



SUSTAINABLE LAND MANAGEMENT

A SAFE FUTURE FOR
GERMANY'S COASTS





Sheep grazing in a polder in Zeeland, The Netherlands.

- Climate change will affect Germany's coastal landscape – this much seems certain. But what can be done to protect humans and the landscape from the effects of climate change in the future? Scientists in the research project COMTESS are working out scenarios aimed at assisting the decision-makers in politics and government with the generational challenge of coastal protection.**

The North Sea coast between Greetsiel and Emden is a picturesque landscape. Geese, ducks and many other bird species feed happily on the mudflats; sheep graze on the dikes, and farming is flourishing in the hinterland. Life in this part of Eastern Frisia is certainly good at present. But will the future look as rosy for this idyllic coastal landscape and its inhabitants? A research project allocated 3.3 million Euros in funding by the German Federal Ministry of Education and Research seeks to find detailed scientific answers to this very question by the end of 2015, concentrating on two areas on the North Sea and Baltic coasts. The project, titled »Sustainable Coastal Land Management: Trade-offs in Ecosystem Services«, or COMTESS for short, is coordinated by Professor Michael Kleyer from the University of Oldenburg. Seven German universities are also involved, along with international scientists and partners from a number of nature conservation organisations.

The Eastern Friesland project area on the North Sea coast is one of the regions that could be particularly



Dune erosion in the »Heiligensee und Hütelmoor« nature conservation area on the Baltic coast.

severely affected by a change in climate: the hinterland lies up to two metres below sea level. Already for many years it has been necessary to drain the farmland by pumping water from behind the dike into the sea in winter. This is expensive and consumes a lot of energy. Climate change could exacerbate this situation if, as predicted, the sea level rises, flooding becomes more frequent and more precipitation falls in winter. The dikes have provided sufficient protection until now, and although raising them higher would not present any technical difficulties, this would be a costly operation and would take a long time, as project coordinator Kleyer explains, citing Lower Saxony as an example: »Lower Saxony is responsible for 700 kilometres of dikes. If it wishes to raise the crown of the dikes by half a metre, it manages to do so at a rate of only seven kilometres a year, and must allow costs of up to 40 million Euros for this«, he explains. What is more, there is a risk that the heavier dikes could sink in some areas, causing the lighter land behind to raise up.

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Thus it is questionable whether technical measures alone are the ultimate solution for absorbing the



Rewetting in the »Grenztalmoor« nature conservation area in Mecklenburg-West Pomerania.

effects of climate change. The COMTESS scientists are therefore working to find alternatives. Kleyer describes their approach as follows: »We want to investigate how far climate change can intensify and the sea level rise before the existing land use along the coast is no longer productive. The question then arises as to how a sustainable alternative use might appear«. In his view the research team are breaking new scientific ground in that they are simulating climate change in terms of its effects not just on the climate and sea levels but on the whole landscape.

Future ideas for the region

To allow them to make an assessment of possible future developments, the scientists are basing their research on three scenarios for which they wish to simulate the effects of rises in sea level and climate change until the year 2100. The »Water Management« scenario provides for the construction of a water storage area surrounded by embankments, a so-called polder, in low-lying areas. This polder can absorb salt water when the dikes flood and also store excess fresh water from the hinterland during the winter months. The water could be used during dry periods in the summer to irrigate the fields and grasslands for example, while the reeds growing in the polder could be used for bioenergy.

»With this option, smaller, very low lying areas would have to be set aside as polders«, says Kleyer. In the second scenario »Carbon Sequestration«,



Extensive grazing of coastal areas in Denmark at risk of flooding.

the reeds growing within the polder would not be used for energy but would be left standing to remove carbon from the atmosphere and store it as peat. And in the third »Trend« scenario, the present dairy cattle farming and grassland management would continue unchanged. The COMTESS scientists still wish to model the effects of rising groundwater levels on agriculture, however, as these will lead to higher drainage costs. »The ecological and economic sustainability of this type of land use could decrease significantly«, says Kleyer. The scientists also seek to calculate and assess the consequences of changes in ecosystem functions such as the water balance or soil conditions for the flora and fauna and for humans. Ecosystem services can be clearly illustrated taking reeds as an example: the tall-growing grasses reduce the risk of flooding by increasing evaporation. They also bring in revenue for the farmer, if used for energy. On the other hand, the reeded areas are no longer available to the farmer for growing cattle fodder or for grazing.

»Smaller, very low lying areas would have to be set aside as polders.«

»We wish to quantify and assess such ecosystem services ecologically and in socio-economic terms«, Kleyer explains.

The scientists are focusing on these issues in different study groups working in two project areas, one



Managed realignment in the »Insel Koos, Kooser See und Wampener Riff« nature conservation area.

on the North Sea coast between Greetsiel and Emden on the Krummhörn and one in the Baltic Sea region near Rostock on the Barther Bodden lagoon. In Eastern Friesland, coastal engineers from the Braunschweig University of Technology are investigating for example how far and how fast sea water can penetrate into the hinterland. The planned extension of the dike line seems likely to ensure that the dikes would remain safe even if the water level rose by a metre.

Salination becoming a problem

Many of the COMTESS sub-project groups are working on the basis of research conducted by Dr. Thomas Gräff from the University of Potsdam who has produced models of the water levels and salt content in the inland project areas. He is paying particular attention to the problem of salination. »The salination of the substratum will increase with climate change, and will strongly affect use of the land behind the dikes«, the hydrologist explains. If as a result of climate change less rain falls in the summer in future and temperatures rise by between 2 and 4 degrees Celsius, as predicted, more surface water will evaporate. Salt water will then be drawn up onto the surface of the soil, especially during dry periods. In the project region this would not be a rare occurrence, since a third of the study area lies below sea level and has to be drained by artificial means. This has an effect on land use. Gräff outlines the consequences: »The land becomes more saline, the vegetation



Brackish water reeds in the Barth Lagoon, Baltic coast.

changes, the cattle farming on the grassland that has been practised until now could hardly continue«. The scientist has established that this is already the reality in some parts of the meadows on the Krummhörn where the salt has risen. »The water there is already so brackish in summer, that the cattle can no longer drink it.«

In another COMTESS sub-project, scientists from the Universities of Rostock and Oldenburg are investigating the consequences of the three baseline scenarios on carbon binding and on methane and nitrogen concentrations, both of which play a significant part in climate change. In the North Sea project area, soil scientist Professor Luise Gianì from Oldenburg University is focusing her attention on reeds. The intention is to grow these in the future polder areas. Her investigations to date have established that reeds release large quantities of methane. »This is possibly due to the fact that the reed stocks that we analysed are still very young«, says Gianì.

»The water there is already so brackish in summer, that the cattle can no longer drink it.«

If the reed stocks were older, she assumes that the methane emissions would be lower. Gianì wishes to investigate this more thoroughly in further experiments. With the grasslands it is the extensively



Drainage ditches in Eastern Frisia, North Sea coast.

used land remaining under water for a long time that releases methane in particular. »We have not yet established a connection with soil type, groundwater level and carbon content«, she says. It is conceivable, however, that there is a connection with labile carbon, or easily degradable carbon compounds. Further investigations should confirm this. »On the other hand, hardly any methane is released from intensively used grassland areas that are drained«, says Sarah Witte, who is studying for a doctorate at the University of Oldenburg Institute of Biology and Environmental Sciences.

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In the COMTESS project, however, the intention is not just for the scientists to contribute their expertise: practical action is also required. In one sub-project, so-called stakeholders are developing their own scenario to reflect their view of how the project area landscape might look in the future. Leena Karrasch has been able to persuade fifteen experts and decision-makers from local authorities, groups and organisations in the fields of water management, agriculture, nature conservation, politics and tourism to participate in a regional planning group. »Behind all this is the attempt to arouse understanding of the need for sustainable land management«, explains the



Dunes and beach at Ahrenshoop, Darss-Zingst.

scientist from Oldenburg University, who is studying for a doctorate on the roles played by the actors in planning processes. »The stakeholder scenario and the three other COMTESS scenarios will be comprehensively assessed according to consistent criteria«.

Polders regarded with scepticism

Already a direction is emerging: »Essentially there is a preference for the »Trend« scenario, in other words for business as usual«, she says. This is above all because of the well constructed drainage systems, which the experts trust. »The users favour technical solutions, with the argument that they have always worked very well until now«, explains Karrasch. Possible polders are viewed with scepticism. »If land has to be given up for new flood areas, the area of land available for typical use is greatly reduced« – this is the fear of many users. Of course the stakeholders are also faced with a dilemma. »Many realize that climate change is a reality and will have consequences. For this reason they want the land to be used more sustainably, but they are reluctant to begin taking measures on their own doorstep«, says Karrasch.

Godehard Hennies, a member of the work group accompanying the COMTESS project, is eagerly awaiting the scientists' results. Naturally the Manager of the Regional Association of Water Authorities is in favour of reliable coastal protection since the Association represents the 24 main dike authorities along the North Sea coast.



Brackish water reeds on the River Ems, Eastern Frisia.

Together the associations maintain the dikes over a total distance of some 650 kilometres. »Coastal protection is a long-term task«, says Hennies. For this reason he is also very interested to learn which coastal protection measures might make sense from the scientists' perspective. There is still much that requires clarification, particularly with regard to the possible effects of climate change on the North Sea: how will wind conditions in the German Bight change? Can salt water advance into the agricultural land? What effects will this have? Are the dikes high enough? To allow a reaction to such questions before it is too late it is important for the COMTESS scientists to identify the different options for action.

Advice for the experts

Project Leader Kleyer sees it as another central task of COMTESS to offer well-informed advice. »Our scenarios are intended to provide advice to help the local experts and politicians with the decisions they have to make regarding coastal protection and the shaping of the landscape«, he says. Kleyer is aware that these scenarios, which could be applied to other similar coastal landscapes in North America and Korea, also present a major scientific challenge: it will be difficult for example to model the effects of the water balance on animal and plant species. Until now these have been based only on rough assumptions which do not reflect the reality. As Kleyer says: »This diversity cannot be described in mathematical equations«.

There is also a great deal of feedback to take into account in the modelling of the water balance. »Models on precipitation, ground water levels and the absorption capacity of the soil all have an influence here; it is not easy to link all of these together systematically«, he says. But the landscape ecologist from Oldenburg and his COMTESS team are happy to tackle these hurdles in order to be able to offer sustainable solutions for the generational challenge of coastal protection.



Regional production systems researched are:
Agriculture (extensive), livestock, tourism

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