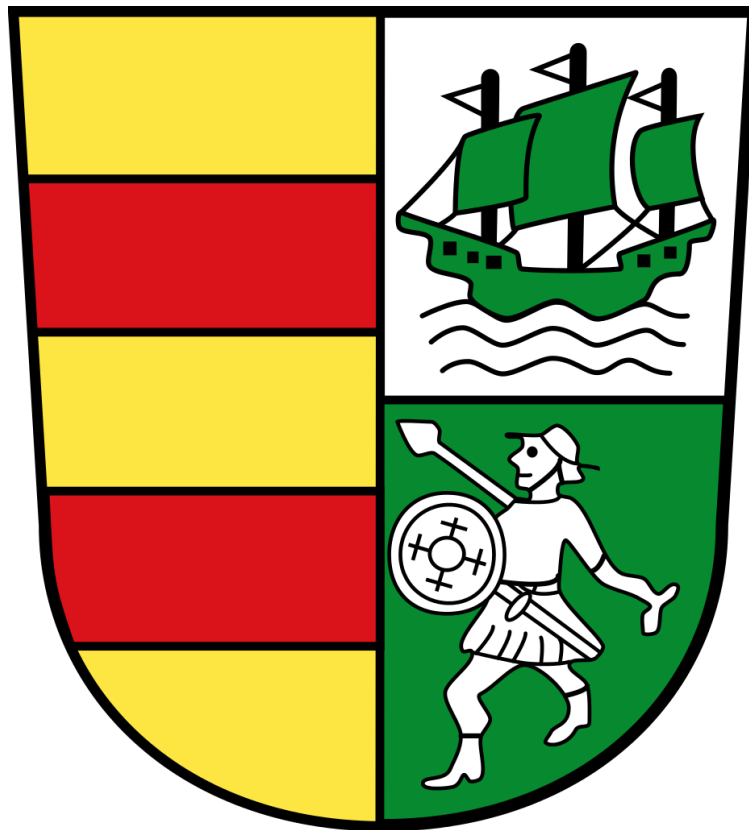


HZ University of Applied Sciences

Multi-layer safety in the Wesermarsch

Delta management



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30-9-2016

Interreg
North Sea Region



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European Regional Development Fund

Table of content

Summary.....	2
1. Introduction	4
1.1 Problem Description.....	4
The Wesermarsch	4
What is the problem?	5
Governance.....	6
Threats	6
German national flood safety policy.....	6
1.2 Research questions.....	8
1.3 Research goal	9
2. Theoretical framework	10
2.1 Literature about Multi-layer safety.....	10
2.2 Resilience	10
2.3 LAWA system, MLS And the EU flood directive.....	11
2.5 Conceptual model.....	15
3. Methodology.....	16
3.1 Introduction	16
3.1.1 Research Design.....	16
3.2 Explanation	17
3.3 Main concepts.....	18
4. Results	19
4.1 Pilot description.....	19
4.2 Relevant data to answer the sub questions	21
4.2.1 Sub question 1 - Which technical measures are used?	21
4.2.2 Sub question 2 - What policies are implemented?	21
4.2.3 Sub question 3 - What measures could still be implemented?.....	22
4.2.4 MLS comparison	22
4.3 GIS maps.....	24
5. Conclusion and discussion	26
5.1 Conclusion.....	26
5.2 Discussion.....	26
5.3 Recommendations about MLS	26
6. References	27

7. appendixes	28
7.1 Individual Research logbooks.....	28
7.2 Draft GIS map.....	36
7.3 planning.....	37
7.4 E mail conversations	38
7.5 research proposal	43
1. Introduction	45
1.1 Problem analysis	45
The Wesermarsch	45
what is the problem?.....	45
Governance.....	47
Threats	47
German national flood safety policy.....	48
2. theoretical framework.....	49
Multi-layer safety	49
Resilience.....	50
Conclusion.....	51
Conceptual model.....	51
Conceptual problem analyses.....	52
3. Methodology.....	53
3.1 Introduction	53
Research Methodology	53
Final Note.....	54
References	55

Summary

To ensure the impact of the project is positive and will not over expand the budget, there is a feasibility study in the making. It will be important to find the challenges and opportunities that climate change and therefore changed external influences affect water management, coastal protection and agriculture in the area of the Wesermarsch, Germany. The three main points of this study will be : the comparison of the Dutch Multi-layer safety approach to the German approach. Also An integrated adaptation approach for problems that will occur in the hinterland of the Weser in future. Last but not least the possible improvements of the current system.

The Wesermarsch is part of the Climate proof areas, which is a project all over Europe that aims to make areas that have endangered eco- systems and economic importance safe for the future even with the consequences of climate change.

In this Project the Food-risk-protection played a smaller part than the ecology and water economic problems due to the current status of the area. When it comes to flood risk management, the Project relies on the German national approach made by the Bund/Länder-Arbeitsgemeinschaft Wasser. However, this means that the multi-layer safety approach is not implemented. To see what exactly this means and how the German approach works compared to the Multi-layer safety approach there needs to be a good understanding on how it works. (Climate proof areas, 2009)

The chapters in this report include gathering relevant data to answer the research questions and the way the data is gathered. The chapter about theoretical framework contains the relevant data and the chapter about methodology will explain how the data is gathered and from which source. In the chapters after that the research questions will be answered and a conclusion is drawn up.

1. Introduction

This research report is about the Wesermarsch area in Germany. In this area there are certain water related problems. This report will help search for possible solutions to these problems. The problems will be described in the chapter about the problem analysis. The theoretical framework describes the actual situation in the Wesermarsch and the possible solutions for the problems.

The main goal of this proposal is to answer the main research question, which is; How is the multi-layer safety strategy used in the flood prone area of the Wesermarsch? The problem must first be identified before the research question can be formulated.

1.1 Problem Description

In the text below different aspects of the Wesermarsch are being explained to give a clear picture about the challenges of the area.

The Wesermarsch

Climate change, the rise of the overall surface temperature due to the accumulation of CO₂ in the atmosphere, changes many natural systems on this planet. It triggers a lot of smaller local problems which need to be dealt with to protect society, natural systems and economy. The current situation in the Wesermarsch is based on the first layer of Multi-layer safety which is a dike and canal system.

Land use

The Wesermarsch county is used to 90% for agriculture, which mostly is dairy cattle. Besides the Weser ports Brake and Nordenham the county is rural. (Helge Bormann, 6 August 2012)

The hydrological pressure in the area comes from many different directions. In winter time, water needs to be drained from the area in order to avoid flooding. In summer time the region does not have enough water to maintain the marsch and water areas. There are many stakeholders involved to regulate the water of the Wesermarsch. Six water boards are responsible: Braker Sielacht, Entwässerungsverband Stedingen, Entwässerungsverband Jade, Entwässerungsverband Butjadingen, Stadlander Sielacht and Mooriem Ohmsteder Sielacht. Together with two dike boards (I and II Oldenburgischer Deichband), they are organised within one umbrella organisation, but generally decide individually on how to regulate water levels and flows within their respective areas. All

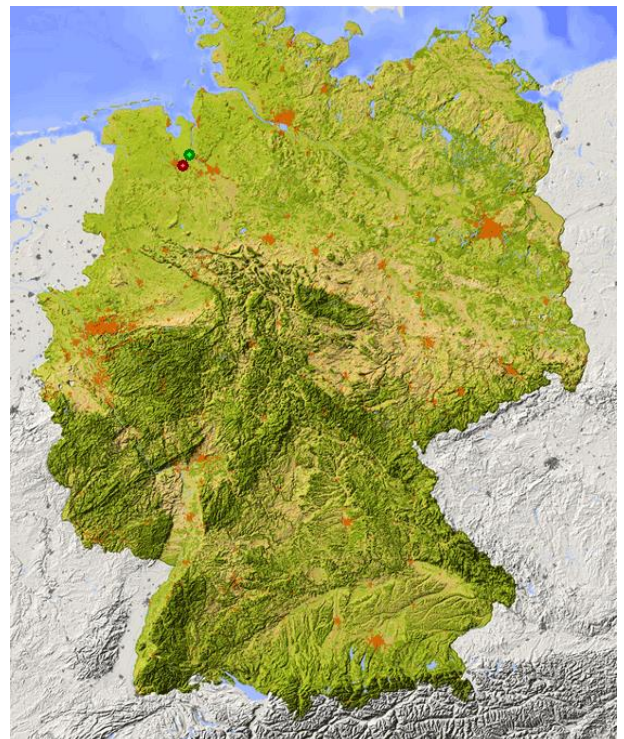


Figure 1 map of Germany, arrow indicates the Wesermarsch area, the two dots represent the cities of Brake and Nordenham in the Wesermarsch area

land owners in the Wesermarsch are compulsory members of the boards. And executives of the water boards are elected by the members just like in the Netherlands. (Helge Bormann, 6 August 2012)

What is the problem?

The low lying areas of the Wesermarsch in the north west of Germany suffers from a few water related problems. These problems include storm surges that cause floods from the sea, the consequential salinization of the groundwater due to the peninsula like situation, as well as floods coming from the rivers. As a consequence of climate change increased precipitation and sea level rise problem is threatening the area of the Wesermarsch. Besides this some parts of the area lie below sea level. This area is under pressure from both ecological and human perspectives. (Ossietzky, 2016)

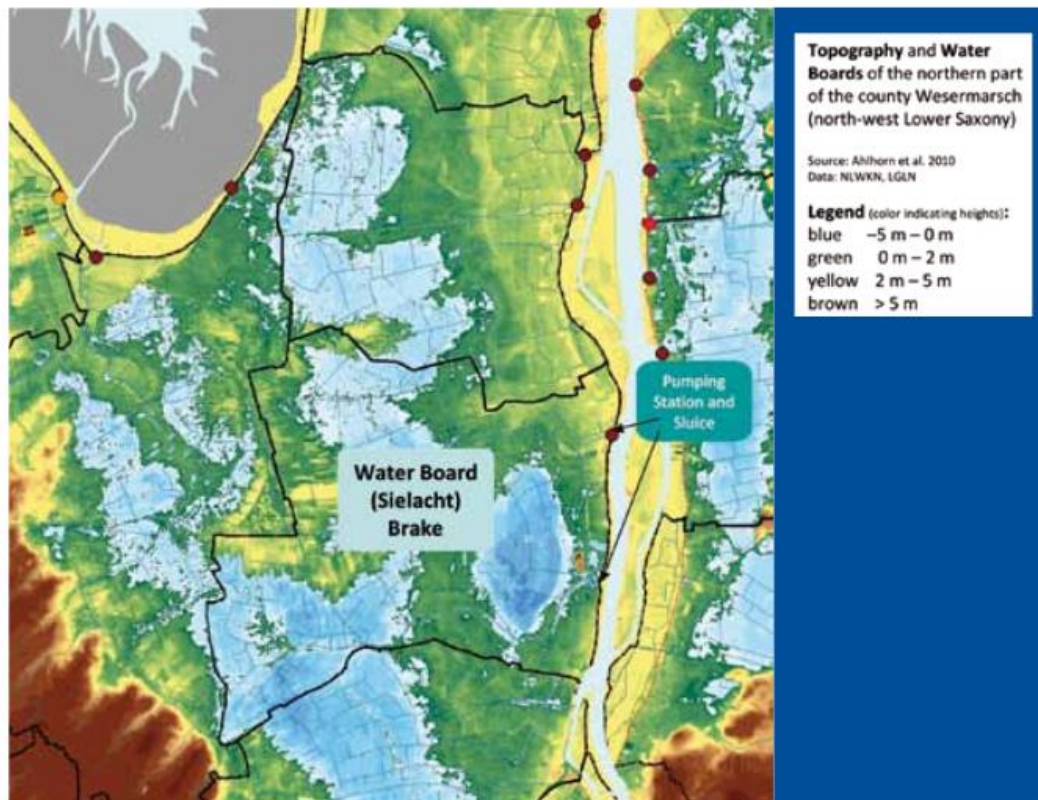


Figure 1 This map shows the elevation of one are of the Wesermarsch (Brake)

Governance

Since the Wesermarsch is a big area that combines many different interests like, agriculture, industry, fishery, there are many different actors and stakeholders involved. The municipalities of Brake and Nordenham are located within and close to the Wesermarsch. Both are home for industrial harbours. Furthermore the saltwater intrusion endangers the fresh water supply for the close lying cities. So this includes the drinking water supply and sewage disposal companies as stakeholders. The big grass land patches in the Wesermarsch are important for local farmers to maintain their cattle. This also influences the chamber of agriculture.

Finally the waterboards are big stakeholders in the area with a large influence because they manage the water system in the Wesermarsch. (Bormann, alhorn, Giani, Klaassen, & Klenke)

Threats

The ecological problems that are threatening the area developed over a longer time period. Due to climate change over the years the water surplus in the winter and the scarcity in the summer has become a problem and will develop into a real threat until the year 2050. Climate change causes the slow process of sea level rise, as well as it enhances the occurrence of storm surges and extreme rain events. The problem therefore started as soon as the industrial revolution when the burning of fossil fuels caused the greenhouse effect. (Bormann, alhorn, Giani, Klaassen, & Klenke)

In the Wesermarsch area live a lot of people that are affected by the consequences that the problem brings with it. One of these consequences is the fact that there are drainage problems when there is a lot of precipitation. In the area there is a lot of agriculture (cattle, corn and weed), the agriculture is badly affected by the salinization of the groundwater which results in a lack of irrigation water.

On the picture below it can be seen that the Wesermarsch area is a low lying area, at some spots the land is 2,5 meters below sea level. Because of this, the area is vulnerable to flooding's. If this happens, all the agricultural land will be flooded and this would cause an salinization problem

German national flood safety policy

Germany suffered a lot from floods lately with damage running in the billions. The highly organised and advanced way of living in western Europe makes it also vulnerable to floods. In Germany there are two main elements, which consists of flood risk reduction and coping with floods.

Länder-Arbeitsgemeinschaft Wasser.

The Länder-Arbeitsgemeinschaft Wasser is a cooperation of responsible ministries of each Bundesland or "State" for water related economy and Water-rights. This Cooperation is discussing questions regarding these topics to initiate national solutions. (Prof. Dr. rer.nat.habil. Uwe Grünewald, 2004)

The Lawa meets at least twice a year to discuss new issues or continue work. The leading role switches every two years to another Bundesland. The organisation has some specialised committees that are constantly working on important topics. Each topic has its own committee. The Topics are: Gewässerkunde (waterecology), Gewässer und Meeresschutz (protection of lakes, rivers and sea), Hochwasserschutz (floodprotection), Küstenschutz (coastal protection), Grundwasser (groundwater management), Wasserversorgung (water supply) and Kommunal und Industrieabwasser management (Community and Industrial sewage management). Although these are national committees dealing with national issues they also try to pay close attention to regional factors that will alter the approach for each region.

Spatial measures:

- keeping constructional development out of floodplains as far as possible
- Constructional measures: ensuring appropriately adapted construction methods in areas prone to flooding
- Risk reduction measures: own financial provisions (backed by insurance)
- Behavioural measures: explaining, preparing for and practicing how to cope with flood-related danger situations
- Informational measures: alarming, warning and informing about impending events
- Increasing natural water retention in catchment areas
- Technical flood protection: constructional facilities for water retention (such as dams, storage reservoirs, polders)

Coping with flood disasters above all means:

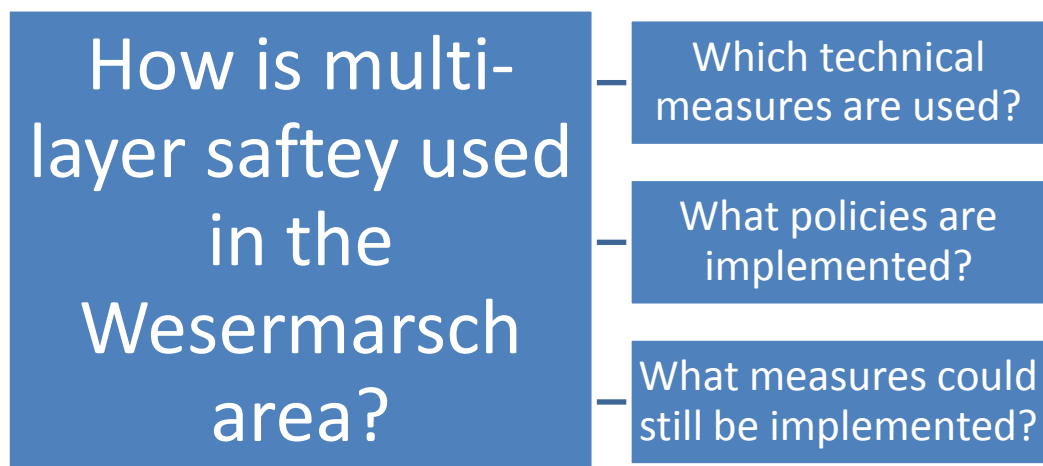
- Averting disastrous impacts of flooding
- Help for victims
- Construction aid
- Reconstruction

Germany has a federal system which means that governmental tasks are divided between federal government and state government (Länder). Germany's environmental policy is mainly responsible for the water management issues like floods. Each Bundes state is bound by the environmental and water acts and carry out different tasks. (Prof. Dr. rer.nat.habil. Uwe Grünwald, 2004)

1.2 Research questions

All the above mentioned ecological, economic and social problems can't be ignored. Since countries like the Netherlands already demonstrated, how the Multi-layer safety can positively influence actual as well as perceived safety for the citizens nearby, the question if this could present a solution for the problems of the Wesermarsch arises. The three layer approach help to manage complex water problems that are interlinked with society. Properly implemented this approach will improve the overall situation regarding water ecology, economy and water safety. Therefore a few questions related to this problem need to be answered to get to the core. The main research question will be: How is the multi-layer safety strategy used in the Wesermarsch? The sub questions are important for in depth understanding: What technical measures are used? ; What policies are implemented in Germany? ; What effect do these technical measures have? ; Which measures could still be implemented? And ; In what way do these policies help to solve the water problems?

The sub questions are derived from a brainstorm session with the group members, in this group meeting all of the group members came up with relevant data they want to get from their research. The data the research needs to have is what measures and policies from multi-layer safety are already implemented and which measures can still be drawn up. In this way the research will show a clear picture of the current status of the Wesermarsch in relation to Multi-layer safety.



1.3 Research goal

The goal of this research report is to gain more insight in the way the multi-layer safety concept is used in the German region of the Wesermarsch. Research questions are erected to get a clear answer on this subject which are stated in the previous chapter. The Wesermarsch itself is a pilot area for a climate proof concept. This makes the research an interesting subject to connect it with flood risk management. Flood risk management in Germany is completely different than in the Netherlands. But it is still comparable with the concept of multi-layer safety.

In the chapter about the conclusions and recommendations the research data is analysed and a recommended situation will be described. The situation in the Wesermarsch could still be improved and new policies may be implemented. The goal of the recommendation is to enhance the flood risk safety in the region as a whole.

2. Theoretical framework

This chapter contains information gathered from trustworthy sources about the pilot area or about the policies and regulation which are implemented in the Wesermarsch. Furthermore the Multi-layer safety approach is explained and the European flood directive is taken into account.

2.1 Literature about Multi-layer safety

The multi-layer safety approach evolved at the start of this millennium in the Netherlands and Flanders. It is an integrated approach for flood risk management which takes the risk into account. This means that not only the probability but also the consequences of a possible flood event are taken to account. Originally introduced in the Netherlands in 2009, the risk based approach to flood management was already encouraged by the EU in 2007. (Maria Kaufmann, 30. November 2015) Still the approach is not yet fully integrated in the most countries. The multi-layer safety approach is consisting of out of three layers.

Firstly the hard measures which include dikes, dams, sluices and other measures that prevents the water from intruding. The second layer consist of measures involved in spatial planning such as: elevated infrastructure as main streets, hospitals, power plants and more. This guarantees a certain amount of services that still will be functioning even though the hard measures failed. The third and final layer is about disaster management. This layer approaches the evacuation or the help with important goods. Combined these (urban green blue grid, 2008)

2.2 Resilience

“Infrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event.”
(NIAC, 2009)

Resilience is, as the NIAC states, important for effective infrastructure or enterprises. It is also very important for a water system and its management. Water systems are very complex systems that have to deal with a lot of different pressures at the same time. Some of them are directly man made like pollution through industry, some are indirectly influenced by humans like climate change and others are due to natural circumstances.

Effective in this case means effective in keeping the eco system while being able to store enough water to guarantee security for companies and citizens working and living in the area.

The effectiveness however is determine by the ability to adapt, absorb, or recover from an ecological pressure. This is related to climate change in this case since it brings most of the changing pressures.

Climate change

Climate change is happening all over the world including in the north of Germany. The Wesermarsch has to deal with climate change problems like salinization due to sea level rise and storm surges from the north sea. Furthermore in the summer there will be more water shortage and in the winter there will be a surplus of rainwater that discharges into the river system. Because of climate change the old system can't cope with the changes.

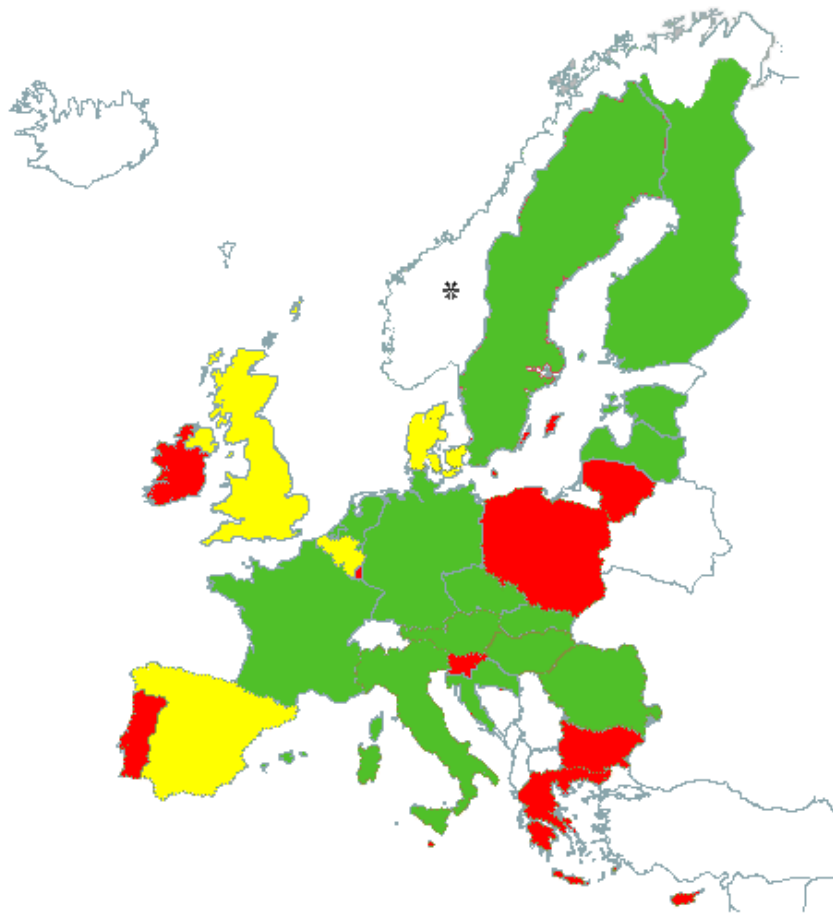
Water management

Water management addresses an integrated and interdisciplinary approach involving, chemistry, biology, economy and social aspects. Water management is important since water is everywhere in our culture and represents a very complicated and fragile eco system. It is used for transport, irrigation, cooling water, drinking water and so on. Therefore it is closely related to governmental processes. Delta management focuses on the governance and is therefore responsible for policies like the Multi-layer safety strategy.

2.3 LAWA system, MLS And the EU flood directive

Besides their own flood risk management plan Germany, like all EU member states have the EU flood directive to take into account. The text below will give a short explanation of the EU flood directive;

- Member States of the European Union will by 2011 undertake a preliminary flood risk assessment of their river basins and associated coastal zones, to identify areas where potential significant flood hazards may occur.
- For places where real damage may be the issue, the member states must by 2013 develop flood hazard maps and flood risk maps for such areas of vulnerability. These maps will identify areas with a likely hood of flooding at least a 1 in 100 year event. And extreme events or low likelihood events, in which expected water depths should be taken into account. In the areas identified as being at risk the number of citizens potentially at risk, the economic activity and the environmental damage potential will be indicated.
- Lastly, by 2015 flood risk management plans must be drawn up for these areas. These plans are to include measures to reduce the probability of flooding and its potential consequences. They will address all phases of the flood risk management cycle (Which MLS tackles in the Netherlands) but focus particularly on prevention (layer one and three) protection (by taking measures to reduce the likelihood of floods and/or the impact of floods in a specific location such as restoring flood plains and wetlands) and awareness of the people (e.g. providing instructions to the public on what to do in the hazard of flooding). Due to the nature of flooding, much flexibility on objectives and measures are left to the Member States in view of subsidiarity. (European commission of environment, 2016)



GREEN – Reporting for all Units of Management with significant flood risk
YELLOW – Reporting for some, but not all, Units of Management with significant flood risk
RED – No reporting

Figure 2 Overview of countries who implemented the EU flood directive, European commission o environment

The second and the first layer of multi-layer safety are covered by a German implemented policy and framework called the LAWA system. The Lawa Guidelines for climate proof flood protection have established committees for flood protection. These are handling floods and their consequences, and are at the moment also active for the Wesermarsch region. This chapter will show the most important aspects of this document to make it easier to compare it with the Multi-layer safety approach. This helps to see the process of thought when it comes to flood protection in Germany.

Floods and their roots

The report differentiated three different flood types or important factors. First of all floods that are caused by natural cause. This is caused by the Water cycle itself and shows up when there is an increased discharge of rain or melting water.

The next flood cause or factor is the discharge increasion by humans. This means that a natural flood is enhanced by human activity. A good example is the interference in natural water storage systems through acts like: sealing the ground with settlements or other paved areas, deforestation and turning the area in to agricultural fields which decreases

the storage capacity of the vegetation, the building of dams that enhance the discharge speed towards the river mouth.

The report also deals with the causes for these interferences. Statistics say that 4/5 of natural floodplains are now cut off by dikes. The Infrastructure and municipal buildings increased from 3% (1900) to 12% (1995). For more detailed information on statistics, it is suggested to read through this report which exists in english, french and german. One factor will also be the increased precipitation figures that suggest that flood management problems will occur, paired with anthropological causes for decreased discharge.

Strategies and Protection norms

This approach is centred around the possibilities of the interference with floodwater for flood mitigation and the opportunity to adapt to decrease the consequences. A bundle of implementations that include both of these ideas of mitigation and adaptation was introduced. These are focused on the natural retention areas and an engineering approach towards flood protection which involves hard measures.

Retention strategies

Flood risk management and natural retention

The goal in this strategy is to hold as much water as possible for the longest time possible in areas that have the natural predestination to do so. The idea is to not drain away all the water that falls on houses or farms because every litre of water that is not drained immediately can help to relax the water management situation when it comes to flood discharge.

Flood risk and retention management in rural areas

The philosophy about the drainage of areas is very simple: the water that falls as rain should seep into the ground where it touched the ground. It should not be discharged only through the sewage system. The approaches to this are different, depending on the environment. In the city, sealed areas should be disconnected from the canalisation and sewage so that rainwater can runoff to a close by green area and seep into the ground. When it comes to open ground and rural areas the situation is a little bit different. Here the idea is to counter act open and unused agricultural areas between the harvest and the new seeding. The drainage systems of agricultural complexes should be decreased, so the time that the water stays on the ground is increased and discharge ways will be absolved. Fertiliser also has a big influence on the structure of the ground. Natural and organic fertiliser improve the structure of the ground when it comes to seepage and storage capacity. It is also important that economic roads for agricultural machines are not functioning as discharge rivers as soon as precipitation appears, since this would shorten the retention time. (Schafer, 1995)

Flood protection in Germany

Retention management in Wetlands and floodplains

Natural water flows with floodplains and meadows have a big advantage towards straightened and artificial flows. The flow is slower and therefore also reduces the flood

peak downstream. Meadows do not only help with discharge and retention capacity but are also very important for re naturalisation because they are the rarest and mostly endangered ecosystems in Germany. Re naturalisation is a big pillar in this philosophy as well. Dikes should be reconsidered and removed to a better spot to allow meadows to flood again, to increase retention areas and improve ecological quality.

Technological adaptation

The second part of the main philosophy is the adaptation the flood consequences. This includes hard measures like dikes, dams and channels. In residential areas the security norm is 100 years. This means that they will be secure for an event which occurs estimated only once a hundred years. So if once a hundred year the water level rises to a certain level, this is the safety minimum. Technological adaptation has its price and is not always feasible. Only if it overcomes the costs by its potentially prevented consequences it is realistic and feasible.

Protection through Walls and dikes

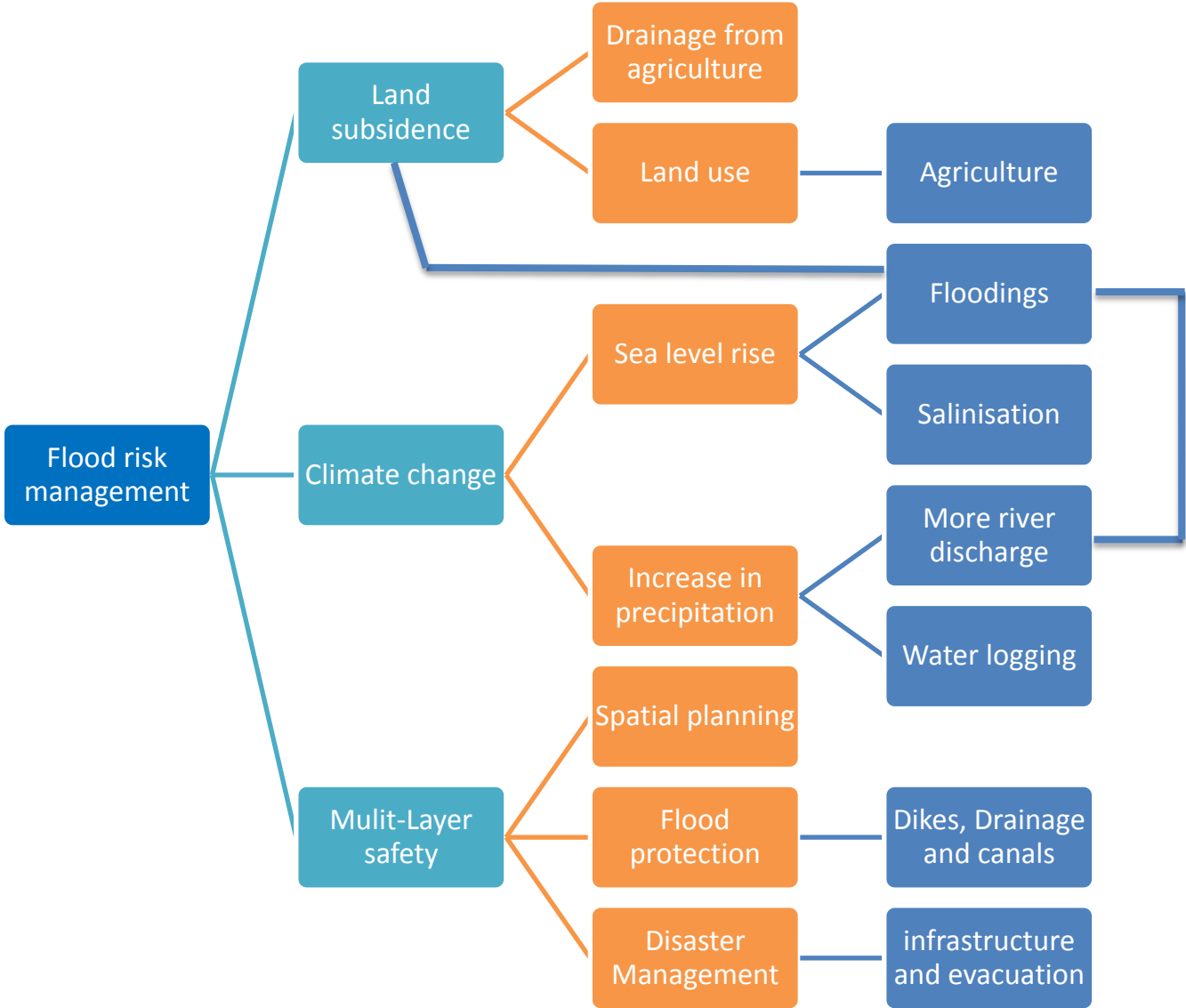
At the lower Rhein there is a trend that can be seen which is to increase hard measures with expensive investments. Due to the feeling of protection and the lack of space these Municipalities moved industry and residential zones behind the dikes. This leads to an overall increased risk since the dikes, when overflowed might break, and flood the whole area at once. These measures also need maintenance which increases the price a lot, since they are not functional or at least weaker when not maintained.

Protection through artificial retention and dams.

Dams create an artificial retention area for water. In this area water can be hold to take pressure of the discharging water ways. The use of these retention areas are almost similar to those created by nature. The water will be stored for a certain amount of time and then released. In this case it is released controlled by humans.

Furthermore the LAWA systems deals with retention of water in upstream regions, this is also mandatory for the Wesermarsch region. (Schafer, 1995)

2.5 Conceptual model



The Wesermarsch is an county which has natural marsh land combined with agricultural and urban landscape. The whole area is surrounded by salt water making salt intrusion and salinization a problem. Furthermore due to climate change in the winter there is too much excess river and rain water from the Weser river. And during the summer there is a shortage of fresh water in the area. Lastly the rising sea level creates another flood prone area. The policies that are already implemented concerning these issues are the German law about flood risk safety and the European flood directive.

3. Methodology

3.1 Introduction

This chapter about the methodology explains how the data concerning the pilot area is gathered, and which kind of data is necessary to answer the research question about multi-layer safety in the Wesermarsch area. Furthermore the person who may be contacted are mentioned and in which way they are contacted. It also shows how we gathered data with two examples of the search for sources. The two examples show the key words used to come by these sources and how they are trustworthy. Furthermore the policy analysis was used to gather data for answering the subquestions.

3.1.1 Research Design

How is the Multi-layer safety approach used in the Wesermarsch?

This research question was chosen because of the big amount of stakeholders in the area plus the beneficial effects on water management that the Multi-layer safety approach offers. The research will aim to find out how much the approach is already implemented in the situation, how the stakeholders experience this and how good this approach fits to this area. The Multi-layer safety theory might solve problems water management caused by the lack of communication between stakeholders, different interests in the area such as ecological, economic and social interests. Later in the chapter about results there will be a part that compares the current german policy on flood risk management with multi-layer safety.

The Research will be consist of research on secondary data, researching articles that are accessible for everyone but also, and more importantly, out of e mail contact with people responsible for other research in the matter. These will be held with the authorities in the area. This includes the Water boards mentioned above, as well as the municipalities of Nordenham and Brake offers possibilities . The stakeholders and actors involved in the Wesermarsch and its water management could be approach too. These consist out of the agricultural board, the industry located in the harbours of Nordenham and Brake and if possible some of the population. This is an important step of the research because it determines the perception of the stakeholders and shows different interests which might have to be integrated in the multi-layer safety approach. Last but not least interviews at the University of Oldenburg are planned to get the opinion of local, independent and rising water managers that are not tied to their authority.

With the data collected in the end of the research, it will be used to make a conclusion and recommendation considering multi-layer safety in the Wesermarsch area. Possible outcomes are for example; which layers are already implemented and how may it be improved in the area. Which other policies are implemented concerning flood risk management in the area. And lastly which technical measures are used in the area or could still be implemented to improve the situation in the Wesermarsch.

3.2 Explanation

The desk research mentioned above will be mainly consist of research in the library and internet research. Science direct will be the main search engine since it is reliable in delivering trustworthy sources. The main goal of the desk research is gathering sufficient data to conclude a problem for the topic at hand and answering the giving research question. Furthermore there will be contact with people involved in the Wesermarsch area from other research institutions. These offer the most oppertunities because of their knowledge about the subject and their research which will offer plenty of usefull data and scientific underlined sources.

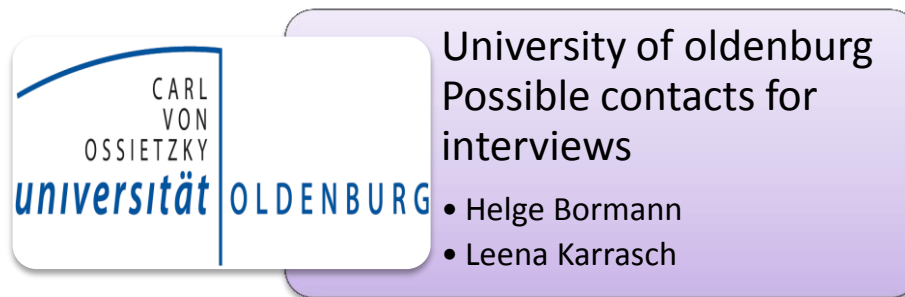


Figure 3 This is the University of Oldenburg and the people who are contacted about the research

With this combined information there will be an overall social and economic evaluation of the Multi-layer safety approach and its state in the Wesermarsch, to give recommendation on factors that could be better and more effective to ensure security and social and economic development.

Example of scientific source search method

The tables below show how the data was gathered with key words and description included. Also which search method was used to gather the data is included.

Reference n.	1	Date of consultation	20-10-2016	Date of publication	6-8-2012
Author(s)	Helge Bormann, F. A.				
Title	<i>Adaptation of water management to regional climate change in coastal region - Hydrological change vs. community preception and strategies</i>				
Editor	-				
Source	Sciences direct search engine				
5 Keywords	Adaptive programme Wesermarsch Flood protection; University of Oldenburg Germany				
Description	Scientific document from the university of Oldenburg about regional climate change.				
Comments	-				
reference	Helge Bormann, F. A. (6 August 2012). <i>Adaptation of water management to regional climate change in coastal region - Hydrological change vs. community preception and strategies</i> . Elsevier.				

Reference n.	2	Date of consultation	10-12-2016	Date of publication	21-10-2016
Author(s)	Unknown				
Title	European commission of environment. (2016, October 21). Retrieved from European Commission: http://ec.europa.eu/environment/water/flood_risk/implem.htm				
Editor	-				
Source	Google				
5 Keywords	Adaptive programme Germany Flood risk management Wesermarsch EU policy				
Description	Information about the EU flood directive retrieved from their official website.				
Comments	This is a trustworthy source even though it is searched with google, because it is the official website from the European Union.				
reference	European commission of environment. (2016, October 21). Retrieved from European Commission: http://ec.europa.eu/environment/water/flood_risk/implem.htm				

3.3 Main concepts

The first concept to gather data is to use sources we found on the internet via trustworthy websites like Sciencedirect.com or researchgate.net. this way of gathering data mainly helped the research by searching for relevant information about the pilot area and the policies and regulations.

The second concept to gather data was to contact two persons from the university of Oldenburg which are mentioned above. This resulted into e-mail contact with mainly H. Bormann, and this gave the research some useful information and in what direction the research needed to go.

4. Results

The chapter about the results of the research shows information about the pilot area and answers the research questions mentioned earlier. Also the sub questions are given attention. The pilot area is also described in two GIS maps which will show the first two layers of the multi-layer safety concept in the Wesermarsch. The third layer is not included in the GIS maps because it mainly consists of policies and regulations.

Secondly the research question on how multi-layer safety is used in the Wesermarsch area is stated in this chapter. It is a quit easy to answer this question, which is; multi-layer safety is not used in the Wesermarsch area. But contact wit H. Bormann mentioned other policies and regulations which have basically the same functions as the multi-layer safety concept. So the results in this chapter will describe other policies which are comparable with multi-layer safety and how they are used in the region of the Wesermarsch.

4.1 Pilot description

The Federal Government adopted the German Strategy for Adaptation to Climate Change in the Wesermarsch region. The implementation of the EU Floods Directive according to federal states working group on water related issues (LAWA) is based on the holistic concept of risk management, including prevention, emergency management and aftercare which will be described in the next chapter.

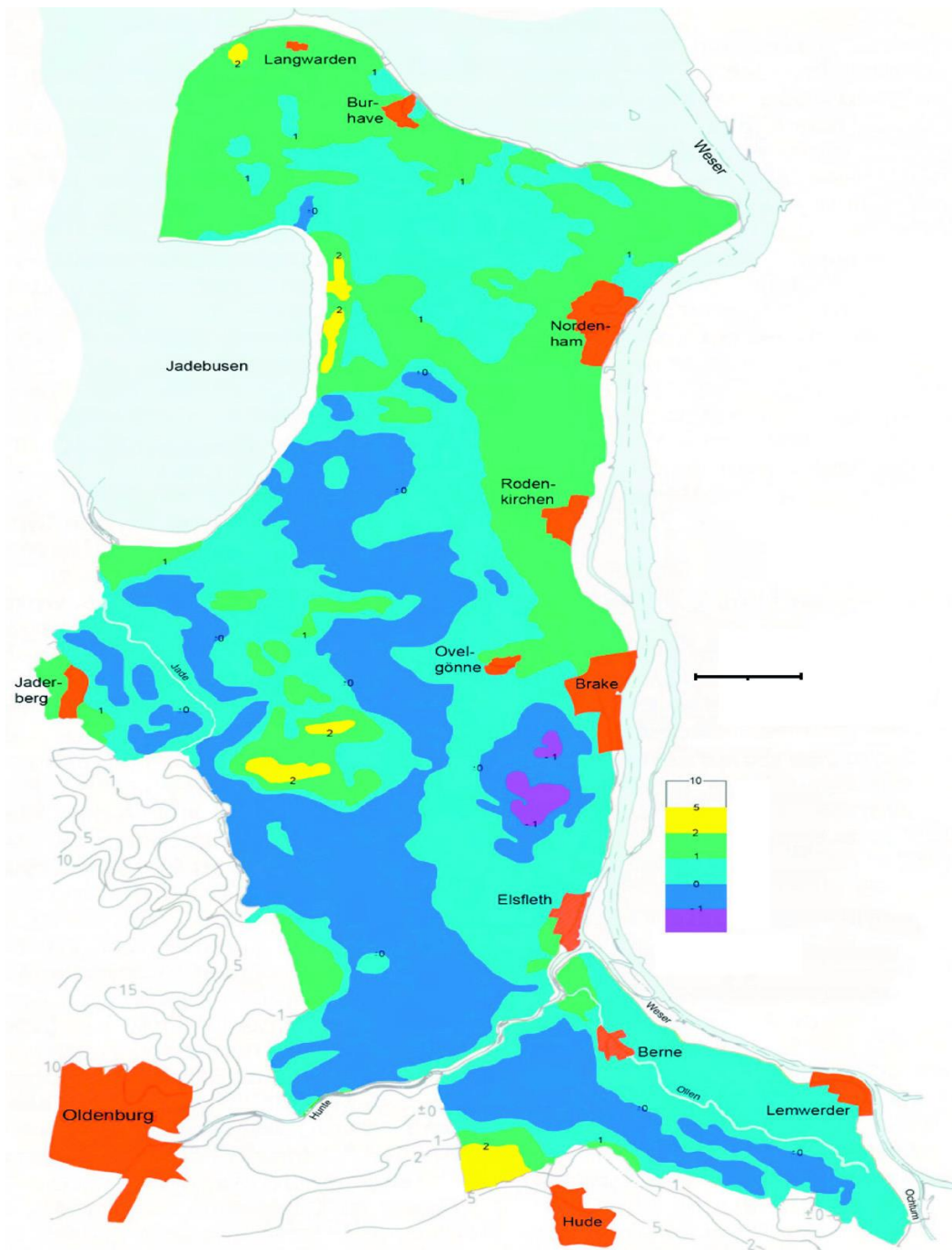


Figure 4 elevation map of the pilot area, Adaptation of water management to regional climate change in a coastal region. The map above shows the elevation of the Wesermarsch, everything that is stated blue is thus vulnerable for flooding's.

The stakeholders of the region were willing to actively participate in such a participatory process since water management plays a central role in further regional development. In order to safeguard the region against storm surges, dikes have been constructed for centuries and continuously heightened to reduce the risk of flooding. In order to minimise the energy amount required for pumping, the region is drained during low tide as far as possible. For this purpose, during high tide, fresh water from the Weser River is conveyed into the canal system of the Wesermarsch, regulated by the water boards. (Adaptation of water management, 2012)

4.2 Relevant data to answer the sub questions

Relevant data for the sub questions is needed to provide clear and trustworthy answers. When this is provided the conclusions and recommendations will be clear. Also this text will explain how multi-layer safety and the German flood risk management can be compared.

4.2.1 Sub question 1 - Which technical measures are used?

The Wesermarsch County has continuously been affected by river engineering activities in the last century in order to enable an economic development along the Weser River. Thus, adaptation to hydrological change has been an important topic in the region. Furthermore, the stakeholders of the region were willing to actively participate in such a participatory process since water management plays a central role in further regional development. The topography of the area is predominantly flat (elevations between -2 and 5 m above sea level), and soils are generally either fine textures (marsh soils) or organic (peat). In order to safeguard the region against storm tides, dikes have been constructed for centuries and continuously heightened to reduce the risk of flooding. (Helge Bormann, 6 August 2012)

4.2.2 Sub question 2 - What policies are implemented?

The policy that is implemented via the European union is the EU flood directive which covers all the member states in the union. This plan basically forces member states to categorise their river basins. In September 2007 a Directive of the European parliament and of the Council on the assessment and management of flood risks was adopted by the European Council. The aim of the Directive is to reduce and manage the risks that floods pose to people, the environment, cultural heritage and the economy.

The Directive required Member States to first carry out a preliminary flood risk assessment (figure out which river basins are vulnerable) by 2011 to identify areas at risk of flooding. For these hazard areas they would then need to make flood risk maps by 2013 and establish flood risk management plans focused on prevention which resembles the second layer of multi-layer safety, protection and preparedness by 2015. The directive is mandatory for the Wesermarsch as well. (international commission for the protection of the Danube river, 2014). The EU flood directive can be compared to a part of the third and second layer of the Multi-layer safety programme in the Netherlands.

The other policy which is implemented is the LAWA system which covers most of the layers of multi-layer safety. The text below shows some examples of the lawa systems advanced flood protection policies.

Limits of flood protection

The measures of seepage, renaturalisation and retention can actually decrease the consequences of a major flood. It However cannot provide total protection through natural measures. The same goes for the technological approach. It can decrease the consequences but cannot erase the risk. Therefore the behaviour of the citizens is very important as well. This means that the final strategy is to use the experience with floods to raise awareness that floods are possible for those living in natural flood plains. For this reason the Hochwasservorsorge or flood prevention care was introduced. This includes the Flächenvorsorge or preventive area care, the Bauvorsorge or preventive building care, the

Verhaltensvorsorge or Preventive behaviour care and the Risikovorsorge or preventive risk care.

Flächenvorsorge

This means that in optimal cases no building permit will be agreed upon if this building will be inside of a floodplain. For this local Municipalities create maps with the consideration of historical floods and flood risks. This also includes the management of building proofed areas inside the floodplains. To move these outside and try to let nature return with meadows and flood plains. Every municipality that demands more storage capacity from upstream communities has to start building retention areas as well.

Bauvorsorge

Bauvorsorge includes the adaptation to floods. This means that flood risk and consequences can be prevented just by planning to build right. Vital functions not on the ground floor for example. This encourages the creativity of the individual or team which plans and realises the building.

Verhaltensvorsorge

This part tackles aims at the time where the flood is announced and the actual arrival. This time period can be between 36 h on big rivers to 6 h on smaller rivers, the Wesermarsch is considered a smaller river. Information and awareness should be carried towards the affected people in different ways to ensure the information reaches the target. The information about steps that should be taken when a flood occurs should be brought to the target group between floods and in times where no actual risk is at hand. This raises awareness and lowers panic and chaos in the actual situation.

Risikovorsorge

Even after investing a lot into natural retention, seepage and drainage as well as technological solutions the individual can still be overwhelmed to produce savings for the case of a flood. For this there is an insurance policy that, combined with individual savings can provide a good cushion for affected citizens to restore lifestyle and housing.

This only works in combination. The awareness that is raised should motivate for specific insurances and savings, to overcome financial impacts of the consequences of floods. (Schafer, 1995)

All the above mentioned policies are also in effect within the Wesermarsch area by law.

4.2.3 Sub question 3 - What measures could still be implemented?

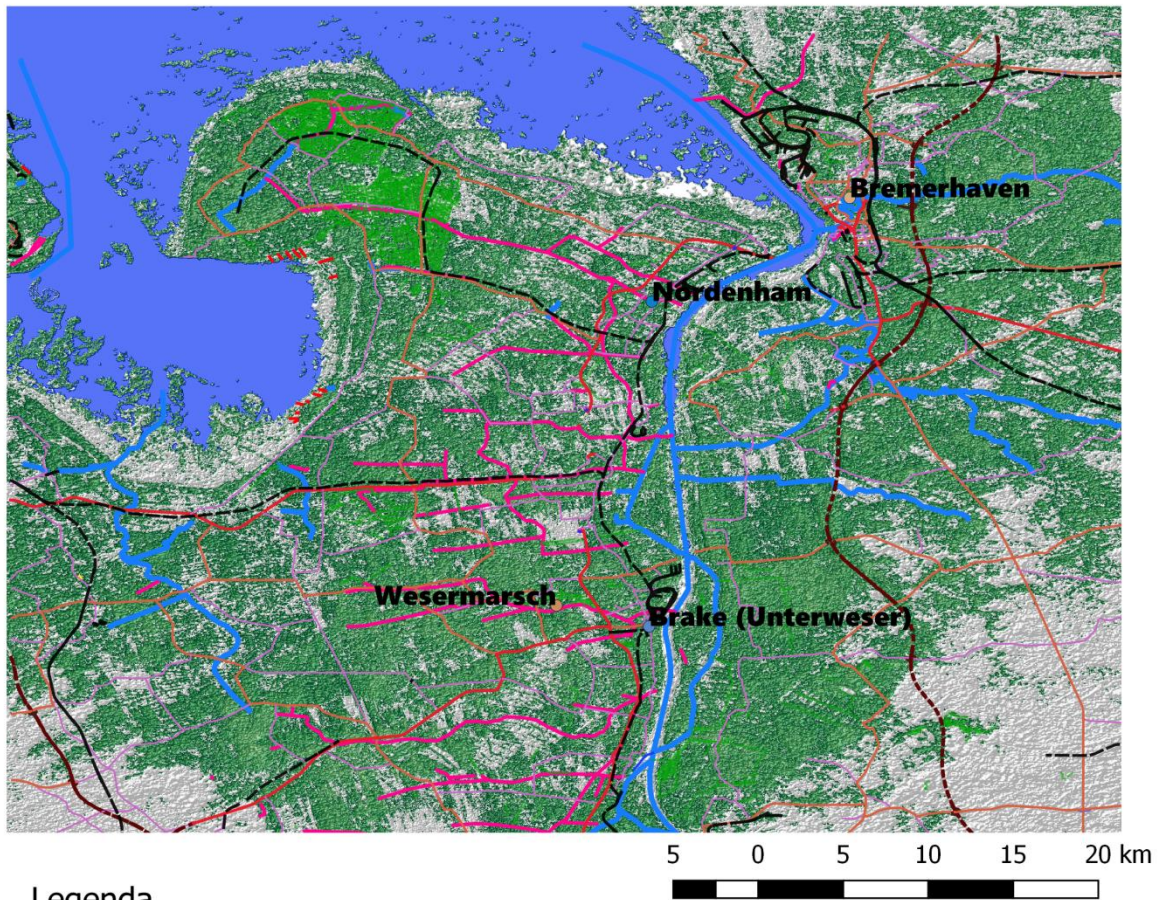
After reading through many documents carefully there are a couple of subjects which could still be improved, for instance just like in the Netherlands the awareness of the population is still a bottleneck when it comes to flood safety in flood prone areas. So a good flood risk management plan can be drawn up, because this is the main thing that is missing in the German flood risk management strategies. Furthermore the LAWA system used as source in this research document is from 1995. The LAWA plan is almost 20 years old and may need small updates in its policies concerning flood risk management. (Schafer, 1995)

4.2.4 MLS comparison

The three layers of multi-layer safety can be translated into the German policies. The basic water management and flood protection in the Wesermarsch area resemble the first

layer. The spatial planning and all the vorsorge in the German embedded law and the LAWA system resemble the second layer of multi-layer safety system. The last layer can also be seen in the LAWA and the EU flood directive which resemble the disaster management.

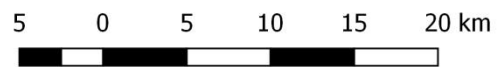
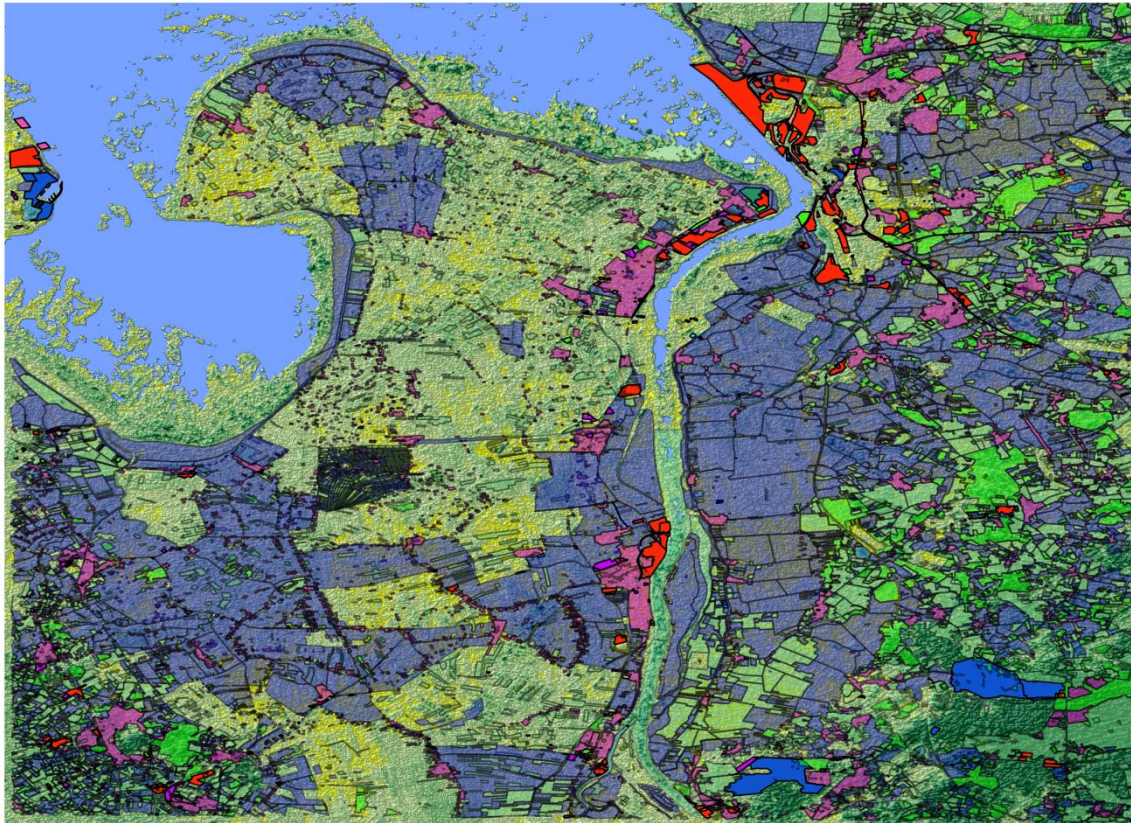
4.3 GIS maps



Legenda

places	waterways	Height
• Brake (Unterweser)	— canal	■ ≤ -2
• Bremerhaven	— dam	■ -2 - -1
• Nordenham	— ditch	■ -1 - 0
• Wesermarsch	— dock	■ 0 - 1
--- railways	— drain	■ 1 - 2
roads	— lock	■ 2 - 3
--- motorway	— navigation	■ 3 - 4
— motorway_link	— pond	■ 4 - 5
— primary	— reservoir	■ 5 - 6
— secondary	— river	■ 6 - 7
— tertiary	— stream	■ 7 - 8
	— weir	■ 8 - 9
	natural	■ 9 - 10
	■ riverbank	
	■ water	

Figure 5 Map of MLS layer one Wesermarsch



Legenda

natural	landuse	Height
forest	aquaculture	≤ 0
park	basin	0 - 6.4 Flood prone area!
riverbank	commercial	6.4 - 9.6
water	construction	9.6 - 12.8
	farmland	12.8 - 16
	greenhouse	16 - 19.2
	industrial	19.2 - 22.4
	meadow	22.4 - 25.6
	military	25.6 - 28.8
	reservoir	> 28.8
	residential	

Figure 6 Map of MLS layer two Wesermarsch

5. Conclusion and discussion

This is the last chapter in this report and it is about the conclusion of the flood risk management in the Wesermarsch. The main research question on how is multi-layer safety used in the Wesermarsch area is answered and its sub questions with it. This chapter deals with the discussion and recommendation for the Wesermarsch area.

5.1 Conclusion

The main conclusion is that multi-layer safety is not used in the Wesermarsch area but there are a lot of policies which act the same as the MLS concept. For example as shown in the previous chapters the LAWA system and the EU flood directive cover a lot of policy and flood risk management in the Wesermarsch area. Furthermore the LAWA has policies which are embedded in German law and has to be implemented in the Wesermarsch. The chapter about results and theoretical framework describes some of these aspects of the German flood risk management which would cover the MLS. To achieve this conclusion we had contact with Leena Karrasch And Helge Bormann from Oldenburg via e-mail. The e-mail conversation is in the appendixes of the report. To conclude, the way MLS principle is used in Germany is completely different than in the Netherlands but it covers most of its aspects.

5.2 Discussion

The Wesermarsch is an Flood prone area with a lot of different characteristics like industry, agriculture, wetlands, river lands and urbanisation. This makes the study about how multi-layer safety is used in the Wesermarsch quit interesting. Looking back on how the research developed, it reflected the issues as the Netherlands has but a different approach was used.

5.3 Recommendations about MLS

Like mentioned in the chapter before the recommendation which stands out is mostly awareness of the people in flood prone areas. The way the policies are implemented in Germany is in a top down way. More co-operation between the people and the policies which are implemented may improve the flood risk management in the Wesermarsch and other flood prone areas in Germany. Furthermore the LAWA system is an old plan and may be updated to current threats from climate change. This may include small adjustments but this could be of some significance for the Wesermarsch.

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7. appendixes

7.1 Individual Research logbooks

Logbook Jules de Smit

Week one 5 - 11 September

Course introduction.

Week two 12 - 18 September

With the help of a website we could choose a country where we would do our project about. I first was in the Belgium group, but because of lack of people in other groups I chose to join the Germany group.

Week three 19 - 25 September

We had to work with the 6 W questions for our project of the Wesermarsch area, together with Frank Warmerdam I did the last 3 questions.

Week four 26 - 2 October

We worked on the research proposal.

Week five 3 - 9 October

We found out together with the teacher that we had a good start and we had to adjust a few small things. We worked this out as the day advanced.

Week six 10 - 16 October

We attended a lecture about tools for our research.

Week seven 17 - 23 October

This week we needed to hand in our research proposal. We finished this and handed it in.

Week eight 24 - 30 October

Autumn break

Week nine 31 - 6 November

No class

Week ten 7 - 13 November

Exam week

Week eleven 14 - 20 November

Paris excursion

Week twelve 21 - 27 November

Me and Cor Lange made a presentation about the theoretical framework.

Week thirteen 28 - 4 December

Me and Frank attended the class and worked during the day on the conceptual model. We also had a meeting with the teacher Jean-Marie Buijs. We received feedback on our proposal and conceptual model.

Week fourteen 5 - 12 december

We learned how to make a GIS map in the lesson we attended.

Week fifteen 13 - 20 december

We finished the draft report.

Week sixteen 21 - 28 december

Christmas Holiday

Week seventeen 29 december - 5 January

Christmas Holiday

Week eighteen 5 - 12 January

Received feedback for the end report and adjusted it in class with Cor Lange. We also made a start for the presentation.

Week nineteen 13 - 20 January

I made my own logbook and finished the report. Christoph Sonneck and Frank Warmerdam present the end result of our project.

Log Cor Lange

Week one 5 - 11 September

Introduction about the course, I didn't really learn anything and found the practise assignment with the egg industry a bit weird.

Week two 12 - 18 September

We made groups in the class, together with my groupmates we choose Germany as our research subject. We thought it would be interesting to learn about water projects which aren't Dutch.

Week three 19 - 25 September

Today we had a lecture about the basics of a research proposal. Our group worked on the 6 W questions as a start for the research proposal for the Wesermarsch area. Me and Christoff Sonneck began with the first three questions.

Week four 26 - 2 October

Today we worked on the research proposal and I mainly focused on my research log.

Week five 3 - 9 October

The group got feedback on our proposal and we had a group meeting with Jean Marie Buijs. It turned out that we needed to adjust a few things but we had a good start. The rest of the day we worked on the logbook and the feedback he gave us.

Week six 10 - 16 October

We got an lecture about the different tools we could use in our research. Since we didn't had a lot of feedback last week. We didn't have much work to do.

Week seven 17 - 23 October

This week we first had a lecture from Dick Fundter and at the end of the week we needed to hand in our research proposal. The lecture from dick was quite interesting and we could use some information from his slides for our research. The end of the week I finished the proposal and turned it in.

Week eight 24 - 30 October

Autumn break

Week nine 31 - 6 November

No class

Week ten 7 - 13 November

Exam week

Week eleven 14 - 20 November

Paris excursion

Week twelve 21 - 27 November

Me and Jules made a presentation about the theoretical framework and I applied on research gate.

Week thirteen 28 - 4 December

Me and Jules again were the only ones showing up and we worked on the conceptual model. Further we had a group meeting with Jean-Marie Buijs and we got some feedback on our proposal and the conceptual model. Lastly on request of Jean-Marie I did some research about the flood risk policy of Germany and included it in our research.

Week fourteen 5 - 12 december

I mainly worked With Frank Warmerdam and Christoph Sonneck to improve our report and draw up the final report. The work consisted out of gathering more relevant data to answer our research questions. Besides that I made the GIS maps for our report, this took up most of my time on the research assignment this week.

Week fifteen 13 - 20 december

This is the last week before Christmas and I with Frank Warmerdam draw up the conclusions and finished the report on time.

Christoph Sonneck

Research assignment Wesermarsch - individual log

Week one 5 - 11 September

Introduction about the coarse, I didn't really learn anything and found the practise assignment with the egg industry a bit weird.

Week two 12 - 18 September

We made groups in the class, together with my groupmates we choose Germany as our research subject. We thought it would be interesting to learn about water projects which aren't Dutch.

Week three 19 - 25 September

Today we had a lecture about the basics of a research proposal. Our group worked on the 6 W questions as a start for the research proposal for the Wesermarsch area. Me and Christoff Sonneck began with the first three questions.

Week four 26 - 2 October

Today we worked on the research proposal and I mainly focused on my research log.

Week five 3 - 9 October

The group got feedback on our proposal and we had a group meeting with Jean Marie Buijs. It turned out that we needed to adjust a few things but we had a good start. The rest of the day we worked on the logbook and the feedback he gave us.

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Week seven 17 - 23 October

This week we first had a lecture from Dick Fundter and at the end of the week we needed to hand in our research proposal. The lecture from dick was quite interesting and we could use some information from his slides for our research. The end of the week I finished the proposal and turned it in.

Week eight 24 - 30 October

Autumn break

Week nine 31 - 6 November

No class

Week ten 7 - 13 November

Exam week

Week eleven 14 - 20 November

Paris excursion

Week twelve 21 - 27 November

Me and Jules made a presentation about the theoretical framework and I applied on research gate.

Week thirteen 28 - 4 December

Me and Jules again were the only ones showing up and we worked on the conceptual model. Further we had a group meeting with Jean-Marie Buijs and we got some feedback on our proposal and the conceptual model. Lastly on request of Jean-Marie I did some research about the flood risk policy of Germany and included it in our research.

Week fourteen 5 - 12 december

I mainly worked With Frank Warmerdam and Christoph Sonneck to improve our report and draw up the final report. The work consisted out of gathering more relevant data to answer our research questions. Besides that I made the GIS maps for our report, this took up most of my time on the research assignment this week.

Week fifteen 13 - 20 december

This is the last week before Christmas and I with Frank Warmerdam draw up the conclusions and finished the report on time.

Frank Warmerdam

Weeks	What did I do?
1, 5-11 September	Introduction lesson to the course with an interesting assignment about the egg industry.
2, 12-18 September	The groups were divided this week, with our group we chose Germany as our research subject.
3, 19-25 September	Lecture about the research proposal. Worked with the group on the 6W questions.
4, 26-2 October	Meeting with the teacher and a lecture about the existing types of research. First time uploading research log, but forgot to do that.
5, 3-9 October	First feedback on the research proposal which showed that some adjustments were needed.
6, 10-16 October	Lecture about research tools, together with the group we finished the adjustments that had to be made to the research proposal.
7, 17-23 October	A lecture from Dick Fundtner, by the end of the week the adjusted research proposal had to be turned in, we worked on this as a group to bring it to a good result.
8, 24-30 October	Autumn Break
9, 31-6 November	No class
10, 7-13 November	Exam Week
11, 14-20 November	Paris excursion
12, 21-27 November	For this week the theoretical framework had to be presented, next to this I applied on research gate.
13, 28-4 December	Did not go to class, received feedback on our research and tried to improve this in our research.
14, 5-11 December	Worked together with Cor Lange and Christoph Sonneck on the report and we made a big step towards the final report. We searched for more relevant data to answer the research question and sub-questions.
15, 12-18 December	We received an indicative outline for the final report and got a lecture about the phases in a research, next to this I worked together with Cor Lange and Christoph Sonneck on the Draft report and finished it perfectly on time.
16, 19-25 December	Handed in the Draft report as a group.
17, 26-1 January	Christmas Break
18, 2-8 January	Christmas Break
19, 9-15 January	Received the guidelines of the presentation that had to be presented by me and Christoph Sonneck, unfortunately I had to be at the hospital when the presentations were held, so I asked Cor Lange to take my place.
20, 16-22 January	Christoph Sonneck and Cor Lange held our final presentation. I uploaded my Peer assessment.

Research assignment Wesermarsch - individual log Christoph Sonneck

Week one 5 - 11 September

Introduction to this class. Week 1 assignment egg industry

Week two 12 - 18 September

Groups were formed for the different Pilot areas. I chose to be in the Wesermarsch group because I could help a lot because most sources are probably in German

Week three 19 - 25 September

Basics for the research proposal. We talked with whole group on the 6 W questions. Later worked with Cor on the first three questions

Week four 26 - 2 October

Group work on the proposal overall. Worked a bit on the area analysis and introduction

Week five 3 - 9 October

We worked together at the feedback to the proposal to adjust it as it was recommended.

Week six 10 - 16 October

Fine tuning on details that were left from last week's feedback.

Week seven 17 - 23 October

The lecture of Dick Fundter which gave good input. Finished the proposal and handed it in. Mainly working on the layout.

Week eight 24 - 30 October

Autumn break

Week nine 31 - 6 November

No class

Week ten 7 - 13 November

Exam week

Week eleven 14 - 20 November

Paris excursion

Week twelve 21 - 27 November

Preparing the email contact with Dr. Borrmann. Talked to Dr. Karrasch before

Week thirteen 28 - 4 December

gathering sources about the Lawa

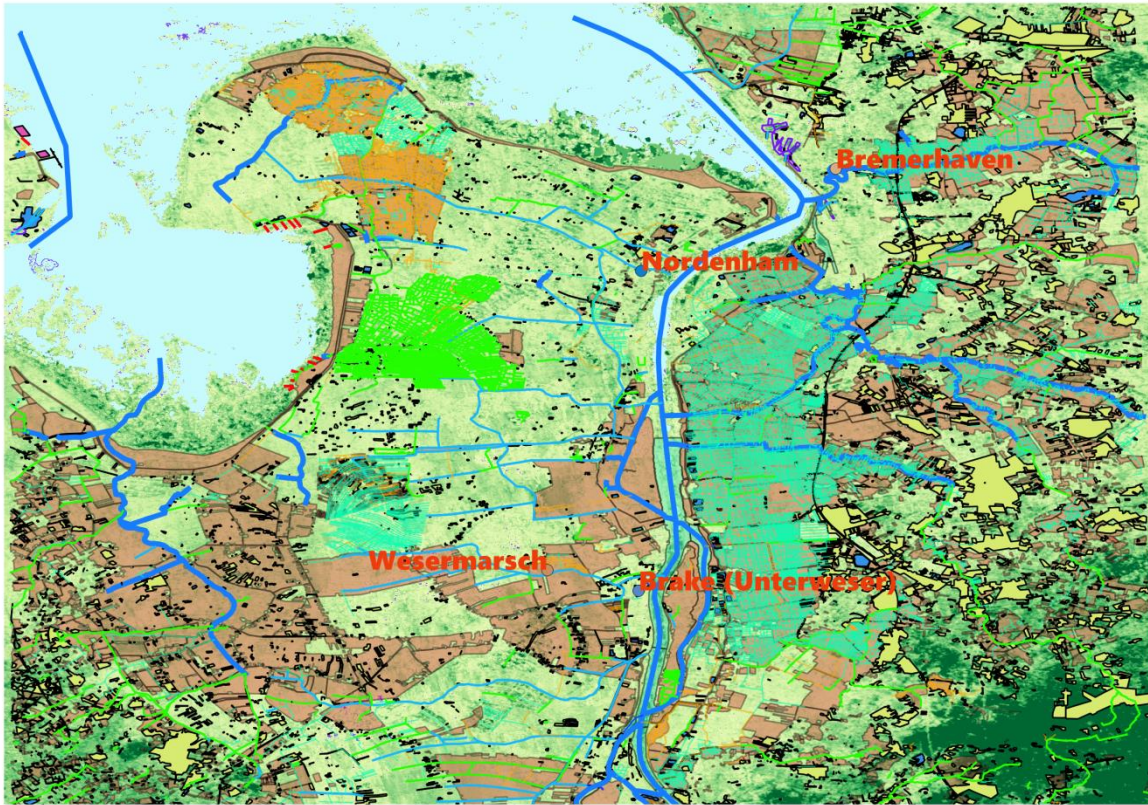
Week fourteen 5 - 12 december

Working with Frank and Cor on little details in the report. Brought the final part about the lawa regulations into the report.

Week fifteen 13 - 20 december

In this week I tried to find newer sources and go into detail to help frank and cor so they could finish the report.

7.2 Draft GIS map



Legenda

buildings

- bridge
- dock

places

- Brake (Unterweser)
- Bremerhaven
- Nordenham
- Wesermarsch
- points
- railways
- roads

waterways

- canal
- dam
- ditch
- dock
- drain
- lock
- navigation
- pond
- reservoir
- river
- stream
- weir

natural

- forest
- riverbank
- water

landuse

- aquaculture
- basin
- meadow
- wastewater_plant

7.3 planning

		12-Sep	19-Sep	26-Sep	3-Oct	10-Oct	17-Oct	24-Oct	31-Oct
Project phases		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
	Choosing area								
	Beginning								
	Research proposal draft								
	Research proposal								
	Conceptual model								
	Draft report								
Group meetings	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
		7-Nov	14-Nov	21-Nov	28-Nov	5-Dec	12-Dec		
Project phases		Week 9	Week 10	Week 11	Week 12	Week 13	Week 14		
	Choosing area								
	Beginning								
	Research proposal draft								
	Research proposal								
	Conceptual model								
	Draft report								
Group meetings	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								

7.4 E mail conversations

Email conversation with Dr. Karrasch

Mo 28.11.2016 13:48 to Dr. Karrasch:

Sehr geehrte Frau Karrasch,

mein Name ist Christoph Sonneck, ich komme ursprünglich aus dem Rheinland und studiere nun Deltamanagement auf der Universität für angewandte Wissenschaften in Vlissingen in den Niederlanden.

In diesem Semester beschäftigen wir uns mit den Pilotprojekten der Climate proof areas und untersuchen diese, um wichtige Aspekte des Wassermanagements zu ergründen. Die Projektgruppe in der ich arbeite besteht aus vier Personen; Cor Lange, Frank Warmerdam, Jules de Smit und mir. Wir haben uns für das Pilotprojekt in der Wesermarsch entschieden und möchten dieses nun mit dem Schwerpunkt auf den Multi-layer-safety approach untersuchen, welcher hier in den Niederlanden schon Anwendung findet.

Da wir wissen, dass die Universität von Oldenburg und sie persönlich, eine wichtige Rolle in der Untersuchung und Ausführung in diesem Project haben, würden uns sehr freuen wenn Sie uns einige Fragen zu diesem Thema beantworten könnten.

Vielen dank und mit den freundlichsten Grüßen,

Christoph Sonneck

Mo 28.11.2016 14:08 From Dr. Karrasch to Christoph Sonneck

ieber Christoph,

vielen Dank für Dein Interesse! Leider habe ich nicht in dem Projekt mitgearbeitet. Versuche es einmal bei Dr. Thomas Klenke (thomas.klenke@uni-oldenburg.de).

Falls Herr Klenke keine Zeit haben sollte, könnt ihr euch mit euren Fragen auch an mich wenden - vielleicht kann ich trotzdem weiterhelfen.

Viele Grüße
Leena Karrasch

Dr. Leena Karrasch
Dr. Klenke:

Mo 28.11.2016 15:00 To Dr. KLenke

Sehr geehrter Herr Dr. Klenke,

mein Name ist Christoph Sonneck, ich komme ursprünglich aus dem Rheinland und studiere nun Deltamanagement auf der Universität für angewandte Wissenschaften in Vlissingen in den Niederlanden.

In diesem Semester beschäftigen wir uns mit den Pilotprojekten der Climate proof areas und untersuchen diese, um wichtige Aspekte des Wassermanagements zu ergründen. Die Projektgruppe in der ich arbeite besteht aus vier Personen; Cor Lange, Frank Warmerdam, Jules de Smit und mir. Wir haben uns für das

Pilotprojekt in der Wesermarsch entschieden und möchten dieses nun mit dem Schwerpunkt auf den Multi-layer-safety approach untersuchen, wie er hier in den Niederlanden Anwendung findet.

Da wir wissen, dass die Universität von Oldenburg und sie persönlich, eine wichtige Rolle in der Vorbereitung und Ausführung in diesem Project haben, würden uns sehr freuen wenn Sie uns einige Fragen zu diesem Thema beantworten könnten.

Vielen dank und mit den freundlichsten Grüßen,

Christoph Sonneck

Mo 28.11.2016 16:22 From Dr. Klenke to Christoph Sonneck

Sehr geehrter Herr Sonneck,

vielen Dank für Ihre Anfrage.

In dem anlaufenden EU-Vorhaben FRAMES werden mit dem MLS-Ansatz die Arbeiten des Vorhabens CPA in der Wesermarsch teilweise wieder aufgegriffen. Koordinator dieser Arbeiten ist Prof. Dr. Helge Bormann, Fachhochschule Oldenburg (cc), der ebenfalls in CPA an den Untersuchungen maßgeblich beteiligt war. Ich schlage deshalb vor, dass Sie sich mit Herrn Bormann absprechen.

Ich wünsche Ihnen und Ihren Teamkollegen eine erfolgreiche wie aufschlussreiche Projektgruppenstudie.

Herzliche Grüße

Thomas Klenke

Dr. Bormann:

Mi 30.11.2016 15:03 To Dr. Bormann

Sehr geehrter Herr Dr. Bormann,

mein Name ist Christoph Sonneck und ich studiere Deltamanagement an der Universität für angewandte Wissenschaften in Vlissingen in den Niederlanden.

In diesem Semester beschäftigen wir uns mit den Pilotprojekten der Climate proof areas und untersuchen diese, um wichtige Aspekte des Wassermanagements zu ergründen. Die Projektgruppe in der ich arbeite besteht aus vier Personen; Cor Lange, Frank Warmerdam, Jules de Smit und mir. Wir haben uns für das Pilotprojekt in der Wesermarsch entschieden und möchten dieses nun mit dem Schwerpunkt auf den Multi-layer-safety approach untersuchen, wie er hier in den Niederlanden Anwendung findet.

Wir haben von unserem Lektor Jean Marie Buis die Mailadresse von Dr. Karrasch erhalten, die uns über Dr. Klenke an sie verwies. Da die Universität von Oldenburg und sie persönlich, eine wichtige Rolle in der Vorbereitung und Ausführung in

diesem Project haben, würden uns sehr freuen wenn Sie uns einige Fragen zu diesem Thema beantworten könnten.

Vielen dank und mit den freundlichsten Grüßen,

Christoph Sonneck

Fr 02.12.2016 12:13 From Dr. Bormann to Christoph Sonneck

Lieber Herr Sonneck,

gerne kann ich Ihnen ein paar Fragen zum Projekt Climate Proof Areas beantworten.

Mit freundlichen Grüßen,
Helge Bormann

Sa 03.12.2016 14:50 to Dr. Bormann

Sehr geehrter Dr. Bormann.

Ich freue mich sehr dass sie bereit sind uns ein paar Fragen zu beantworten. Wie sie wissen werden wir ein Report über diesen Research schreiben. Deshalb wäre es sehr hilfreich wenn Sie uns die wichtigsten Dokumente senden könnten die sich mit dem Multi-layer-safety approach innerhalb der Wesermarsch befassen.

Außerdem interessieren wir uns für ihre persönliche Meinung über diese Herangehensweise mit Hinsicht auf diese Region:

Gibt es besondere Faktoren die sich spezifisch in der Wesermarsch bemerkbar machen in Hinsicht auf die Umsetzung?

Was sind die Stärken und wo liegen die Schwächen dieser Methode?

Erläutern Sie uns bitte wie der Approach in der Wesermarsch greift, und weshalb er implementiert oder nicht implementiert wurde.

Sollten sie ihn einer abgewandelten Form implementiert haben, dann würden wir gerne wissen was verändert wurde und weshalb.

Mit wem im Project beteiligten Personen sollten wir noch sprechen um detaillierten Einblick zu erhalten falls Fragen offen bleiben oder neue Fragen aufkommen?

Vielen dank für ihre Zusammenarbeit!

Mit den freundlichsten Grüßen,
Christoph Sonneck

Mo 05.12.2016 09:43 From Dr. Bormann to Christoph Sonneck

Lieber Herr Sonneck,

ich bin mir nicht sicher, ob Sie die Situation in der Wesermarsch ggfs. missverstanden haben:

1) In der Wesermarsch ist der Multi-layer-safety approach bisher nicht angewendet worden.

Dies ist ein Niederländischer Ansatz. Insofern kann es auch keine Dokumente zur Anwendung

des Ansatzes in der Wesermarsch geben.

2) Da dieser Ansatz in der Wesermarsch bisher nicht angewendet wurde, habe ich zur Umsetzung

auch (noch) keine persönliche Meinung.

3) Das Projekt "Climate Proof Areas" hat sich allgemein mit der Anpassung der Wasserwirtschaft an den Klimawandel befasst. Wesentliche Dokumente sind unter folgender www-Seite zu finden:

<http://www.climateproofareas.com/output/climate-proof-strategies>

<http://www.climateproofareas.com/output/feasability-study>

<http://www.climateproofareas.com/project/wesermarsch-urban>

<http://www.climateproofareas.com/project/rural-hinterland>

4) Das Projekt "FRAMES" wird sich mit Aspekten des hochwasserrisikomanagements in der Wesermarsch beschäftigen, die dem Multi-layer-safety Ansatz entsprechen. Dieses Projekt ist

aber erst kürzlich bewilligt worden, und die konkreten Arbeiten im Pilotgebiet haben noch nicht

begonnen. Insofern liegen auch noch keine Erfahrungen zur Anwendung vor.

Mit freundlichen Grüßen,
Helge Bormann.

Mo 05.12.2016 12:36 to Dr. Bormann

Sehr geehrter Herr Dr. Bormann,

vielen dank für ihre Aufklärung.

Es gibt also keine ähnliche Praxis der deutschen Behörden, da das Hochwasserrisikomanagement noch nicht im Zentrum des Projektes stand? Mit freuden werde ich die Quellen auf <http://www.Climateproofareas.com> durchlesen.

Vielen dank für ihre offenen Antworten,

mit den freundlichsten Grüßen,
Christoph Sonneck

Mo 05.12.2016 13:35 From Dr. Bormann to Christoph Sonneck

Lieber Herr Sonneck,

wie Sie sicher wissen, gibt es in Deutschland, die LAWA, die Bund-Länder-Arbeitsgemeinschaft Wasser, die u.a. Empfehlungen für die Praxis im Bereich Hochwasserschutz und Hochwasserrisikomanagement gibt.

Dokumente der LAWA zu diesem Thema finden Sie unter <http://www.lawa.de/Publikationen-Veroeffentlichungen-nach-Sachgebieten-Hochwasser-und-Niedrigwasser.html>

Mit freundlichen Grüßen,
Helge Bormann.

Mo 05.12.2016 15:34 to Dr, Bormann

Sehr geehrter Dr. Bormann,

Vielen dank für die freundliche Korrespondenz. Wir werden die Quellen bearbeiten und in unseren Report aufnehmen.

Mit freundlichen Grüßen,

Christoph Sonneck

7.5 research proposal

Hz university of applied sciences

Multi-layer safety in the Wesermarsch

Delta management

Christoph Sonneck, Frank Warmerdam, Jules de Smit and Cor Lange
30-9-2016

Table of content

1. Introduction	45
1.1 Problem analysis	45
The Wesermarsch	45
what is the problem?	45
Governance	47
Threats	47
2. theoretical framework.....	49
Multi-layer safety	49
Resilience	50
Conclusion.....	51
Conceptual model	51
3. Methodology.....	53
3.1 Introduction	53
Research Methodology	53
Final Note.....	54
References.....	55

1. Introduction

This research proposal is about the Wesermarsch area in Germany. In this area there are certain water related problems. This proposal will help search for possible solutions to these problems. The problems will be described in the chapter about the problem analysis. The theoretical framework describes the actual situation in the Wesermarsch and the possible solutions for the problems.

The main goal of this proposal is to answer the main research question, which is; How is the multi-layer safety strategy used in the flood prone area of the Wesermarsch? The problem must first be identified before the research question can be formulated.

1.1 Problem analysis

The Wesermarsch

Climate change, the rise of the overall surface temperature due to the accumulation of CO₂ in the atmosphere, changes many natural systems on this planet. It triggers a lot of smaller local problems which need to be dealt with to protect society, natural systems and economy.

Land use

The Wesermarsch county is used to 90% for agriculture, which mostly is dairy cattle. Besides the Weser ports Brake and Nordenham the county is rural. (Helge Bormann, 6 August 2012) The hydrological pressure in the area comes from many different directions. In winter time, water needs to be drained from the area in order to avoid flooding. In summer time the region does not have enough water to maintain the marsch and water areas. There are many stakeholders involved to regulate the water of the Wesermarsch. Six water boards are responsible: Braker Sielacht, Entwässerungsverband Stedingen, Entwässerungsverband Jade, Entwässerungsverband Butjadingen, Stadlander Sielacht and Mooriem Ohmsteder Sielacht. (Helge Bormann, 6 August 2012)

what is the problem?

The low lying areas of the Wesermarsch in the north west of Germany suffers from a few water related problems. These problems include storm surges that cause floods from the sea, the consequential salinization of the groundwater due to the peninsula like situation, as well as floods coming from the rivers. As a consequence of climate change increased precipitation and sea level rise problem is threatening the area of the Wesermarsch. Besides this some parts of the area lie below sea level. This area is under pressure from both ecological and human perspectives. (Ossietzky, 2016)

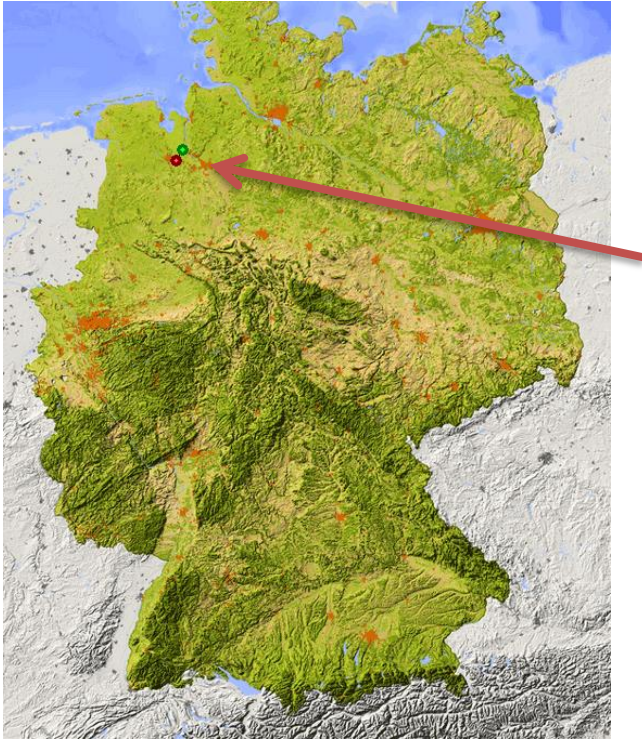


Figure 7 map of Germany, arrow indicates the Wesermarsch area

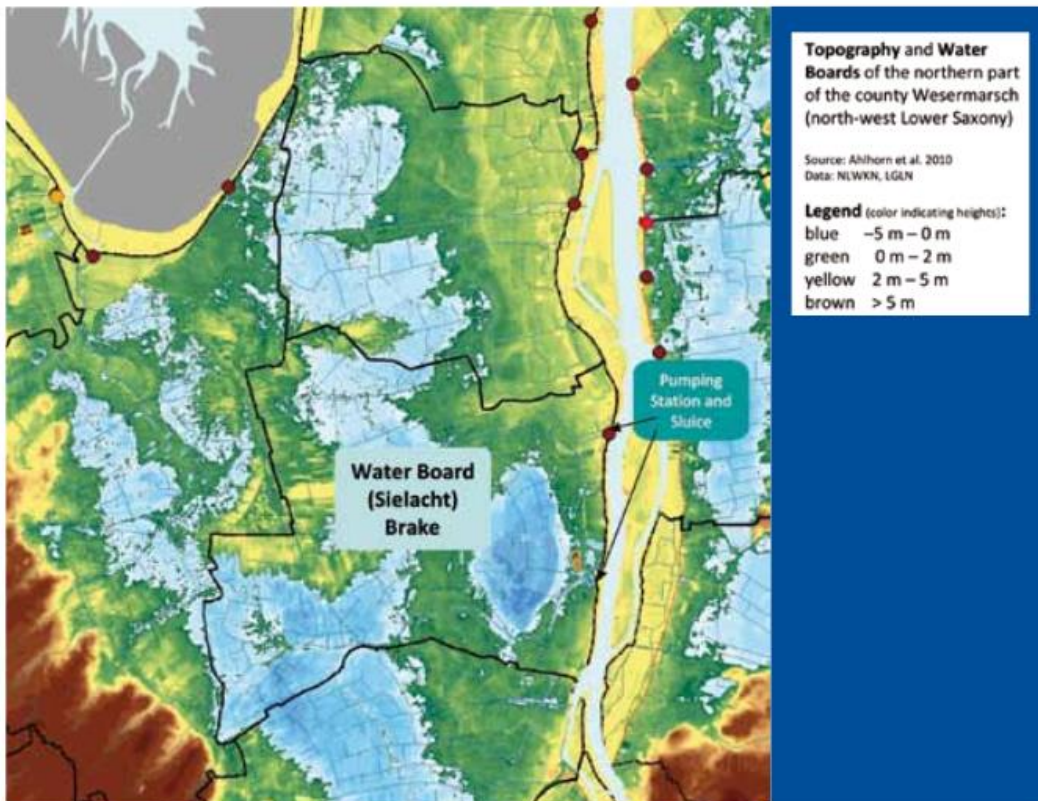


Figure 8 Map of the Wesermarsch

Governance

Since the Wesermarsch is a big area that combines many different interests like, agriculture, industry, fishery, there are many different actors and stakeholders involved. The municipalities of Brake and Nordenham are located within and close to the Wesermarsch. Both are home for industrial harbours. Furthermore the saltwater intrusion endangers the fresh water supply for the close lying cities. So this includes the drinking water supply and sewage disposal companies as stakeholders. Additional to that nature protecting organizations consisting out of NGO's and GO's. The big grass land patches in the Wesermarsch are important for local farmers to maintain their cattle. This also influences the chamber of agriculture.

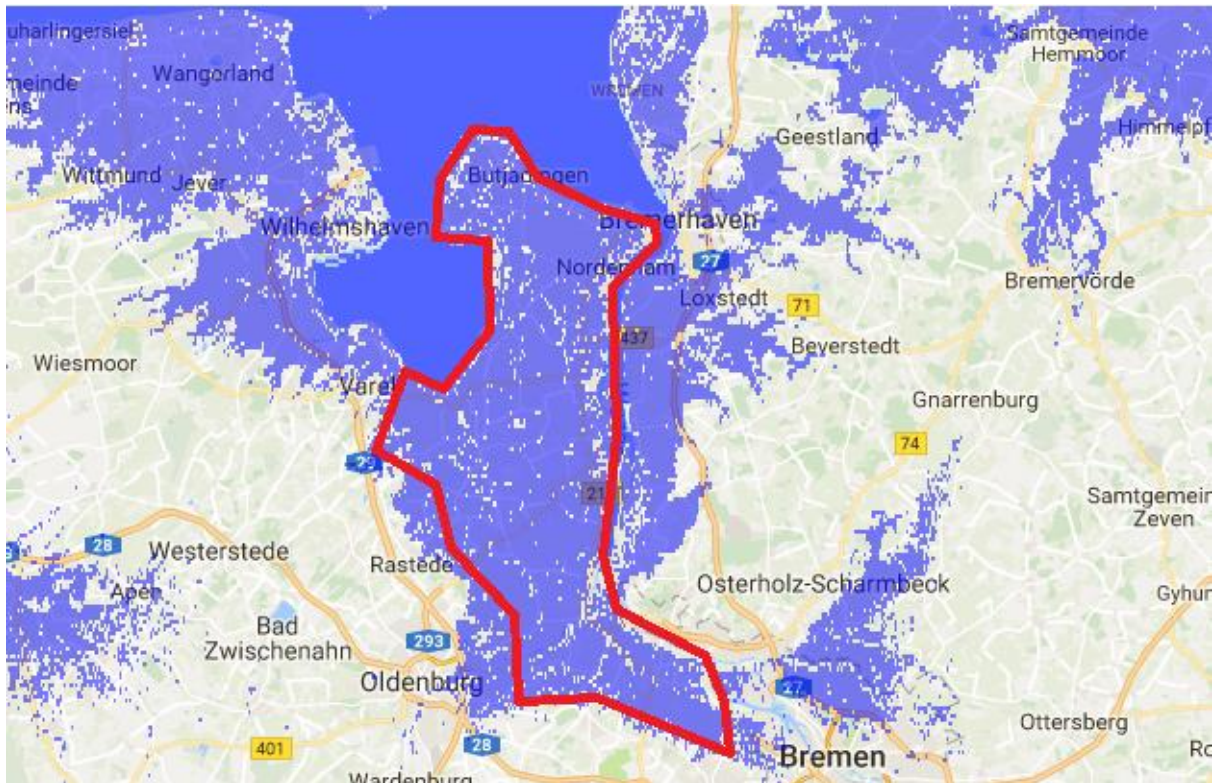
Finally the waterboards are big stakeholders in the area with a large influence because they manage the water system in the Wesermarsch. (Bormann, alhorn, Giani, Klaassen, & Klenke)

Threats

The ecological problems that are threatening the area developed over a longer time period. Due to climate change over the years the water surplus in the winter and the scarcity in the summer has become a problem and will develop into a real thread until the year 2050. Climate change causes the slow process of sea level rise, as well as it enhances the occurrence of storm surges and extreme rain events. The problem therefore started as soon as the industrial revolution when the burning of fossil fuels caused the greenhouse effect. (Bormann, alhorn, Giani, Klaassen, & Klenke)

In the Wesermarsch area live a lot of people that are affected by the consequences that the problem brings with it. One of these consequences is the fact that there are drainage problems when there is a lot of precipitation. IN the area there is a lot of agriculture, the agriculture is badly affected by the salinization of the groundwater which results in a lack of irrigation water.

On the picture below it can be seen that the Wesermarsch area is a low lying area, at some spots the land is 2,5 meters below sea level. Because of this, the area is vulnerable to flooding's. If this happens, all the agricultural land will be flooded and this would cause an salinization problem



German national flood safety policy

Germany suffered a lot from floods lately with damage running in the billions. The highly organised and advanced way of living in western Europe makes it also prone to floods. In Germany there are two main elements, which consists of flood risk reduction and coping with floods.

Spatial measures:

- keeping constructional development out of floodplains as far as possible
- Constructional measures: ensuring appropriately adapted construction methods in areas prone to flooding
- Risk reduction measures: own financial provisions (backed by insurance)
- Behavioural measures: explaining, preparing for and practicing how to cope with flood-related danger situations
- Informational measures: alarming, warning and informing about impending events
- Increasing natural water retention in catchment areas
- Technical flood protection: constructional facilities for water retention (such as dams, storage reservoirs, polders)

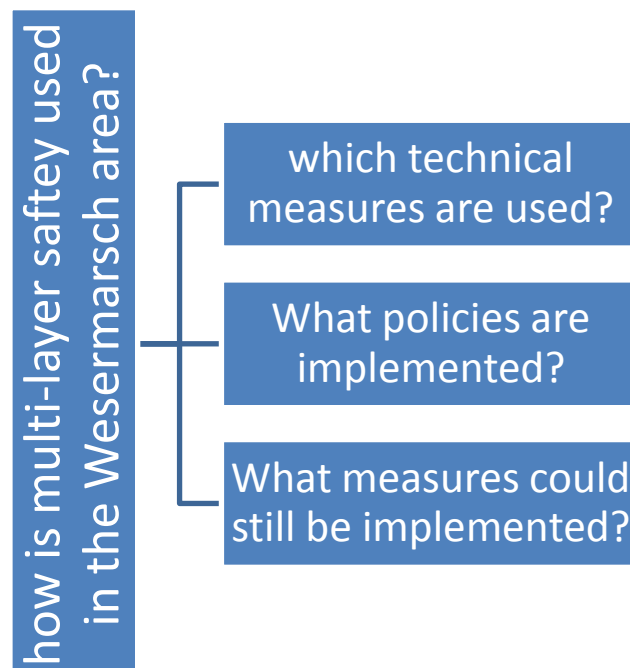
Coping with flood disasters above all means:

- Averting disastrous impacts of flooding
- Help for victims
- Construction aid
- Reconstruction

Germany has a federal system which means that governmental tasks are divided between federal government and state government (Länder). Germany's environmental policy is mainly responsible for the water management issues like floods. Each Bundes state is bound by the environmental and water acts and carry out different tasks. (Prof. Dr. rer.nat.habil. Uwe Grünewald, 2004)

1.2 Research question

All the above mentioned ecological, economic and social problems can't be ignored. Since countries like the Netherlands already demonstrated, how the Multi-layer safety can positively influence actual as well as perceived safety for the citizens nearby, the question if this could present a solution for the problems of the Wesermarsch arises. The three layer approach help to manage complex water problems that are interlinked with society. Properly implemented this approach will improve the overall situation regarding water ecology, economy and water safety. Therefore a few questions related to this problem need to be answered to get to the core. The main research question will be: How is the multi-layer safety strategy used in the Wesermarsch? The sub questions are important for in depth understanding: What technical measures are used? ; What policies are implemented in Germany? ; What effect do these technical measures have? ; Which measures could still be implemented? And ; In what way do these policies help to solve the water problems?



2. theoretical framework

Multi-layer safety

The multi-layer safety approach evolved at the start of this millennium in the Netherlands and Flanders. It is an integrated approach for flood risk management which takes the risk into account. This means that not only the probability but also the consequences of an

possible flood event are taken to account. Originally introduced in the Netherlands in 2009, the risk based approach to flood management was already encouraged by the EU in 2007. (Maria Kaufmann, 30. November 2015) Still the approach is not yet fully integrated in the most countries. The multi-layer safety approach is consisting of out of three layers.

Firstly the hard measures which include dikes, dams, sluices and other measures that prevents the water from intruding. The second layer consist of measures involved in spatial planning such as: elevated infrastructure as main streets, hospitals, power plants and more. This guarantees a certain amount of services that still will be functioning even though the hard measures failed. The third and final layer is about disaster management. This layer approaches the evacuation or the help with important goods. Combined these (urban green blue grid, 2008)

Resilience

“Infrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event.”
(NIAC, 2009)

Resilience is, as the NIAC states, important for effective infrastructure or enterprises. It is also very important for a water system and its management. Water systems are very complex systems that have to deal with a lot of different pressures at the same time. Some of them are directly man made like pollution through industry, some are indirectly influenced by humans like climate change and others are due to natural circumstances.

Effective in this case means effective in keeping the eco system while being able to store enough water to guarantee security for companies and citizens working and living in the area.

The effectiveness however is determine by the ability to adapt, absorb, or recover from an ecological pressure. This is related to climate change in this case since it brings most of the changing pressures.

Climate change

Climate change is happening all over the world including in the north of Germany. The Wesermarsch has to deal with climate change problems like salinization due to sea level rise and storm surges from the north sea. Furthermore in the summer there will be more water shortage and in the winter there will be a surplus of rainwater that discharges into the river system. The current situation in the wesermarsch is based on the first layer of Multi-layer safety which is a dike and canal system. Because of climate change the old system can't cope with the changes.

Water management

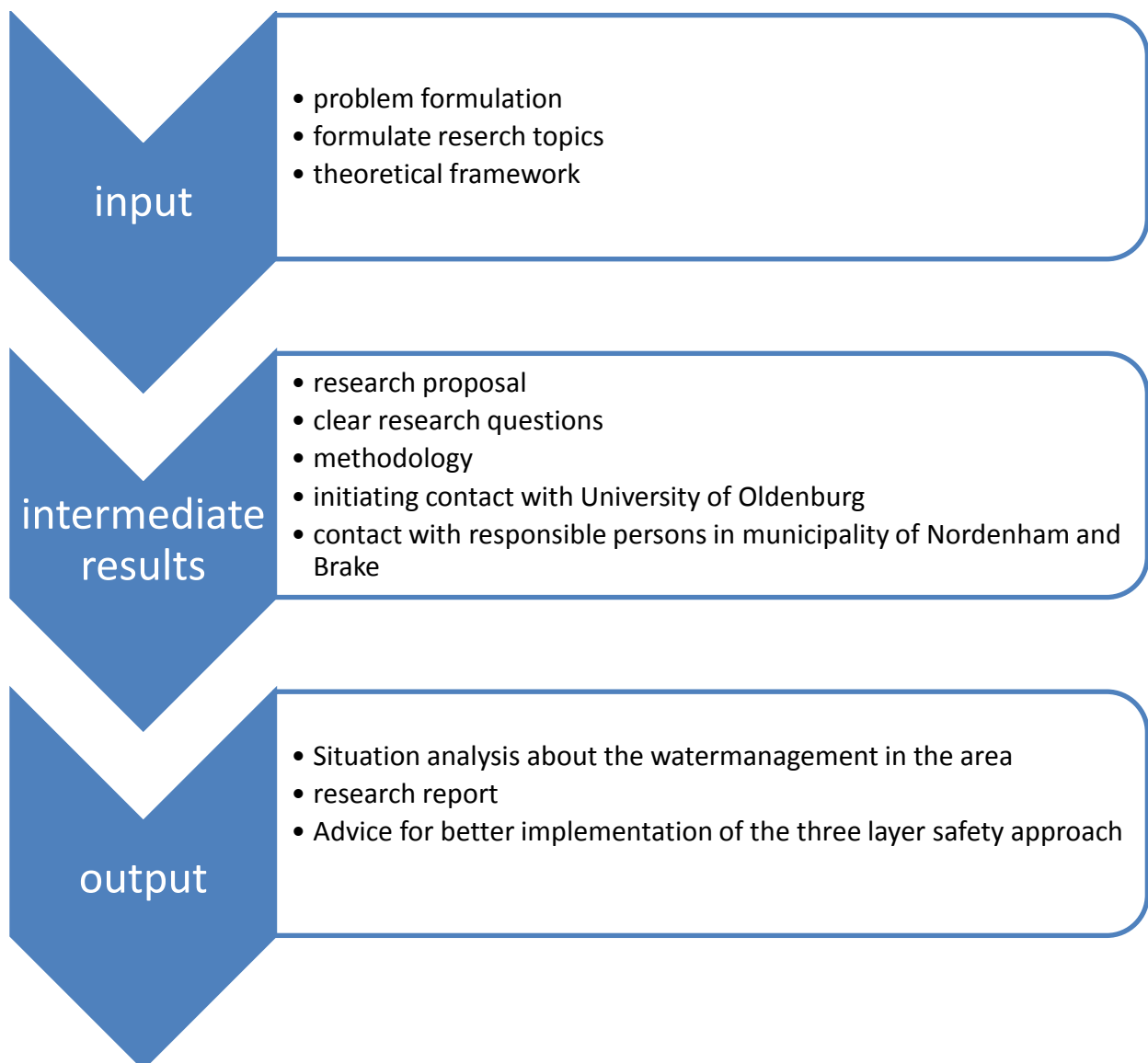
Water management addresses an integrated and interdisciplinary approach involving, chemistry, biology, economy and social aspects. Water management is important since water is everywhere in our culture and a represents a very complicated and fragile eco system. It is used for transport, irrigation, cooling water, drinking water and so on. Therefore it is closely related do governmental processes. Delta management focuses on

the governance and is therefore responsible for policies like the Multi-layer safety strategy.

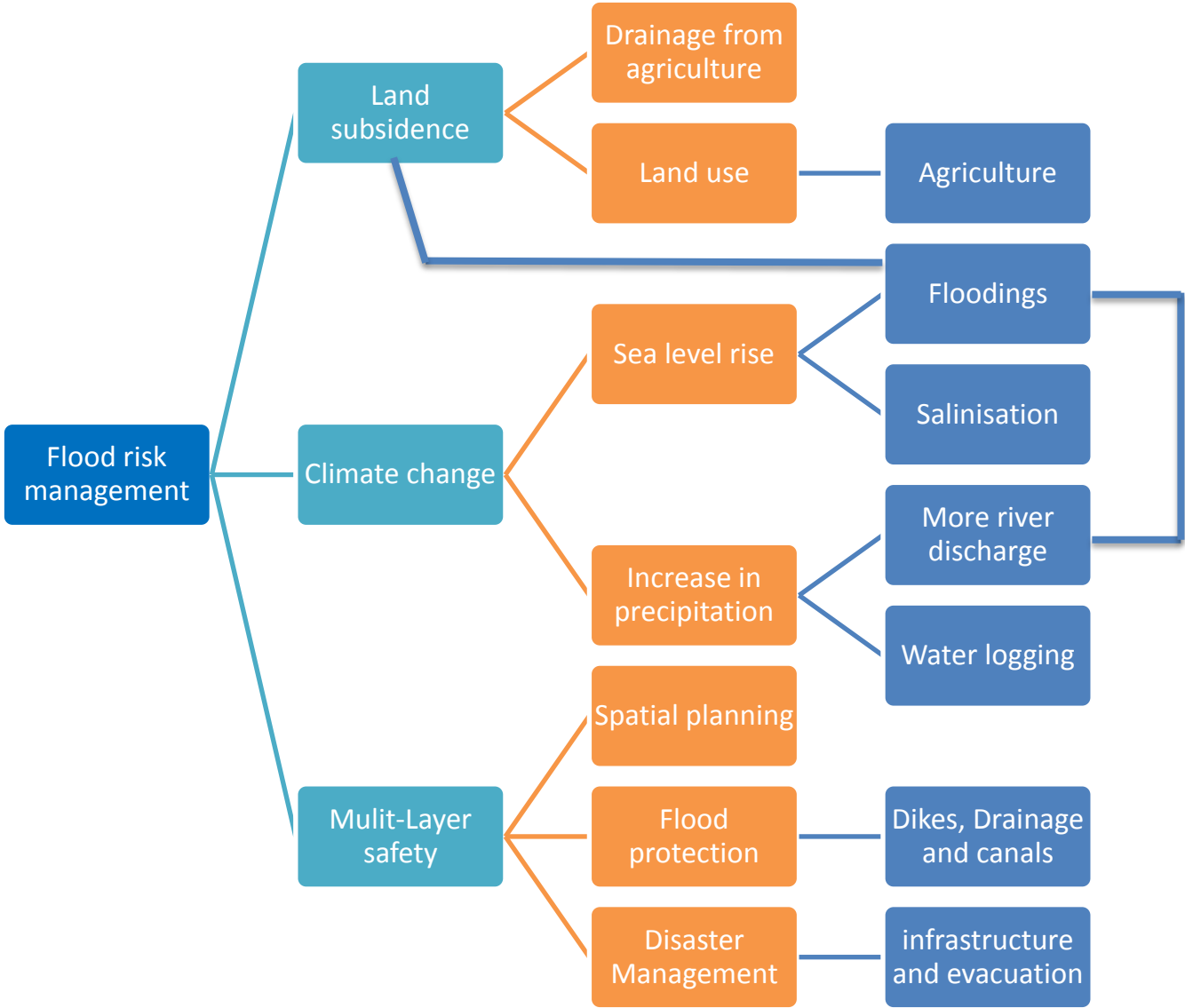
Conclusion

The Wesermarsch is an county which has natural marsh land combined with agricultural and urban landscape. The whole area is surrounded by salt water making salt intrusion and salinization a problem. Furthermore due to climate change in the winter there is too much excess river and rain water from the Weser river. And during the summer there is a shortage of fresh water in the area. Lastly the rising sea level creates another flood prone area.

Conceptual model



Conceptual problem analyses



3. Methodology

3.1 Introduction

Research Methodology

How is the Multi-layer safety approach used in the Wesermarsch?

This research question was chosen because of the big amount of stakeholders in the area plus the beneficial effects on water management that the Multi-layer safety approach offers. The research will aim to find out how much the approach is already implemented in the situation, how the stakeholders experience this and how good this approach fits to this area. The Multi-layer safety theory might solve problems water management caused by the lack of communication between stakeholders, different interests in the area such as ecological, economic and social interests.

The Research will be consisting on research on secondary data, researching articles that are public for everyone but also, and more importantly, out of interviews with people responsible. These will be held with the authorities in the area. This includes the Water boards mentioned above, as well as the municipalities of Nordenham and Brake. The stakeholders and actors involved in the Wesermarsch and its water management will be approach too. These consist out of the agricultural board, the industry located in the harbours of Nordenham and Brake and if possible some of the population. This is an important step of the research because it determines the perception of the stakeholders and shows different interests which might have to be integrated in the multi-layer safety approach. Last but not least interviews at the University of Oldenburg are planned to get the opinion of local, independent and rising water managers that are not tied to their authority.

Desk research

The desk research mentioned above will be mainly consist of research in the library and internet research. Science direct will be the main search engine since it is reliable in delivering trustworthy sources. The main goal of the desk research is gathering sufficient data to conclude a problem for the topic at hand and answering the giving research question.

With this combined information there will be an overall social and economic evaluation of the Multi-layer safety approach and its state in the Wesermarsch, to give recommendation on factors that could be better and more effective to ensure security and social and economic development.

Final Note

The Wesermarsch area is a low-lying area which faces different problems when it comes to water aspects. Some parts of the area are 2,5m below sea-level. Storm surges occur and cause a flood once in a while. Also, floods come from the Wezer river. And salinization is another problem happening in the peninsula like area. Agriculture, fishery and industry are all affected by these problems. The municipalities of Brake and Nordenham are both part of the Wesermarsch. The local waterboards are also big stakeholders in the area.

The Wesermarsch county is used to 90% for agriculture, which mostly is dairy cattle. The hydrological pressure in the area comes from many different directions. In winter time, water needs to be drained from the area in order to avoid flooding. In summer time the region does not have enough water to maintain the marsch and water areas.

After all the information we have now from the area, one main question was chosen about this area. How is the Multi-layer safety approach used in the Wesermarsch? The answer could solve problems in the communication between the many stakeholders that are present in the area. The research will consist of studying articles, information and surveys.

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