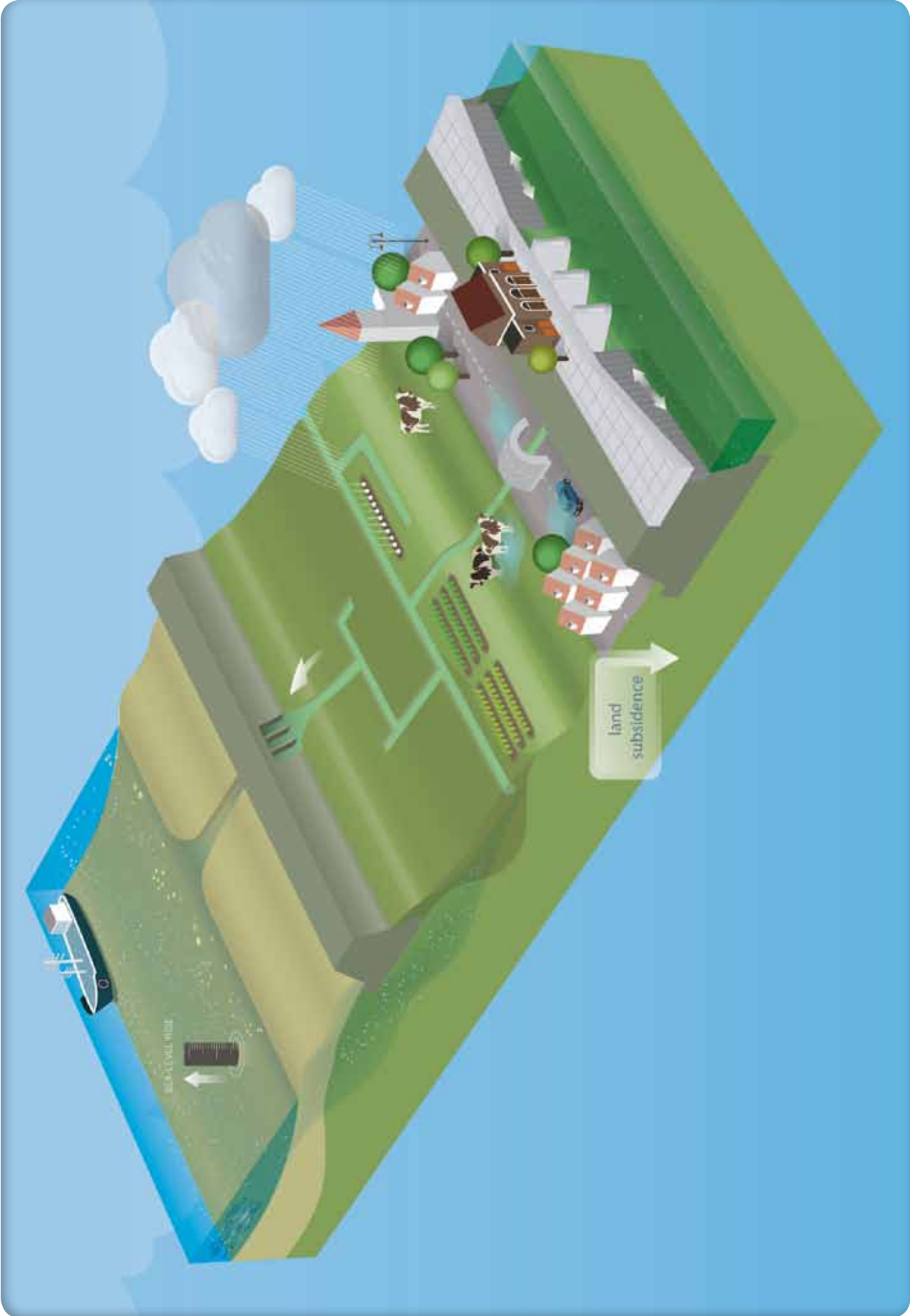




## Wesermarsch, urban areas (DE)

The county of Wesermarsch is affected by storm surges and river floods as well as by groundwater salinisation due to its peninsula-like situation. The county is surrounded by the Jade Bay, the North Sea and the Weser River. As part of the EU Interreg IVB project “Climate Proof Areas”, a detailed regional climate change impact analysis was performed with respect to the regional hydrological regime, soil functions and the regional water management system. In a comprehensive participation process, relevant regional stakeholders developed a joint landscape vision for the year 2050. These stakeholders jointly developed and agreed on common principles for water management (on drainage and watering), which were used as the basis for the development of future water management adaptation options. As main results of the process, the stakeholder group contributed to a possible adaptation strategy for water management in urban areas containing water management adaptation measures in terms of drainage and storage. Main pillars of the concept are the identification of urban areas where water can be stored in case of inland flooding (e.g., low lying green areas, parking areas: urban areas act as a sponge) while surrounding rural areas shall be used for water retention in case of suitable topographic characteristics and low potential for damage. Finally, all stakeholders contributed to and agreed on a joint vision for water management in the county in the year 2050 and declared their interest to continue contributing to a county wide, cross-sectoral adaptation process.



# Wesermarsch Water Cycle

Historically, the regional water cycle of the Wesermarsch is dominated by the diurnal, tidal inundation of the North Sea. Constructing dikes was the reaction of the population in order to get the Wesermarsch protected for a permanent colonisation. As a consequence, drainage of the landscape was necessary due to the positive water balance of the region (precipitation is larger than evapotranspiration).

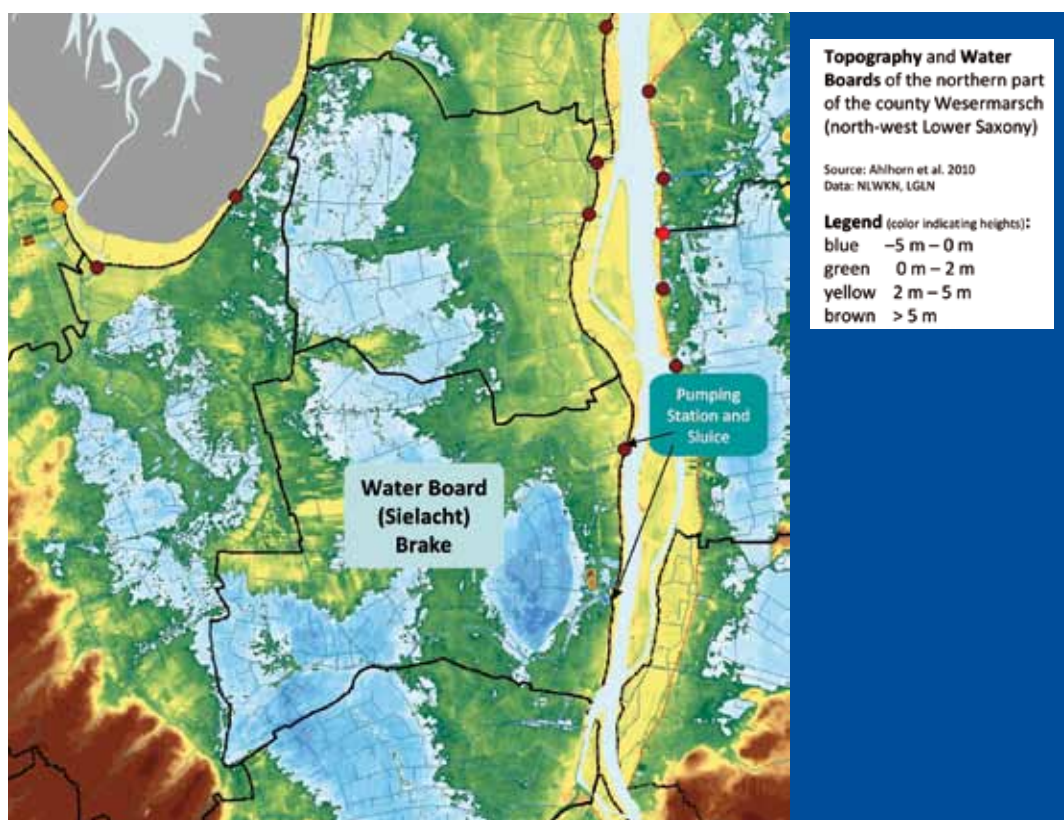
Therefore, in the Wesermarsch a water management system has been developed over the last centuries, consisting of a network of canals and ditches, sluices and pumping stations. This drainage system guarantees drainage in wet periods as well as the watering in dry summer periods using water from the Weser River when the water level in the ditches and canals is too low.

# Wesermarsch

The county of Wesermarsch is located in North Northwest Germany and has approximately 91,000 inhabitants. Large parts of the area (822 km<sup>2</sup> in total) are below mean sea level (up to -2.5 m below sea level) and therefore are potentially at risk with respect to flooding. A dense network of canals and ditches was established to be able to permanently colonise the Wesermarsch region. Low lying areas can be artificially drained by pumping stations, only. However, except a few cities (e.g., Brake, Nordenham), the county is sparsely populated.

The physical region is characterised by coastal marshland between Jade Bay in the West, North Sea in the North and Weser River in the east. The Wesermarsch is therefore encircled by salt water. The predominant marsh and bog soils are mainly used for agriculture. Grassland is dominating the area, feeding dairy cattle. From an economic point of view, the harbours of Brake and Nordenham are of regional importance for trade and industrial development.

In order to study the impact of climate change on the Wesermarsch and to develop adaptation options for urban areas, the water board of the city of Brake (Unterweser) was selected (see figure).





# Problem definition

Due to current climate conditions and climate variability, the urban parts in the Wesermarsch county already face water management problems in terms of a water surplus in winter time and as a consequence of heavy rainfall events, requiring an intense drainage and additional storage if the drainage systems are overburdened.

Currently, the only water management option of the water board of the city of Brake is to pump out exceeding water in winter time and caused by heavy rainfall events into the Weser River up to the maximum capacity of the pumping station.



Already today the available drainage system runs into problems due to extreme weather conditions caused by its limited drainage capacity. Additionally, in the last 40 years the amount of impervious areas in the city of Brake has increased by a factor of 5 inducing an additional volume of water to be drained. It can be expected that the above mentioned problems will be worsened due to future climate change. Sea level rise, an expected increase in winter precipitation and an increase in frequency and intensity of flood generating precipitation events all over the year will increase the amount of water to be drained.



Hence, it can be expected that the climate vulnerability of the region will increase in future in the case of taking no adaptation measures. In the city of Brake a particular situation occurs: on the one hand, the canal draining the rural hinterland passes through the city of Brake. Thus, in case of a flood event, the city area is endangered also by water from rural areas. On the other hand, the sluice as well as the Brake pumping station is integrated into an industrial area in a way that an extension is not feasible. This situation raises conflicts between the urban and rural areas concerning water management including taxes, prioritisation of drainage, and risk to flooding.

# Process and stakeholder engagement

The integration of regional stakeholders into the development and the implementation of adaptation measures are essential for raising awareness, informing the public, considering local knowledge (on problems and possible solutions) and for improving the acceptance of possible adaptation measures. Therefore, a participatory and integrative approach was chosen for the Wesermarsch pilots in order to take care of the local people's interest and the multifunctional use of the area. The following stakeholder groups were involved in the process: water boards, dike boards, the county administration, municipalities, a drinking water supply and sewage disposal company, nature protection organizations (GOs, NGOs), the chamber of agriculture and the peasantry. Stakeholders were involved in all phases of this process of developing adaptation options (problem analysis, development of a landscape vision (see figures), collection of possible water management adaptation options) by means of interviews, expert meetings and round tables (regional fora).



## Concept and methods

Main work was done in the Wesermarsch pilots on the first three steps of the problem solving cycle used for the development and implementation of climate change adaptation measures:

### 1. Problem identification

One-to one interviews with all members of the regional stakeholder forum and discussions within the regional forum involving all water related stakeholders of the Wesermarsch region identified the main current (and probably also future) water related problems. To complement available information, a detailed literature review on climate change impact studies was carried out.

### 2. Problem analysis

Several actions were taken in order to specify the available information on expected regional water management related issues. Results from the literature review on climate change impact studies in similar regions described the general hydrological trends to be expected. A hydrological model application based on SRES scenarios of the IPCC, down-scaled to the Wesermarsch region, gave insight into likely regional climate change impacts. Finally, the group of stakeholders developed a future landscape vision for the year 2050 in order to define boundary conditions for possible climate change adaptation options.

### 3. Elaboration of adaptation options

A focus group, delegated from the regional forum, discussed adaptation alternatives with respect to future water management in the urban parts of the Wesermarsch. For the city of Brake a concept of water drainage and storage in and around the city was prepared in advance, discussed and altered by the stakeholders. This concept was based on existing examples in water management in urban areas in Europe. Several options for the storage and a delayed drainage of surface water were collected. The focus group analysed the advantages and disadvantages of these different options. The resulting concept is described in the joint Wesermarsch vision (Ahlhorn et al., 2011). For comparison, an international group of water management experts developed alternative adaptation options focusing on a sustainable development of the region in terms of "living with water" in the framework of a partner meeting of the "Climate Proof Areas" project.

# Products and results

The stakeholders are aware of climate change impacts and are interested in the development and discussion of possible climate change adaptation options. Within the process they agreed upon common principles of a sustainable water management:

- ▶ sustainable water management should consider the topographical situation,
- ▶ sustainable water management should be carried out in a regional context and consider cross-sectoral water related requirements,
- ▶ sustainable water management should contribute to the improvement of water quality,
- ▶ sustainable water management should be harmonised with land use management, and
- ▶ water management measures should be flexible in order to be able to adapt to changing boundary conditions.

Central result of the pilot study for the city of Brake (Wesermarsch urban) is a concept to link flood mitigation measures in urban areas (urban areas as a sponge) to flood adaptation measures in the rural surroundings (flood retention in the rural environment). Possible elements of the mitigation of flood generation in urban areas are:

- ▶ establishing green covered roofs for enhancing evapotranspiration and increasing the water storage of urban areas,
- ▶ using multifunctional areas for a temporal water storage in case of extreme events (e.g., parking areas, sports grounds), and

- ▶ preserving the existing green corridors in cities, and in case of natural depressions, using them as temporal flood storage volume in case of extreme events.

For a realisation of the two latter options it is beneficial if those areas are located closely to the drainage network to minimise pumping costs after a flood event. As complementary options for the rural surroundings of the city of Brake following options are proposed:

- ▶ further development of the existing drainage network in terms of storage volume (e.g., by removing sediment from canal beds),
- ▶ allocation of suitable land (e.g., low lying areas linked to the drainage system) for the installing of polders as part of a formal planning process.

Combining both complementary approaches is able to maximise the effect on flood reduction and assists the adaptation process with respect to water management without upgrading the sluices and pumping stations.

The results of the stakeholder based development of an adaptation strategy are described in the Wesermarsch vision (Ahlhorn et al., 2011).



# Policy Recommendations

Within the Wesermarsch pilots we integrated the regional stakeholders and therefore the public in all stages of the climate change adaptation process which were performed. We learned that stakeholder participation...

- ▶ increases the awareness of the climate change problem,
- ▶ provides a wider range of possible solutions,
- ▶ increases acceptance of possible solutions,
- ▶ increases willingness to compromise and therefore
- ▶ accelerates the implementation of suitable measures.

Based on these experiences we strongly recommend to

- ▶ integrate stakeholders at an early stage in a participatory process of climate change adaptation.

We also learned that stakeholder know very well their region and the problems they already have today managing the water system. We therefore recommend to

- ▶ use current problems to raise awareness for climate change related problems in the future.

Based on the discussions to the stakeholders we recognised that climate change is an important issue but – of course – not the only important issue affecting water management activities. For example, water management is interacting with the development of industrial and commercial zones, but mostly in a reactive way.

Based on these experiences, we recommend to

- ▶ integrate water management (adaptation) directly into spatial planning processes, as an example, to
- ▶ integrate new infrastructure (e.g., motorways/ highways) into coastal defence plans (2nd dike line), and to
- ▶ consider climate change adaptation in urban development,

Due to their vision on the future landscape the stakeholders focused on technical adaptation measures.

However, they also admitted that possibilities of technical solutions are limited in the long run. In agreement with the group of international water management experts we therefore recommend to

- ▶ try to combine technical adaptation options with adapting land allocation and land use in a sustainable way to changing climate conditions and
- ▶ try to develop joint solutions for urban and rural areas in order to increase the flexibility of the entire water management system.



# Background documents

- ▶ Ahlhorn, F., Bormann, H., Giani, L., Klaassen, K., Klenke, T., Malsy, M., Restemeyer, B. (2011): Klimasichere Region Wesermarsch - Die Zukunft der Wasserwirtschaft. Erste Schritte auf dem Weg zu einer Klimaanpassungsstrategie für den Landkreis Wesermarsch. (in German)

You can find these documents on [www.climateproofareas.com](http://www.climateproofareas.com)

# EU inspiration

- ▶ Comcoast project (Combining functions in Coastal Defence Zones): EU-Interreg IIIB North Sea Programme ([www.comcoast.org](http://www.comcoast.org))
- ▶ TiDE project (Tidal River Development): EU-Interreg IVB North Sea Programme ([www.tide.eu](http://www.tide.eu))
- ▶ C2CI - Cradle to cradle islands project: EU-Interreg IVB North Sea Programme ([c2cislands.org](http://c2cislands.org))
- ▶ SAWA (Strategic Alliance for integrated Water Management Actions): EU-Interreg IVB North Sea Programme ([www.sawa-project.eu](http://www.sawa-project.eu))

# What is Climate Proof Areas?

Climate is changing and Europe needs to adapt. Scientists and civil servants from Belgium, England, Germany, Sweden and the Netherlands united in one project: Climate Proof Areas, funded by European North Sea Region Program. Their goal? Creating safer, more natural and more prosperous land use options for future development.

Thirteen partners from these five different countries joined forces to develop new and innovative methods and help render threatened areas 'climate proof'.

Since 2008, the team has gained insights on:

- ▶ the regional effects of climate change on the North-Sea Region
- ▶ the implementation of innovative measures in 8 pilot sites
- ▶ recommendations for gaining political support
- ▶ the necessary tools for building your own climate proof area

Please visit our website to find our results ...  
Time to adapt!

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