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SUSTAINABLE LAND MANAGEMENT

COMTESS

MINIMIZE THE IMPACT OF CLIMATE CHANGE ON VULNERABLE NORTHERN EUROPEAN COASTAL LANDSCAPES

Analysis of the Ecosystem Services of Alternative Land Management Scenarios (Aichi Target No. 10)

Introduction

The reclaimed coastal lowlands of the North Sea and the Baltic Sea (Europe) with the estuaries of the rivers Rhine, Scheldt, Maas, Ems, Weser, Elbe, Warnow, Peene, Oder etc. and the coastal peatlands in their hinterland are extremely vulnerable to changes in terrestrial water cycles, rising sea levels and increasing storm surges (IPCC 2007). Therefore, almost the entire mainland is protected by sea dikes and other man-made and natural barriers. Higher rainfalls are predicted in winter for North-West European coastal regions (BACC Author Team 2008, Jacob et al. 2008). On the contrary, lower rainfalls and increasing temperatures are expected during summer (UBA 2007, BACC Author Team 2008). This may reduce groundwater reservoirs in summer and – with sea level rise – increase the risk of salt water intrusion in unconfined coastal aquifers. Reed fens have dominated the flood-prone regions of the Wadden Sea coast before dike building started in medieval times. Likewise, river floodplains in Northeast Germany were dominated by reed fens. In recent centuries, reclamation and drainage of reed fens for dairy farming favored peat mineralization, leading to substantial declines in land elevation, thus releasing stored CO_2 and increasing vulnerability to catastrophic floods. The degradation of drained coastal peat reservoirs may even increase with expected rise of summer temperatures, with strong repercussions on the European CO_2 balance (Strack et al. 2008).

COMTESS (Sustainable Coastal Land Management: Trade-offs in Ecosystem Services)

The collaborative research project COMTESS funded by the German Federal Ministry of Education and Research will perform an inter- and transdisciplinary investigation of four possible land management scenarios (see figure) to react to changing hydrology due to climate change: **(1) Water management**: Construction of second coastal defense lines within the hinterland instead of heightening the primary sea wall and formation of freshwater polders enclosed by the primary and secondary dike line. Primary aims of this scenario are to restrict flooding to the polder area in case of limited breaches, to increase freshwater retention for use in dry periods, to prevent subsurface salt water intrusion, and to use reeds for green energy. **(2) Carbon sequestration**: Similar to the first scenario but polders will be extensively covered with reed fens to yield active peat formation. **(3) Trend**: Dairy farming and grassland as usual. **(4) Stakeholder-based**: The three project-led scenarios were submitted to the evaluation of stakeholders of each case study region to explore stakeholder land use preferences.

COMTESS will quantify and evaluate the performance of multiple ecosystem functions and services (ESF / ESS) in each scenario in socio-economic and ecological terms.

Indicator of Ecosystem Services

Water retention: Hydrological modeling based on field surveys will quantify groundwater levels and freshwater retention provided by the different land management scenarios for the period 2010-2100. Based on simulated water provision, COMTESS will model ecosystem services provided by the vegetation.

Vegetation: The vegetation plays a pivotal role in the provisioning of coastal ESS. Net primary productivity and standing biomass of plant communities and their trait composition (e.g. palatability, leaf nitrogen content) indicate the amount of food or green energy production. Different plant communities exhibit saturated or unsaturated species diversity, depending on the size of the community species pool, the environmental conditions and their variability in space and time (Kirmer et al. 2008). Biodiversity will be indicated both by local species diversity relative to the size of the community species pool (Ozinga et al. 2005) and functional diversity, the variation of species level traits on multiple environmental gradients.

Breeding and resting birds: Birds are a highly suitable keystone group to assess impacts of habitat change on diversity as they are particularly vulnerable to the loss of sites on which they traditionally rely for part of their annual life cycle (wintering, migratory fuelling, and breeding). Coastal areas are of crucial importance for large numbers of bird species of all functional groups (from waterfowl and waders to meadow birds, songbirds and birds of prey), e.g. an estimated 11 million waterbirds use coastal sites along the Wadden Sea to refuel on their annual migration (Van Eerden et al. 2005). But coastal sites are also important breeding sites for many threatened meadow and reed birds which currently face rapid population declines most likely related to clashes between traditional breeding habitat requirements of the birds and agricultural land use practices of the recent decades (Beintema et al. 1997, Kleijn et al. 2001, Newton 2004). Therefore, COMTESS will model the occurrence of breeding and resting birds for each scenario based on vegetation and land use information.

Outlook

Combining the scientific findings, together with stakeholders we will develop concrete action- and decision-oriented suggestions on local and regional levels to promote sustainable management of vulnerable coastal landscapes in response to expected climate change. Based on the extensive research program, COMTESS will contribute both scientifically and practically to the design of an evidence-based management of multi-functional coastal landscapes.

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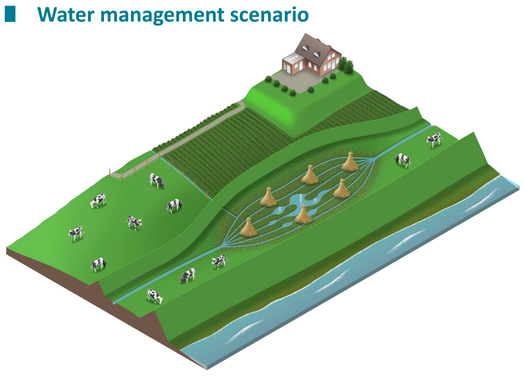
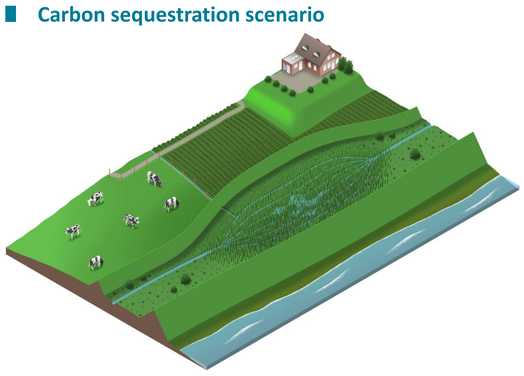
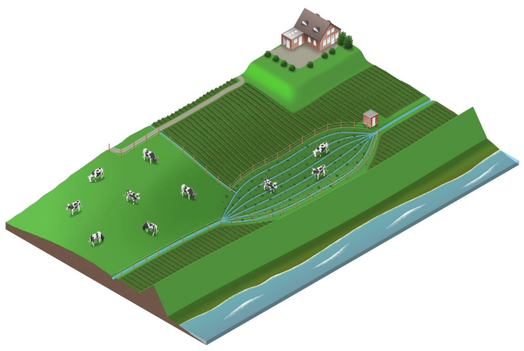
Water management scenario



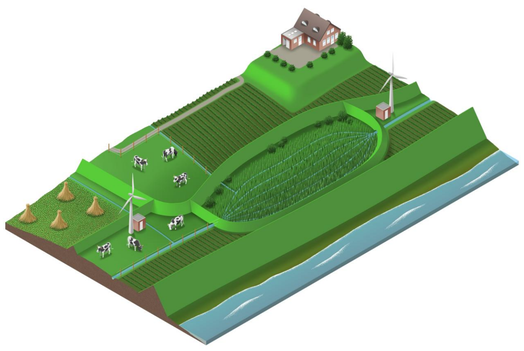
Carbon sequestration scenario



Trend scenario



Stakeholder-based scenario



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