effects as it prevents excessive interference of aeolian sediment transport towards the dunes, while the position of the province on the municipality is able to restrain the overall development of beach hut through the municipality.

RQ5. Based on the construction of the integrated mental model, what mechanisms can be included into the integrated model that can aid the system to reach a balanced state in which all the functions of the coastline are protected?

From the stakeholder consultations, there is broad consensus that the beach should be devoid of seasonal beach hut constructions in the winter period as it is perceived that in the winter season the dunes get to grow, due to uninterrupted aeolian sediment transport. Empty beaches would also be beneficial to nature as human activity along the beach during this period is kept at a minimum. Furthermore recreationists also tend to enjoy empty beaches. There is pressure from the developers to extend the beach hut season in order to increase their yearly earnings, but an extension of the season would likely make it even more attractive for developers to construct more beach huts as the expected income would increase with extended beach hut seasons (figure 20). Extended beach hut seasons together with favourable market conditions most likely increase the pressure on the municipalities and lead to an increasing imbalance in the system. Therefore shortening the beach

hut season would probably count on general support. Because much of the pressure to continue with beach hut development comes from the developers, it might also be sensible to increase the parcel rent fees in order to decrease the expected income for the developers, which will lead to less pressure exerted on the municipality. These straightforward adaptations would restrain the development and thus put less pressure on the functions of the beach-dune environment.

One component of the integrated model that seems to be somewhat inactive is the "nature conservation policy". Concretizing this component would allow the province to have more control on the development and its effects on all functions of the coastline. In other words, there will be a more effective counter balance of the development cycle. Probable effects of enforcing this policy is that non-nature protected areas will experience more development, instead of the development being spread out across all areas. Concentration of development within non-nature protected areas is likely to increase the flood risks as there is more potential for local morphological disturbances.

Alternatively, inclusion of nature organization in the decision making process for the adaptation of municipal zoning plans can prevent further escalation of controversies in the future. Such a strategy would likely synergize municipal development plans with the nature visions of nature organizations on a local level.

7.2 Reflection on the interview results

The individual causal loop diagrams are the results from the many interview sessions with the various stakeholders from different backgrounds. Visual comparison between these diagrams shows some differences and also some resemblances between them. These differences may be attributed to their individual frame of perception on this issue. These differences in the mental models are referred to ambiguity of the problem understanding between the stakeholders. Noteworthy is the difference in expectations of beach hut development on the long term. The municipality expects a positive spin-off on the economy, while the province, SSV and ZMF are foreseeing that it will lead to a deteriorated state of the beaches which would attract less tourism and thus interfere with economic growth.

The presence the different mental models on the issue of beach hut development implies that it has the characteristics of a complex unstructured problem as many different core problem are perceived and certain effects are not acknowledged by all stakeholders. Kolkman, et al. (2005) describe that these frames of perception are influenced by the different types of perspectives, i.e. technical, organisational, personal, ethical and aestethic. These perspective types help shape each stakeholder's mental model of the system. Each perspective type is related to the stakeholder's position within the decision making process (Schön & Rein, 1994). As this research was aimed at eliciting the stakeholder mental models, the extent of which each stakeholder's mental model is influenced by their roles within the system hasn't been explicitly determined.

As mentioned in the method section, the interview results (in the form of CLDs along with their respective detailed description) were communicated to the interviewed stakeholder via email for validation. Most of the interviewed stakeholders replied with the exception of the representatives of Rijkswaterstaat and ZMF. All validation responses were positive and adaptation to the CLDs weren't needed. This may not be case if the interviewer had personally communicated the results and allow for participated feedback. This approach allows for more in depth-feedback on the results.

7.3 Research method in context with the adaptive management approach

The research method applied in this thesis, i.e. mental model construction in the form of causal loop diagrams, is the initial phase of the systems dynamic approach, where information gathered from different stakeholders within a system is used to create a conceptualised representation of the social-ecological system. The constructed combined causal loop diagram can be used as the foundation for the conceptual model creation in the future which should have accurate mathematical representation of the system (elements within the system are quantified and the links are mathematically connected) and thus can be used as a valuable tool in the decision-making process.

Adaptive management is a strategy that aims to create flexible resource management policies that can be adjusted as project outcomes are better understood and as stakeholder preferences change. It is interdisciplinary, has strong theoretical component, and represents a departure from traditional management approaches where actions aren't constantly being monitored and improved. It emphasizes careful monitoring of economic and environmental outcomes of management actions. It also seeks to engage stakeholders in a collaborative "learning by doing" process. Overall, it is a "common-sense" strategy for addressing the reality of a changing and uncertain environment (Committee to Assess the U.S. Army Corps of Engineers , 2004).

The applied method within this research resembles the initial three steps within the adaptive management process (figure 21), wherein the problem is assessed, current knowledge is gathered through elicitation of stakeholder mental models and relevant uncertainties are identified. The results of this research thus provide information to the decision-makers to continue with the adaptive management process (i.e. implementation of actions/policies, monitoring of the effect of the implemented policies, and evaluation and learning from result outcomes which are to be compared with original expectations). The adaptive management process is then repeated as new knowledge is learned which might change how the system is managed. Every reiteration thus reduces the uncertainty of how the system is behaving and improves management decision making.

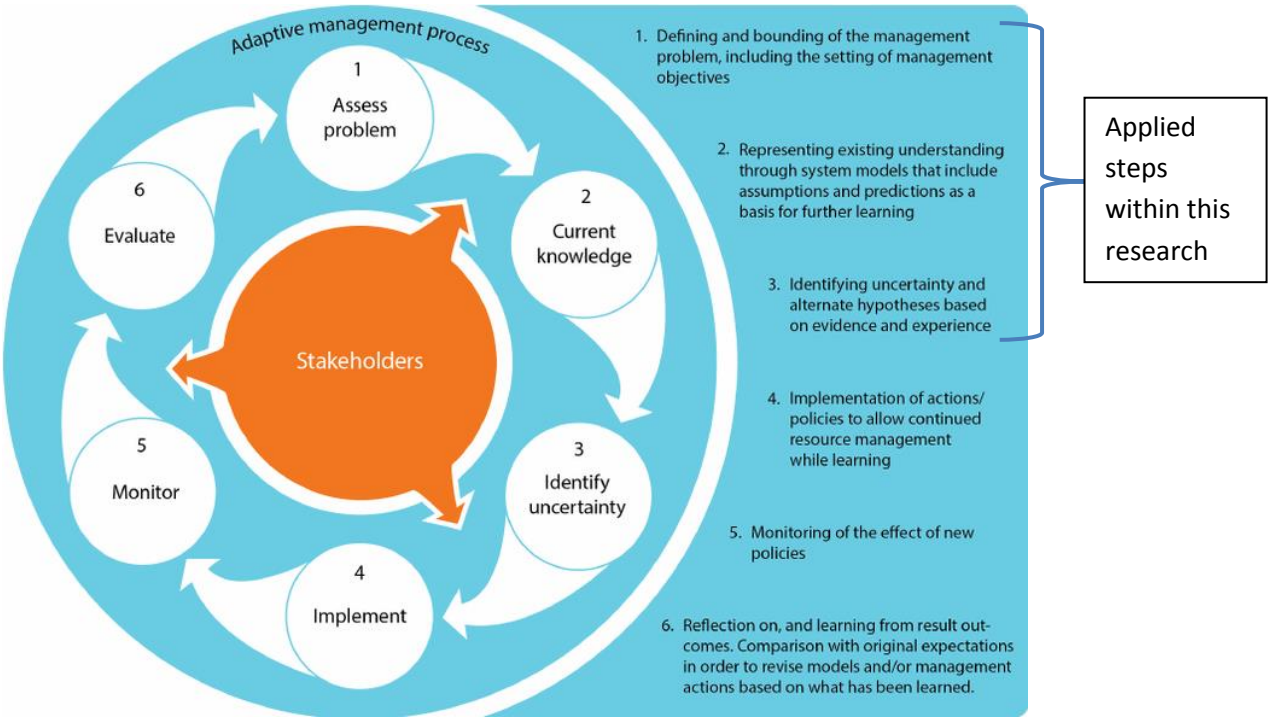

Figure 21: The adaptive management process (Holling, 1978).

In context of this case, relevant identified uncertainties as discussed in section 7.3 are the effects of beach hut development on nature and whether the recreational quality for visitors would be affected. The next stage would be the implementation of the proposed interventions (section 6.2) with consultation with the stakeholders.

Monitoring plans for the nature status is required to observe any changes in its quality. Because natura2000 aims to protect the bird and threatened species habitats, it is crucial to measure the changes in their population. Apart from this, trends in visitor rate requires careful monitoring to see whether there is continued recreational appeal for visitors. Finally the outcomes of the interventions are evaluated to see if the implemented interventions lead to a balanced scenario as described in section 7.2. It is conceivable that the objective changes, for example the decision makers (i.e. province Zeeland, municipality Veere) chooses for a different system scenario or that the interventions are unable to lead the system in a balanced state. In such case the whole process needs to be restarted.

8 Conclusions and recommendations

This chapter contains the conclusions of the present work in which the research questions are answered. Furthermore, recommendations are given.

8.1 Conclusions

Goal of present work was to elicit the stakeholder perspectives on the effects of beach house constructions (both positive and negative effects) in order to develop a balanced scenario in which all the dune functions remain protected.

Initial consultation and analysis, i.e. mental model construction, have shown the many perceived effects of beach hut construction along the coastline. Most of which are related to the recreation function of the beach-dune environment which contradicts the researcher's initial thoughts about its significant effects on the flood safety function of the dunes.

Nature conservation regulations seems to be the talking point, as the large majority of the stakeholders have great concerns about the changes continuous beach hut development might bring to the recreation appeal and the nature function of the coastline. The integrated model shows out that continuous beach hut development would affect the many nature and landscape characteristics of the coastline while the only nature protection mechanism, i.e. nature conservation policy is being ineffectively enforced. Regarding the regulations within the water permit, many stakeholders are strongly against extension of beach hut season.

All of the stakeholder's mental model show similar dynamics in the detrimental effects on nature and recreation functions as a result from beach hut development. There is wide agreement that the ongoing development is due to the pressure from the developers on the political environment and/or the municipality. Besides this forcing onto the system, some stakeholders see a reinforcing loop in the form of economic and/or financial benefits as more beach huts are built which reinforces the municipalities' positive attitude towards beach hut development process.

There are a couple of interventions that can keep the functions of the dunes protected and help the ecological socio-economic system arrive to a balanced state. Maintaining or even shortening the period allowed for beach hut construction, as given in the water permit, would allow space and time for nature dynamics to take place during winter time and furthermore will also relax the pressure on the municipality from the developers. Besides the water permit, there is much demand to bolster the enforcement of nature conservation policies such as the natura2000 species and habitat protection act.

This research uncovered the perceived effects and concerns of the ongoing beach hut development trend in Zeeland and made relations between various actions more explicit to the reader. The creation of the integrated model aids in examining the core of the issue and contributes to the structuring of complex ecological socio-economic system.

8.2 Recommendations for further research

Gather data from stakeholders who weren't interview in order to create a more complete integrated model. The selected stakeholders who weren't interviewed may hold important knowledge which cannot be easily elicited from other sources. Access to this knowledge can improve the credibility of the integrated model.

Conceptualize the model through group stakeholder meetings in which their experiences, perceptions, assumptions, knowledge can be openly shared and documented. Such a meeting can aid in aligning the stakeholders problem interpretation of the issue and help create a better simulation platform for interventions.

Implement frequent surveys on nature habitats near new beach hut areas to assess the effects on bio-diversity. Results from these surveys will help with appropriate enforcement of Natura2000 policies.

Assess coastal areas where dune growth contributes to decrease in recreation space. The national water plan strategy is to keep the coastline at the 1990 position. However, the recreation capacity of coastal areas with narrow beaches might diminish if dune growth is observed.

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Appendices

Appendix A: Sources used

The following websites were used as data sources:

- http://natura2000.eea.europa.eu/
- http://www.ruimtelijkeplannen.nl/
- www.scholar.google.com

Appendix B

List of focal points and questions used in the case

1) Characteristics and functions of the coastline
    a) Which characteristics of the coastline do you value as a stakeholder?
    b) What are the activities that you as a stakeholder along the coastline?
    c) What factors can influence your valued characteristics of the coastline?
2) Beach hut development on the functions of the coastline
    a) What is your understanding of beach hut development?
    b) How many beach huts are there along the Dutch coastline and Zeeland?
    c) What are the factors that contribute to the beach hut development?
    d) Does beach hut development affect your valued characteristics and/or functions of the coastline?
    e) Will the overall quality of the coastline change?
    f) What are the positive effects of beach hut development? (Prompt for tourism etc.)
    g) Will the construction of additional beach huts lead to an increase in the number of visitors?
3) The authorities and their regulations
    a) Which authorities are involved with beach hut development?
        i) What are their roles?
        ii) Do they work together? How?
    b) Are you satisfied as a stakeholder with the actions of the authorities?
    c) What vision of the coastline do you have for the future? How can the authorities work to reach this vision?
    d) Do you have an influence on the decision-making process regarding beach hut development?
    e) What challenges do you see in the future regarding beach hut development?
4) Sediment transport by wind – Aeolian sediment transport
    a) How aware are you with this natural process? And its importance to the dunes?
    b) What factors can influence this natural process?
    c) How do beach hut constructions influence this process and ultimately the environment as a result from the impacted process?
    d) Do the present regulations help in mitigating the impact on aeolian sediment transport?
    e) Does sand nourishment contribute to the aeolian sediment transport process? How?
    f) Are the dunes impacted from beach hut development?
5) In light of the beach hut development along the Dutch coast/Zeeuwse coast, how would you describe the core problem of this development?

Appendix C

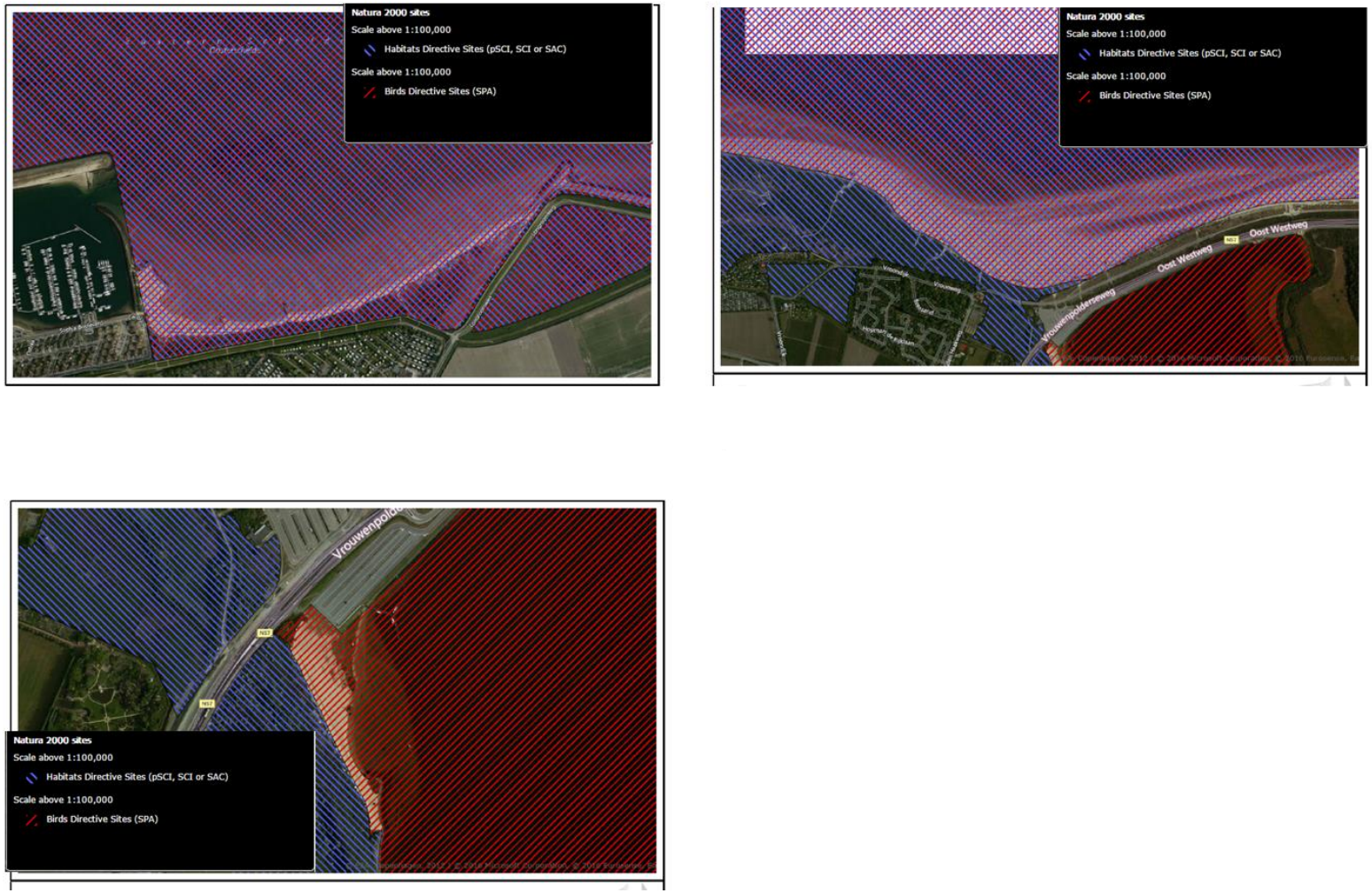

Figure 22: Cases of beaches with beach huts in Natura2000 designated areas. Sophia beach (top left), Vrouwenpolder sea-side (top right) and Vrouwenpolder hinterland (bottom left).