Water management in low-lying areas

Synergies and conflicts in multifunctional planning projects

Double Degree Programme:

Environmental and Infrastructure Planning

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Water and Coastal Management

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Abstract

Due to changing precipitation patterns, the frequency of inland floods increased. Therefore, alternative drainage measures are in demand to counteract the increasing flood risk. To investigate how these measures are implemented a comparative case study research between Germany and Netherlands is conducted. The research objective is to unfold synergies and conflicts between involved stakeholders within water-related planning projects in low-lying coastal areas. Therefore, the theories of flood resilience, decentralised planning and multifunctionality are applied to evaluate their compatibility through a case-specific document analysis and expert interviews, which will be interpreted through developed criteria matrixes. This should contribute to a comparison of theory and practice of the case studies and to possible improvements within planning theory and practice.

Keywords: Water management, low-lying coastal areas, flood resilience, decentralised planning and multifunctionality

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DP	Decentralised planning
FR	Flood resilience
GM	Großes Meer
IPCC	Intergovernmental Panel on Climate Change
LLCA	Low-lying coastal areas
MF	Multifunctionality
OL	The Onlanden
SD	Sustainable development

1 Introduction

1.1 Problem definition

Climate change is a threat for low-lying coastal areas (LLCA). Currently, climate predictions forecast the intensification of heavy rainfalls for Europe. This includes increasing precipitation amounts, especially in the winter months (IPCC, 2007; IPCC, 2014) and sea level rise due to human and natural factors. Therefore, low-lying human agglomerations have to face increasing sea-level rise, increasing precipitation patterns, land subsidence processes and growing surface sealing. The research by (Menoni et al., 2012) tries to unfold deficits in current flood control measures through the EU funded project ENSURE, that attempts to improve the resilience of vulnerable agglomerations. Climate change put low-lying areas under increasing pressure, "as *(White et al., 2001) pointed out: "the indisputable rise in threatening phenomena has not been matched by enhanced community and environmental response so that mitigation strategies and measures have been inadequate in addressing the threat*" (Menoni et al., 2012). Besides that, the Intergovernmental Panel on Climate Change (IPCC) lists the future challenges in the Fourth Assessment Report. They mention the necessity for societal adaption to the projected impacts of climate change and point out, that an "*increase in the likelihood of systematic failure*" (IPCC, 2014) requires, **first** the improvement or development infrastructure, such as increasing dikes (engineered defence) or water storage capacities (ecosystem-based measures). **Second**, societal change has to occur, such as spatial transitions and the development of new planning concepts. **Third**, increase the awareness of uncertainties through climate change, so that society can react and predict unexpected future changes (IPCC, 2007).

Table 1: Climatic effects and consequences (IPCC, 2014)

Effects	**Consequences**
Changing precipitation- and discharge regimes	- Intensification of heavy rainfalls - Increasing water amounts in the winter months - Higher frequency of occurrence of prolonged droughts in summer periods
Land subsidence and deformation processes of the ground surface	- Altitude difference within the water body between dyke foreland and dyke hinterland
Increasing tidewater-levels	- Altitude difference within the water body between dyke foreland and dyke hinterland Increasing inflow of water

Increasing surface sealing	- Lower retention capacity - Poor soil-water-storage capacity

Table 1 illustrates the most important climatic effects and their consequences, which include furthermore human effects, such as increasing surface sealing, which is intensifying the effect of climate change. Therefore, the mentioned effects in table 1 are having crucial consequences on drainage of the dike hinterland and are intensifying the critical circumstances for sufficient drainage and water management. Consequently, changing precipitation and discharge regimes will lead to increasing water peaks within an area. Land subsidence processes due to gas extractions, will cause increasing altitude differences between the dyke fore- and hinterland and can lead to surface depressions. As well, the sea-level rise will lead along the North Sea coast to increasing water levels in the dyke foreland, which put more pressure on the dikes resulting in altitude differences of water bodies between dyke fore- and hinterland and more water inflow into the dyke hinterland (IPCC, 2014). Increasing surface sealing is reducing the natural retention capacity and leads to poor soil-infiltration-rates, accelerating climatic effects (see figure 1). The consequences of all four aspects for inland drainage are more inputs of water amounts, increasing runoff, decrease of natural storage capacity, increasing land subsidence through gas extractions and increasing energy costs due to more regular pumping. The main relevant consequence is a higher peak volume that need to be drained within the dyke hinterland.

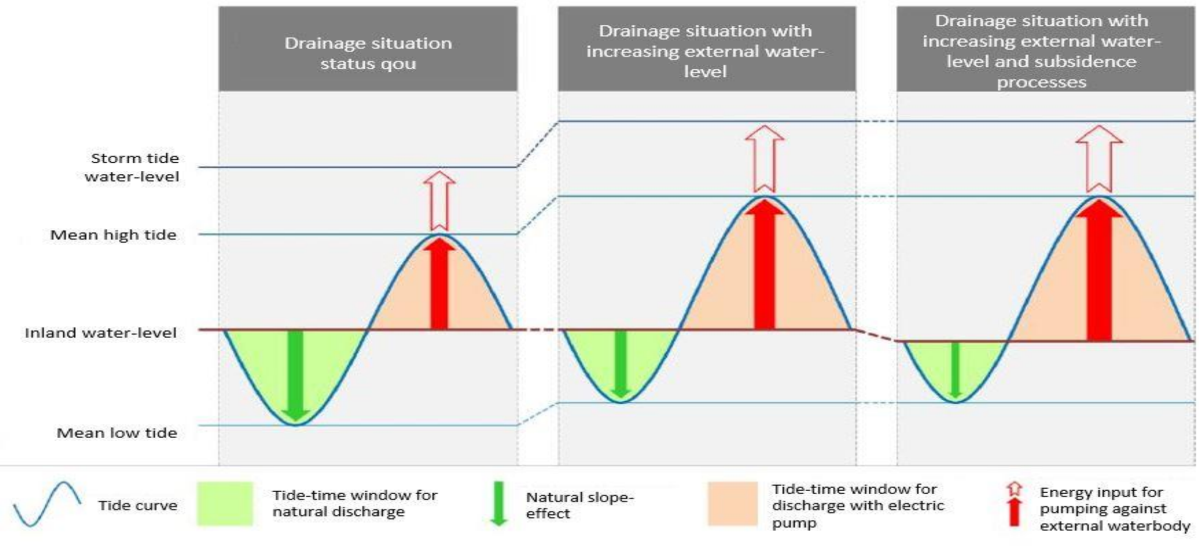

Figure 1: The effects of increasing water levels and subsidence processes on drainage

The dependencies between human actions, hydrology- and temperature-shifts led to an institutional shift from sectoral to inter-sectoral water management (Pahl-Wostl, 2006), consequently, the interest for alternative solutions in water management intensified (Temmerman et al., 2013). As mentioned by Temmerman et al., (2013) ecosystem-based measures are in demand, which tolerate changing water flows and levels as a natural part of the landscape. The combination of engineered defence, such as dykes and ecosystem-based measures, such as retention areas are indispensable to face future threats (Temmerman et al., 2013), as the time window for natural drainage (see figure 1) is decreasing due to climate effects and consequences (see table 1).

1.2 Classification and relevance of the research topic

Climate change is occurring while simultaneously the main part of the world's population lives in coastal agglomerations or in low-lying areas (Collet et al., 2015). Therefore, comprehensive drainage management is important to protect the low-lying areas against flooding (Lower Saxony Ministry for the Environment, Energy and Climate Protection, 2012). The technical approach, which focused on the strengthening of existing engineered defence, is not enough anymore. Alternatives, which are more adaptive and flexible contributing to the economy, environment and society (Kruse, 2010), are needed to treat vulnerable and valuable LLCA differently regarding their circumstances. Therefore, comprehensive drainage management requires institutional inter-sectoral integration to develop integrative solutions (Pahl-Wostl, 2006) and the combination of engineered defence and ecosystem-based measures (Temmerman et al., 2013) to obtain coastal regions as settlement areas, productive agricultural land or as economic centres. The combination of these two principles is crucial to face climate change and antagonise its impacts to build more robust and adaptive water management regimes. Gleick (2003) describes it as followed: "*A transition is under way to a 'soft path' that complements centralised physical infrastructure with lower cost community-scale systems, decentralised and open decision-making, […]*". More robust water management is related to returning space for water instead of holding it back and follows the three-step approach of retaining, storing and then discharging water (Hooimeijer et al., 2008). The principle is to use an area for retention purposes in case of an extreme event, that is retaining and storing the water until normal discharge is possible again. Therefore, this research will investigate in which extent two case study regions - in the Netherlands and Germany - adopted their water management to make it more robust.

1.3 Objective and research question

After having explained the importance of ecosystem-based measures to prevent flooding of low-lying areas, this research will consider adaptive and integrated water management of low-lying areas to accept water as a natural part of the landscape, to give it more room and to increase the temporary storage capacity (DWA, 2013). Table 2 illustrates different ecosystem-based measures, which can be integrated in the natural landscape, are assimilated in agricultural cultivation or modifications in settlement areas. The highlighted sections indicate the relevant measures within this research, as they were of major importance to the case study regions.

Table 2: Ecosystem-based measurements of an adaptive water management in low-lying areas.

<table>
<tr><th>Predicted impacts</th><th>Influenced landscapes</th><th>Possible measures</th></tr>
<tr><td rowspan="2">Decreasing run-off and peak discharge</td><td rowspan="2">(1) Settlement areas</td><td>Roof greening</td></tr>
<tr><td>Rainwater processing</td></tr>
<tr><td>Increase of soil retention capacity through better soil and pore properties</td><td rowspan="2">(2) Agricultural land</td><td>Conservation soil cultivation and direct seeding</td></tr>
<tr><td>Increase in storage capacity and erosion protection through extensive soil cultivation</td><td>Transformation of agricultural land into grassland</td></tr>
<tr><td>Higher evapotranspiration and change in discharge regimes</td><td rowspan="2">(3) Forest</td><td>Forestation</td></tr>
<tr><td>Mixed forests with higher retention capacity</td><td>Forest conversion</td></tr>
<tr><td>Increasing water amounts within one catchment area</td><td rowspan="2">(4) Water body</td><td>Increase of tolerable water levels</td></tr>
<tr><td>Restoration of retention capacity</td><td>Reactivation of swamps and wetlands</td></tr>
<tr><td>Retention effect and increase in storage capacity</td><td>1, 2 and 4</td><td>Retention basin</td></tr>
</table>

Within the case study regions, the realisation of retention areas, the reactivation of swamps and wetlands as well as the transformation of agricultural land was relevant. In regards to the environment and the predicted climatic changes, the measures can increase the environmental quality but trigger tensions between different land uses.

The main objective of this research is to find out about synergy-effects and conflicts of adaptive ecosystem-based measures (see table 2) in water management and if they create flood resilient places. The implementation of a retention area can trigger the reactivation of swamps and indicates a synergy for example. As water-related planning projects intervene and influence their landscape, tensions between different interest groups and landowners emerge. But since climate change forces society to find alternative adaptation strategies, multifunctional land uses seem essential to fight climate change in a sustainable way (Ahlhorn F. and Meyerdirks J., 2010). Therefore, this research uses the favoured theories of decentralised planning (DP), flood resilience (FR) and multifunctionality (MF) to identify synergies and conflicts between landscape functions in water-related projects, to improve water- and drainage management in LLCA and to advance inter-sectoral institutional communication. This approach should contribute to a more sustainable, adaptive and robust water- and drainage management in future planning projects. Considering the objective of this paper, the main research questions to be answered are the following, which will be answered in connection with two water-related planning-projects, one in the Netherlands and one in Germany:

(1) How do comparable areas cope with flood risk?

(2) To what extent does DP work in planning practices?

(3) Do experts feel that a change in MF creates more sustainable environments?

1.4 Structure of the research paper

The structure of the research paper is build up to get a better understanding of the recent issues of water management in low-lying areas. The introduction started with the general problem definition, followed by the research relevance and ended with the research objective and resulting research questions. The second chapter explains the relevant theories and builds the theoretical framework. The third chapter consists of a comparative case study, a document analysis, expert interviews and the development of a criteria matrix, which creates with the second chapter the conceptual model to answer the research questions. The fourth chapter conducts the document- and stakeholder analysis to present results and concludes through a comparison the two cases study regions. The fifth chapter discusses the results and the sixth chapter concludes the whole research.

2 Theoretical framework

The second chapter describes the theoretical framework, which consists out of relevant theories, such as **FR**, **DP** and **MF**. The theories will be elaborated in the context of water management in low-lying areas and will contribute to the assessment through the methodical procedure in the fourth chapter. FR is relevant in the context of the two case study regions, as they are used for water retention purposes and are located below mean sea level. Both case study regions are stamped by diverse land uses and different stakeholders with different interests, explaining the relevance of the theories MF and DP.

2.1 Flood resilience

A shift in water management occurred through increasing climatic variables and uncertainties. So far, the field of water management was dominated by flood probability, which focuses on the prevention of floods by spatial and technical measures (Meijerink & Dicke, 2008). As mentioned by Ward et al. (2013, p. 518): *"flood risk is defined as the probability of floods multiplied by the potential consequences"*. The formula will be solely used as a supporting point of view as it is not the aim to calculate the flood risk rather to identify how comparable areas cope with flood risk.

Figure 2: Flood resilience approach

Figure 2 illustrates that the new flood risk approach considers safety standards based on the risk of floods and their consequences. This research investigates two case study regions, which function as retention areas in the case of an extreme event, by accepting the risk of flooding to reduce the risk in a nearby geographic place, spatially separated from each other. That indicates that acceptance and perception should be part of the definition of (flood) risk.

Therefore, the case study regions function as flood risk prevention areas, by reducing the probability and consequences of flood events in a nearby area.

A shift towards more integrated and adaptive management approaches seem to be necessary, where a sufficient protection against the destructive power of water is only possible with engineered defence with ecosystem-based measures in combination (Aerts, 2012; Pahl-Wostl, 2006; de Bruin et al., 2009; Temmerman et al., 2013). These more integrated and adaptive management approaches are increasingly recognised as FR, which are characterised by principles such as "*work with nature*" or "*live with the water*" (Meijerink & Dicke, 2008). The shift in water management describes the move towards ecosystem-based measures and non-structural approaches, which come along with conflicts and governance challenges (Huitema et al., 2009). This shift is exemplary for a more area-oriented planning approach, which is not new, rather a step back in time giving back land once claimed for cultivation. Political reactions can already be perceived on international and national levels, such as through the Flood Risk Directive on European level (European Parliament and Council, 2000; 2007) and as well through the programme "*Room for the River*" initiated by the Dutch Senate (Rijke et al., 2012). Programmes such as the Room for the River programme are characterised by ecosystem-based measures, which do not consist out of hard physical structures rather of spatial configurations that try to contribute to natural dynamics and uses them as buffer or adaptive flood protection measure.

However, this research focuses on the protection against inland flood events due to increasing precipitation events as calculated by the IPCC, through more integrated and adaptive flood risk measures. According to Meijerink & Dicke (2008) two main strategies can be distinguished, "*Reduce Probability of flooding*" and "*Reduce Impact of flooding*" which will be further dismantled in the following heels. Moreover the social transformability mentioned by Walker (2004) and Folke (2010) which describes the acceptance of flood uncertainty will be detailed as well.

2.1.1 Hazard reduction

Hazard reduction wants to **reduce the probability** of flooding by keeping floods away from flood prone areas (Meijerink & Dicke, 2008). Flood prone areas can be urban as well as agricultural areas. The attempt in doing so is to build spatial and technical structures, such as dykes, dams and retention areas to increase robustness (Davoudi et al., 2012). This approach provides protection for urban areas and fertile grounds for agriculture. The increase of climate change puts more pressure on LLCA and requires the combination of spatial (e.g. retention areas) and technical measures (e.g. dykes), which indicates a mixture of engineered defence and ecosystem-based measures. Therefore, the hazard reduction describes the risk of an insufficient storage capacity in one region, which would affect the probability and consequences of floods in another region. Concerning this research the hazard is reduced in one region by shifting the hazard to another region.

2.1.2 Vulnerability reduction

Vulnerability reduction wants to **reduce the consequences** of flooding through the preparation of areas for flood events (Meijerink & Dicke, 2008). To prepare areas for flood events, vulnerable land uses need to be identified and avoided if possible. Emphasis lies on preparation to minimise the consequences of floods and keep damages as low as possible contributing to the adaptability of the system (Walker, 2004). As vulnerability can be understand as the sensitivity of a system in the case of an extreme event, it describes in what extent LLCA are adapted and which actions have been taken. Accordingly, vulnerability reduction describes within this research the reduced consequences of flooding through adaptation strategies such as discouraging vulnerable land use in flood-prone areas through parcel exchange or land acquisition.

2.1.3 Transformability

Walker (2004) describes transformability as the potential to trigger change if the current system is not sufficiently functioning. **Accepting uncertain** climatic conditions, which are decreasing the efficiency of the system requires social transformability and increasing public awareness. Transformability describes the shift in water management, where strategies of sufficient drainage management needed to be reconsidered. As mentioned by Folke (2010, p.

5), "*transformational change often involves shifts in perception and meaning, social network configuration […]*". Therefore, transformability describes in the context of this research, fostering social change through risk communication and educational programmes. Transformability is represented through the reconfiguration of social perception for floods, which should contribute to an improved awareness of the public concerning flood risk.

In the case of LLCA, flood risk is intended to be minimised by reducing the consequences as well as the probability of floods while simultaneously triggering social change. Fulfilling all three FR criteria, stays usually unaccomplished in current planning practice. This study will investigate in what extent flood resilient places were created. The next section introduces theories that can help to achieve FR.

2.2 Decentralised planning

DP describes a shift in planning from higher national authorities towards more involvement of lower planning authorities, such as provinces, cities and regions. The core point of the shift from centralised towards DP is the reallocation of decision-making power on lower spatial planning levels (Allmendinger, 2009). The shift was triggered through the realisation of insufficient distribution of resources, when it was realised that higher national authorities often do not have the local knowledge to fight specific uncertainties and problems (Zuidema, 2016). DP stands for sharing responsibilities and involving all relevant stakeholders, which is thought highly important in a fragmented and continuously changing society. Therefore, instrumental rationality is considered insufficient in complex and intertwined situations,

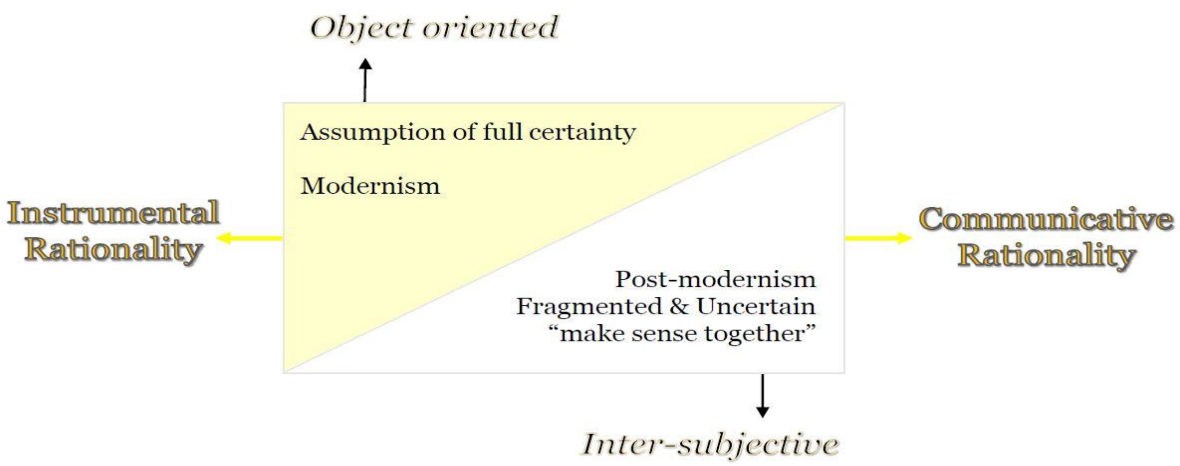

Figure 3: The connection of instrumental- and communicative rationality

where the reclamation of collaboration led to the discovery of communicative rationality as indicated in figure 3 (Habermas et al., 1981). Communicative rationality is based on an inter-subjective perception, were individuals make sense together, which was outlined by Habermas (1989) in his publication "*The structural transformation*" and Healey (1996) with the introduction of the communicative turn. DP dissociates itself from the instrumental rationality and assumes that the link between problem and solution can only be tackled by communication, based on trust and reciprocal respect, which are principles of collaboration and has proven to be essential in current planning practice.

As explained above, the communicative rational is used if planning situations are stamped by uncertainty, such as climate change to find common consensus between different interest groups. The explained shift in water management (see chapter 2.1) can be linked to a shift from instrumental rationality towards communicative rationality (see figure 3), where fragmented and uncertain situations need to be solved by making sense together and finding adaptive solutions for water management. In the case of planning projects in LLCA, collaboration plays an especially important role as climate uncertainties are hard to predict (e.g. increasing rainfall events, storm surges and sea level rise) and many different landscape functions come together represented by multiple interests groups. Therefore, water management in terms of increasing uncertainty requires the involvement of all influenced stakeholders to find a common consensus through reasonable climate change governance. The next sub-chapters illustrate new planning approaches concerning to decentralisation and will help to evaluate in which extent DP is beneficial for planning practices.

2.2.1 Climate change governance

Climate change governance can be connected to the communicative rational (see figure 3), where high uncertainty about weather patterns leads to the need of broad participation amongst relevant experts. Governance is a process, which connects formal and informal experts to participate in problem solving and achieve convertible solutions. Climate change governance contributes to the development of a collective descriptive framework for the action of spatial planning in uncertain situations, such as climate change (Spiekermann, 2014). The development of a collective descriptive framework is crucial, as the government is not able to oversee the complex issues of climate change and is confronted to stay legitimate and simultaneously hold a decision-making ability (Zuidema, 2016). The discourse of different actors within climate change governance can be used to generate norms, because the interplay between different interests enables a common orientation (Greiving & Fleischhauer, 2008). The implementation of norms generated through climate change governance requires interlocking with classical governmental processes, such as legislation to guarantee accountability and legitimacy (Meadowcroft, 2009). Spatial planning is considered as the cross-sectoral approach, connecting formal and informal networks to generate the necessary requirements, such as:

- the activation of networks and promotion of collaboration,
- the development of principles and concepts and
- the role as agent to coordinate between different interests (Spiekermann, 2014).

To execute these requirements for more governance the local institutions or stakeholders should be equipped with enough resources.

2.2.2 Stakeholder involvement

Stakeholder involvement is essential for DP and collaboration to solve spatial problems. The stakeholders represent the variety of individual interest involved in a planning process with different resources and expertise. According to Karrasch (2011, p. 17): *"a stakeholder is, or represents an institution, an organisation or group that is affected by an intervention"*. In regards to post-modernism (see figure 3), the involvement of stakeholders became an important part of environmental management as participatory process (Meadowcroft, 2004). A wide amount of stakeholders contributes to the planning process through the allocation of information and represents public concerns and needs. Therefore, a stakeholder should be aware of the range of the planning interventions, the involved participants, the key concerns, the surrounding area with its geographical and physical specifications and the used resources. In addition, stakeholder involvement contributes to the common interest and is disadvantageous for single stakeholder interests. Stakeholder involvement stands for the involvement in the decision-making process, to increase the local, traditional and professional knowledge, which improves the case specific knowledge and needs. The involvement advances transparent and participatory planning practice, which contribute to sustainable development (SD) (Reid, 2005), because it integrates multiple interests. Especially important is the involvement of stakeholders in order to secure a complete and comprehensive consideration of potential benefits and risks. In addition, the stakeholder involvement in the planning process can identify development goals, positive outcomes, reduce negative outcomes and uncertainties to detect the stakeholder impairment (Termeer et al., 2012). Furthermore, collaboration between relevant stakeholders is important to understand the causal relationships of different interest groups and to develop an inclusive chain of causalities, which lead either to synergies or to conflicts. The principle behind stakeholder involvement is that it guarantees a fair and transparent decision-making context through the consideration of multiple interests. Consequently, the participatory process is important to confirm that guidelines are suitable and applicable and encourages that the planning process follows the desired outcomes (Mullally et al., 2013).

Summarising, DP describes the stakeholder involvement as the consideration of multiple interests, which need to be accompanied by an agent. DP therefore is important to manage and coordinate within complex planning circumstances with multiple involved interests groups. The next section comments on theories that are relevant in such complex planning circumstances.

2.3 Multifunctionality

Water emerges in many different forms (groundwater, seawater, surface water and rainwater) and is connected to many different issues: water quality, water demand, water supply, water scarcity, sea level rise and the modification of the hydrological balance. Besides, water has multiple functions for the economy, society and ecology, for instance, for navigation, for drinking water supply and to sustain ecosystems (van der Brugge et al., 2005), that is why it is used here as an indicator for MF. In addition, water also offers values, for example the social value in form of a cultural or recreational meaning. Pahl-Wostl (2006a) explains in her paper the relatedness of water between different components, she uses the definition by the framing committee (GWSP, 2005, p. 9), which defines the global water system: "*as the global suite of water related human, physical, biological, and biogeochemical components and their interactions*". The multiplicity of water also explains the shift in water management, because it needs to be managed for many different functions, such as safety, water supply and flood control (van der Brugge et al., 2005). Therefore, it is assumed that the multiplicity of water can contribute to reduced flood risk. The core point is that water is multifunctional regarding his management, as it needs to be managed across different functions and stakeholders. Besides, the MF of water, the multiple purposes of the landscape are characterised by water management-, nature conservation-, agricultural-, touristic- and cultural-purposes. Whereas, the interplay of different landscape functions emboss the multifunctional character and can contribute to flood control. The multiplicity of water and the MF of the landscape can trigger synergies and conflicts, where this research will answer how to balance multiple objectives and if multifunctional landscapes create sustainable environments.

2.3.1 Climate adaptation

"*Adaptation refers to adjustments in ecological-social-economic systems in response to actual or expected climatic stimuli, their effects or impacts*" (Smit & Burton, 1999, p. 200). De Bruin et al., (2009, p. 24) describes climate adaptation as: "*the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences*". Climate adaptation therefore describes the necessary link between flood risk and improved spatial planning. Adequate climate adaptation strategies are necessary, as society is aware of climatic changes and uncertainties. The IPCC mentions this challenge in their report 2007, illustrating that the knowledge gap about coastal systems, their interactive nature and non-linear behaviour can lead to bad implementation and effectiveness-reduction of adaptive climate-related measures (IPCC, 2007). The essential relevance of different contexts for adaptation measures becomes important for spatial planning and policy-making, as climate adaptation measures need to reflect on the full setting, where adaptation takes place including their capacity to adapt (Tol et al., 2008; Füssel, 2007). This means that expert knowledge needs to be connected with local knowledge to overcome the knowledge gap and secure consideration of the full setting. This will promote more comprehensive planning and optimal allocation of resources. Main idea of climate adaptation is that spatial planning considers future uncertainties to counteract lingering climate change as well as extreme weather events to prepare spatial and site-specific adaptation measures, as mentioned in previous chapters (2.1.3 and 2.2.1) (Spiekermann, 2014). An additional challenge to the context related knowledge gap is the planning for the "*unknown unknown*" triggered by climatic uncertainties mentioned by Termeer et al. (2013). This is also addressed by Spiekermann (2014), who demands more flexible and stepwise planning approaches instead of predetermined planning steps to achieve a more adaptive planning approach. Therefore, climate adaptation describes the connection between necessary communicative aspects and the MF of a landscape to counteract the "*unknown unknown*". Next to the site-specific criteria the technical-, social- and institutional-complexity can hamper climate adaptation measures (de Bruin et al., 2009; Spiekermann, 2014). Concerning to climate adaptation the ability and willingness of institutions and the society under investigation and the development of a concept is crucial to find suitable adaptation measures. A simplified form of climate adaptation is the modification or redesign of the landscape, consequently adaptation measures can conduct synergies or conflicts.

2.3.2 Sustainable development

Sustainability is commonly known as the recognition of the environment, the economy and the society as equal columns for future development. The term SD emerged as a consequence of an unequal distribution and recognition of the three columns. One of the earliest and most famous literature addressing the problems and challenges of modern society was Meadows book about "The Limits to Growth", firstly published in 1972 (Meadows et al., 2004). Especially during the time of industrialisation, Meadows main concern was the antagonistic interplay between economic growth and environmental protection. This gap between cost effectiveness and nature conservation on global scale triggered the formation of the "United Nations Climate Change Conferences", which come together every year since 1995, to discuss how to establish legally binding obligations for greenhouse gases and more eco-friendly economic interventions (United Nations, 2014). The intention is to find economic growth, which supports environmental protection through innovation. The Brundtland Commission defined SD, as "*[…] the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development, 1987). The Brundtland Commission and the "United Nations Climate Change Conferences" opened a rash of reports concerned with SD, which clarifies the full complexity of the term itself. According to Jordan (2008) a reinforcement of SD emerged, as the all-encompassing objective of anthropogenic development on international, national and local scale. The problem of SD is that it remains a peripheral law instead of a legally binding obligation (Jordan, 2008). The interest of cost effective development still overrules environmental protection. SD falls victim of inter-subjective perceptions that makes it impossible to formulate a holistic definition, which calls for re-interpretation and adaptation of the concept through social dialogue and reflection. The main finding is that SD evolves in relation to his context and is therefore context dependent. Thus, the practical implementation needs an inclusive strategic approach, which considers the ecological, economic and social column as equal measures (Jordan, 2008). Moreover, Vanclay (2003) clarifies that SD needs to be integrated in the development process between and within all planning stages.

Summarising, this paragraph illustrates that climate adaptation measures are linked with reduced probability (FR) and that multifunctional landscapes are emerging out of multiple interests. Therefore, MF is used as indicator for sustainability to value multifunctional planning projects. The challenge remains, how to build flood resilient places while simultaneously considering multiple interests that are creating multifunctional landscapes. The next section is concluding the theories within a theoretical framework.

2.4 Conclusion

The theoretical framework consists of three main fields, the communication and cooperation (DP) that creates multifunctional land uses through the new water management approach of FR (see figure 4). Therein, the theory of FR represents the current shift in water management and the planning intention of creating water systems that are more robust and adaptive to withstand climatic pressures. This is intended by reducing the probability and the consequences of floods, while simultaneously preparing the public through rising awareness for flood risk. The theory of DP and stakeholder involvement should contribute to the improvement of spatial plans by enhancing cooperation and coordination. The intention is to integrate people that are influenced through the planning action and are familiar with the surrounding area. This creates a group of representatives able to cope with all disciplines and problems associated with the planning action. The theory of MF describes the requirement of being flexible within planning due to fluctuations in climate. This depends on the ability of creating adaptive measures and openness for multifunctional planning purposes (see figure 4). Therefore, the theories are expected to contribute to reduced vulnerability of LLCA. Core point is the contribution of the theories, to make predictions of differences between planning theory and practise. The next chapter introduces the methods used within this research.

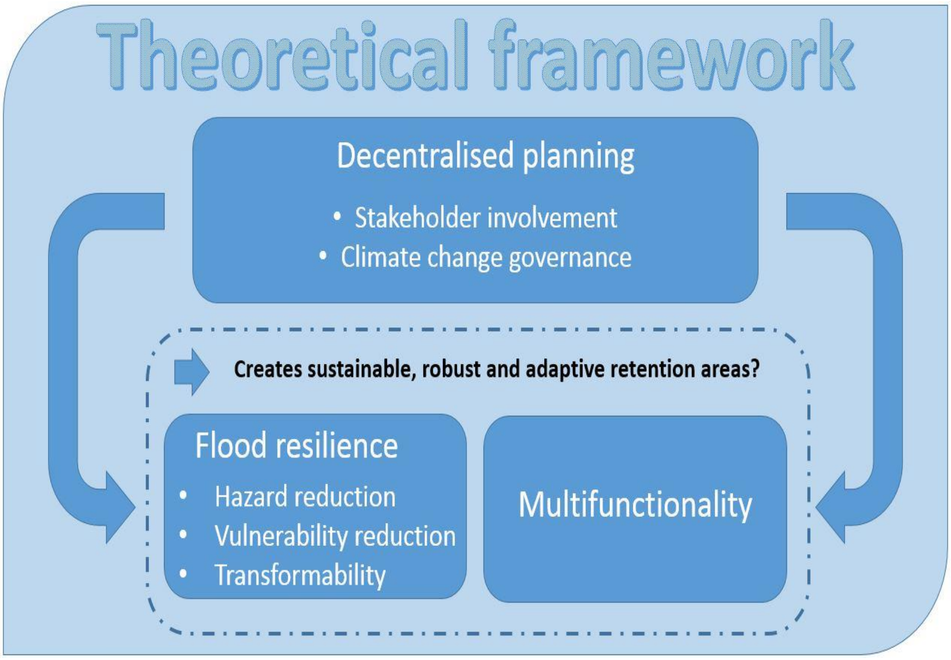

Figure 4: Theoretical framework

3 Methodical procedure

The following chapter describes the methods, which are used to answer the mentioned research questions in the first chapter. The methods consist out of a comparative case study, a document analysis, expert interviews and the development of a criteria matrix. Thereby, synergies and conflicts can be unfolded, a comparison between theory and practices can be conducted and lessons to learn can be identified. The comparative case study research between Germany and the Netherlands will help to make estimations about the planning deficits and potentials between the cases.

This paper emphasises qualitative research over quantitative, to compile the amount of interaction and cooperation between involved stakeholders and the resulting multifunctional issues with their benefits or downsides. Qualitative research is preferred because it frames the individual perception and helps to assess sectoral perception to unfold different emphasis. The individual perception guarantees an inside into different sectors and contributes to a comprehensive analysis. To judge upon the success of multifunctional outcomes, interviews with different experts involved in the project will help to make statements about synergies and conflicts. Here qualitative research is beneficial to review the subjective perception of the interviewed experts more precisely (Flick, 2006).

3.1 Comparative case study research

To be able to make estimations about the planning process and its outcomes a comparative case study research will be executed. As mentioned by Yin (2009, p. 17): *"The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result"*. In the context of this research, the comparative case study wants to investigate the process instead of the decision. As the two national contexts need to deal with the same problem "*climate change*", politicians and governments can pick up lessons from the respond of their counterparts. It is important to treat the two countries as two separated cases, to prevent premature and rashly judgements (Rose, 1991). The comparison of two different cases contributes to a valid statement by providing a chain of evidence through the above-mentioned methods. As this research investigates two planning projects and its influence on water management in low-lying coastal regions, the comparison of two cases becomes useful to uncover learning potentials (Yin, 2009). The case study is used to analyse how different countries deal with a similar problem in a comparable geographical setting. And if they made use of the current situation to establish more resilient and sustainable retention areas. To guarantee that cross-border learning is possible, cases should be selected by special criteria, such as culture, economic structure, planning system, administrative culture, legislation and social system that should not differ too much. In other words, as mentioned by Rivolin (2012), the institutional planning system consisting out of multiple vertical and horizontal policy interactions should not be heterogenic rather homogeneous. This means that complex institutional planning systems have multiple vertical and horizontal connections, which can hinder implementation within the two case study regions. At the same time, Wolman (2002) illustrates that cross-border learning is more difficult than learning from inside, which clarifies the importance of careful case selection. Are the cases too similar or too different, cross-border learning becomes doubtful. If the cases are too similar, lessons to learn are hard to identify or maybe not worth to mention, if they are too different lessons cannot be transferred or are hard to implement. Therefore, the planning system plays an important role as it describes the local governance arrangements that structure the spatial developments in one place (Nadin et al., 2008).

3.1.1 Case study selection

Important in the context of this research is, that the first intention is to uncover synergies and conflicts between different stakeholders. Therefore, the evaluation of the planning process itself has first priority, where the case study research gives additional input for possible lesson drawing. The selection of the case study regions is an important step, to secure comparability and the success of the research. Therefore, two cases have been selected with similar economic structure, planning system and legislation. The two case study regions are located in LLCA and exhibit similar geographical circumstances (see figure 7 and 13), which means that they need to find likewise solutions for climate change. In addition, both projects aspire flood safety through the implementation of a retention area, which offers learning potentials.

Therefore, the two projects "*The Onlanden*" (OL) and "*Großes Meer*" (GM) will help to analyse barriers, which emerged during the planning process between different stakeholders. Additionally, statements about the different planning systems and their beneficial or counterproductive influence can be made. An in depth analysis of the cases is done in section 4.2 and 4.3.

The two chosen cases are:

1. Germany, Südbrookmerland: Großes Meer
2. Netherlands, Groningen / Drenthe: The Onlanden

Table 3 indicates the different horizontal and vertical planning levels relevant in both case study regions. The European level is not legally binding, guidelines, principles and policies are formulated by the federal state, which need to be implemented through lower tiers of government. The state level formulates regional plans that are transformed into land use plans on the regional level.

Table 3: Planning from European- to federal-, state- and regional-level (Oxley, 2009)

<table>
<tr><th></th><th colspan="2">HORIZONTAL</th></tr>
<tr><td rowspan="10">VERTICAL</td><td colspan="2">European level</td></tr>
<tr><td colspan="2">Flood Risk Directive (2007/60/EC) and Water Framework Directive (2000/60/EC)</td></tr>
<tr><td colspan="2">Federal level (Guidelines, principles, policies)</td></tr>
<tr><td>Germany (Federal Ministry for Nature Protection, Agriculture, Energy, etc.)
➔ Regional Planning Act</td><td>Netherlands (Rijkswaterstaat)
➔ Spatial Planning Act</td></tr>
<tr><td colspan="2">State level</td></tr>
<tr><td>Lower-Saxony (ARL, NLWKN)</td><td>Groningen and Drenthe (Waterschap Noorderzijlvest, LTO Noord)</td></tr>
<tr><td colspan="2">Regional level</td></tr>
<tr><td>Südbrookmerland (ARSU GmbH)</td><td>Noordenveld and Tynaarlo (Prolander)</td></tr>
</table>

Within the Netherlands, the Spatial Planning Act builds the vertical connection between the three mentioned levels in table 3. The Spatial Planning Act sets the framework for planning decisions through guidelines and policies and leaves implementation to the regional level (Jones, 2005). The planning system is decentralised in combination with central guidance. Within Germany, the Regional Planning Act wants a meaningful spatial planning by summarising local and multidisciplinary spatial plans through regional planning cooperation

(Federal Ministry of Justice and Consumer Protection, 2008). This describes a planning system with hierarchical planning powers, which have mutual influences and the government as enabler and provider for planning decisions.

Apparently, both cases seem to follow a rather DP approach, with decision-making power on the regional level controlled through central guidance or policies. Therefore, both planning systems seem to work in the same way and promise comparability. An in depth analysis of both cases is done in the fourth chapter and interpretations are presented in the fifth chapter.

3.2 Document analysis

The document analysis is used to gain information from different sources concerning the case study regions and the theories. The document analysis of the theories consisted out of relevant and recent publications in the field of water management, collaboration and MF and are listed in the second chapter. The sources for the information acquisition of the case studies are so called secondary information sources, e.g. reports, archives, homepages, information booklets, newspaper, magazines and scientific papers. They are secondary sources as they are not gained by own research or fieldwork. Concerning this report, grey literature will be the main component of information retrieval, consisting out of homepages, reports and information booklets. A document analysis was chosen in this research as it treats two finished projects (see section 4.1). This will help to evaluate the purposes and aims of the projects and if they are in balance with the actual outcome. Therefore, the document analysis will contribute to the analysation of MF within the two case study regions and if they followed, DP to create resilient flood plains.

3.3 Expert interviews

Expert interviews will be carried out to access case specific and practical information. The interviews are the main part of the primary data collection. They are going to be executed with different experts (see table 8 and 9) from the fields of water management, nature conservation, tourism, cultural heritage, agriculture and planning. This will help to get an insight into the project and their different planning foci. The selection of the experts (see section 4.1) plays here a crucial role, as they represent a whole sector, e.g. nature conservation or agriculture. This does not count for planning experts as they represent the full width of the spatial problem. Main advantage of carrying out expert interviews is the received information by people directly involved in the project. The experts were interviewed between May and August 2016. The questioning started with personal and introductive questions, followed by questions regarding FR, DP and MF and ended with questions regarding the future outlook of the project. After the expert interviews where hold, transcription started followed by a content analysis based on the chosen criteria (see section 3.4). The content analysis will help to interpret speech and text through linguistic frequency of words as indicator for a criteria, e.g. participation as indicator for DP (O`Leary, 2004). Next to the content analysis, a narrative analysis is supportive to understand the stories told by the experts, as perception is highly subjective and is often expressed in metaphors (Gläser & Laudel, 2004). The extraction and interpretation of the information will make data comparable. The work with open categories is crucial as new facts and indicators can emerge during the expert interviews (Meuser & Nagel, 1991). Therefore, the expert interviews are not just used to investigate different emphasis in different sectors but also to generate information that have been overlooked and need to be added to the criteria matrix – if necessary. Therefore, semi-structured interviews are used. Interviews, which address rather open questions and allow the interviewee to respond subjectively and integrate his or her ideas. This is especially useful in this research, as it wants to proof the differences between theory and practice to unfold synergies and conflicts. Therefore, an interview framework or guide is prepared to request specific topics (see Appendix I). An advantage of semi-structured interviews is that questions can be rephrased, when different experts are interviewed (Keats, 2001). This can be very useful as different experts can have different perspectives on specific theories addressed in the questionnaire. Correspondingly, questions do not need to stick to a particular format resulting in more freedom for the interviewer and more tailor made questions. Semi-structured interviews are based on subjective theory regarding the expert (Flick, 2013). In addition, the self-effacement, flexibility, explication, communication, reflexivity and confrontation-questions of the interviewer are important elements for successful interviewing (König & Zelder, 2002; Flick, 2013). Besides, semi-structured interviews are especially suitable in this kind of research, as new concepts such as MF, DP and FR are addressed. As they are not sufficiently defined in the scientific and political world, they fall victim of inter-subjective perception. Therefore, the expert interviews can unfold different perceptions regarding the theories.

3.4 Development of criteria matrix

The development of the matrixes is important to evaluate the analytical fragments of the interviews and the information gained through the document analysis. Therefore, the document analysis and the expert interviews representing the main input of data. The judgment will be executed in connection to the theories, the documents and on personal descriptive interpretation. In the end, this will help to identify synergy-effects or conflicts but also to assess which sector contributed the most concerning specific criteria.

Table 4: Assessment table for the influence of measures upon different sectors

Measures / Sectors	M1	M2	M3	M4
Water management				
Nature conservation				
Tourism				
Agriculture				

Table 4 will help to evaluate how different areas cope with flood risk and which measures were taken. The measures M1 – M4 and sectors can differ in both cases and are explicitly mentioned in section 4.2.4 and 4.3.4. The table cells will show weighting (--/-/0/+/++) based on the scoring system in table 7 and therefore clarify, which sector took more disadvantageous or advantageous development. If two sectors exhibit a positive development under the same measure, a synergy can be assumed. Next to that, the table reveals multifunctional characteristics and which measures have been taken to cope with flood risk.

Table 5: Assessment table for synergies and conflicts between sectors

Synergies & Conflicts	Water management	Nature conservation	Tourism	Cultural heritage	Agriculture
Water management					
Nature conservation					
Tourism					
Cultural heritage					

Agriculture					

Table 5 is an additional support to visualise the synergies and conflicts, which emerged between different sectors. The table will show synergies and conflicts between sectors through weighting (--/-/0/+/++) based on the scoring system in table 7. Therefore, the intensity of synergies and conflicts between involved stakeholders can be visualised. This should contribute to a better understanding of the two case studies and improved comparison between them to unfold potential lessons to learn. In addition, it will give indirect answer to the research question of DP and will unfold, which sectors need better integration.

Table 6: Criteria matrix for the identification of sectoral perception upon the theories

Criteria \ Actors		W1	W2	N1	N2	T1	A1	P1	P2
Stakeholder involvement									
Climate change governance									
Reduce probability	Urban								
	Rural								
Reduce consequences									
Social transformability									
Multifunctional land use									

Table 6 will identify sectoral perception upon the theories based on expert interviews. Input is solely the information gained through the expert interviews, therefore table cells will be filled with expert statements from the interviews (see table 12 and 15). The actors W1 – P2 can differ in both cases and are explained in table 8 and 9. In addition, the different influence of the criteria (theory) upon the sectors can be identified. Further, the table will give answers to the questions how comparable areas cope with flood risk and to what extent DP works in practice. Finally, the table will help to answer how different experts feel about multifunctional landscapes and if it creates more sustainable environments.

The criteria was extracted from the theory chapter and not generated through the interviews. DP indicates participation (stakeholder involvement) and coordination (climate change governance). The theory of FR is represented by the reduced probability, by the reduced consequences and social transformability. The theory of MF wants to prove sustainability and will be evaluated through expert perceptions gathered during the interviews. An in depth explanation is given in the second chapter.

Table 7: Scoring system from 1 to 5 based on multi-criteria-analysis

Scoring system			
++	1	Excellent	1,0 – 1,5
+	2	Good	1,51 – 2,0
0	3	Neutral	2,1 – 2,5
-	4	Satisfactory	2,51 – 3,0
--	5	Bad	3,1 – 3,5

Table 7 describes the scoring system, which is used to assess table 4 and 5. Within this research, five different scores are preferred over three, to avoid too many neutral scores, as many sectors or measures are characterised by positive as well as negative development.

3.5 Conclusion

The method chapter started with the comparative case study research, as this paper investigates two different case studies with similar problems (see section 3.1.1). This secures that an appropriate approach is used to assure comparability between the two case study regions. Basis of the conceptual model are the theories from the second chapter, which are combined with the methods explained in the previous part (see figure 5). The document analysis and the expert interviews will help to evaluate in what extent two comparable case study regions deal with flood risk, to what extent DP works and if planning experts feel that multifunctional landscapes are creating sustainable environments. To visualise and assess the outcome of the case studies a criteria matrix and assessment tables have been developed. The research process of design, data collection, analysis and reporting are pictured in figure 5.

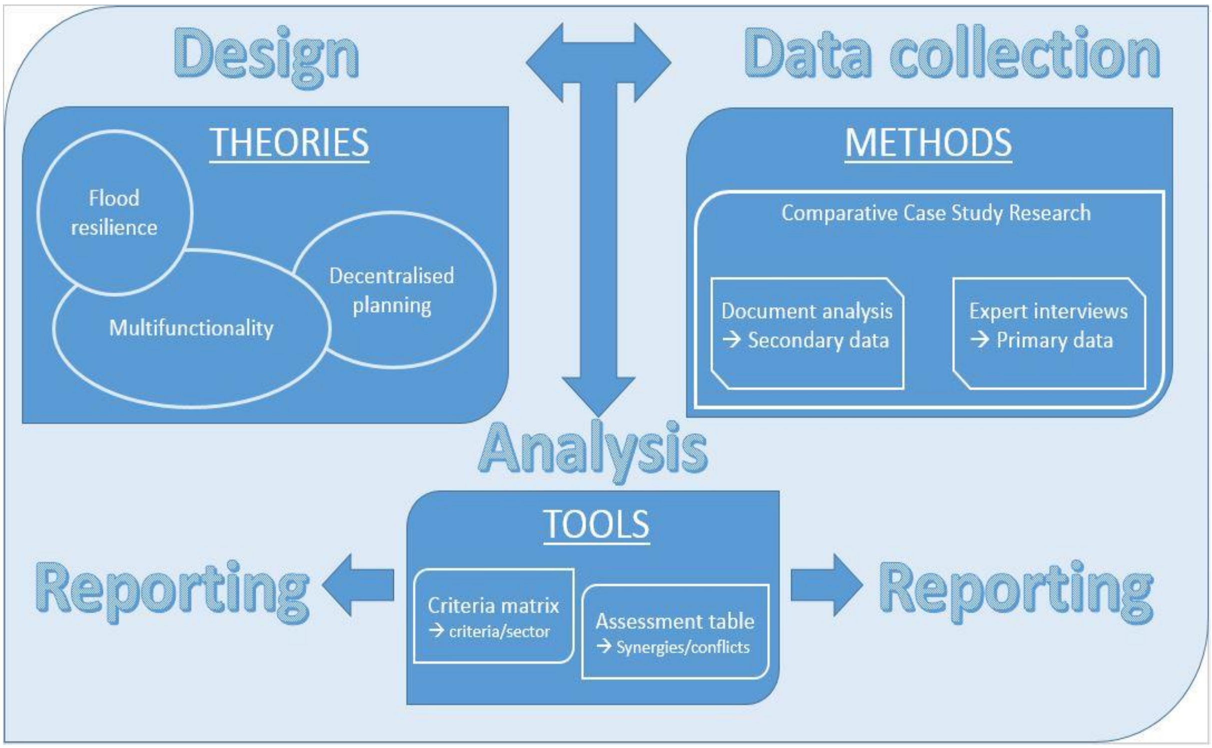

Figure 5: Conceptual model

The next section will conduct a comparative case study analysis based on important documents and reports. The analysis of MF and stakeholders within the two projects are the theoretical results, which are going to be combined with the practical data gathered in the expert interviews, to answer the mentioned research questions.

4 Results

The first part of the result chapter is used to explain the different sources of information, which is followed by an introduction into the two case study regions and ends with an analysis and comparison of the GM and the OL.

4.1 Information acquisition

4.1.1 Case I. – Großes Meer

Document analysis – secondary data collection

Main secondary sources of information regarding this research are the homepages of the project:

- Homepage: http://www.projekt-grosses-meer.de/
  http://www.grossesmeer.de/reisemagazin/grosses-meer.html
  http://www.wiesenvoegel-life.de/projektgebiete.html
- Information booklet:
  Südbrookmerland „Großes Meer“, Gastgeber 2016, Grünes Ostfriesland
  Erster Entwässerungsverband Emden „Gestern. Heute. Morgen“
- Report: Obermeyer & Brunken-Winkler 2012, Bündelung von Instrumenten der Landentwicklung

The homepage (projekt-grosses-meer) is relevant because it describes the purpose of the reclamation concept *“Meer erleben – Mehr verstehen”* and functions as a masterplan. Within that reclamation concept, the necessary measures to antagonize the bad ecological conditions within the GM are explained. The second homepage (grossesmeer) is relevant as it describes the integration of the project within the sustainable regional development goals; especially tourism and recreation play a crucial role. The third homepage (wiesenvogel-life) gives relevant information concerning the natural value of the area and factors that influence planning objectives. The information booklet is similar to the second homepage and gives deeper insides in the touristic concept and recreational opportunities of the area. The report published by Obermeyer & Brunken-Winkler (2012) explains the process of parcel exchange and taken measures within the project.

Stakeholder analysis / Expert interviews – primary data collection

Table 8: Stakeholder Großes Meer

Großes Meer, Lower-Saxony (Germany)				
Sector	Institution	Contact person	Function	Explanation (Why)
Water management	Drainage Union Emden	Mr. J. van Dyk **(W1)**	Civil engineer	Mr. van Dyk is involved in the construction of technical facilities and their maintenance. His duty is the discharge of rainwater in case of an extreme event. Mr. Paulsen-Jacobs is the construction manager for water related objectives within the reclamation concept. The agency is responsible for the planning and construction works of the four embankments and the artificial reed tank.
	Lower Saxony State Office for Water Economy, Coastal and Environmental Protection (NLWKN)	Mr. H. Paulsen-Jacobs **(W2)**	Construction manager	
Nature conservation	Rural district Aurich	Mr. T. Poppen **(N1)**	Biologist	Mr. Poppen is responsible for nature conservation and was involved in the project since 2006. His field of activity is the integration of nature concerns in the reclamation concept. Mr. Wendeburg is responsible for nature protection areas, conservation management and the execution of preservation and development measures. He has an advisory role for nature concerns and is responsible for the allocation of financial resources, since 2004.
	NLWKN Oldenburg	Mr. Wendeburg **(N2)**	Advisory role	
Tourism	Tourism GmbH Südbrookmerland	Mrs. Sutorius **(T1)**	Business manager	Within the organisation, she is essentially responsible for the touristic management. The promotion of tourism is the main intention, contributing to the economy of the community Südbrookmerland.
Agriculture	Department for Regional Development Weser-Ems (ARL)	Mr. G. Bohlen **(A1)**	Project leader	Mr. Bohlen and Mr. Baalmann are responsible for the execution of an ecologically worthwhile land division. Within the reclamation concept, they were responsible for the land consolidation process of farmland. Focus is the utilisation exchange of farmland.
		Mr. Baalmann **(A1)**	Advisory role	
Planning	Regional Planning and Environmental Research Group (ARSU GmbH)	Mrs. Brunken-Winkler **(P1)**	Project manager	Mrs. Brunken-Winkler wrote the aim conception and have been commissioned by the community Südbrookmerland to do the project management. Mr. Meyer is department manager for planning, construction works and the environment and needs to secure that aims and visions are in accordance with political restrictions.
	Municipality Südbrookmerland	Mr. Meyer **(P2)**	Department manager	

4.1.2 Case II. – The Onlanden

Document analysis – secondary data collection

Main secondary sources of information regarding this research are the homepages of the project:

- Homepage: http://www.natuurindeonlanden.nl/onlanden.html
  https://www.natuurmonumenten.nl/natuurgebied/de-onlanden
- Report: Waterschap Noorderzijlvest, Good Practice The Onlanden.
- Information booklet: De Onlanden, natuur- en waterbergingsgebied

The homepage (natuurindeonlanden) gives relevant information about the natural value of the area and the purpose of creating a water storage area. The second homepage (natuurmonumenten) engages more with the recreational potential of the area and gives information about activities and recreational routes within the OL. The report (Good Practice The Onlanden) explains the project process, the aims and problems that emerged and functions as a masterplan. The information booklet clarifies the increase in natural value through the project and explains functions of flora and fauna.

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Stakeholder analysis / Expert interviews – primary data collection

Table 9: Stakeholder within the Onlanden

The Onlanden, Drenthe (Netherlands)				
Sectors	Institution	Contact person	Function	Explanation (Why)
Water management	Waterschap Noorderzijlvest	Mr. K. de Jong & G. Zeemans **(W1)**	Hydrologists	Mr. K. de Jong and Mr. G. Zeemans are in charge for the project implementation. Mr. K. de Jong works as a hydrologist securing that future changes are adequate addressed. Mr. G. Zeemans played an additive role within the interview, able to explain technical, monetary and temporal issues of water management purposes.
	Staatsbosbeheer (governmental organisation)	Mr. B. Hummelen **(W2)**	Representative of governmental nature organisation	Mr. B. Hummelen represents the governmental nature organisation within the steering committee, they are a big landowner with the interest to improve natural values through a combination with water interest.
Nature conservation	Secretary of Nature and Importance Onlanden	Mr. W. van Boekel **(N1)**	Biologists	Mr. W. van Boekel was involved in the realisation of the containment area. He is managing the homepage natuur in de onlanden on a voluntary basis. Besides, he lives in *Peize* and is familiar with the greater area.
Tourism	Natuurmonumente (non-governmental organisation)	Mrs. M. Dunning & Mr. J. Tukker **(T1)**	Assistant project manager and project manager	Mrs. M. Dunning and Mr. J. Tukker working for the non-governmental organisation Natuurmonumente, a big landowner in the Netherlands for natural environments. They are protector and buyer for nature, to protect it for the future.
Cultural heritage	RUG University, Archaeological Institute	Mr. Dr. J. Nicolay **(C1)**	Archaeologists	The institute is responsible to guide the archaeological process; Dr. J. Nicolay was the project leader excavating 60 archaeological sides.
Agriculture	LTO Noord (Groningen, Frysland and Drenthe)	Mr. R. Visser **(A1)**	Representative of the farmers union north	Mr. R. Visser represents the interest of farmers that were influenced by the OL project. He was involved in how much farmland is needed to realise the project.
Planning	Prolander	Mr. B. van Guldener **(P1)**	Project manager	Mr. B. van Guldener works for an executive agency for rural areas; they translate provincial policy into concrete plans and secure implementation. He is the secretary of the steering committee. Mrs. C. Alma is a chosen member of the executive board of the water authority. She is the political responsible person, taking decisions within the executive board and therefore responsible for the policy planning part.
	Waterschap Noorderzijlvest	Mrs. C. Alma **(P2)**	Representative of the water authority	

The next section will introduce the case study regions, which is followed by an analysis and comparison of both projects.

4.2 Großes Meer

The GM is the biggest natural inland lake of East Friesland (Germany) located in the municipality Südbrookmerland. Aurich located in the northeast and Emden in the south are the biggest urban agglomerations in the area. In addition, two smaller lakes are part of the surrounding area, the *Loppersumer Meer* and the *Hieve* located in the west. Together with the GM they are creating a bigger water system (see figure 6) for water storage and drainage (NLWKN, 2010).

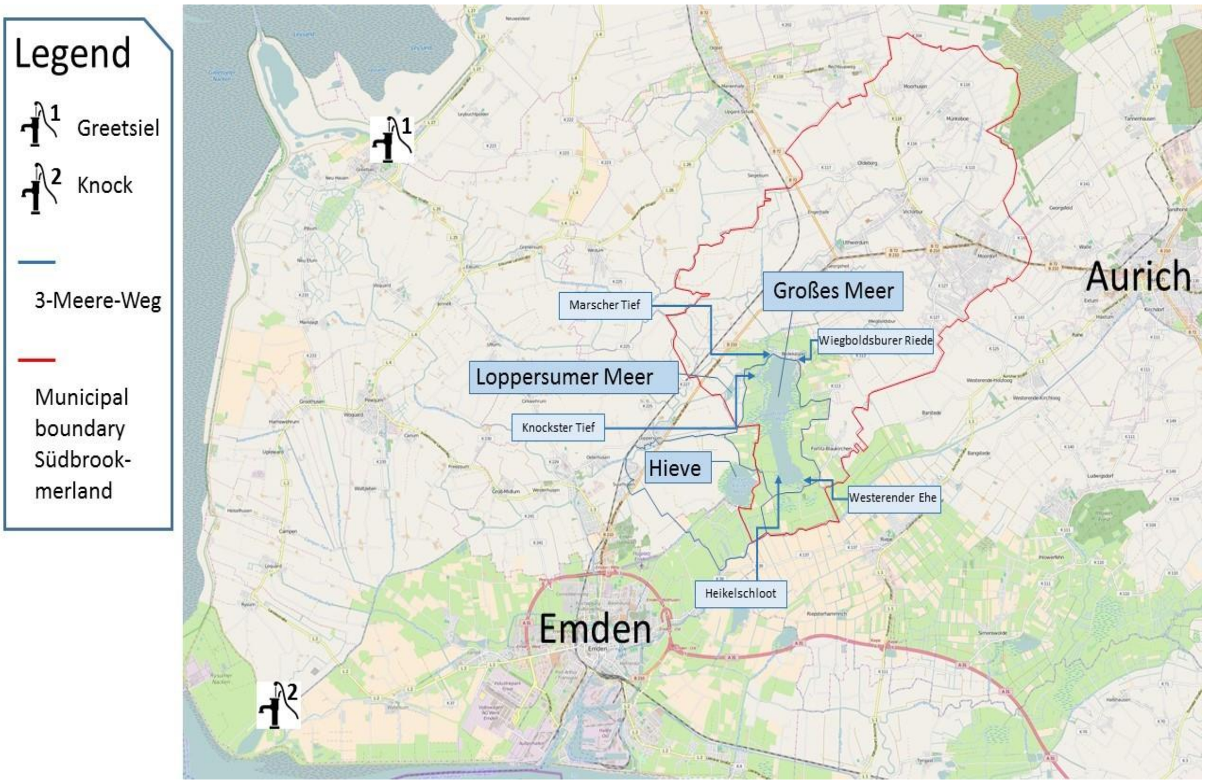

Figure 6: General map of the Großes Meer and the surrounding area (Open Street Map, modified)

The main influx of water is coming from the channels of *Westerender Ehe* in the south and *Wiegboldsburer Riede* in the north. The channels are routed around the GM to control the influx of water. Main discharges are the *Heikelschloot* in the south, the *Knockster Tief* and the *Marscher Tief* in the north (ARSU GmbH, 2011). Along the mentioned discharges, the water is derived across the *Loppersumer Meer* and the *Hieve* to the pumping stations *Greetsiel* and *Knock* into the North Sea.

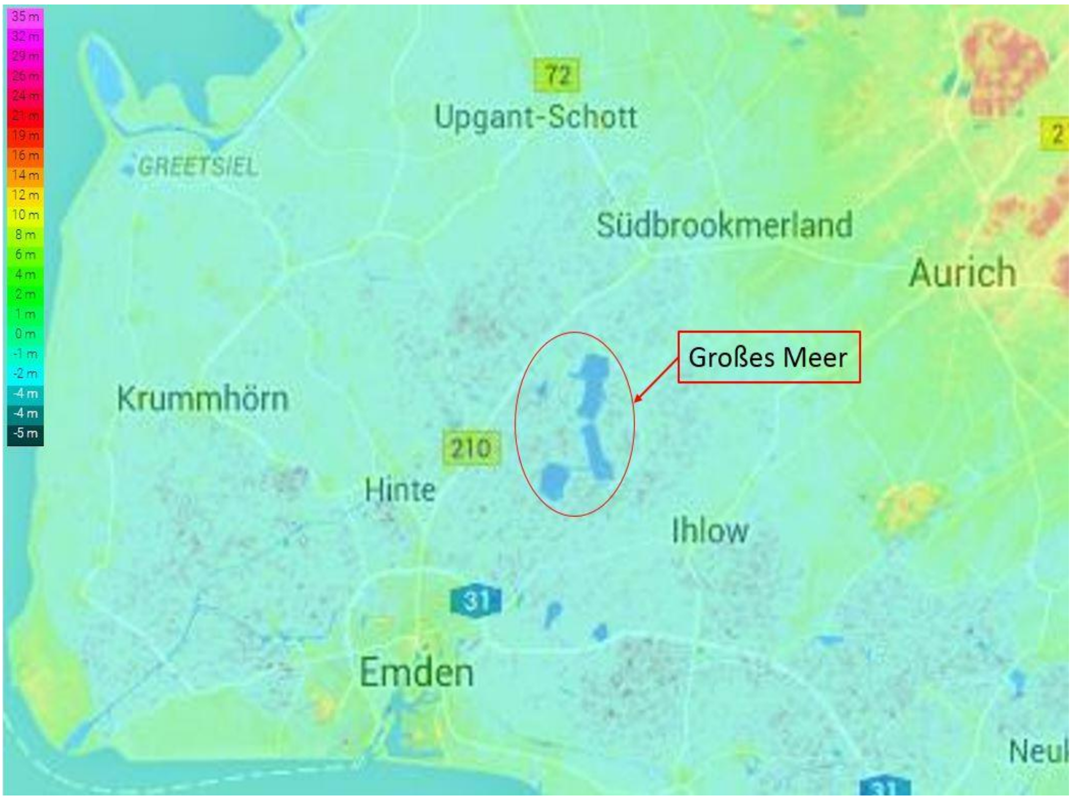

Figure 7: Topographic map of the greater study area in Germany (de-de.topographic-map.com)

The lake is located in a transient area between moraines and marshes. As the lake is located in a so-called *Sietland* - a low-lying area located between higher elevated landscapes – a shallow lake developed due to ground water accumulation (ARSU GmbH, 2011). Therefore, the location of the GM secures a flow of water along the slope towards the North Sea (see figure 7). A catchment area cannot be defined for the GM as it is located below mean sea level and water levels are regulated artificially through pumping stations.

4.2.1 Historical development

The GM is a natural shallow lake. In the early 19th century, the lake was characterised by strong water fluctuations and high water levels in the winter months and had good water dynamics (NLWKN, 2010). Natural water dynamics describe strong water fluctuations between summer and winter. Through time and particularly through human influence by the drainage union Emden, which wanted to secure sufficient drainage of the area due to safety and economic reasons, the quality and the dynamics of the water body decreased, as mentioned by Mr. van Dyk. In 1989, the water quality decreased drastically, as phosphor and nitrate input increased and blue algae started to bloom, which resulted in bathing prohibition

(Obermeyer & Brunken-Winkler, 2012). The insufficient water dynamics led to ecological problems such as silting, aggradation, eutrophication and loss of biodiversity and habitats within the lake. Main threats were the missing dynamic of the water body and the inflow of nutrients from agriculture. In 1996 a roundtable task force developed and formulated sustainable regional development goals, where economic-social claims are equally considered and where the use and conservation are compiled to develop mutual benefits (ARSU GmbH, 2011). To achieve better dynamics of the water body and to promote SD goals, embankments have been installed in 2012 to raise the water level and contribute to better water dynamics. The purpose of the reclamation concept "*Meer erleben – Mehr verstehen*" is to improve the ecological conditions through increasing water-storage and -levels, while not harming the overall socio-economic interests of the region.

4.2.2 Land use and land development

The land use of the area surrounding the GM is grassland, arable land, standing water bodies and streaming water (LIFE Project, 2015). Next to the actual land use of the area, many different utilisation claims and interests developed. Nature conservation, water management, agriculture and tourism are the main interests around the GM (see figure 8). The southern part of the GM is a nature conservation area and is part of the Natura 2000-habitats and the EU-Bird Sanctuary Ostfriesische Meere, protected as nature protection area since 1974 (NLWKN, 2010). A wide reed belt encircles the lake itself, which is partly located in the southern protected landscape. Reed is according to § 28 NNatG a protected habitat, only through

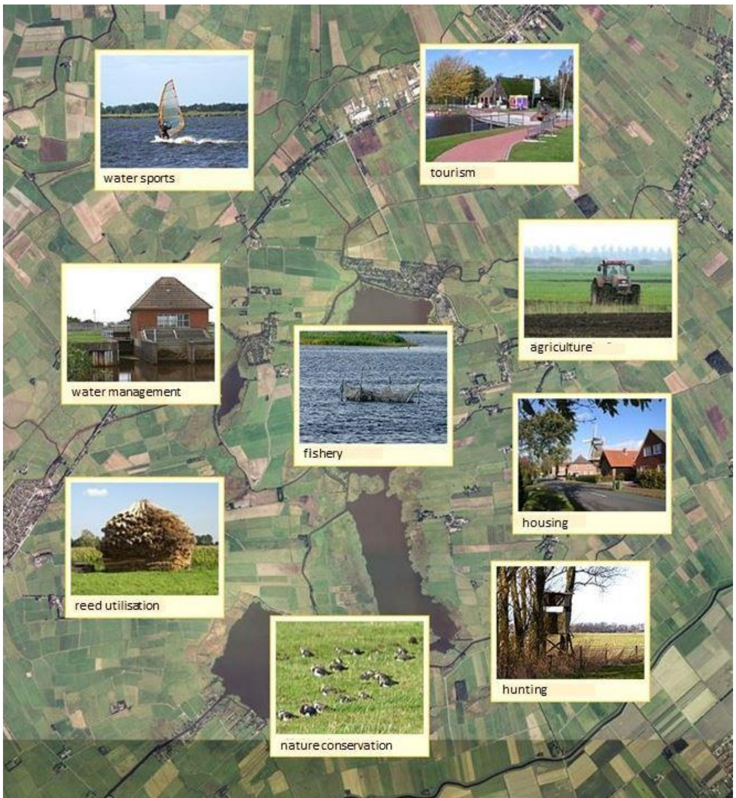

Figure 8: Landscape interests Großes Meer

exceptional permission by the responsible nature conservation authority harvesting is permitted (NLWKN, 2010). The harvest and use of reed is a regional tradition and still performed for roofing. The Siersmeer and Herrenmeeder Meer connected to the south of the GM are temporally flooded and are valuable marsh areas for grassland birds and used for extensive agriculture (see figure 10). Agricultural land is mainly used as grassland but through sufficient drainage, more intensive agriculture is possible. In total, 140 agricultural farms are located in the greater area, contributing to high utilisation- and competition-pressure. Through effective drainage, the intensive cultivation of corn and grain became possible, with negative effects on the water quality of the lake. Water management is important as the GM functions as retention area and is called the fifth pump of the drainage union Emden (Drainage Union Emden, 2007). It is called the fifth pump, as the GM retains water in case of an extreme event and is replacing an otherwise necessary pump at the Knock. The GM is surrounded by many channels and ditches, which are used to drain the nearby area and are creating one big water system. The shallow lake is used in multiple ways, where touristic and recreational activities play a relevant role (Südbrookmerland Touristik GmbH, 2010). The northern part of the GM is used for touristic activities, such as sailing and wind surfing. Next to that, activities such as cycling and camping are at present. Besides the main interests hunting, fishing, habitation and the use of reed are relevant activities, which need to be considered.

The challenge for tourism is to extent the quality and supply of touristic activities and accommodations, while not damaging the basis for attraction, the environment as mentioned by Mrs. Sutorius (see figure 9). Next to the improvement of infrastructure, the preservation of natural circumstances is part of the future development. Therefore, environmental-education-stations and information-activities, -guides and –seminars have been developed after a touristic survey. The *3-Meere-Weg* is one of the newly developed hiking- and cycling-tracks, where lookouts equipped with information boards should contribute to an improved regional identity and to a better understanding of the importance of our environment and the function of the GM as retention area. (Südbrookmerland Touristik GmbH, 2016)

4.2.3 Spatial problems and solutions

The GM is characterised by many interdependencies, which are visible by the ecological problems mentioned-above. Ecological problems will consequently become economic problems as well. As the GM mainly functions as retention area and touristic centre, the quality of the water body and the capacity for storage need to be guaranteed. Consequently, solutions must be found to counteract silting, aggradation, eutrophication and the loss of habitats and biodiversity. Concerning the GM and its feature as Natura 2000-habitat, the question arises, how ecological- and economic-interests can be unified as indicated in figure 9 (ARSU GmbH, 2011).

Figure 9: Antagonistic interplay of nature conservation and economic development

Therefore, a regional development concept or reclamation concept was elaborated, which should contribute to SD within the region. To create win-win situations problems, causes and utilisation interests need to be analysed and were discussed within the roundtable task force, which is actively integrated in the project since 1996. The roundtable task force consists of multiple organisations, institutions or alliances, which sorts out common development goals and try to make use of subsidies to secure the consideration of all relevant interests (Obermeyer & Brunken-Winkler, 2012).

Figure 10: Großes Meer with the four embankments and the Siersmeer and Herrenmeeder Meer (Open street maps, modified)

The roundtable task force decided to construct four embankments around the GM, for improved regulation of water levels and better water dynamics within the lake (ARSU GmbH, 2011). New water management measures started in 2009 and are finished since 2012. This will lead to improved water supply of reeds, better erosion of dead plant material, reduction of aggradation, a process of self-purification, improved storage capacity and a reduction of energy costs through an increase in the retention capacity. In addition, flooding areas were realised in the south of the GM. Here two areas, the *Siersmeer* and *Herrenmeeder Meer* (see figure 10), which silted up in the last centuries are reused for temporal flooding (Drainage Union Emden, 2007).

To counteract eutrophication, the input of nutrients, especially phosphorus from agricultural sources should be limited up to 70-90% (ARSU GmbH, 2011). This would counteract the blue algae blooms in spring and summer and would contribute to better oxygen concentrations in the lake. Therefore, an artificial reed tank (see figure 11) was realised to filter the inflow from agriculture. To defuse the loss of biodiversity and habitats, typical vegetation types, such as reeds, should be promoted to support the repopulation of certain bird and fish species (NLWKN, 2010). The rewetting and the reduction of farmland will contribute to the recovery of habitats and species.

2014: artificial reed tank after construction finished | 2015: artificial reed tank with vegetation

Figure 11: Artificial reed tank after construction and one year later

Complementary, environmental education is provided in several forms to illustrate the potentials to harmonise different utilisations for SD within the region. The above-mentioned sustainable regional development goals want to preserve and promote extensive agricultural utilisation. Therefore, an improvement of the agrarian road network and marketing is aspired. Water levels need to be efficiently managed to guarantee a sufficient water supply in summer and a good traffic ability for agricultural machines in winter (Drainage Union Emden, 2007). At the same time, a reduction of nutrition inflows and the compliance to standard values is expected from the farmers. On the other hand, farmers want productive fields without any use restrictions. Therefore, the sustainable regional development goals seek to explore additional income sources for the agricultural sector, through the integration in a wider regional concept "*Meer erleben – Mehr verstehen*" (ARSU GmbH, 2011). Thereby, the main aims of new water management, e.g. the restoration of natural water dynamics, a flexible utilisation of the flood storage function and a reduction of the energy pumping costs within the GM can be realised.

4.2.4 Analysis of the Großes Meer

Table 10 is used to visualise the disadvantageous or advantages development of the taken measures onto the involved sectors. Table 11 analyses the synergies and conflicts between the sectors and table 12 helps to get a case- and expert-specific perception of the project itself.

Table 10: Disadvantages or advantages between taken measures and involved sectors within the Großes Meer.

Sectors \ Measures	3-Meere-Weg	Four embankments	Reed tank	Parcel exchange
Water management	+	++	++	0
Nature conservation	+	0	++	++
Tourism	++	0	0	0
Agriculture	+	0	0	+

The 3-Meere-Weg had rather no influence on water management. The required manually operating ferries across the canal had been a neutral intervention within the water body. Next to that, information boards along the 3-Meere-Weg explain the function of the GM for water management, so that a rather positive development took place, resulting in a *good* score. Concerning nature conservation the 3-Meere-Weg contributes through educational stations to an increased sensitisation of the public for their surrounding environment, as indicated by Mr. Meyer: "*On the 3-Meere-Weg several information boards have been issued with educational purpose, implemented by the ARSU GmbH to sensitise the public for their surrounding environment*". At the same time, the 3-Meere-Weg is attracting more people in before prohibited areas, as Mr. Poppen explained: "*The 3-Meere-Weg is a touristic facility, there is no one on the political side that realises areas prohibited for the public*". During breeding season, the educational path is closed for tourists. The *good* score is based on the personal perception that sufficient nature protection can only be guaranteed if people can experience nature. For tourism, the 3-Meere-Weg is an additional attraction for their visitors, which improved the road network and tries to increase the understanding of the area as Bird Sanctuary, Natura2000 region and retention area. Consequently, the score given is *excellent*. Agriculture scored *good* related to the 3-Meere-Weg as it also profited from the improvement of the road network, as described by Mr. Bohlen: "*We have constructed roads, which are not only used for agriculture but also for tourism*". Within planning the 3-Meere-Weg triggered conflicts as it was a big intervention within the landscape. The described ferries and the increased traffic of cyclists encountered resistance within nature conservation and the public.

The four embankments had positive influence on water management as the water level within the GM can be increased by 30 centimetres when the embankments are closed. Therefore, flood risk can be reduced, as indicated by Mr. van Dyk: "*The GM can hold through the construction of the embankments 1.050.000 m^3 more water*" and an *excellent* score was given. Concerning nature conservation the construction of the four embankments will help to improve the bad ecological conditions through higher water levels but certainly, they do not solve all problems, as explained by Mr. Poppen: "*Thereby, we do not solve the sludge and phosphate effects*". Therefore, a *neutral* score was given. Tourism did not profited from the embankments and initial problems, such as the too narrow embankments to enter the lake for sailors was solved, so that a *neutral* score was given. Agriculture profited in the sense of reduced flood risk in low-lying farmlands, on the other hand reed cutting within the GM got limited due to higher water levels, resulting in a *neutral* score. From the planning perspective, the construction of the embankments was difficult because of scarce public knowledge, which was clarified by Mrs. Brunken-Winkler: "*Looking back main problems have been the missing public understanding*". Some citizens were afraid of a tsunami wave after retention.

The reed tank scored *excellent* for water management and nature conservation as it contributes to improved water quality, small-scale retention and the development of important bird habitats. The reed tank does not play a crucial role for tourism yet, the natural filtration site could be integrated in the touristic concept to increase the public sensitisation for the environment, and therefore the score is *neutral*. Concerning agriculture the reed tank will contribute to lower nutrient levels but also to increased utilisation claims, what Mr. Bohlen exemplified: "*Out of the farmers perspective the construction of the reed tank was also a loss of agricultural land*", therefore the score is *neutral*. Within planning the construction of the reed tank was uncomplicated and was appreciated.

Water management scored *neutral* concerning the parcel exchange, as water related interventions were scarcely influenced through it. Nature conservation profited the most through parcel exchange and scored *excellent*, as land parcels along rivers or creeks will be transformed into extensive agriculture or preferred into wet nature. Which Mr. Poppen clarified: "*We try to establish ecological networks along water bodies in order to reduce the input of nutrients*". Best example are the Siersmeer and Heeren Meer located in the south of the GM, which are used for extensive agriculture. Tourism was not influenced through parcel exchange resulting in a *neutral* score. Agriculture took advantageous development through parcel exchange, as farmers were relocated on higher grounds and closer to their homes resulting in lower travel time and improved safety. Mr. Bohlen said: "*We want to provide beneficial development for agriculture by sorting the area in the most useful way*". Some farmers were emotionally connected to their land, so that the score is *good* and not excellent.

Table 10, therefore, gives an answer how the GM project handled the intertwined interests, which measures have been taken and which sector profited the most. The next part will analyse the synergies and conflicts that emerged between the involved sectors.

Table 11: Synergies and conflicts within the Großes Meer project.

Synergies & Conflicts	Water management	Nature conservation	Tourism	Agriculture
Water management				
Nature conservation	+			
Tourism	0	0		
Agriculture	0	+	0	
Planning	+	++	++	+

The higher water levels through the construction of the embankments will improve water inundation in the reed belts, will increase the storage capacity and will improve the water dynamics. On the other hand, the embankments will limit the accessibility during water retention for fish species, which was tackled through free fish movement during spawning season, as Mr. van Dyk clarified: "*The closure of the embankments needed to be discussed because the GM must be accessible for the pike at certain temperatures*". Additionally, water management wants to have full retention capacities in winter resulting in low water levels, which is counterproductive for nature conservation and specific habitats. As the synergies overbalance the conflicts, a *good* score was assigned. The four embankments restricted the accessibility of the GM for sailors during retention; however, the retention purpose with higher water levels can have positive influence on tourism if water quality is improving in the long run. Therefore, no significant synergy and conflict can be analysed and a *neutral* score is given. Agricultural land in the GM region was a factor why the general water levels could not be increased to higher the storage capacity, as explained by Mr. van Dyk: "*Farmers do not want higher water levels, because they want sufficient drainage and no irrigation*". Therefore, farmers preferably were relocated through parcel exchange and a *neutral* score is assigned. Within planning, water management was relevant and profited but not the only intention of the project resulting in a *good* score.

Tourism is dependent on nature conservation, as indicated by Mrs. Sutorius: "*There are conflicts bust most tourists come because of nature*". Therefore, the right balance between touristic exploitation and nature conservation standards needs to be found. The 3-Meere-Weg is one example triggering synergies and conflicts, resulting in the *neutral* score. Agriculture is bad for nature conservation if it is practiced intensively, but the Siersmeer and Heeren Meer southwards from the GM are good examples for how useful extensive agriculture can be for the preservation of special habitats, e.g. wet meadows and marshes. This was explained by Mr. Wendeburg: "*It is important for nature conservation that grassland is managed, without agriculture the requirements cannot be reached*". Therefore, agriculture can be a friend and contributor to nature conservation if practised in the right way, causing the *good* score. Planning tried to find the most suitable land distribution through parcel exchange to antagonise the bad ecological conditions and to integrate the sustainable regional development goals. Therefore, planning tried to promote and improve natural circumstances, explaining the strong synergy and *excellent* score.

Agriculture benefited through the improvement of the road network triggered by touristic purposes, however agriculture could be better integrated into the touristic concept to push the public sensitisation for the rural landscape. Therefore, a *neutral* score was given as some potential between agriculture and tourism remain. Tourism is one of the main objectives for the planning of the reclamation concept, as Mr. Meyer clarified: "*The focus within the GM project are tourism and nature conservation*". Therefore, tourism is an important economic factor within the region and is dependent on the water quality, explaining the strong synergy between planning and tourism. Between planning and agriculture, a synergy developed due to the relocation of farmers and the parcel exchange to reach a reasonable distribution of landscape functions, what Mr. Bohlen explained by saying: "*We have to strike a balance between agriculture and flood related issues. Therefore, a bunch of activities are available where we act supportive by parcel exchange*".

Synergies emerge out of conflicts, which explains the many neutral scores in table 10 and 11. Concerning the measures in table 10, the reed tank and the 3-Meere-Weg scored the best results. Parcel exchange and the four embankments were necessary measures within the planning process, which demand more willingness to compromise as they influence a wider spectrum of interests. Within the sectors, water management and nature conservation took the most promising development regarding the measures, whereof tourism also profited. The analysis of synergies and conflicts in table 11 are showing the emphasis of the project for nature conservation and tourism. Conflicts emerged through the construction of the 3-Meere-Weg, the four embankments and between planning and the public perception. Main synergies emerged between planning and water management and nature conservation, as the intention of the project was to counteract the bad ecological conditions. This can trigger further synergies between others sectors, for example tourism if the water quality is improving through taken measures. At the same time, it can be seen that the landscape redistribution is triggering a lot of synergies and conflicts, which need to be balanced in the long run to explore the full landscape potential.

Table 12: Expert perception concerning the criteria within the Großes Meer project.

Criteria \ Actors		Mr. J. van Dyk	Mr. H. Paulsen-Jacobs	Mr. T. Poppen	Mr. Wendeburg	Mrs. Sutorius	Mr. G. Bohlen and Mr. Baalmann	Mrs. Brunken-Winkler	Mr. Meyer
Stakeholder involvement		To achieve win-win situations everybody influenced needed to take part in the process and nobody was discriminated.	All relevant interest groups have been involved and actively integrated. Within that specific context, it is important not to neglect anybody.	Everybody is contributes so that we achieve what we wanted. We pull on one string together.	Involvement is essential for any planning, you always need to get all players into the boat otherwise you will fail.	All relevant interests were represented within the round table and majority took decision.	Different interests were considered through sub working groups.	Everybody got informed and could raise his or her voice, it is not always possible but we tried to involve everybody.	Involvement of different specialised fields to counteract ecological problems.
Climate change governance		Parcel exchange was practiced to realise different interests. Within the roundtable we tried to develop win-win situations.	Within the roundtable, concepts have been developed through compromises. Once a year a meeting is hold for monitoring.	The roundtable was advantageous to overcome bureaucratic barriers. Contributed to a more trustful working relationship.	We try to harmonize and connect tasks through a common denominator. If possible we tackle things by interpret them in connection to the local conditions.	I think we have found a good working relationship, although there are always trade-offs in the end.	We need to coordinate between different interests. Parcel exchange has the advantage of coherent planning.	If necessary lower task forces have been involved to solve specific issues.	Coordination and cooperation was perfect to overcome conflicts. Development of sub working groups.
Reduce probability	Urban	The GM can hold through the construction of the embankments 1.050.000 m³ more water	The four embankments contributed to improved usage of the GM in an economic water related way.	Four embankments contribute to increased storage capacity against flood risk.	Strong precipitation events are dominated in such a manner that water can be relatively fast discharged.	Subject not covered	The four embankments contributed to a more flexible flood management.	The Großes Meer is the fifth pumping station of the area.	Construction of four embankments to reduce energy costs and flood risk.
	R	Farmers do not	We developed a	Improved	The good control	It was hoped	We want to	The four	Strengthening

	ural	want higher water levels, because they want sufficient drainage and no irrigation	concept for the revitalisation of the reed belt.	inundation in necessary spaces: Siersmeer Heerens Meer.	leads to no more natural temporal floods with disadvantageous development for flora and fauna.	that the four embankments would improve the traffic ability for sailors.	provide beneficial development for agriculture by sorting the area in the most useful way	embankments secure drainage of the surrounding area without any time pressure.	of surrounding dikes.
Reduce consequences		We suggest retention basins with every new construction project that causes surface sealing.	Heavy rain events can be buffered by a consideration of retention areas during the construction of residential structures.	We try to establish ecological networks along water bodies in order to reduce the input of nutrients	Normally the whole region need to be assigned as nature protection area.	Subject not covered	We have to strike a balance between […]. Therefore, a bunch of activities are available where we act supportive by parcel exchange.	Agricultural guidance needed to achieve extensive agriculture and more wet landscapes.	Protect settlements through rewetting of certain areas, Siersmeer and Heerens Meer.
Social transformability		Implementation of an auditive nature trail.	Subject not covered	Triggered through the 3-Meere-Weg but with negative effects for nature conservation.	Subject not covered	3-Meere-Weg offers information board about flood- and environmental topics.	Subject not covered	Environmental educational stations (3-Meere-Weg).	On the 3-Meere-Weg several information boards have been issued with educational purpose, […] to sensitise the public for their surrounding environment
Multifunctional land use		Many different interests existing around the GM.	Three main interests, quantitative water management,	The context is an incredibly diverse cross-linked structure	The Großes Meer is a colourful palette in space with different	MF is necessary but it needs a lot of willingness for	E.g. extensive agriculture is important in multifunctional	I think the project is on a good way [...] to create	The focus within the GM project are tourism and

		nature conservation and the issue of water quality.	with such a variety of problems.	priorities.	compromises. I hope that priorities could be emphasized more clearly.	landscapes, as they contribute to natural values such as water quality.	sustainable environments, it is an ongoing process.	nature conservation.

4.3 The Onlanden

The OL is an area located south-west from Groningen in the province of Drenthe. The region is located around the villages *Peize*, *Rode* and *Eelde* in the south, *Leek* towards the west and bordered to *Hoogkerk* and *Eelderwolde* towards the northeast (see figure 12). The purpose of the OL project is to protect the low-lying settlement areas in the southern part of the city of Groningen against flooding and create a more valuable environment (Natuurbelang De Onlanden, 2016). Problematic are the southwestern parts of the City of Groningen (*Hoogkerk*, *Eelderwolde* and adjoined districts), which were nearly flooded in 1998. Therefore, the area between the southwestern parts of Groningen and the villages *Peize*, *Rode*, *Leek* and *Eelde* were assigned for a combination of water safety and nature conservation function (see figure 12).

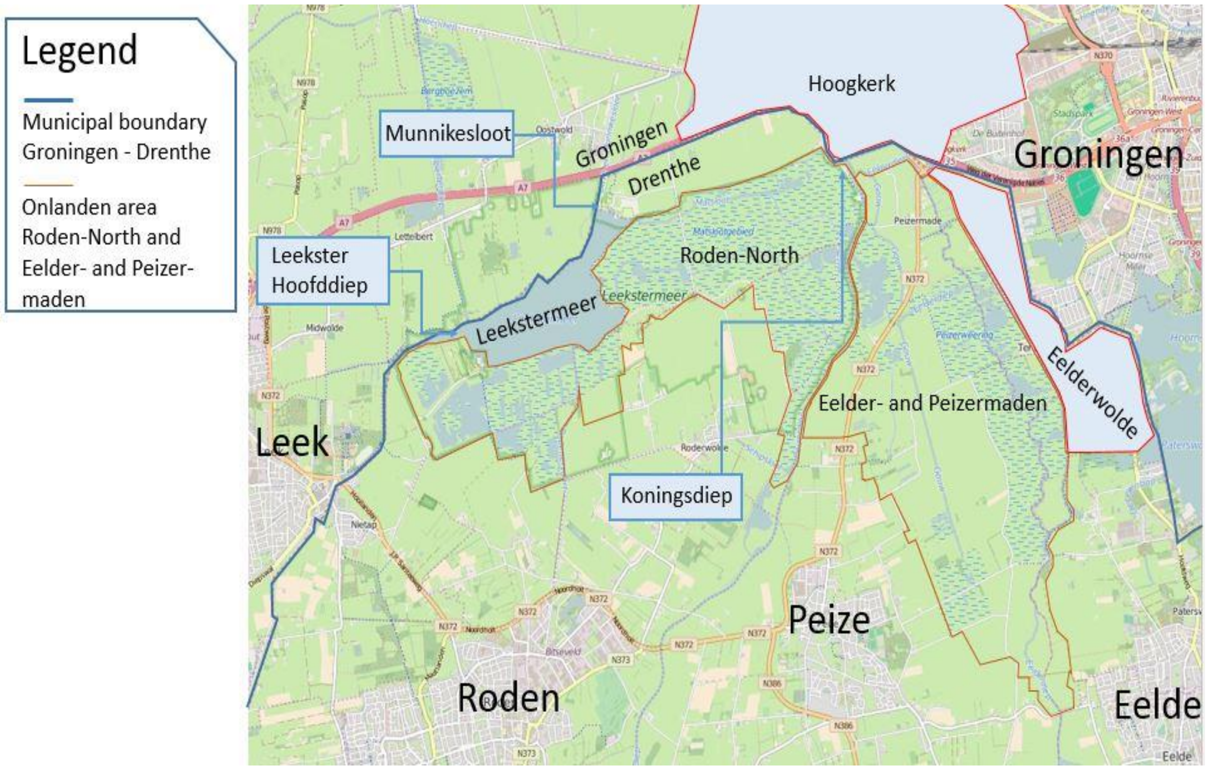

Figure 12: General map of the Onlanden area (Open street maps)

The OL covers an area of 1700 hectares, divided in a western part *Roden-North* comprising of the *Leekstermeer* and an eastern part *Eelder- and Peizermaden* (Natuurmonumenten, 2016). The elevation differences between the Drenthe plateau - which consists of higher sandy soils - and the lower wetlands in the OL are good preconditions for a water storage area. Therefore, the discharge of water along the slope towards the North Sea is guaranteed (see figure 13).

Figure 13: Topographic map of the greater study area in the Netherlands (de-de.topographic-map.com)

4.3.1 Historical development

The OL region was used as settlement area and agricultural land in the past, which was proofed through the excavation of the archaeological sides. Due to low elevation levels in the area, as indicated in figure 13, settlements and agriculture needed high maintenance expenditure. Therefore, the redevelopment of the *Roden-North* area in 1981 had the purpose of improving the agricultural structure and the natural values (Waterschap Noorderzijlvest, 2012). Continuative, the natural values of the *Eelder- and Peizermaden* area was realised and led to parcel exchange between the LTO Noord and Natuurmonumenten, to change agricultural land into nature in 1989. Due to disadvantageous land development in the past, the *Nature Policy Plan* introduced the *Ecological Main Structure* in 1990. Main objective is the connection of wet and dry nature areas. The *National Ecological Network* defines the objective more precisely on creating a green buffer through improved spatial and environmental settings for nature (Natuurbelang De Onlanden, 2016). Besides the already taken measures, the flood in 1998 triggered finally the drastic land redevelopment and the start of the OL project. Back then, the southwestern parts of the city of Groningen, *Hoogkerk,* *Eelderwolde* and adjoined districts were nearly flooded. After the flood administrative forces joined within a steering committee to realise the combination of water safety and nature conservation function within the 1700 hectares of the OL. This was accomplished through further parcel exchange between LTO Noord and Natuurmonumenten, where 500 hectares within the OL succumbed a function change. The development of the project solution took place from 1998 to 2008 and was realised in 2012.

4.3.2 Land use and land development

The land use of the OL area was dominated by agriculture, with an emphasis on mowing management, hay gathering and grazing of young stock in the past (see figure 14, 1998). It turned out that the low-lying grounds were not the best farmland. Therefore, parcel exchange and land acquisition directed a new distribution of the landscape with different functions. That is why, as described above, farmland was mainly converted and transferred into nature within the possession of Natuurmonumenten. Figure 14 indicates the drastic landscape change, from mainly agricultural utilisation in 1998 into nature in 2015.

Figure 14: The Onlanden region before and after the project (http://www.topotijdreis.nl/)

Creating agricultural landscapes was not much of an issue, rather the compensation of farmers to convert their properties into wet nature (Waterschap Noorderzijlvest, 2012). This happened in the OL through relocating the farmers completely. In some cases, this was beneficial for the farmers, as they received land in immediate distance to their homes. Normally compensation measures are monetary measures, where farmers receive money for temporal flooding of their property. This was not applied in the OL, as temporal flooding of agricultural land will have a negative influence on the productivity (Morris & Brewin, 2014) and the main intention was to create a valuable environment with a water storage feature.

As the project produced a drastic spatial re-distribution of the landscape, multiple touristic ideas and activities have been realised within the OL region. Tourism and recreation became a part of the project. The area is located closely to the city of Groningen and offers cycle tracks and food paths for daily trips (Province Drenthe, 2014). Furthermore, activities such as walking, horse riding, fishing, sailing and boating are possible. Cycling paths are distributed across the whole OL region. The *Leekstermeer* is the centre for sailing, canoeing and camping (Natuurmonumenten, 2016). During the project, 12 km of new cycling tracks and footpaths have been realised and environmental educational stations have been constructed. The *Olanderij* is an environmental educational station with a coffeehouse located in the *Eeldermaden* managed by the Natuurmonumenten. They offer hiking tours to explore the wildlife and enjoy the beautiful scenery during sunset. In addition, archaeological sites have been discovered and posed a barrier during project realisation. Concerning tourism and recreation, the archaeological sites are an additional highlight of the OL region, offering some cultural experience, which still need to be better integrated in the touristic concept.

Next to tourism, nature profited extremely through the redevelopment of the landscape. Key challenges were the vegetation management of brooks and the redevelopment of old meanders, as flow regimes need to be optimised because of safety reasons (Natuurmonumenten, 2016). The newly developed bank and ditch vegetation, such as *Water Violet* indicates improved infiltration rates (Natuurbelang De Onlanden, 2016). Further, reed vegetation developed, which contributes to the livelihood of endangered bird species, such as the *Bluethroat*. Brooks mostly located in low-lying areas have a high ecological potential; they are connected with swampy and wet grasslands, where *Alnus glutinosa* is quite dominant. Higher grounds have different ecological values, consisting of heathland and raised bog (Waterschap Noorderzijlvest, 2012). Within the greater Onlanden area migratory and endangered birds, plants, butterflies, amphibians and even mammals, such as the European otter can be found. Therefore, the OL project developed from a fragmented landscape towards an environmental friendly and dynamic one, contributing to the *National Ecological Networks*.

4.3.3 Spatial problems and solutions

The spatial problem within the project are the low-lying districts *Hoogkerk* and *Eelderwolde* located in the southwest from Groningen. Before the project was realised the districts were exposed to high flood vulnerability. Additionally, the cultivation of crops and cattle have been semi optimal in the low-lying wet area westwards from Groningen, which was not accepted by the farmers instantly. Therefore, redevelopment of the landscape took place.

To find sufficient and holistic solutions a steering committee was established. Within the steering committee, it was from prime importance to integrate all influenced stakeholders. The Waterschap Noorderzijlvest and the province of Drenthe were the main organisations that guided the project (Waterschap Noorderzijlvest, 2012). The steering committee secured a common goal early in the planning process, which made conflict handling easier and gave more room for alternative solutions. If necessary small-specialised working groups have been established to tackle particular problems, as mentioned by Mrs. Alma: "*They introduced a sub-commission next to the main commission, which was just about agriculture […]*". Key point are regular meetings between involved parties, to secure that everybody is still working towards the long-term vision and to solve small-scale problems of influenced individuals. Especially the Waterschap Noorderzijlvest is exerted to have regular monitoring to secure a sufficient water storage capacity to guarantee safety, as Mr. de Jong clarified by saying: "*The consequences of the water storage area will be monitored*".

Physically, the construction of dykes around the storage area was one of the first steps. The project constructed trenches and tubes to connect the *Eeldermaden* with the *Peizermaden* and three drainage gates instead of one. Next to that, weirs have been installed separating four landscapes with different altitudes within the region (Natuurbelang De Onlanden, 2016). The connection between the *Eeldermaden* and the *Peizermaden* secured a reduced inflow in the *Koningsdiep* and therefore towards the western districts of the city of Groningen. The water within the OL area is now preferred drained northwards across the *Leekstermeer* by the

Munnikesloot and the *Leekster Hoofddiep* to the pumping station Electra, which pumps the water into the *Lauwersmeer,* where it flows into the North Sea (Waterschap Noorderzijlvest, 2012). Three additional drainage gates contribute to a reduced peak discharge and better runoff during an extreme event. Main advantage of the realisation of the OL project, is that the water storage capacity is doubled contributing to lower water levels in case of an extreme event.

The redevelopment of the landscape through parcel exchange has the objective to create more sustainable and resilient environments through the right utilisation of land parcels, which Mr. de Jong indicated: "*Agricultural land was of low quality, which was not very attractive for farming. Therefore, they were willing to leave through parcel exchange*". It was practiced to change agricultural land into valuable nature, which should contribute to improved and reasonable land management. Virtually, new bank stripes, ditches and peat holes have been dug to trigger swamp development and to form improved passages between land and water. In addition, areas have been enriched with peat to create nature that is more valuable. Through the landscape interventions, ecological networks have been created and improved the natural value of the area, as Mr. van Boekel explained: "*There was a high amount of bushes, which did oust grazing birds and meadow breeding birds. Therefore, the natural values have been low, the re-development of the area as water containment area and marshland increased the natural value*".

Natuurmonumenten created the *Olanderij* where a better perception of nature is aspired, by connecting local schools and kindergartens with the project (Natuurmonumenten, 2016). Thereby, improved perception of natural values and enhanced consciousness to flood events is wanted. The land redevelopment contributed to lower flood risk and an increase in natural value.

4.3.4 Analysis of the Onlanden

The analysis procedure follows the same principle as applied in chapter 4.2.4.

Table 13: Disadvantages or advantages between taken measures and involved sectors within the Onlanden.

Measures / Sectors	Recreational paths	Construction of dykes	Mosquito hills	Parcel exchange
Water management	0	++	-	++
Nature conservation	-	+	+	++
Cultural heritage	0	+	0	-
Tourism	+	+	0	+
Agriculture	0	-	0	+

Water management and recreational paths did not influence each other, resulting in a *neutral* score. As the recreational paths cut through habitats, the development for nature conservation is rather negative resulting in a *satisfactory* score, as Mr. van Boekel said: "*I do not know if tourism is profitable for the area. Many people come to the area and do not stay on tracks […]*". The recreational paths did not contribute to cultural heritage, besides the archaeological sites are not well enough integrated in the touristic concept of the area, as Mr. Nicolay clarified: "*The idea of archaeology should be better integrated in the concept, as it is part of cultural history*", resulting in a *neutral* score. Concerning tourism, the recreational paths improved the accessibility of the area and increased the touristic potential explaining the *good* score. As most farmers have been relocated through parcel exchange, the development of the recreational paths is rather *neutral* for agriculture. Besides the positive development for tourism, the construction of the recreational paths have been disadvantageous for planning and required intensive coordination and communication, as one statement by Mrs. Dunning explains: "*The construction of one connecting road close to the Leekstermeer required intensive discussions*".

The construction of dykes was a big advantage for water management, as the embankment of the area contributed to an increased storage capacity and safety purpose, explaining the *excellent* score. Nature conservation, cultural heritage and tourism profited from that development and scored *good*. Through the embankment of the area, the landscape value changed and more wet nature triggered the reclamation of certain flora and fauna, as Mr. van Boekel explained: "*The biotopes completely changed, from a landscape with fixed water levels* *towards flexible water levels*". The increase of water levels will create anoxic conditions, which is advantageous for the conservation of cultural sites, as Mr. Nicolay clarified: "*The idea emerged to higher the water levels, which can be good for archaeology as water will make the ground anoxic*". Besides, the landscape change was advantageous for tourism as the increase in flora, fauna attracts nature lovers, and the rewetting of the area unseals touristic potential, which Mr. Zeemans exemplified: "*You see for instance, that a person that lives in Roderwolde owing a canoeing company is profiting from the project*". For agriculture, the development was more disadvantageous, as higher water levels decreased the productivity for cultivation and solely enables extensive agriculture, as Mr. Visser explained: "*There have been studies proofing that temporal flooding of agricultural land is negative for the productivity of the land*". Therefore, most farmers were relocated through parcel exchange, explaining the *satisfactory* score. For planning, the first objective was safety and consequently the construction of the dykes was first priority and accepted within the planning process, as Mrs. Alma clarified: "*The first intention was safety to reduce the risk of flooding due to the flood of 1998*".

The mosquito hills were measures to keep mosquitos away from settlement areas. As the rewetting of the area triggered an increase in the mosquito population, water management scored only *satisfactory*. For nature conservation, the construction of mosquito hills is rather advantageous as it creates more diverse habitats and attracts more species, resulting in a *good* score. For cultural heritage, agriculture and tourism the construction of mosquito hills is *neutral*. Concerning planning, the construction of mosquito hills illustrates the necessity of regular monitoring, to secure that mosquitos are not becoming a problem for nearby settlements or tourism. Mr. Zeemans said: "*Especially the mosquitos required external experts to advise us, due to the ecological issues of mosquito reproduction we need to monitor and control their development*".

The parcel exchange was *good* for tourism and agriculture as the redevelopment of the area triggered advantageous development, such as more valuable nature and reasonable land distribution, as Mrs. Alma explained: "*Mainly agricultural area changed into nature and water safety function*". Nature conservation and water management profited the most, as the water storage increased and resulted in more diversity explaining the *excellent* score. Mr van Boekel outlined: "*The natural values have been low and the re-development as water containment area increased the natural value*". Parcel exchange could not relocate the archaeological sites, meaning that the cultural sites will disappear in the long run as other interests overbalance, resulting in a *satisfactory* score, as Mr. Nicolay clarified: "*There is the option that the sides will disappear if the area will have an increasingly water management interest*". For planning, the process of parcel exchange was outbalanced between effort and outcome, meaning that it triggered some complications but resulted in the intended aim.

Table 14: Synergies and conflicts within the Onlanden project.

Synergies & Conflicts	Water management	Nature conservation	Tourism	Cultural heritage	Agriculture
Water management					
Nature conservation	+				
Tourism	++	0			
Cultural heritage	+	-	-		
Agriculture	0	-	0	0	
Planning	++	++	+	-	+

Water management triggered a drastic landscape change within the OL project. Synergies between water management, nature conservation, tourism and planning emerged during the process. The rewetting increased the diversity, improved the touristic potential and fulfilled the planning aim for more safety. The issue between water management and nature conservation is that the water authority wants to have always-sufficient storage capacity in case of an extreme event, while nature conservation would prefer flexible water levels. Mr van Boekel said: "*Nature preservation authorities would prefer flexible water levels with better conditions for nature*". The cultural heritage can profit from current water management as it creates anoxic conditions beneficial for archaeological conservation. Therefore, a synergy emerged, which is questionable related to future water management. In the first place, agriculture did not profit through current water management as it created higher water levels with counterproductive influence for agricultural productivity, next to that, the relocation through parcel exchange compensates with farmland on higher grounds, explaining the neutral outcome. Mr. de Jong clarified that by saying: "*The OL does not only function for the* *city itself, there is also an other area that profited from the project, especially agriculture, as the OL is preventing inundation of other areas that are in agricultural use*".

Nature conservation and tourism need to be balanced. An increase in natural values will attract more tourists, which triggers more responsibility for the touristic sector to maintain and secure sufficient nature protection. Mrs. Dunning outlined: "*Natuurmonumenten has certain aims within the OL, we protect the nature, but we also think it is good people can visit and enjoy the beauty of nature*". Leaving big parts of the area for nature conservation purposes describes a conflict with cultural heritage as the roots of reeds can destroy the archaeological sites, as Mr. Nicolay exemplified: "*The archaeological sides are the highest grounds in the area so a lot of reed and bushes grow there, which is not good for the preservation of archaeological sides*". For agriculture, the increase in wet habitats was counterproductive as well, as irrigation decreases the productivity and needs a mind-set change of farmers for extensive agricultural practices, as Mr. de Jong explained: "*There is just one farmer doing extensive farming in the area, as extensive farming needs a new mind-set of farmers*". The natural value profited through planning, as the aim of safety could only be realised through a landscape change, which changed a once agricultural dominated landscape into a wet nature area.

Tourism should better integrate the archaeological sites into their concept as it describes the history of the area and explains why low-lying areas are not directly suitable for agriculture. Mr. Nicolay clarifies that: "*The medieval landscape layer should be presented as one part of the landscape. The archaeological research proofs the purpose of the OL project, as it shows that already decades ago people tried to settle even it is not actually possible*". Tourism and agriculture did not have any influence on each other but planning contributed to tourism. Planning triggered touristic development through the reconstruction of the area by creating more wet nature. Cultural heritage and agriculture did not influence each other, while planning was quite surprised through the amount of archaeological sites in the area, as Mrs. Alma said: "*We did not know archaeology is there and it surprised us*". This triggered a conflict within planning, as the excavation increased the planning costs. Agriculture was compensated through planning in an overall positive way through the relocation of farmers to higher grounds.

Table 13 and 14 illustrate the advantageous or disadvantageous development, which results in a varying intensive degree of synergies and conflicts. The construction of dykes and the parcel exchange were the most effective measures within the project. The construction of dykes embossed and triggered the parcel exchange, as the landscape redistribution required new land use management. Mosquito hills were necessary to reduce negative effects and recreational paths should improve the touristic potential. Therefore, more disadvantageous development emerged as both measures intended a specific interest. Whereas, water management and nature conservation benefited the most through the taken measures.

Water management triggered the most synergies within the project due to the drastic water-related landscape change, which created many opportunities. Next to that, planning created many synergies, as the project purpose was clear early in the planning process, which Mr. Visser explained: "*Early in the process, we tried to give the people certainty, so they would know what is happening*". Main conflicts within the project emerged between the cultural heritages, nature conservation and planning. Balancing the natural and agricultural interests triggered also conflicts due to different ambitions.

Table 15: Expert perception concerning the criteria within the Onlanden project.

Criteria \ Actors		Mr. K. de Jong & G. Zeemans	Mr. B. Hummelen	Mr. W. van Boekel	Mr. Dr. J. Nicolay	Mrs. M. Dunning & Mr. J. Tukker	Mr. R. Visser	Mr. B. van Guldener	Mrs. C. Alma
Stakeholder involvement		We wanted to have the opinion of everybody from that area. Key is listening good to find out about the best solutions.	All relevant interests were involved within the steering committee.	Organizations were involved in all the discussions how the OL is taking form, where channels will be dug, etc.	I did not feel that archaeology was a problem within the project and we took part in regular meetings after they discovered the archaeological sides.	Communication and interaction are a necessity within planning nowadays. We try to find out what everybody wants and make it organic.	Negotiation with the farmers owing land in the region was indispensable. The discussion started when the plan was clear and negotiations went quite well through early involvement.	You plan as low as possible with the people connected to the land and problems. People need to be willing to openly interact with each other.	We needed to be open in the relation to the people in the surrounding, which changed the plans but not the primary aim. Local experience and knowledge is really important.
Climate change governance		The president within the steering committee was important as leading role, converted conflicts into solutions.	We had an independent chairman that secured everybody was working towards the same aim and was coordinating between different interests.	First, it was a plan and during the process, things changed, so I am happy people were willing and open to interact.	During the reconstruction of the area, they found the archaeological sites and then they asked the university as a partner to take care of that.	It is important, because that means that every department has its own quality and we can combine it to make better solutions.	Early in the process, we tried to give the people certainty, so they would know what is happening.	The province alone is not capable of dealing with the intertwined issues on its own. You have to bring in an independent partner. You combine technological knowledge with local knowledge.	Long-term vision was set, but opened in the process how to reach it. Sub-commission next to the main commission.
Reduce probability	U	Analyse and optimize the system. So more	Subject not covered	Flexible water system is better	The idea is to higher the water	Flood risk means that	We work on solutions to cope with climate	Water management in	The first intention was

Reduce probability	rban	from the point of view which consequences it has and that the storage capacity is sufficient.		than all the other approaches in the Netherlands with pumping water.	levels, which can be good for archaeology as water will make the ground anoxic	people are safe. So the city has the main interest.	uncertainties and the OL is a good example. The project copes with flood risk management for the interests of cities, not for farmers.	the Netherlands is ruled by keep it up in the higher parts, store it in between and then pump it out.	safety to reduce the risk of flooding due to the flood of 1998
	Rural	The OL does not only function for the city itself, there is also an other area that profited from the project, especially agriculture, as the OL is preventing inundation of other areas that are in agricultural use	We should not put more water within this area, as the combination of functions will be gone	Nature preservation authorities would prefer flexible water levels with better conditions for nature	In general, flood risk management is contradicting with archaeology, but more water can improve but also decrease the quality of archaeology.	Nature is not always getting better through flood risk management, it is getting wetter. That can be good and bad at the same time.	Storing water, was also in the agricultural interest to have a solution in the case of heavy rainfall. So urban people benefit and farmers need to pay the bill.	The system is designed to keep the water in the system. You try to make longer rivers […] and combine it with the river banks, so the water can spread. Damage control!	The first intention is drain the area through ditches and canals to channel the water towards the sea as fast as possible. Now we think we better retain the water on a small scale.
Reduce consequences		To secure future safety, parcel exchange was practiced and adjustments to infrastructure will be made.	We represent nature, so we look anyway for areas that are not useful for agriculture.	The natural values have been low and the development as water containment area increased the natural value	Subject not covered	The OL was bought because of the flood risk management. If not, it still would be agricultural land.	There have been studies proofing that temporal flooding of agricultural land is negative for the productivity of the land, so farmers were relocated	Subject not covered	Mainly agricultural area changed into nature and water safety function
Social transformability		There is just one farmer doing extensive farming in the area, as extensive	We are used to dry lands, especially within the	We have to accept that true nature does no longer exist.	The medieval landscape layer should be presented as one	Natuurmonumenten has certain aims within the OL,	There is a national agreement on waterbeheering that says we have to be prepared	Subject not covered	Dry feed study 2050, where people conclude what

	farming needs a new mind-set of farmers.	public a mind-set change is necessary.	But that does not mean that we can limitlessly use the remaining nature for our own purposes.	part of the landscape. The archaeological research proofs the purpose of the OL project, as it shows that already decades ago people tried to settle even it is not actually possible	we protect the nature, but we also think it is good people can visit and enjoy the beauty of nature	for climate change and evolving problems.		needs to be done in the next years to keep the system dry.
Multifunctional land use	Agriculture and nature have been separated in a large extent to diminish tensions.	In these times especially within the Netherlands it is a necessity as space is not multiple.	Economically it profited through tourism and next to that it was more for safety and developing natural values.	Actually, there is no real idea about archaeology in the multifunctional concept. The idea of archaeology should be better integrated in the concept, as it is part of cultural history.	The landscape is designed in a multifunction al way. The tricky thing with MF is to keep the balance.	In this project, MF is the combination of nature and tourism, at least nowadays with the water retention purpose.	Within agriculture we separate functions; the economic value is the most important. The OL is a good example for combining functions.	These are the future solutions as we facing big uncertainties due to climate change.

A comprehensive analysis of both cases is done in the next part.

4.4 Comparison of the case studies

As compiled in the previous part, the two case study regions have some crucial differences that need to be mentioned to understand the thereinafter interpretations of the cases. The OL consists of artificial created lakes, which were new established after the flood in 1998 in Groningen to counteract the consequences in case of an extreme event. The GM consists of natural lakes, which underlay a new planning process to counteract the bad ecological conditions within the lake and to increase the water storage at the same time.

4.4.1 Comparison of flood risk approach

Table 16 consists of the general similarities and differences between the cases, crucial differences are highlighted.

Table 16: General similarities and differences between the Onlanden and the Großes Meer

Similarities	**Differences**	
	The Onlanden	**Großes Meer**
Water retention purpose	Artificial & natural water body	Natural water body
Beneficial nature development	Water safety & nature restoration purpose	Restoration purpose
Parcel exchange to diminish vulnerable land uses	Temporal flooded	Always flooded but flexible water level
Located in LLCA below mean sea-level	7 million m³ storage ability	3 million m³ storage ability
Joining forces through DP	Finished after 14 years	Project duration 20 years and still continuing
Multiple interests present	- Daily tourism - Water & nature emphasis	- Holiday tourism - Nature & tourism emphasis

The beneficial nature development is explained in section 4.2.3 and 4.3.2 and is visualised in figure 11 and 14. The similarities in table 16 are explaining common planning aims, such as the realisation of a water retention area and planning practices to achieve this aim, such as joining forces through DP.

A significant difference between the two cases is that the OL area is only temporally flooded if necessary, while the GM is carrying water during the whole year. That is also explaining why the land use within the GM region did not change drastically, only small-scale land use changes emerged, as indicated in figure 11 and 15. Different water levels at different times of the year surely change the appearance of the landscape but did not trigger crucial landscape change.

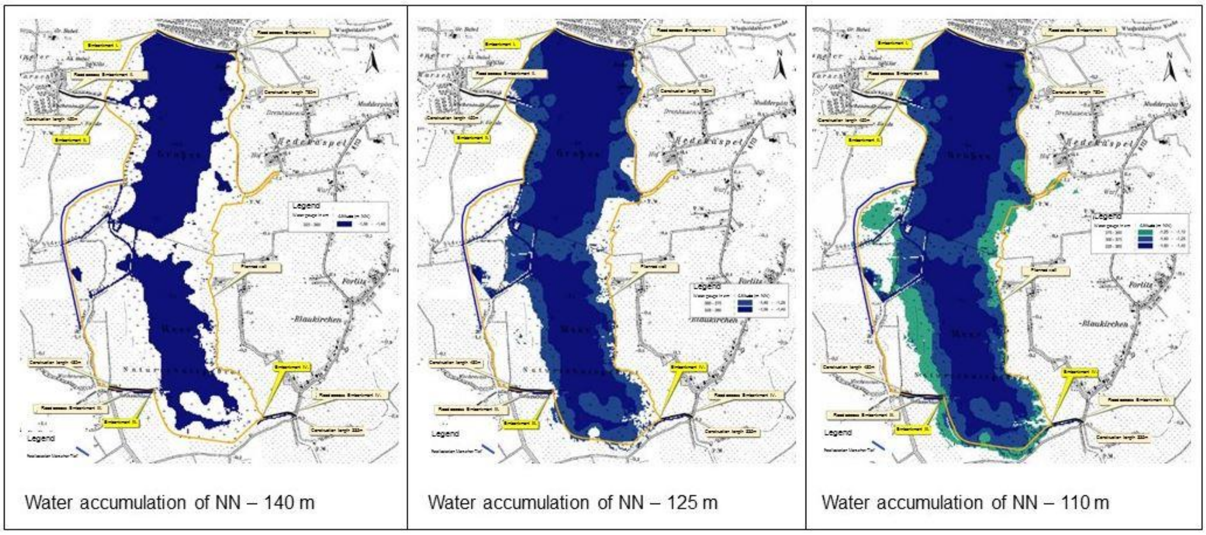

Figure 16: Different water levels within the Großes Meer region

The OL project encompassed a more drastic land use change, as visualised in figure 14. Figure 15 and 16 are visualising the different water levels, which are explained in table 17. The figures help to understand the differences between an artificial, temporally flooded and a natural, constantly flooded water body. These characteristics partially answers the question how the case study regions cope with flood risk. Table 17 connects to table 16 but adds the elevation levels within both regions. This explains in more detail how the two systems work related to flood risk management and what happens in case of an extreme event. In addition, table 17 clarifies the different approaches of both systems, which are connected to the different water levels. The OL area is filling up from the lowest to the highest point. Depending on the water quantity, parts or the

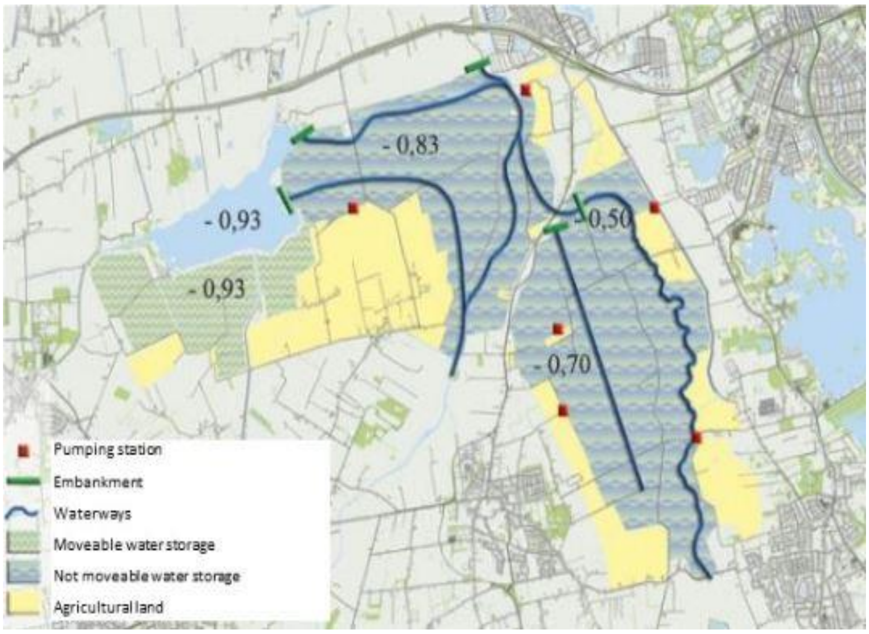

Figure 15: Water levels within the Onlanden region.

whole region can be flooded. The GM functions as one retention area that fills up to a maximum level of NN -1,10 metres after the embankments have been closed. To the point, both areas retain water in case of an extreme event but the GM seems rather fixed concerning water distribution, while the OL seems flexible depending on the intensity of the extreme event.

Table 17: Water management specifications within the Onlanden and the Großes Meer.

Water management	
The Onlanden	Großes Meer
The region has a water capacity of 7 million m^3 and is 17 km^2 big.	The lake has a volume from 3 million m^3 and is 4,61 km^2 big.
The whole Onlanden region can be divided in four different elevation levels: I. the western part of the *Eelder- and Peiermaden* with an elevation difference of **NN -0,50 metres,** II. the eastern part of the *Eelder- and Peiermaden* with an elevation difference of **NN -0,70 metres,** III. the area east of the *Leekstermeer* towards the *Peizermaden* with an elevation of **NN -0,83 metres**, IV. the *Leekstermeer* area with an elevation of **NN -0,93 metres** with ➔ a maximum safety level of **NN -0,20 metres.**	The Großes Meer region has a rather constant water level during the year. Maximum water levels are varying in summer and winter: I. Maximum winter level is **NN -1,40 metres**, II. maximum summer level is **NN -1,27 metres** and III. a maximum water level in case of an extreme event is **NN -1,10 metres**. ➔ The dykes around the area were heightened to **NN -0,70 metres**, leaving a security difference of 40 centimetres in case of an extreme rainfall event.
Discharge is slowed down through different altitude levels within the region to decrease flood risk. In the future movable weirs are intended to increase storage ability.	Store the water within the GM and discharge when surrounding area has reached low water levels again. Contributes to decreased flood risk.

Within the OL Mr. Visser explained: "*There is a national agreement on waterbeheering that says we have to be prepared for climate change and evolving problems*", which summarises the intention to reduce the flood risk. Reducing the probability of floods is done by spatial and technical measures, as Mr. van Guldener clarified: "*The system is designed to keep the water in the system. You try to make longer rivers and channels, so that the water stays longer in the system and combine it with the river banks, so the water can spread*". The consequences of floods were tackled by discouraging vulnerable land use, as Mr. de Jong explained: "*To secure future safety, parcel exchange was practiced […]*". Social transformability is aspired as explained by Mrs. Dunning within the area through the educational station Olanderij.

Within the GM Mr. Paulsen-Jacobs said: "*The four embankments contributed to improved usage of the GM in an economic water related way*" to reduce the probability of floods. Mr. Bohlen added: *"[…] we act supportive by parcel exchange"* to reduce the consequences of floods and Mr. Meyer clarified: "*On the 3-Meere-Weg several information boards have been issued with educational purpose […]*" to trigger social transformability.

The expert's perception in table 12 and 15 are indicating that suitable measures concerning the criteria of FR have been taken within both projects. Concluding, agriculture enabled through parcel exchange the implementation of flood resilient places and triggered the synergies between water management and nature conservation within the OL project and water management and tourism within the GM project. The next part consists of interpretations concerning the theories of DP and MF within both case study regions.

5 Interpretation

5.1 Comparison of decentralised planning

DP was practiced in both cases. Within the OL a steering committee was established and within the GM a roundtable task force, which was accompanied by an independent partner to secure targets were met. If more specialised problems emerged, sub commissions have been established in both cases, to fight problems with more tailor-made approaches. Table 12 and 15 indicate the expert's perception regarding the DP process.

Mr. van Guldener said: "*You plan as low as possible with the people connected to the land and problems. The aim is more or less clear but how to achieve it? You combine technological knowledge with local knowledge. Listen to them and make sure parties working for the general aim and not for their own*". Mr. Wendeburg adds: "*Plans must be interpret in connection to the local circumstances to find the lowest common denominator. That is essential for any planning, get everybody involved into the boat, otherwise you cannot reach your goals*". Additionally, Mr. Poppen clarifies that: "*Somebody needs to have the hat on*", which clarifies, that DP requires an independent neutral partner steering the planning process. Within the OL, Mr. Hummelen confirmed that by saying: "*We had an independent chairman that secured everybody was working towards the same aim […]*". Within the German case, the ARSU GmbH steered the process as independent agent and contributed to the development and implementation of the project between different interests (ARSU GmbH, 2015). Within the Dutch case, the Prolander agency was involved to translate the regional policy into concrete plans as designer and independent representative of involved interests (Prolander, 2016). These statements proof that DP was practiced in both cases and that responsible planning experts were aware of the importance of equal participation within the planning process to convert conflicts into synergies. On the other side Mrs. Brunken-Winkler clarifies that: "*the lower task forces have been implemented as the amount of interests groups within the roundtable task force were so high that sufficient working was not possible anymore*". Mr. van Guldener adds: "*Dutch planning is becoming more difficult, networks are really complex and people generate their own knowledge*". Especially, the access to new technologies, such as media and the internet contributes to the development of own knowledge. These two statements indicate the emerging complexity through DP in current planning practice.

DP can make planning more difficult, if the project duration is exceeding experts can change and new people with different interests will get involved in the project, which was a problem within the GM project (see table 16). On the other hand, too fast project implementation can neglect certain issues, such as cultural heritage within the OL case. Generally, the amount of participants within a project is a crucial factor for the accountability of DP. Mr. Poppen expressed that by saying: "*We focus rather on the legal barriers that we have to soften in order to achieve more*". This statement alludes to the amount of participants in vertical and horizontal planning interactions (see table 3), which seemed to be a barrier in the GM project due to unclear responsibilities especially on the horizontal federal level. Consequently, successful DP requires early certainty about the planning purpose, an independent planning agent and regular meetings to discuss "*how*" to implement the planning purpose.

This section explained to what extent DP worked within the two case study regions and gave answers about barriers within DP.

5.2 Comparison of multifunctionality

Both projects emphasise different sectors (see chapter 4.2.4 and 4.3.4). The OL case had a strong water safety purpose, which was combined with nature objectives. The GM had strong nature aims, as the ecological circumstances decreased drastically, which was combined with tourism. Therefore, touristic potentials are better exploited within the GM than in the OL, where further touristic potential exists. These differences give a hint about the different land use distribution within the cases and connect to the multifunctional character of both areas. Table 12 and 15 illustrate next to figure 8 and 16 the multifunctional character of the two case study regions.

Mrs. Dunning said: "t*he tricky thing with MF is to keep the balance*" and Mrs. Brunken-Winkler added: "*MF within the landscape is difficult, most of the time a multifunctional use of an area between two sectors is possible but between three it becomes almost impossible*".

Through the critical statements by the two experts, it becomes clear that MF is connected to different scales. Perception about MF differs in each sector (see table 12 and 15) and depends on scale. As explained by van Guldender: "*agriculture is a good example for the separation of functions; here the economic value is the most important*" and Mr. Paulsen-Jacobs ads: "*Three main interests, quantitative water management, nature conservation and the issue of water quality*". This indicates that MF is connected to expertise and context and implies different things to different sectors. Consequently, the scale of the project determines the multifunctional potential and which sectors are preferred over others.

Furthermore, some statements by the experts indicate the importance of MF. Mr. Hummelen said: "*In these times especially within the Netherlands it is a necessity, as space is not multiple*" and Mrs. Sutorius adds: "*MF is necessary but it needs a lot of willingness for compromises. I hope that priorities could be emphasised more clearly*". Consequently, MF requires a common interest. Combining functions means to find the right balance between them, as Mr. Hummelen indicates: "*It is not always good to compromise but it is good to search for it*". In a country like the Netherlands, space is scarce and not multiple, explaining that multifunctional landscapes are a future necessity to fight climate uncertainties. However, do the experts actually think that a multifunctional planning purpose is creating sustainable environments? The answer by Mrs. Brunken-Winkler is detailed and reflects on the full complexity of multifunctional landscapes: "*I think the project is on a good way but needs more effort to maintain such intensive cultivated landscapes to create sustainable environments, it is an ongoing process*". This proofs that the projects adopted to local circumstances to create the best possible environments. Besides, especially planning experts were convinced that the projects created sustainable environments (see Appendix II), which need to be interpreted with caution and is rather critical reflected within this research.

Therefore, it becomes questionable if multifunctional landscapes can create sustainable environments and if MF is meant to serve multiple functions.

5.3 Conclusion

The previous section was used to compare and analyse the two case study regions concerning the planning objective and the actual outcome, and furthermore their performance regarding the theories of DP and MF. Results are multifaceted in both cases and table 18 and 19 are summarising the development and the results of the projects.

The GM project changed from once unfavourable land use management towards wet nature and extensive agriculture through the approach of DP and created a more resilient retention area. The biggest conflict was the missing public knowledge and understanding of taken measures and their influence after implementation. Emphasis of the project is tourism and nature, which was promoted from a planning perspective but could not trigger a substantial synergy between them.

Table 18: Großes Meer: problems, solutions and actors

Großes Meer			
Problem	Solution	Involved actors	Future outlook
Bad ecological conditions of the water body	Construction of four embankments	Nature conservation, water management, tourism, agriculture, sport and nature societies	- Improve the involvement of the public sector. - Better conflict handling between tourism and nature conservation necessary.

The OL project changed from once agricultural land with low productivity into a water and nature purpose with a function as retention area. This was achieved through principles of DP and created a resilient retention area with multiple landscape functions. The biggest conflict was the discovery of the archaeological sites, which hindered the project implementation. Aim of the project was to combine the water issue with nature purposes, which triggered synergies and conflicts.

Table 19: The Onlanden: problems, solutions and actors

The Onlanden			
Problem	Solution	Involved actors	Future-outlook
Flood 1998	Realisation of the OL project as retention area	Nature conservation, water management, tourism, agriculture and cultural heritage	- Regular monitoring - Improvement of the touristic potential - Holistic consideration of local circumstances

Concerning both projects, it is obvious that planning stays an ongoing process and needs future improvements through monitoring to maintain the functions of a multifaceted system. The next section will reflect upon the chosen theories and methods and will propose possible improvements, which were identified through the research process and outcome.

6 Discussion

This part of the paper is used to reflect upon the chosen theories and methods based on the research outcome and process.

The research topic of water-related planning projects in LLCA is relevant as climate change, such as changing precipitation and increasing sea-level rise are indicating. These modifications in our physical environment and climate is triggering a shift in current planning practice and theory. The shift from instrumental- to communicative-rationality, the shift from considering just the probabilities of floods towards also considering the actual consequences of floods and the shift in perception and meaning of our landscape are indicating that the theories of DP, FR and MF are adequate in addressing this shift in our physical environment and climate. Optionally, theories such as the social impact assessment (Vanclay, 2003) or ecosystem services (Bull et al., 2016) could be added to further elaborate the influence of multifunctional landscapes onto human well-being and to find a supplementary solution for balancing the antagonistic interplay between economic development and nature protection. Furthermore, the complexity theory (Byrne, 2003) could be used to dismantle the complex character of multifunctional planning projects and to disclose responsibilities between horizontal and vertical planning interactions to improve planning practice.

The methods used within this research, were mainly based on qualitative research methods. This was intended, as the objective was to unfold synergies and conflicts within the planning process between involved stakeholders. Therefore, a document analysis was conducted to proof if planning outcomes were in balance with the actual objectives and expert interviews were carried out to analyse the expert's perception. This helped to compare theory versus practice and to get an individual inside into the two case studies. However, a pure qualitative method needs to be treated with caution, as experts act as representative of their institution. The data is affected by individual subjective perception and contextual circumstances, which is an important consideration for a holistic interpretation of data. Besides that, the interviewer-respondent relationship is influenced by emotions, attitude and behaviour, illustrating the difficulty of evaluating qualitative data. Therefore, the method could be extended by quantitative research methods to not solely examine individual cognition but also connect it to numerical listing of criteria. This would help to explain causal relations based on numerical data and would make results more significant. Moreover, an institutional analysis (Alexander, 2005) could help to identify, which institutions triggered which synergy or conflict and could contribute to improved conflict handling.

Concerning the process and outcome of the research, the two chosen case study regions were well selected and contributed to a good comparison and analysis of the research objective. In addition, another case study could be selected to make statements more credible. The next section concludes the research through answering the research questions and will suggest improvements for planning practice and theory.

7 Conclusion

Concluding this research paper, water management in LLCA is in imposition as the two case study regions have shown. Both cases indicated that uncertain situations, such as climate change are triggering landscape redistributions, which require compromises and the combination of landscape functions and different interests. To create win-win situations the approach of DP is used to consider all relevant stakeholders within the planning intervention. This planning approach creates multifunctional landscapes, which aspire FR to reduce the increasing flood risk due to climate change. These shifts within planning theory were analysed and led to adequate responses in planning practice.

Flood risk is defined as the probability of floods multiplied by their consequences, concerning to theory. Within both case studies, the probability of floods was reduced through the combination of engineered defence and ecosystem-based measures. The consequences were minimised through parcel exchange and land acquisition to reduce vulnerable land uses and social transformability was triggered through educational paths or programmes. Therefore, planning practice shows that the formula of flood risk should be rephrased as function of probability, consequences and social transformability, which would simultaneously improve FR.

DP within planning theory describes the coordination that is necessary to involve all relevant stakeholders to achieve worthwhile solutions. Within both case studies, all relevant interests groups were represented and discussed within a roundtable or a steering committee. To secure coordination an independent agent that creates a network of all relevant stakeholders to develop common planning principles was represented by the Prolander Agency in the OL and by the ARSU GmbH within the GM. This shows that planning practice complies with planning theory, but that theory ignores the issue of increasing complexity through increasing involvement and unclear responsibilities.

In addition, MF was described as adaptation measures developed through multiple stakeholders caused by climate uncertainties to establish sustainable environments. Within both cases diverse landscapes with multiple adaptation measures and different emphasis developed. Planning practice established contextual multifunctional landscapes, which represent the full width of the planning intervention. Therefore, planning theory needs to enhance flexible and open planning approaches to embrace the full multifunctional setting.

Finally, flood risk was tackled in both cases through spatial measures to increase the robustness, adaptability and transformability of LLCA. Therefore, both projects created flood resilient places, which need further improvement of the social transformability to prepare the public for the consequences of climate change and regular monitoring and aftercare to secure sufficient retention capacities. Besides this, the planning approach of DP poses a barrier within planning practice, as it increases the scope of the planning intervention and results in a higher level of complexity. The higher level of complexity is connected to multiple interests involved, creating multifunctional landscapes. To coordinate between the interests and the actual planning objective the approach of DP is extremely important for successful coordination even it is increasing in complexity. Therefore, the functionality of DP in practice depends on the willingness to compromise, to open cooperation and to comprehensive discussions. This indicates that a careful target conception and project implementation are crucial factors to guarantee reliability of DP. The multifunctional character of the landscape is connected to the multiple interests represented through DP within planning practice. This multiple interests trigger synergies and conflicts, which create contextual multifunctional landscapes. Therein, the equal distribution of ecological, economic and social claims depends on the local circumstances, confirming context dependency of sustainability. Thus, it stays questionable if multifunctional planning projects are creating real sustainable environments, but surely, they are contributing to sustainability through flexible and open planning practice, which respects the planning context and reflects comprehensively on local needs. Consequently, the definition of MF within planning theory and planning practice requires the contextual consideration of multiple principles or theories to reflect on the full planning setting.

In summary, the comparative case study research has revealed different emphasised synergies, such as nature conservation and water management within the OL and nature conservation and tourism within the GM, which can act as catalyser in planning practice if certainty about the planning objective exists. According to experts, the balance of interests is a success factor within multifaceted planning projects. The GM project indicated unbalanced interests, which led to bad ecological conditions and to a function restriction of the GM. This shows the importance of regular monitoring and aftercare to avoid function restrictions. Therefore, the GM project represents a lesson to learn to avoid unbalanced interests within planning practice. MF can function as catalyser as it creates synergies and conflicts, which need to be balanced to trigger planning potentials. To finalise, the problem of climate uncertainty influences a large number of actors, which demands immediate action. Finding the right measures and right participants within uncertain situations makes adaptation measures a testing and ongoing problem that requires flexible and open planning approaches.

Closing up, the next section will give a future outlook for spatial planning in uncertain circumstances.

8 Prospect

The future-outlook of water-related planning projects in LLCA seems promising. The shift in water management and the three-step approach of storing, retaining and discharging water confirms the shift towards living with water in planning practice. As climate uncertainties will increase, the new approach of living with water is the right tactic to fight inland floods. Anyway, the different objectives of nature organisations and water authorities regarding water management poses future challenges. For sufficient project implementation, the central aim of the project needs to be clear early in the process and solely "*how*" to achieve it needs to be discussed within consistent project teams to secure successful project completion. As land is not multiple and rather scarce nowadays, the development of multifunctional landscapes seems necessary but will trigger more utilisation claims. Further, the antagonistic interplay of economic development and nature protections proofs that multifunctional landscapes are not truly sustainable. Therefore, DP should be used to minimise conflicts through careful and detailed aim conception and can contribute to meaningful land use management. Consequently, sustainability is something vague in current land use management, where it is questionable if once claimed land, which is artificial modified to fulfil current needs can be actually sustainable.

To be conscious that natural- and planning-circumstances are changing and uncertain is extremely important to realise that consistency within spatial planning is aspired but not truly possible. This is strengthening the idea of stepwise and flexible planning and should motivate spatial planners to openly interact and adapt to their environment, which asks for more interdisciplinary planning practice. For spatial planning, it indicates the increasing complexity through increasing uncertainties, which need to be tackled in connection to local circumstances and appropriate theories to turn synergies and conflicts into advantageous development.

Number of words: 21.621

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Appendix I

Interview Guide

1. **Personal questions:**
    a. For which company are you working and what is the role of the company within the project? (responsibility)
    b. Where do you see your personal role within the project? (responsibility)
    c. What concerning to your profession is the aim of the project? (task)
        i. What have been the main economic, ecological and social interest and interventions within the project? (activity)
2. **Questions regarding flood resilience**
    a. What means FR to you?
    b. In what way was FR important concerning to your profession within the project?
    c. Do you think FR is a necessity, if yes, WHY?
    ➔ Do you think flood risk management creates more sustainable and resilient environments, if yes, please name some examples!
3. **Questions regarding the planning process (theory: decentralised planning)**
    a. What do you understand under the term DP?
    b. Why would you consider DP important concerning to your profession within the project?
    c. Do you think DP is indispensable, if yes, WHY?
    ➔ Could you name some situations during the planning process, when DP was counterproductive!
4. **Questions regarding sustainable development (theory: multifunctionality)**
    a. What do you understand under the term MF?
    b. Why would you consider MF important concerning to your profession within the project?
    c. Do you think multifunctional landscapes are a future necessity, if yes, WHY?
    ➔ Do you think MF creates more sustainable environments?

➔ What is the problem with multifunctional landscapes?

5. **Concluding questions**
   a. What kind of future perspective has the current use of the area?
   b. Which ones have been the strongest synergies and conflicts that emerged during the project?
   c. Looking back, what were the biggest barriers/obstacles in the course of the project?
   d. How do you assess the planning process, what could have been better from your point of view?
   e. What were the overall top-down restrictions and legal requirements? Who had the main decision-making power?
   f. Where there any aspects you have missed during the interview? Was the given information sufficient?
   g. Could you name me more people that were involved in the project and could help me regarding my research objective?

Appendix II

The content of the interviews is available after request.