

Master's Program
Water and Coastal Management

Master Thesis

**Stakeholder participation in integrative planning for sustainable
land use management – an assessment framework combining
ecosystem services and social impact analysis**

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Abstract

Adaptive strategies are the basis for a sustainable land management. The structures of both, the community and the ecosystems, are influenced by projects dealing with the development of new options for a sustainable land use management. This paper proclaims the use of a progressive method: the integrated assessment of the ecosystem service approach and the social impact assessment. This provides a combination of natural and social sciences. The developed model optimizes decision-making processes by improving the evaluation of the ecosystem services and leading to a better understanding of human well-being. Capturing the perceptions of local stakeholders and using the multiple trade-off analysis from other scenarios, ecosystem services are evaluated in a socio-economic and (socio-) ecological framework. Scientific and practical implications contribute to a multi-functional land management.

Keywords

Ecosystem services, social impacts, social impact assessment, sustainable development, human well-being, stakeholder involvement, participation, climate change, COMTESS, Krummhörn

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1. Introduction

The coastal lowlands and estuaries of North-West Europe are vulnerable to the climate change. In the coming decades, the changing climate and its induced alterations will cause problems and changes in the coastal areas of north-western Europe. This not only affects issues of coastal protection, but also inland forms of land use management and water management. Therefore, there is a need for new adaptive strategies, leading to a more sustainable development and focusing on human well-being to meet the changing conditions.

The ecosystem service approach and social impact assessment are essential strategies to promote sustainable development. These strategies offer opportunities and risks which have to be reflected with regard to their social, ecological and economic consequences. Throughout this paper, the Millennium ecosystem Assessment (MA 2003) and the conceptualization of social impacts (Vanclay 2002) serve as core literature.

Until now, there is a lack of knowledge concerning the relationship between ecosystem services and social impacts. Human actions provide interventions which affect the existing structures of a region. Problems are generated by a separation of ecosystem services and social impacts which both influence and are influenced by ecosystem services (figure 4) (Vanclay 2002, Slootweg et al. 2001). The changes concerning the land use management lead to beneficial or adverse impacts on human well-being and ecosystem services. While the ecosystem service approach takes effects on socio-economic determinants into account and contributes to human well-being by focusing on the people's dependency and demand on the ecosystem services (figure 2), the social impacts assessment includes also social impacts which affect ecosystem services (figure 3) (MA 2003, Vanclay 2002, Slootweg et al. 2001).

It is the aim of this paper to develop a well-balanced and transdisciplinary framework which equally combines social, ecological and economic issues. Two main research questions are examined:

How is it possible to complement the understanding and evaluation of ecosystem services with social experiences and impacts?

Which ecosystem services and social impacts are important for the experts and are there more relevant ecosystem services than proposed by the COMTESS project?

The paper concentrates on the community of Krummhörn. The community is one main study side of the collaborative research project COMTESS (Sustainable Coastal land Management: Trade-offs in EcoSystem Services). The project aims for the development of four land management scenarios and the weighing of opportunities and risks of new land management strategies¹.

¹ For further information see: <http://www.comtess.uni-oldenburg.de/en/index.html> and <http://modul-a.nachhaltiges-landmanagement.de/en/collaborative-projects/comtess/objectives/>.

The stakeholder dialogue and participation in the integrative planning assessment are essential parts of this paper. Experts and decision-makers from the region of Krummhörn, who are engaged in five different sectors (water management, nature conservation, agriculture, policy and tourism), contribute to the development of concrete and action oriented suggestions on local and regional level towards a sustainable land use management. In order to ascertain the stakeholders' interests, needs, perceptions and opinions with regards to ecosystem services and social impacts as well as the future development of the region, semi-structured expert interviews have been done.

The paper implies the prioritization of relevant ecosystem services like green energy and food production (provisioning services), water retention (regulating services), tourism and recreation (cultural services) and carbon sequestration and biodiversity (supporting services) as well as social impacts like community identification and connection (indicative personal impacts), influence of the climate change (indicative climate change impacts), feelings about environmental issues (indicative environmental impacts), the aesthetic quality and livability of the region (indicative landscape impacts), the material well-being (indicative economic impacts) and effects of changing land use (indicative development impacts). The results are put into a scientific context with the help of an integrative model based on the concepts of the ecosystem service approach and social impact assessment.

An integrative process has been developed by using the linkages and interconnections of the ecosystem service approach and social impact assessment (figures 16, 19, 21, 22). These two concepts are used to analyze complex socio-ecological systems and to structure activities. The shared issue of the ecosystem service approach and social impact assessment is to reach a sustainable development and human well-being. Both concepts aim for an ecologically, socio-culturally and economically sustainable and equitable environment (MA 2003, Vanclay 2002). In order to reach this goal, social and environmental concerns have to be considered in an equal manner to reach a rich picture of sustainable development and human well-being.

Additionally, the concept of the social impact assessment enhances the management process and improves the evaluation and understanding of ecosystem services.

The results show a variety of different ecosystem services, social impacts and statements incorporating the different needs, opinions, interests and perceptions of the stakeholders. They build the basis for the development of a stakeholder-based scenario and further research.

2. Theoretical framework

The theoretical framework sets the background for the assessment of ecosystem services and social impacts and is the basis to develop a balanced framework. The aim is to identify the different issues and to provide definitions and problem statements. Therefore, the topics climate change, sustainable development, ecosystem services, social impact assessment, human well being and stakeholder involvement will be introduced. Thus, the paper is positioned into the theoretical landscape and the necessity for the research will be expressed.

2.1 Climate change

Regarding recent trends in global climate, coastal zones are strongly affected by climate change. The International Panel on Climate Change (IPCC 2007) estimates a rise in sea level between 18 cm and 59 cm as well as increasing weather extremes, for example heavy precipitation and storms, until 2100. In future, coastal regions and their natural and societal systems will have to deal with the consequences and influences of climate change in terms of external events like storm surges and river run-offs as well as interactions in the sub-system (figure 1). The North Sea is a “hotspot of societal vulnerability in coastal zones” (Nicholls et al. 2007: 337).

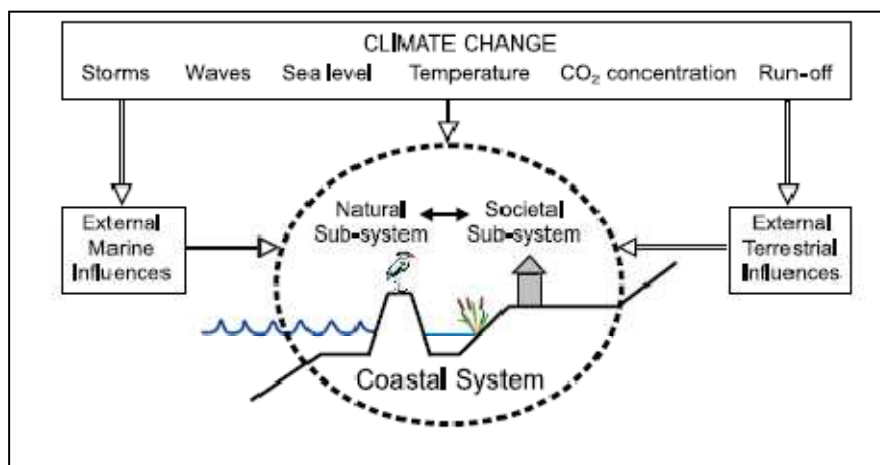


Figure 1: Major effects of climate change on the coastal system, including external marine and terrestrial influences (Nicholls et al. 2007).

The resulting problems of climate change are manifold. Contemporary coastal protection is mainly based on dikes and groundwater regulation via drainage. The Trilateral Working Group on Coastal Protection and Sea Level Rise (CPSL 2005: 9, 42) states that sea dikes “are, generally, necessary to secure present safety standards in coastal lowlands”. They can, however, not guarantee absolute protection. Dike strengthening strongly interacts with natural dynamics and causes several environmental impacts. On local scale alternative solutions are more efficient, also with respect to economic and ecological consequences (CPSL 2005).

The North Sea Coast areas are exposed to significant and increasing storm events which depend on the mean sea level and wind speeds. In case of global warming there might be increasing wave conditions promoted by extreme wind speeds from north-westerly directions (Nicholls et al. 2007, Woth et al. 2005, Beniston et al. 2007, Grabemann and Weisse 2008). Due to a rising sea level and wave dynamics, dike overtopping may occur up to more than 50 km inland, leading to a negative salt intrusion of the surrounding hinterland (CPSL 2005).

On global scale, the mean annual precipitation is expected to increase in Northern Europe (Alcamo et al. 2007). Jacob et al. (2008) highlight, that there will hardly be any significant changes in the average of yearly precipitation in the coastal regions of Germany. There will, however, be a shift in scale and time at the North Sea coast - in summer time there will be a decrease about 25 % and in winter time an increase about 30 % until 2100 (Jacob et al. 2008, Spekat 2007, Beniston et al. 2007).

The river, canal and ditch runoff is an important issue for the water balance of the region of Krummhörn. Due to changing hydrological cycles by increasing inland water levels caused by the increasing precipitation during winter time and the rising sea-level, the time of freshwater discharge increases. Thus, an expanding pumping capacity takes place because it will be problematical to pump water into the sea by gravity. In future, it will then be necessary to build more drains and locks to drainage the region. Due to increased drainage of agricultural land the soils subside further.

Another problem is the salinization of groundwater in the hinterland. The low lying area has to deal with changes in groundwater flow. Usually, the groundwater flows from the inland towards to the sea but with increasing sea level the flow may be reversed. The result is an increasing salinization of groundwater in the hinterland. The predicted droughts during summer may reduce groundwater reservoirs and enhance the salt water intrusion.

Contemporary coastal land management concentrates almost exclusively on the protection against floods by sea walls and groundwater regulation via drainage. The sea level rise and changes in hydrological cycles may restrict the efficiency of these measures in future, including the effectiveness of current land and water management. For this reason, adaptive strategies for the future land management have to be developed.

2.2 Sustainable development

A sustained and sustainable development means to preserve, but also to develop the rich natural heritage and natural environment for the people today and for generations to come. Sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987: 43). The concept of sustainability emphasizes the relationships between environmental, economic and social development (WCED 1987, UN 1992). The economic view focuses towards an improvement of human welfare, for example by increasing flow

of goods and services under the assumption that at least their stocks are maintained and solutions for tensions along disharmonizing developments are provided (Munasinghe 1993, WCED 1987). Sustainability in a social meaning stresses the creation of social well-being, social capital and a meaningful, good life. One key principle specific to practice highlights that sustainable development should be an integral part of the development processes in all stages (Vanclay 2003a, 2003b). The environmental view focuses on protection of the integrity and resilience of ecological systems. Sustainable development and land-use of an area could be achieved by maintaining the ecosystem services and by balancing economic growth and social development with the need for conservation of the environment (MA 2003).

The three key elements of sustainable development are overlapping and problems may occur by interventions, which do not take ecological, social and economic impacts equitably into account. One of the commonly shared fundamental insights of the sustainability debate is that the practical implementation of visions requires a comprehensive strategic approach that integrates and balances the various dimensions of ecological, economic and social aspects (Kopfmüller et al. 2001, Jorden 2008).

2.3 Ecosystem Services

The term “ecosystem service“ describes the variety of uses people obtaining from ecosystems. The nature delivers a broad range of different services building the basis for human well-being.

The ecosystem approach can help to analyze complex human-environment systems, to structure human activities and to develop an impact assessment with regard to changing land-use. It is a strategy for the integrated management of land, water and living resources (CBD 2010, MA 2003).

Ecosystems, which provide a combination of different ecosystem services, are described as complex and dynamic systems that are interacting and associating functional units which depend on a dynamic and changing aggregation of organic and inorganic components and functions of an environmental system (MA 2003, UN 1992). Ecosystem services play an important role in sustaining and fulfilling human life. “They maintain biodiversity and the production of ecosystem goods” (Daily 1997: 3). Constanza et al. (1997) indicate that ecosystem goods and services are natural as well as human made. The MA (2003: 3) defines ecosystem services as “the benefits people obtain from ecosystems” and affect human well-being. Ecosystem services include the benefits “goods”, “services” and “cultural services” that are variable and depend on thresholds and limiting factors, providing a wide range of different benefits for humans (MA 2003). In literature, numerous ways can be found to categorize ecosystem services (de Groot et al. 2002, Norberg 1999, Moberg and Folke 1999, Pimentel et al. 1997, Constanza et al. 1997). According to the MA (2003) this paper will classify ecosystem services along functional lines and focuses on four kinds of services distinguished in

provisioning, regulating, cultural and supporting services (table 1). The categorization of ecosystem services is important to translate the complexity of the environment into understandable units.

Category	Definition	Example
Provisioning services	Products obtained from ecosystems	Food production, green energy production, freshwater retention
Regulating services	Benefits obtained from regulation of ecosystem processes	Water regulation
Cultural services	Non-material benefits people obtain from ecosystems	Recreation, tourism, aesthetic
Supporting services	Necessary for the production of all other ecosystem services, but not directly yield to human benefits (long-term character)	Carbon sequestration, biodiversity

Table 1: Categories, definitions and examples of ecosystem services (according to MA 2003).

The loss of ecosystems and their services provide problems for humans. A sustainable use of the environment is relevant for humans with regard to ecological and socio-economical values. The demand for ecosystem services is increasing and may lead to problems in the capability of ecosystems to provide these services (MA 2003). These trade-offs arise among services and by reducing the provision of one ecosystem service due to the increasing use of another one. Trade-offs are generated from management choices. As a result, there are different clusters of winners and losers depending on decisions that have been implemented. Furthermore, trade-offs contribute to the understanding of long-term effects (Rodriguez et al. 2006, Fisher et al. 2011).

2.4 Social Impact assessment

Social impacts are “the consequences to human populations of any public or private action” (Interorganizational Committee 1995: 11). Social impacts derive from interventions in the given area and show a variety in terms of places, projects and evaluation by affected people (Vanclay 2002). The social impact assessment is a process to assess social impacts of a project and an integral part of the development process (Vanclay 2003a).

The understanding of social impact assessment was defined by Vanclay (2003: 6): “Social Impact Assessment includes the process of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment”.

The social impact assessment provides statements about how people feel about changes in the landscape. "Social impacts must be felt or experienced" in a corporal or perceptual way (Vanclay 2002: 201). The examination of human reactions to expected social changes and anticipation are of key interest (Slootweg et al. 2001). Social impact assessment is not only a technique; it is a process of managing problems and an iterative process. The impacts of an intervention on stakeholders are analysed (predicted, evaluated and reflected) and social change is managed (Vanclay 2002).

This paper places its emphasis on three management elements according to the social impact assessment (figure 23, table 3). The first element is the scoping process, which deals with identification of key issues, possible impacts and stakeholder analysis. Secondly, profiling gives an overview and analyses the social context and trends. The third element is the formulation of alternatives by examining and comparing potentials for change (Taylor et al. 2003, Baines et al. 2003).

According to Vanclay (2002, 2003b), the social impact assessment focuses not only on negative effects caused by an intervention but also on positive effects. It is one objective of the social impact assessment that interventions or projects lead to maximize the benefits and minimize negative impacts. Positive effects are enhanced by mitigation and compensation measures. Better consideration and acceptance for an intervention within a community could be reached by a participatory process (Vanclay 2003b).

In literature, there is often a division between social and environmental assessments. Social impacts are not widely adopted or emphasized by environmental assessments and environmental assessments tend to have a limited view on what social impacts are (Goodland 2000, Vanclay 2003b, Burdge 2003). Nevertheless, a trend is recognizable to combine social impact assessments and environmental impact assessments (Dale et al. 2001). It is a central target to identify how different sectors are affected by undesirable social effects of developments, not only on a global level but also on a local level (Burdge and Vanclay 1996, Vanclay 2003a).

2.5 Human well-being

Human well-being depends on ecosystems and therefore on ecosystem services. Humans as well as economy depend on ecosystems and its services and influence the services by intervention, in the same manner humans are influenced by ecosystem services.

The "natural capital" (MA 2003: 28) is a key element for well-being. In social sciences, "social capital" is a resource for well-being (Adler and Kwon 2002, Vanclay 2002). In this paper, the term "human well-being" incorporates the definitions of both, the natural and social capital.

This paper aims to integrate and harmonize concerns of natural and social sciences leading to well-being and a good quality of life. Therefore, two concepts are used. The first one is the

framework of the MA (2003) and the second one is the social impact assessment, according to Vanclay (2002), (2003b) and Burge (2003).

Ecosystem services

All ecosystem services influence the key components of human well-being (figure 2). Human interventions in existing ecosystems and their services that lead to unexpected changes have positive as well as negative direct and indirect influences. The direct influence is described by its local and short-term character (MA 2003). Indirect effects are more complex chains and include economic conditions, socio-political influence or cultural concerns. The indirect influences affect the direct ones like changes in local land-use and cover, adaptation measures or resource consumption (MA 2005).

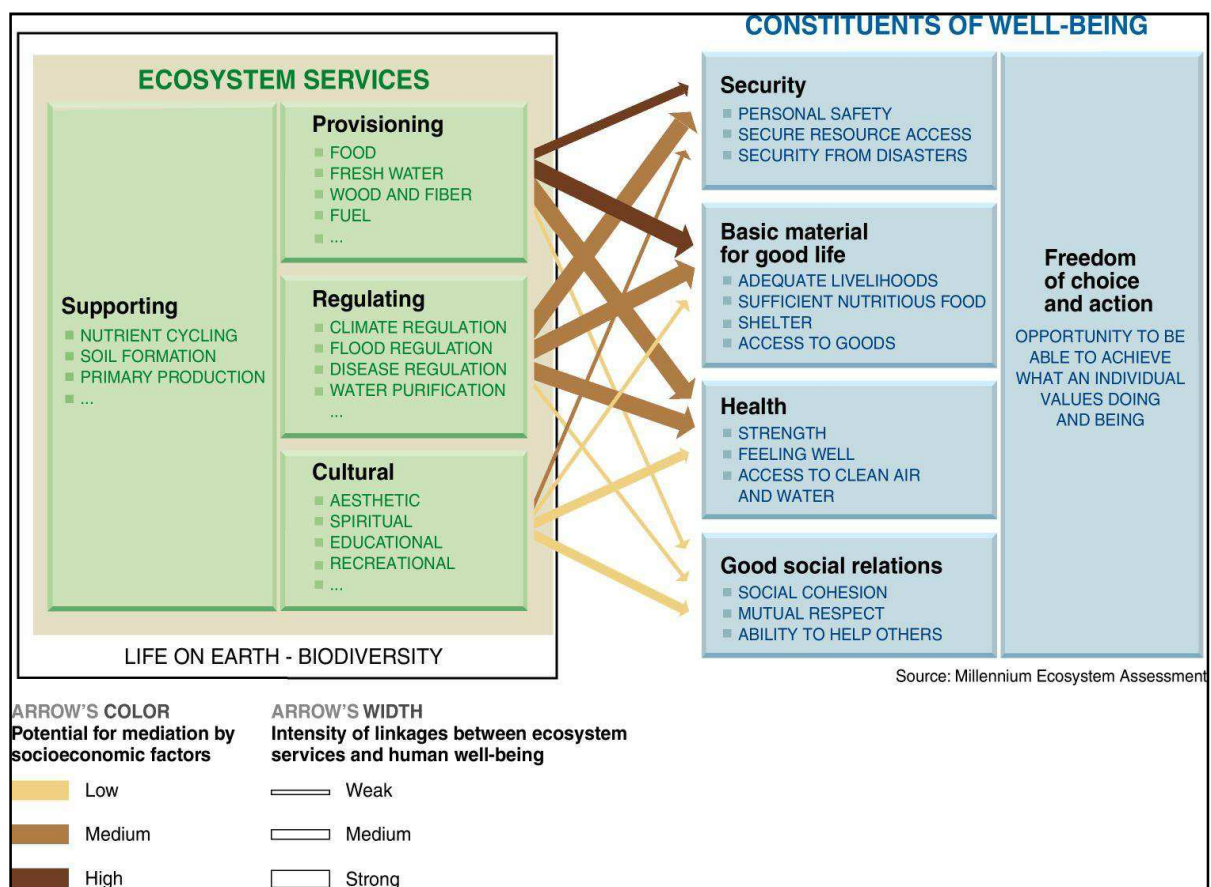


Figure 2: Ecosystem services leading to human well-being. The linkages between the categories of ecosystem services and the components of human well-being include indications of the possible linkage with socioeconomic factors (UNEP/GRID-Arendal 2005).

Changes in ecosystem services lead to adverse or beneficial effects of human well-being (MA 2003). Human well-being can be expressed by individual experiences (security, resources of space) or by productivity (food, material for a good life). The components of human well-being are manifold. The key elements are shown in figure 2. Important aspects which contribute to human well-being are sustainable use and maintenance of resources and ecosystems, now and in the future (MA 2003).

Social impact assessment

It is part of the social impact assessment that human well-being as well as a sustainable and equitable development for the wider community is considered (Vanclay 2003b). The social impact assessment also focuses on direct influences of an intervention (impacts first order) and indirect influences (impacts second- or higher order). The pathways identified by Slootweg et al. (2001) distinguish between changes in the biophysical environment and social change processes. Both have an objective character and lead to social or rather human impacts which have a subjective character (figure 3). First order changes derive directly from the intervention or project. These changes can lead to second order or higher order biophysical changes or social change processes. Changes in ecosystem services (biophysical changes) lead to biophysical impacts (change in quality of a service) which generate indirect human impacts. Direct human impacts derive from social change processes of an intervention (Slootweg et al. 2011).

The concept (figure 3) provides a connection of ecosystem services and social impacts. Biophysical changes can be seen as ecosystem services. The landscape filter reduces the complexity and could be seen as categorization in productive, regulative, cultural and supporting services. Biophysical impacts describe a change in the quality of the provided service which influences human well-being.

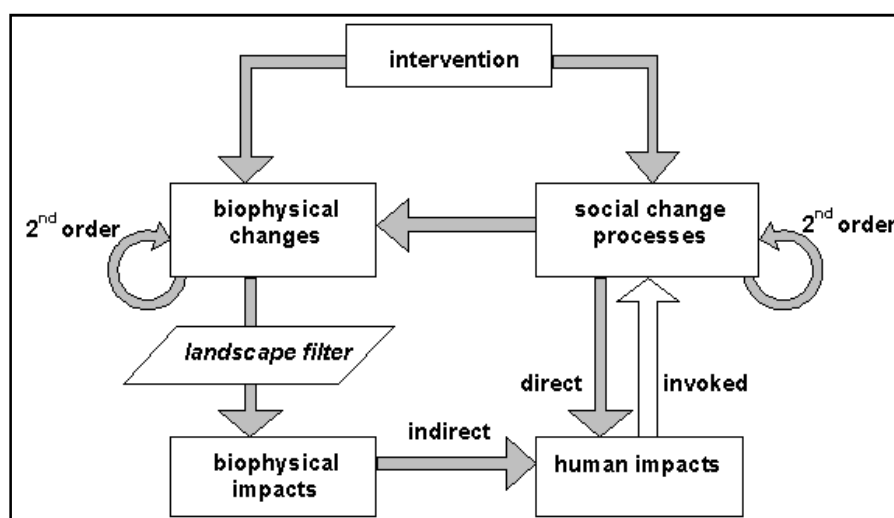


Figure 3: Integrated framework for environmental and social impact assessment (Slootweg et al. 2001).

It is important to mention that social change processes have to be distinguished from social or human impacts. Social change processes can be understood as “a discrete, observable and describable process which changes the characteristics of (parts of) a society, taking place regardless of the social context” (Slootweg et al. 2001: 27). Social (or human) impacts include “all social and cultural consequences to human populations” that influence human life (Interorganisational Committee 1994: 107). Impacts are felt and experienced in a physical or perceptual way by the

community and give the possibility for reactions and anticipation (Vanclay 2002, Slootweg et al. 2001).

It is problematic to separate social and environmental change processes because both affect human well-being. This paper uses a mixture of both, the ecosystem service approach and the framework of the social impact assessment. While the ecosystem service approach focuses on human well-being affected by ecosystem services, the social impact assessment focuses also on social impacts affecting environmental systems.

Because these elements are inherently and inextricably interconnected, this assignment takes parameters of both, the social impacts' influence on ecosystem services and the ecosystem services' influence on social impacts, into account. Social and environmental concerns have to be considered in an equal manner to reach a rich picture of sustainable development and human well-being (figure 4).

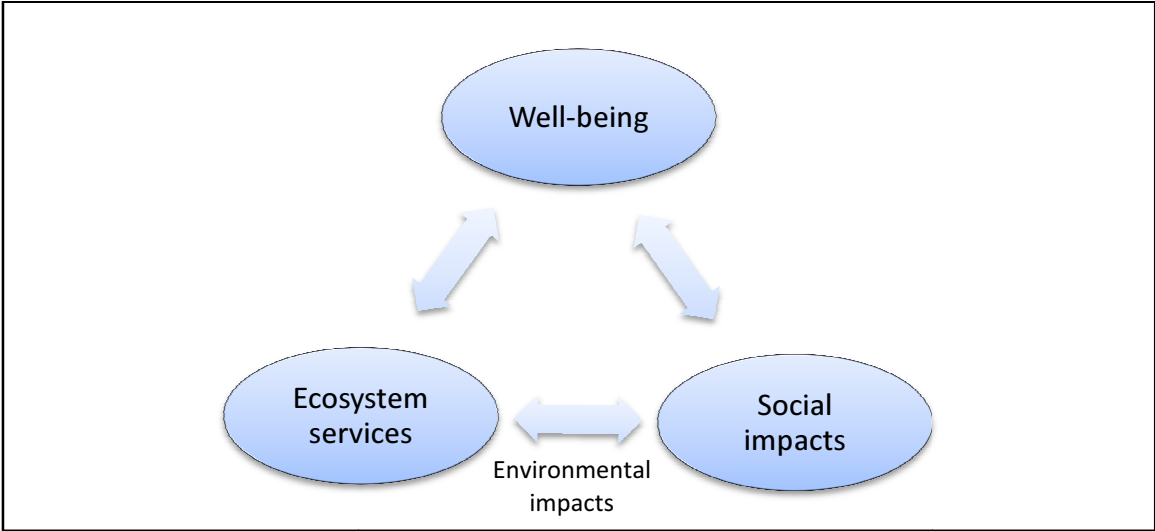


Figure 4: Dependencies between human well-being, ecosystem services and social impacts. Ecosystem services and social impacts both influence and are influenced by human well-being. Additionally, ecosystem services and social impacts are interacting.

Environmental impacts can result from and exert influence on the ecosystem services or social impacts. For example, the ecosystem service “food and fiber” includes environmental impacts resulting from the production of food, the use of grassland, or the cultivation of reeds. Environmental impacts can also result from social impacts and external effects like adaptation to climate or change processes, like new developments. Further research is required to define the environmental impacts.

2.6 Stakeholder involvement

A central part in modern environmental management is the early involvement of stakeholders in a participatory process (Meadowcroft 2004, Petkova et al. 2002, Slocum et al. 1995, Mcglashan and Williams 2003, Freeman 1984). A broad range of stakeholders provides information and give feedback on various needs and concerns. In a broad definition, a stakeholder is, or represents an institution, an organization or group that is affected by an intervention. However, stakeholders affect, use or have other interests concerning ecosystem services (Freeman 1984). Stakeholders should know the extent of the planned intervention, its key issues, participants, areas, used resources and constraints. Stakeholder involvement and participation is included in both, the ecosystem service concept and the social impact assessment.

The Ma (2003) conceptual framework is designed to meet the needs of stakeholders. The focus is on stakeholder involvement in decision-making processes to strengthen the use of local, traditional and practitioner knowledge. It is important to plan new projects with regard to sustainable use of ecosystem services and support it with participatory and transparent instruments. Stakeholders act as mediators because they negotiate the links between ecosystem services and the determinants of human well-being (MA 2003).

In every stage of an ecosystem service assessment and social impact assessment, interactive and iterative stakeholder involvement is required. Stakeholders improve the findings by providing different types of knowledge and essential information and they help to ensure completeness and inclusiveness in the values of potential benefits and risks. Additionally, the identification of development goals, verification of positive outcomes, diminishment of negative impacts, reduction of uncertainty and identification how different stakeholders are affected by interventions has vital importance (MA 2003, Vanclay 2003a).

Stakeholder involvement and transparency of decision-making increase accountability and effectiveness and both lead to a better understanding of impacts, vulnerability and identifying a broader range of response options in a specific context (MA 2005).

Stakeholders improve the findings by providing local, traditional and practitioner knowledge and they help to evaluate potential benefits and risks (figure 5). Additionally, the identification of development goals, verification of positive outcomes and diminishment of negative impacts has vital importance. The reduction of uncertainty and identification of how different stakeholders are affected by interventions are also of central interest (MA 2003, Vanclay 2003a).

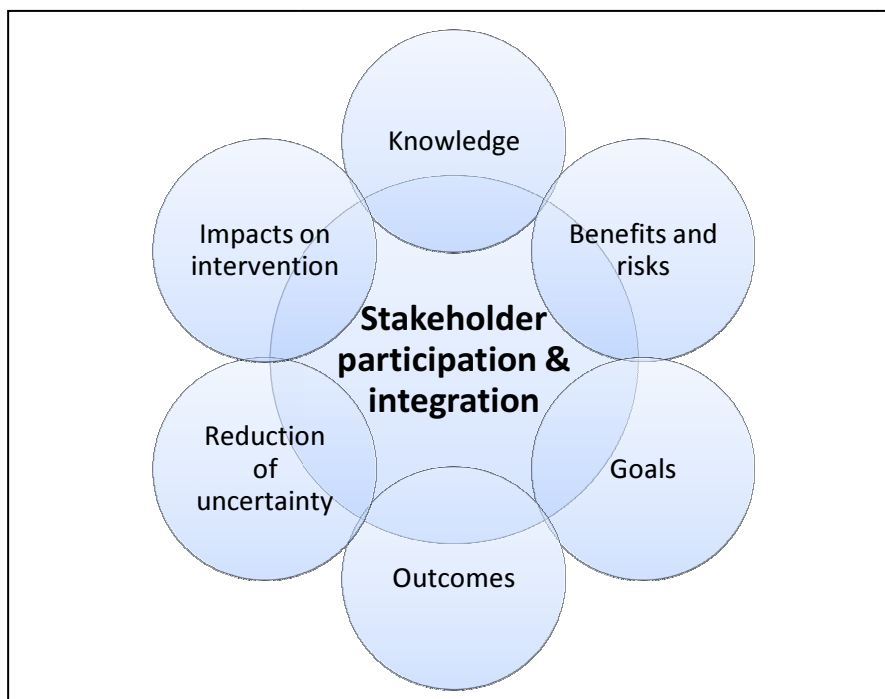


Figure 5: Stakeholder participation and integration in the planning process. Stakeholders improve the process by providing different forms of know-how.

In order to make a comprehensive chain of causalities, collaborative work between all relevant stakeholders is useful. A fundamental principle generated from the core values is that the decision-making process should be transparent and fair, including multiple stakeholder interests and proposals. Participatory processes are necessary for both, ensuring that guidelines are appropriate and promoting the consideration of the process with regard to the outcomes. A social impact assessment includes empowerment of local people and involvement of local knowledge and experiences (Vanclay 2003a, 2003b).

Special emphasis is on the use of local knowledge which has evolved and acquired over time. The use of local knowledge will increase the effectiveness of management processes and is essential for the evaluation and identification of trade-offs and synergies concerning possible impacts (Baines et al. 2003).

2.7 Conclusion

The effects of climate change will influence the development and land-use of coastal regions in future and might be increased due to inappropriate land-use. Human utilization of coastal zones increases.

Connecting and integrating the management of coastal systems with the understanding of their interaction with socio-economic and ecological development, a successful adaptation to the consequences of the climate change could be achieved.

The balanced and integrated management of several ecological, social and economic interests is a fundamental feature of sustainable development. The interactions among the three key elements are important to ensure a balanced assessment of trade-offs and synergies that might exist among those three dimensions.

Ecosystem services and social impacts clarify that they are linked to all three dimensions, especially because the guarantor of human life is the function of ecological systems and the provision of ecosystem services. In other words, sustainability can be described as the equilibrium between supply (environment, ecosystem services) and demand (society) (Slootweg et al. 2001).

Changes in ecosystem services affect human life, to date in and future. It is therefore necessary to develop an appropriate approach to improve the management of ecosystems and to find trade-offs and synergies. This approach should contribute to well-being and the reduction of social impacts caused by changes in ecosystem services.

It is also necessary to give social impacts a high significance. The social impact assessment provides a framework which include social consequences of an intervention and to move towards a more sustainable and equitable environment. The elements of the social impact assessment contribute to a comprehensive view of the effects of interventions. It gives further advices to identify and include social effects of development.

As mentioned above, there is a need for a framework, which integrates both the biophysical and the social environment. Human well-being, which includes social well-being, shall be the objective of planned interventions.

Decision-makers have to find a balance between economic growth and environmental conservation among social development as well as between new developments and sustainability (MA 2003). Therefore, participation, stakeholder involvement, analyses and dialogues as well as community engagement are important parts and should take place at all development phases.

The ongoing interactions with multiple stakeholders promote the identification of crucial ecosystem services, identification of key issues, possible impacts, synergies and trade-offs for decision-making on future land-use management. Decision-making should consider on the assessment of possible impacts. A major objective is to find consensus among the different perspectives of the stakeholders to implement the proposed project.

3. Assessment methodology

The aim of this paper is to assess and evaluate the ecosystem services, social impacts and statements of the stakeholders, addressing the different land management scenarios proposed by the COMTESS research project in an integrated way. Two concepts are addressed: the ecosystem service assessment as well as the social impact assessment.

This chapter is divided into three sections. In the first section, the COMTESS land management scenarios will be described. They will be used as aggregated representations of future ecosystem services. In the following part, the methodology of stakeholder integration in participatory planning processes will be explained to generate data of stakeholder opinions and perceptions. Finally, the method of validating the results will be outlined.

3.1 Scenarios

Scenarios are used in many different fields of work and several definitions exist. Nevertheless, most agree on the following: scenarios describe possible future situations, the pathway that leads to it and contain stories of multiple futures (Bishop et al. 2007, Kosov and Gaßner 2008).

This paper uses the proposed land management scenarios (COMTESS 2010) as a basis for stakeholders to investigate their opinions, preferences, interests and needs. The aim is to introduce the three land management scenarios, applied to the North Sea region Krummhörn in Germany, in order to examine the effects of established and innovative measures for coastal protection (figure 6).

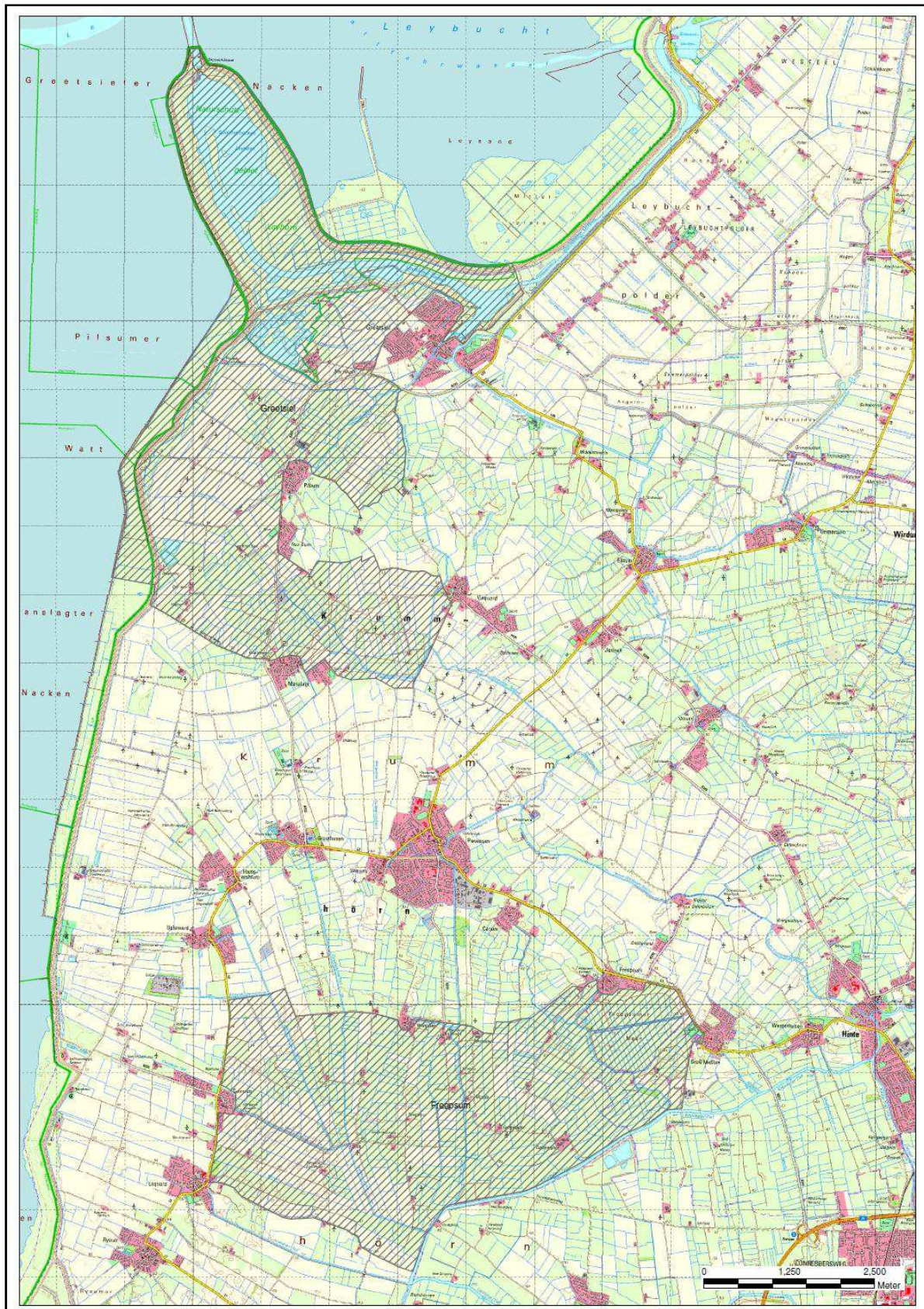


Figure 6: Overview of the COMTESS main study sides in the community of Krummhörn. One of the two main study sides is located on the Freepsumer Meer (south), the second one on the area of Greetsiel (north) (COMTESS 2010).

The first scenario, **“Water management”**, focuses on the establishment of two polders. Open waters and extensive reed stands shall be created. This scenario primarily aims for restricting floods to the polder area in case of increasing precipitation and limited dike overtopping or breaches, using the retained water in dry periods for irrigation measures and the reeds for generating green energy. Additionally, subsurface saltwater intrusion in the area shall be prevented (figure 7(1)) (COMTESS 2010).

The second scenario **“Carbon sequestration”** is similar to the first one. But the rewetted polder areas will be extensively covered by reed fens instead of open water. The aim is to yield active peat formation to store atmospheric CO₂. This corresponds to a “carbon-optimized land management”. Additionally, former natural vegetation shall be restored (figure 7(2)) (COMTESS 2010).

The **“Trend”** scenario focuses on “business as usual”. The region of Krummhörn is primarily used for dairy and agricultural farming. This primary use is complemented by nature conservation and tourism. All activities are supposed to be kept in the future. A challenge will be to prevent their economic and ecologic practicability. Flood events may substantially disrupt the contemporary land use in the future and lead to higher drainage costs which will probably reduce the ecological and economic viability of this land management (figure 7(3)) (COMTESS 2010).



Figure 7: Example how the area could look like according to the scenarios, 1. Water management, 2. Carbon sequestration, 3. Trend.

3.2 Stakeholder involvement

A major task is to investigate stakeholders’ perceptions, opinions and their evaluation of the three proposed land management scenarios. Stakeholders are involved in the participatory planning and refinement of the proposed scenarios. The communication with the stakeholder started with personal conversations and a correspondence (Appendix 1).

The preferences of different stakeholder groups with regards to the three different land management scenarios and associated ecosystem services are analyzed. Together with the stakeholders, concrete and action-oriented suggestions on local and regional level were developed in order to promote sustainable future land use management and strategies.

3.2.1 Stakeholder analysis

A stakeholder analysis for the selected case study site is accomplished. In general, the interviewees have been chosen according to their relevance for the research. The stakeholders will be considered not as individuals but as experts that act as sectoral representatives of a special field of action and have a privileged access to information and responsibility (Meuser and Nagel 1991, Flick 2005, Lamnek 2002). Fourteen local and regional stakeholders of relevance are representatives of the sectors water management, coastal protection, agriculture, nature conservation and tourism (table 2). They cover all relevant fields of decision-making in the community of Krummhörn.

Sector	Water management	Nature conservation	Agriculture	Policy	Tourism
Stakeholder	W1, W2, W3	N1, N2, N3	A1, A2, A3	P1, P2, P3, P4	T1

Table 2: Overview of the interviewed sectors and stakeholders.

The sector water management is represented by three stakeholders. Two experts from the *I. Entwässerungsverband Emden* (W1, W2), which is an autonomic and public corporation. The third expert belongs to the *Deichacht Krummhörn* (W3), which is also an autonomic and public corporation. The experts W2 and W3 still work or have been working in the agricultural sector (see page 32ff.).

The nature conservation sector is represented by three stakeholders. The first expert belongs to the Nationalpark Niedersächsisches Wattenmeer (N1) and the second one represents the biosphere reserve (N2). The third expert is a member of the *NABU* (N3), a German non-governmental organization and registered association. The state recognizes the *NABU* as an ally under the Federal Nature Conservation Act (see page 39ff.).

The agricultural sector is represented by three stakeholders. Two of them belong to the *Landwirtschaftlicher Hauptverein Ostfriesland (LHO)* (A1), one of them acts as representative of the 121 farmers of the community and is also a member of the commission of the *Deichacht* (A2). The *LHO* is a registered association. The third expert (A3) represents the department of the land use planning and rural development as well as the field of the climate and nature protection of the *Landwirtschaftskammer* Niedersachsen, which is an autonomy public corporation (see page 36).

In addition, four experts closely connected to the political sector have been interviewed. The first one is a dignitary (P1) and therefore a highly respected person in the political landscape. P1 is also a member of the commission of the *Deichacht*.

The second one is an administrator working for the county of Aurich. The county is, according to German law, a public corporation. The interviewed expert (P2) is responsible for regional planning,

land use planning and connected projects and aims for a coordination of interests of different fields of action, settlement patterns for example.

The third expert (P3) belonging to the political sector, is a representative of the community and works as a local government administrator. The interviewee is responsible for urban land use planning, the sale of land and bird and nature conservation patterns. The interviewed expert P3 is the only interviewee who has no interest in further participation in the research project.

The fourth expert is a representative of the Domänenamt (P4) which is a state authority. Its task is to administrate the real estate properties (Domänenverwaltung). Additional tasks are the maintenance of the Leysiel retention area, the dike foreland and the leasing of land to farmers, of about 15.000 ha of East Friesland.

The tourism sector is represented by one stakeholder (T1) from the Touristik-GmbH of Krummhörn. The Touristik-GmbH Krummhörn is an independent limited liability company belonging to the community of Krummhörn. Its focus is on the development of a touristic infrastructure related to the administration of touristic marketing.

Only two experts expressed no interest in a further participation within the project; one of them coming from the nature conservation authority on the regional level and one of the Ostfriesische Landschaft, which is a regional association responsible for culture, education and research.

3.2.2 Expert interviews

On the assessment level, stakeholder participation is highly important (figure 5). Local and regional stakeholders of relevance are representative experts of the sectors water management, agriculture, nature conservation, policy and tourism. The experts were interviewed in semi-structured settings between May and August of 2011. Within these questionings, social and ecological concerns were discussed.

Conditions for the semi-structured interviews are principles of “subjective theory” concerning the expert (Flick 2005: 127), the “self-effacement” concerning the interviewer (Lamnek 2002: 165), “flexibility” and “explication” (Lamnek 2002: 167), “communication” (Lamnek 2002: 166), “reflexivity” (Lamnek 2002: 167), and “confrontation-questions” (Flick 2005: 129).

All these principles and fundamental elements can be found in the questionnaire (Appendix 1). In general, the questionnaire is structured into three parts: the first one contains general questions about the background of the expert and opinions about feeling of safety, climate change and sustainable land-use, the second part includes questions concerning the three proposed land management scenarios and the third part focuses on the development of the stakeholder-based scenario. All parts include questions which incorporate answer possibilities with regards to ecosystem services and social impacts.

The basic requirement for an interpretative analysis is the transcription of the recorded interviews. Together with the recorded data the transcription delivers authentic texts which could be verified every time (Mayring 2002, Lamnek 2002). According to Gläser and Laudel (2004) and Meuser and Nagel (1991) the following elements are used for the transcription:

- standard-orthography
- non-verbal statements are only used if meaningful
- notes of linguistic features
- notes of disruptions
- notes of unknowable words
- no use of notation systems
- complete transcription of the record, exceptions only in case of not relevant excursions in form of keywords

The anonymized transcripts of all interviews can be found in Appendix 2. In order to analyze the transcripts, a structured “qualitative content analysis” (“qualitative Inhaltsanalyse”) is accomplished. The approach described by Gläser and Laudel (2004) and Mayring (2002) is used as theoretical guide. Figure 8 illustrates the systematical procedure. Before the analysis of transcripts starts, a system of categories and indicators is developed by using the concepts of ecosystem services and social impact assessment (see next section). This is an essential part of the work because the categories determine the parameters and aspects which shall be extracted and used as guideline for extracting information. Afterwards, the transcripts are divided into analytical fragments. The next step is the interpretation and extraction of information. Raw data are selected, edited and analyzed with regards to the categories. If diverse text fragments fit into the same category, they will be used additionally (subsumtion). Furthermore, it is crucial to work with open categories and to reassure that the process is inductive. This means that by analyzing the transcripts, new categories determined by the stakeholders might be developed. These new categories and indicators are added to the matrices. The analysis is finished when assigning the generated information into matrices of categories and parameters. These matrices will be sector-divided (water management, agriculture, nature conservation, policy and tourism).

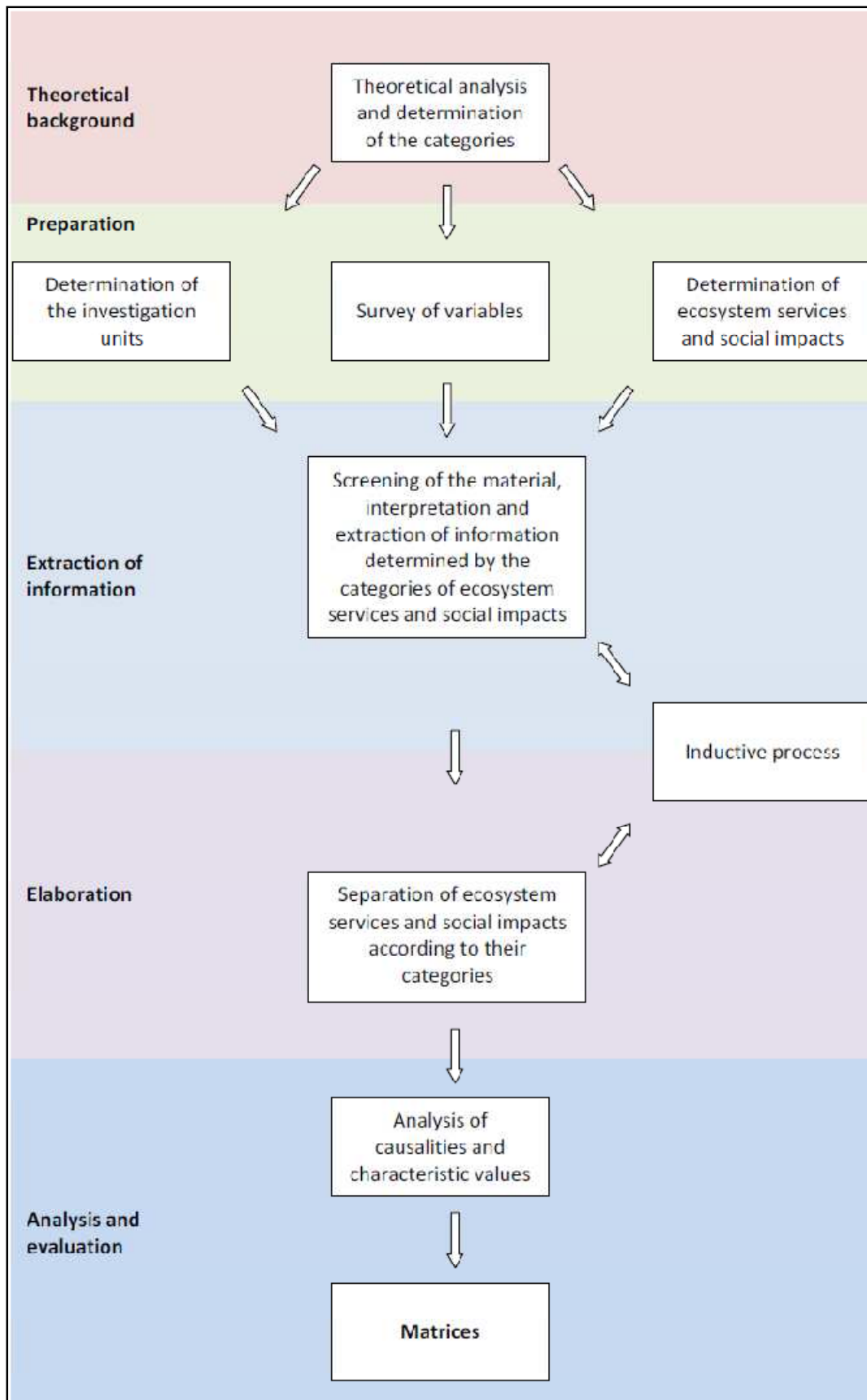


Figure 8: Workflow of the qualitative analysis. Shown are the five work-steps used in the analyzing-process: the theoretical background, the preparation of the extraction, the extraction of information, the elaboration and the analysis and evaluation (according to Gläser and Laudel 2004 and Mayring 2002).

3.3 Theoretical analysis of ecosystem services and social impacts

The social impact assessment is used as a process oriented tool to reach “best practice” with regards to planned interventions (Vanclay 2002). The concept of social impact assessment could be seen as an “umbrella” to deal with changing processes (Vanclay 2003a: 7). The assessment is divided into three different management stages: scoping, profiling and alternatives, according to the “design phase” (Baines et al. 2003: 27) of the social impact assessment (figure 23 and table 3). In every stage of an ecosystem service and social impact assessment, interactive and iterative stakeholder involvement is required.

Scoping	Profiling	Alternatives
Stakeholder participation		
Categorization of ecosystem, Categorization of social impacts, Stakeholder analysis	Examination of baseline data and information	Formulating prospects and options for change

Table 3: The three management phases of the social impact assessment: scoping, profiling and alternatives. Within all stages stakeholder participation is required, according to Baines et al 2003.

The theoretical frameworks of ecosystem services and social impact assessment will be the basis for identifying the parameters: key variables of impacts, identifying key elements of social environment and key social issues, with regards to direct and indirect or direct impacts. The categorization is essential in order to structure the impacts and services and to reduce complexity.

Scoping

In the first process, the scoping, a stakeholder analysis is included (see above). Key issues which the impact assessment should consider and the parameters of ecosystem services and social impacts will be theoretically determined and established. The categorization is important in order to break up the complexity into understandable units. Additionally, the categories are used as guidelines for extracting information out of the expert interviews.

According to the MA (2003), ecosystem services are classified along functional lines and focus on four kinds of services distinguished in provisioning, regulating, cultural and supporting services (table 1).

Each land management scenario implies the prioritization of certain ecosystem services (table 4). The objective is to quantify and evaluate the performance of multiple ecosystem services in each scenario in socio-economic and ecological terms. The table shows hypothesized ecosystem services provided by the three land management scenarios.

Provisioning services	
Food and Fiber	Food production (including plants and animals)
Fresh-water	Freshwater retention for agricultural use
Energy	Green energy production using reeds
Regulating Services	
Water Regulation	Prevention of salt water intrusion
Water Purification	Self-purification of nutrient-enriched water
Erosion Control	Sediment accretion by reed
Cultural Services	
Recreation and ecotourism	Recreation and tourism
Perception of safety	Perception of safety
Supporting Services	
Necessary for the production of all other services	Reduction of GHGs
	Carbon sequestration by peat production from reeds
	Biodiversity of plants
	Biodiversity of birds

Table 4: Ecosystem services referring to the three land management scenarios, proposed by the COMTESS project, according to COMTESS 2010.

With regard to human well-being, the concept of social impact assessment delivers a more detailed framework to evaluate key components of social impacts. For the categorization of social impacts, six different categories are distinguished:

1. Indicative personal impacts,
2. Indicative climate change impacts,
3. Indicative ecological impacts,
4. Indicative landscape impacts,
5. Indicative economic impacts and
6. Indicative development impacts.

Profiling

Within the profiling process, information about the social context is gathered as well as the state of the art. Baseline data are examined. The process contributes to the overall picture of the affected community and therefore provides a broad background for categorizing important ecosystem services and social impacts. Raw data from the literature and the interviews are selected, edited and analyzed using the determined categories. Again, it is important to work with open categories and an inductive analyzing process.

Prospects

The process of formulating alternatives by the stakeholder provides options for future change. The stakeholders give statements about their expectations and aspirations regarding the future.

First, the statements which are named by different stakeholders are filtered out of the interviews. Afterwards, the statements which are similar and named by more than one stakeholder are put into a matrix.

The analysis is finished when assigning the generated information into matrices of categories and parameters. These matrices are sector-divided (water management, coastal protection, agriculture, nature conservation and tourism) and the evaluation is qualitative.

The next chapter provides basic information about the community of Krummhörn with regards to the relevant issues concerning the ecosystem services and social impacts.

4. Study region

This chapter provides an overview on the community of Krummhörn focusing on the relevant issues presented in this paper. The first section deals with the area and history of the region. The second section focuses on the water management. The third one gives insights into the economy of the region, including the topics agriculture and tourism. The issues concerning nature conservation are highlighted in section four.

4.1 Area and history

The community Krummhörn is located between Emden and the Leybucht in the north-western part of Germany (figure 9). It belongs to the state Lower Saxony and the county of Aurich. The region measures 159,21 km² (website Statistisches Bundesamt (a)).

The community was founded in 1972 and is subdivided in 19 villages (figure 9) (further information in Hummerich 1988, Heilscher 1980, Woltmann 2005, Flessner 2008). Since this time, the region is primarily seen as a holiday-, art- and cultural-landscape closely connected to the National Park Wadden Sea. While Pewsum could be described as the administrative center, it is the fisher village of Greetsiel that is better known as a tourist attraction (website Touristik-GmbH Krummhörn-Greetsiel).

In 2010, 12.656 inhabitants lived in the community, which leads to a population density of 79 inhabitants per km². Compared to Lower Saxony, with an average of 166 inhabitants per km², this is rather low (website Statistisches Bundesamt (a), (b)).

Most parts of Krummhörn are located within the marsh. The higher lying Geest surrounds the terrain in the west (Sindowski 1969). The flooding of the marsh has offered a highly productive soil, but it has also endangered life and it still does.

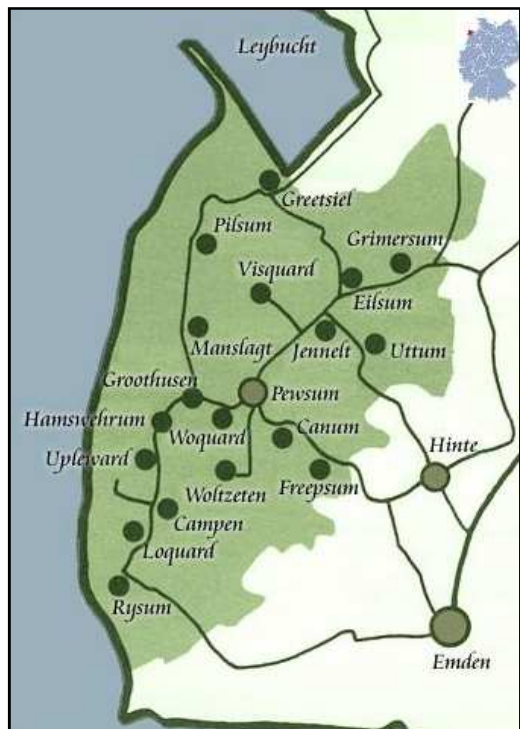


Figure 9: The community of Krummhörn and its 19 villages (website Greetsiel-Krummhörn).

Due to the tidal influence of the North Sea, it is almost impossible to arrange unprotected settlements within the low lying areas. Coarsely clastic material has been deposited since the speed of the water flow has slowed down at the coast. Thus, the banks at the coastline were higher than the hinterland and so the people started to settle on these higher parts of the marsh. For 2000 years, the inhabitants have protected and maintained their settlements and have tried constantly to win new land (Sindowski 1969, Voigt and Roeschmann 1969). Today, one third of the community is below sea level (figure 10 and 11).

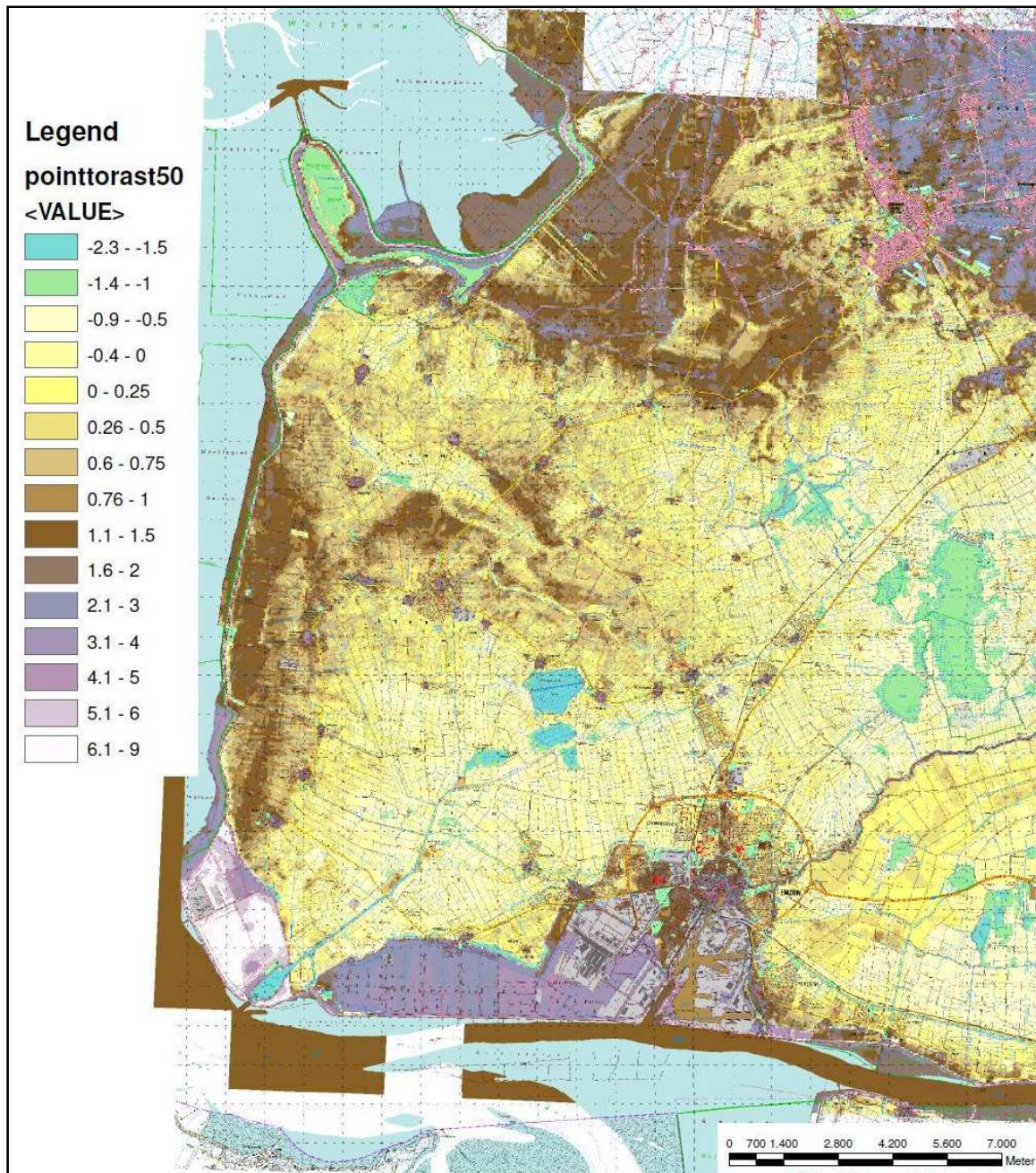


Figure 10: Elevation of the community of Krummhörn. The agricultural hinterland is between 0 m and 1 m above sea level. Most settlements are terp villages ("Wurtendörfer") dating back to early medieval times (elevation ~5 m above sea level), friendly provided by Martin Maier, University of Oldenburg.

The first evidence of human settlement has been provided by findings from the Stone Age and the Roman Empire. The early settlements have been built on dwelling mounds (“*Warften*”) or terps (“*Wurten*”) next to the coastline (website Ostfriesische Landschaft, Schmid 1969). First dikes date back to the 11th century. Flood protection in form of dikes and dwelling mounds was the concern of individual families or communities (Oltmanns and Frick 2005, Reinhard 1969).

4.2 Water management

As a shory region, Krummhörn and its people have always been confronted with the North Sea’s impacts. The sea has taken land away and the people reclaimed land back for resettlements. The entire dyke line has been exposed to the force of the sea for centuries; there were especially severe storm events occurring the southwest, west and northwest (Wilken 2003).

Big floods in 1374 and 1377 made the Leybucht gain its greatest extent. By building new dikes, 10.000 ha of land have been reclaimed. The last land reclamation was done in the last century by the building of the Störtebeker-dike in 1950 (website Deichacht Krummhörn (a)).

Since 1961, new plans to improve the agricultural structure and coastal defence of the Leybucht exist, promoted by the severe floods in 1962 and 1976. The plan of a closure of the Leybucht by dikes has been rejected. After a long planning period, the new dike line and coastal defence zone now unite interests of nature protection, tourism, agriculture and crab-fishery, ecology and economy of this region. In 1991, the new coastal protection of the Leybucht was finished. In 2000, the dike closure between the Leybucht and the Störtebeker-dike was completed (website Deichacht Krummhörn (a)).

In the past, agriculture was strongly constrained by floods and high groundwater levels. Until the beginning of the 20th century, water-mills were used for drainage (Kramer et al. 2004, Oltmanns and Frick 2005, Reinhard 1969). Today, the entire region is supplied with a system of drainage canals (figure 11). The project COMTESS focuses on the area of Freepsum. The Feepsumer Meer has been drained in the 18th century. It is the deepest point in Lower Saxony, lying up to 2,50 m below sea level. Today, it is well used agricultural grassland.

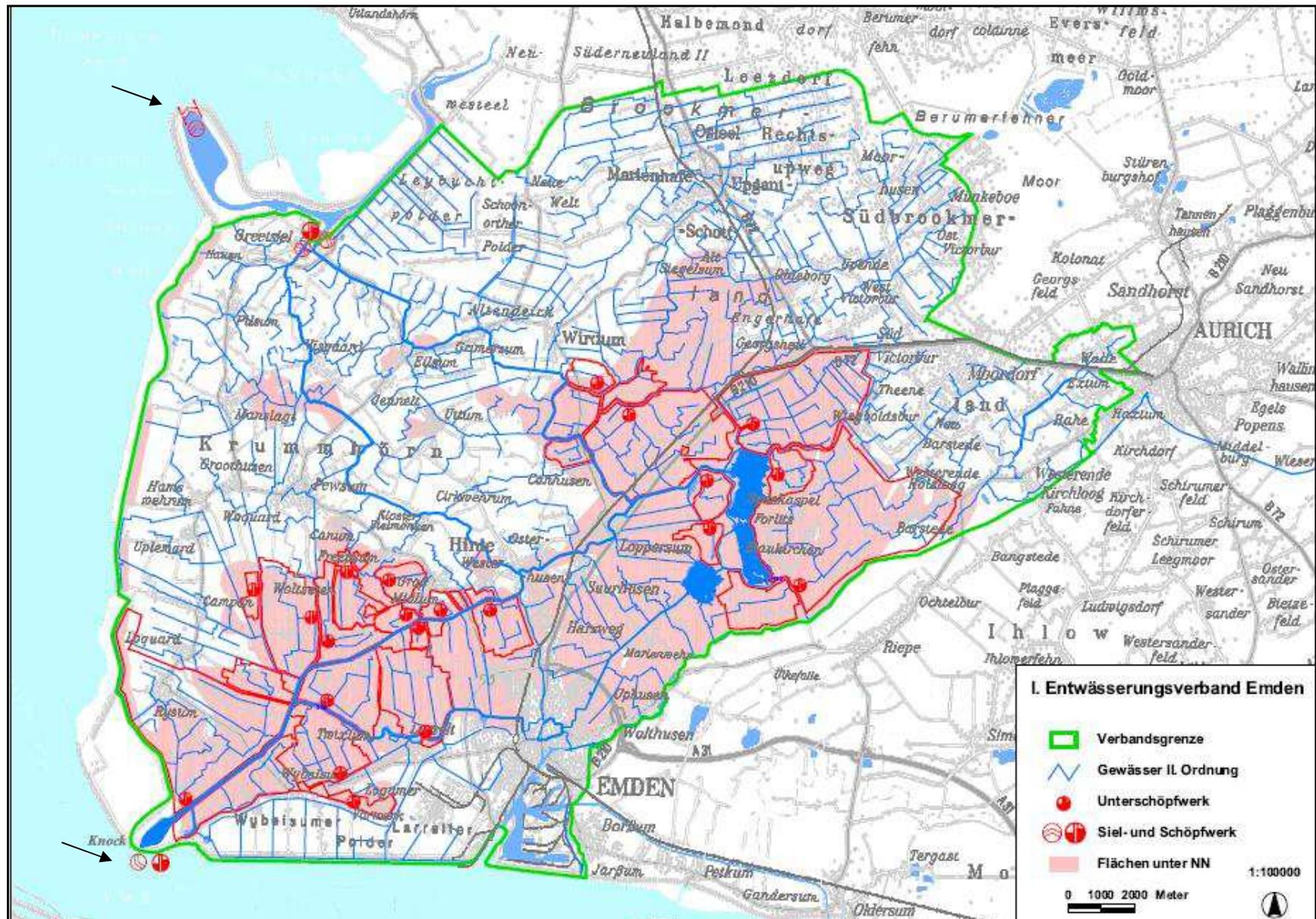


Figure 11: Area of the I. Entwässerungsverband Emden. The pink areas are below sea level. Waters of the 2nd order are marked with blue lines. "Unterschöpfwerksgebiete" are marked with red dots. The sewages are located at Emden Knock and Greetsiel, marked by arrows (website I. Entwässerungsverband Emden).

Entwässerungsverband Emden

Within the last decades, the water management of the region has been improved. New techniques, the renewing and modernizing of existing structures and a healthy management contributed to that. The *I. Entwässerungsverband* Emden has a long tradition. It was founded in 1879 (Kramer et al. 2004).

The *I. Entwässerungsverband* is responsible for the maintenance of the waters of second order with the associated sewers (“*Siele*”) and pumping stations according to the Lower Saxony Water Act (Nds.GVBl. Nr.5/2010, further information website Recht Niedersachsen (b)). The catchment area measures 49.000 ha (figure 11). The *I. Entwässerungsverband* finances itself by members’ contributions and subsidies (Kramer et al. 2004).

Without a proper drainage, the whole region would suffer from flooding. With the help of the *I. Entwässerungsverband* Emden, the remaining problems could be confined. In 1969, the sewer and pumping station Emden Knock was put into operation. The second sewer and pumping station of the community of Krummhörn is located in Greetsiel (figure 11). At Emden Knock, 50 % of precipitation is drained by the sewer and 50 % by pumping. In Greetsiel, 10 % of precipitation is drained by the sewer and 90 % by pumping. The water storage reservoir “Leyhörner” (300 ha) is the “*Vorflutweg*” of both, the *I. Entwässerungsverband* Emden with 11.000 ha and the *Entwässerungsverband* Norden with 24.000 ha (Kramer et al. 2004).

The overall net of drainage systems (including canals and creeks) contains 958 km waters second order and 142 km waters third order, with 220 km of waters used for shipping. Because of the geographical conditions (figures 10, 11), low water levels are necessary. During winter times, the *I. Entwässerungsverband* ensures a water level of 1,40 m below sea level and in the summer time it is supposed to be at 1,27 m below sea level (Kramer et al. 2004, W1).

Every year, the drainage systems are purified with a mowing bucket, every fifth year the systems are desludged. In addition, every 20 to 30 years the canals and creeks are dredged. Another task of the *I. Entwässerungsverband* is the periodic maintenance of the systems, the technical equipment and the extension and maintenance of the waterways. In order to avoid erosions, reed is used as bank reinforcement which promotes rich natural habitats and serves as flood protection device (Kramer et al. 2004, W1).

Deichacht Krummhörn

The *Deichacht* Krummhörn was founded in 1963, according to the Lower Saxony dike Act (Nds.GVBl. Nr.6/2004, further information website Recht Niedersachsen (a)). The *Deichacht* is responsible for the maintenance of the dikes, associated constructions and the dike foreland. The maintenance is promoted by the four dike-sheep farms, the annual disposal of the dead plant material from the dike foreland ("*Teek*") as well as the control of the dike twice a year ("*Deichschau*"). Another task of the *Deichacht* is the disaster control, which steps in when the predicted water level exceeds the mean water level by 1,70 m. Everyone, who lives below 5,00 m above sea level has to pay contributions depending on the reteable value (0,4 %). Additionally, the *Deichacht* obtains subsidies (website *Deichacht* Krummhörn (b), W3).

The dike line of the *Deichacht* passes the East Frisian coast from the northeastern end of the Störtebeker-dike (Leybucht) to Borssum (Emden). It is about 55 km long and between 6,50 m and 8,80 m high (NLWKN 2007, website *Deichacht* Krummhörn (c)).

Since dike protection remains an ongoing process, a heightening and strengthening of the dike is necessary. Currently, the dike at Emden is under improvement (website *Deichacht* Krummhörn (d), Hangen 2003).

4.3 Economy

The region of Krummhörn is primarily used for agricultural purposes, but tourism has also become a huge and increasing source of income.

4.3.1 Agriculture

As mentioned before, agriculture is the most important sector in the region. The type of agriculture depends on the soil conditions. In Krummhörn, two different kinds of marsh-soil can be distinguished. The old-marshes provide good conditions for grassland and are used for dairy farming and for the extraction of forage (Rüther 1999). The areas of young-marshes with fecund clay soil provide good conditions for arable land. The old-marshes are rather attractive for dairy farming (Kelletat 1999).

In 2007, there have been 151 agricultural holdings with a land use area of 12.916 ha. In contrast, due to structural changes in the agriculture, in 2010 there have been 129 agricultural holdings with a land use area of 12.530 ha. The main use of the 129 holdings is arable land with 4765 ha crop land (4131 ha cultivated wheat). Two agricultural holdings cultivate maize, but the acreage is of statistical secrecy. Another important agricultural branch is livestock farming with 109 holdings, using 2/3 of the area as grassland (LSKN 2010a, 2010b, 2010c).

Landwirtschaftlicher Hauptverein Ostfriesland

The *Landwirtschaftlicher Hauptverein Ostfriesland (LHO)* was founded in 1849, it acts as a substitute for the agricultural and rural development. The association provides a wide range of services. It aims for an agricultural and a political representation of interests. In this context, the *LHO* tries to influence political decision-making on local, regional and federal level. The *LHO* supports its members with advices and assistances regarding specified services, like insurances for example. In addition, the formation of opinions, education, press and public relations as well as the improvement of the image are of interest. The association's main interest is to improve the quality of life of the living and working people (website LHO, A1).

Landwirtschaftskammer

The *Landwirtschaftskammer* is an administrative authority. It cooperates closely with the communities and administrative districts of the region. Similar to the *LHO*, the *Landwirtschaftskammer* acts as a substitute for the agricultural interests (A3).

4.3.2 Tourism

Especially in the summer, Krummhörn is a popular tourism region. The cultivated and unique landscape with its typically historical settlements is characterized by intense agriculture and grassland areas, networks of canals and drainage systems and dikes. Especially, the wide and open landscape promotes the recreational value of the region.

The expansion of the tourism sector will be important for the region's future. Figure 12 shows the designated priority areas for tourism and recreation, according to the RROP (2004) ("Regionales Raumordnungsprogramm" – regional planning program). It aims for an increasing economic prosperity and resilience of the region. The turquoise area is Greetsiel and already a hotspot of tourism. The only area which is excluded is the village Pewsum, which is used as administrative center of the community.

The importance of the tourism for the economic prosperity of the region becomes obvious when looking at the numbers of visits. Most tourists visit the region between May and October, with a high peak in August (website LSKN 2011). The community of Krummhörn registered more than 400.000 overnight stays and at least 1.000.000 day tourists in 2010. Numerous of cultural and entertaining events have contributed to the community's name as a holiday, art and cultural region. Greetsiel is the hotspot of tourism but the whole region provides over night stay possibilities. Typical activities are boat tours, activities provided by the national park house and cultural sightseeing (T1).

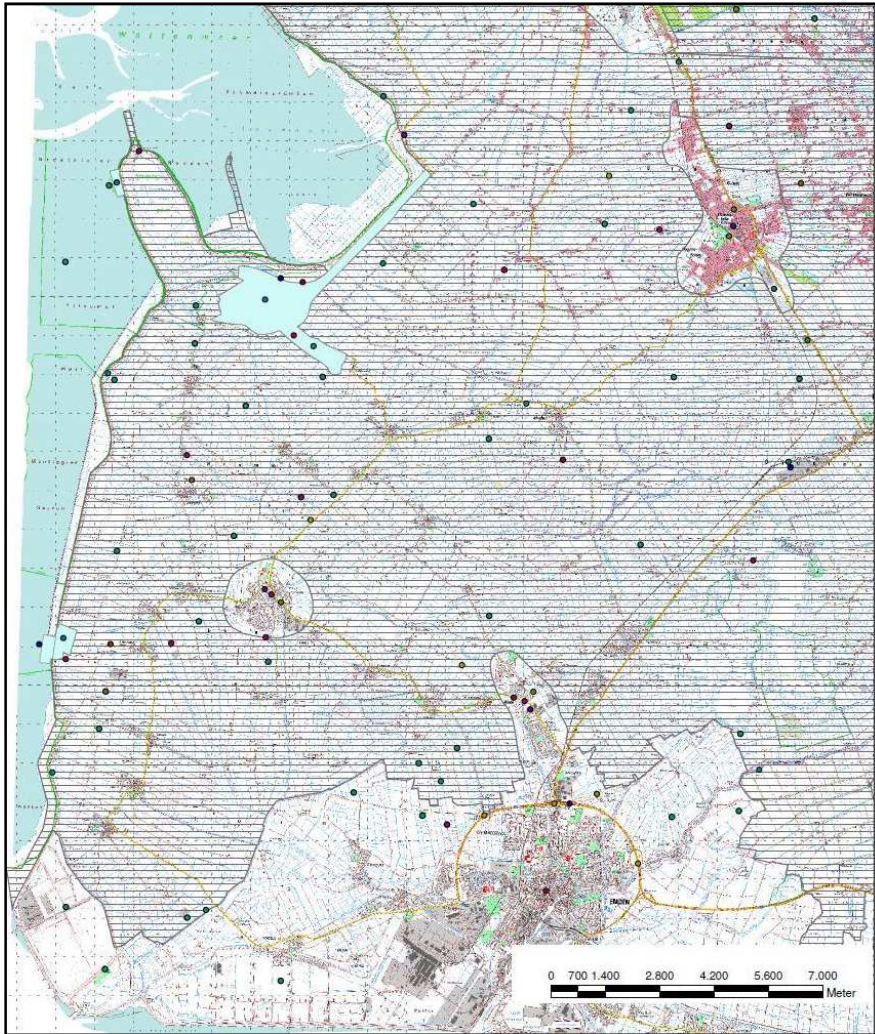


Figure 12: Designated priority areas for tourism and recreation, marked by the stripes (RROP 2004).

4.4 Nature Protection

The natural potential of the whole region is high. Since 1994, the area of Leyhörn has been a nature protection zone as well as an important drainage area for the region (figure 13, 14, 15). The area of 650 ha evolved due to dike building measures and includes 400 ha of newly built biotopes. Therefore, former areas of agriculture and green land have been redeveloped and disturbing factors like shipping, recreation areas or land reclamation areas have been removed. The summer polder Hauener Hooge provides an area for compensation measures (Potthoff 2006, website NLWKN).

East Friesland provides rich habitats for rare bird species. 5779 ha are designated as areas under the Directive on the conservation of wild birds (2009/147/EC) and Directive on the conservation of natural habitats (92/43/EEC) (figure 13), from Leyhörn following the dike line to Emden, including inland areas between Greetsiel and Pewsum (website NLWKN). In the dike hinterland, the marsh regions are of ecological significance for bird species like Lapwing (*Vanellus vanellus*), Black-tailed Godwit (*Limosa limosa*) and Redshank (*Tringato tanus*) (N3).

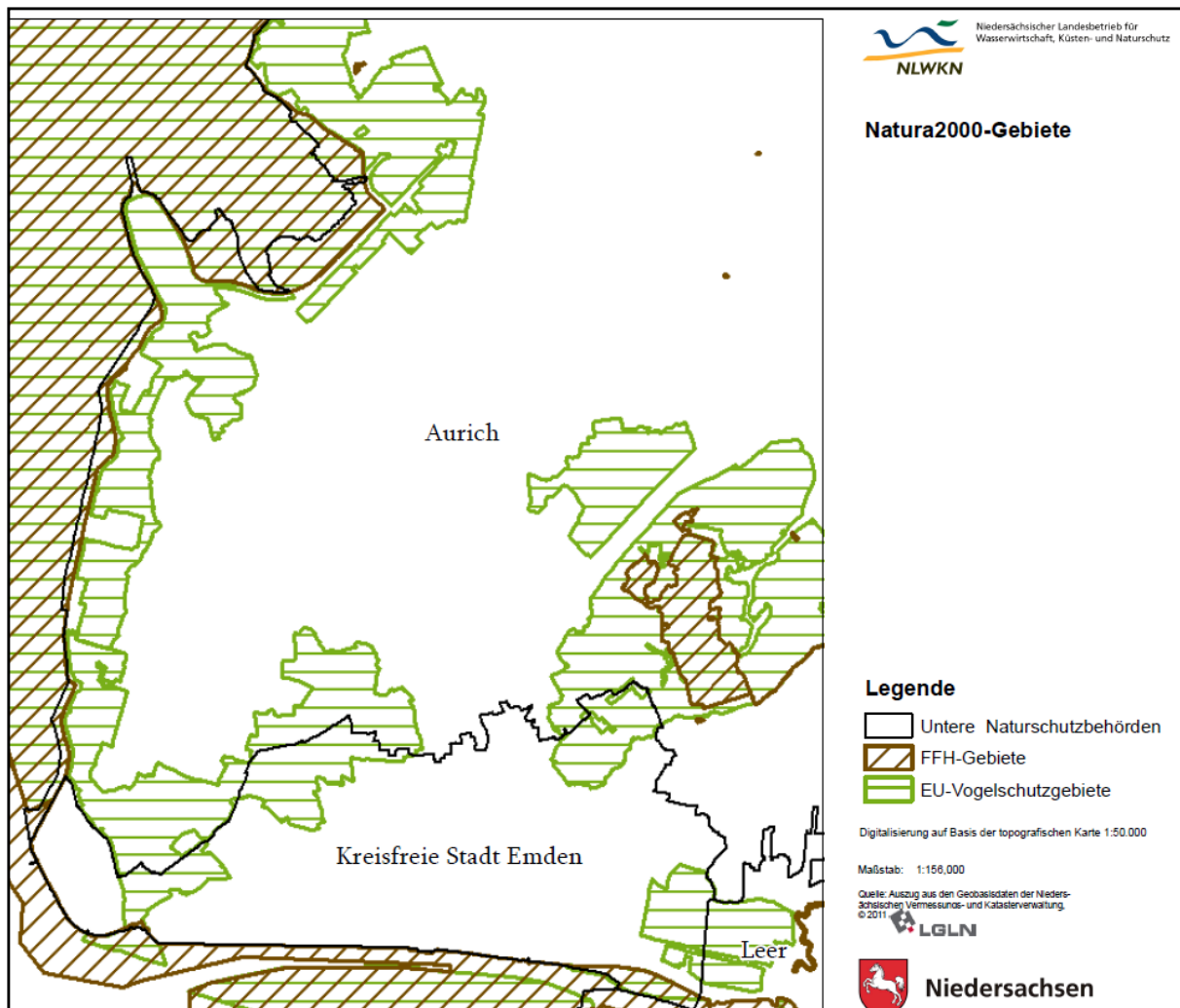


Figure 13: Areas designated according to the Directive on the conservation of wild birds (2009/147/EC), marked by green stripes, and according to the Directive on the conservation of natural habitats (92/43/EEC), marked by brown stripes (website Niedersächsisches Ministerium für Umwelt und Klimaschutz (a)).

During the winter, tens of thousands of geese rest in the community of Krummhörn. But intensive farming includes that huge machines are used on the fields as well as fertilizers and this leads to a decline of the habitats. In addition, a strongly drainage of the region might lead to the loss of habitats. The Lapwing and the Black-tailed Godwit are under serious threat and found at the top of the Red List (website NABU Ostfriesland (b)). While some birds prefer grasslands and open landscapes, others like reeds better. Rare species resting in the region are the Great Bittern (*Botaurus stellaris*), the Spotted Crake (*Porzana porzana*) (both at the top of the Red List), the Savi's Warbler (*Locustella luscinioides*) and the Bearded Reedling (*Panurus biarmicus*) (N3, website NABU Ostfriesland (b)). The community of Krummhörn provides a broad range of national, regional and local areas which are valuable concerning breeding birds and migratory birds (figure 14) (website Niedersächsisches Ministerium für Umwelt und Klimaschutz (a)).

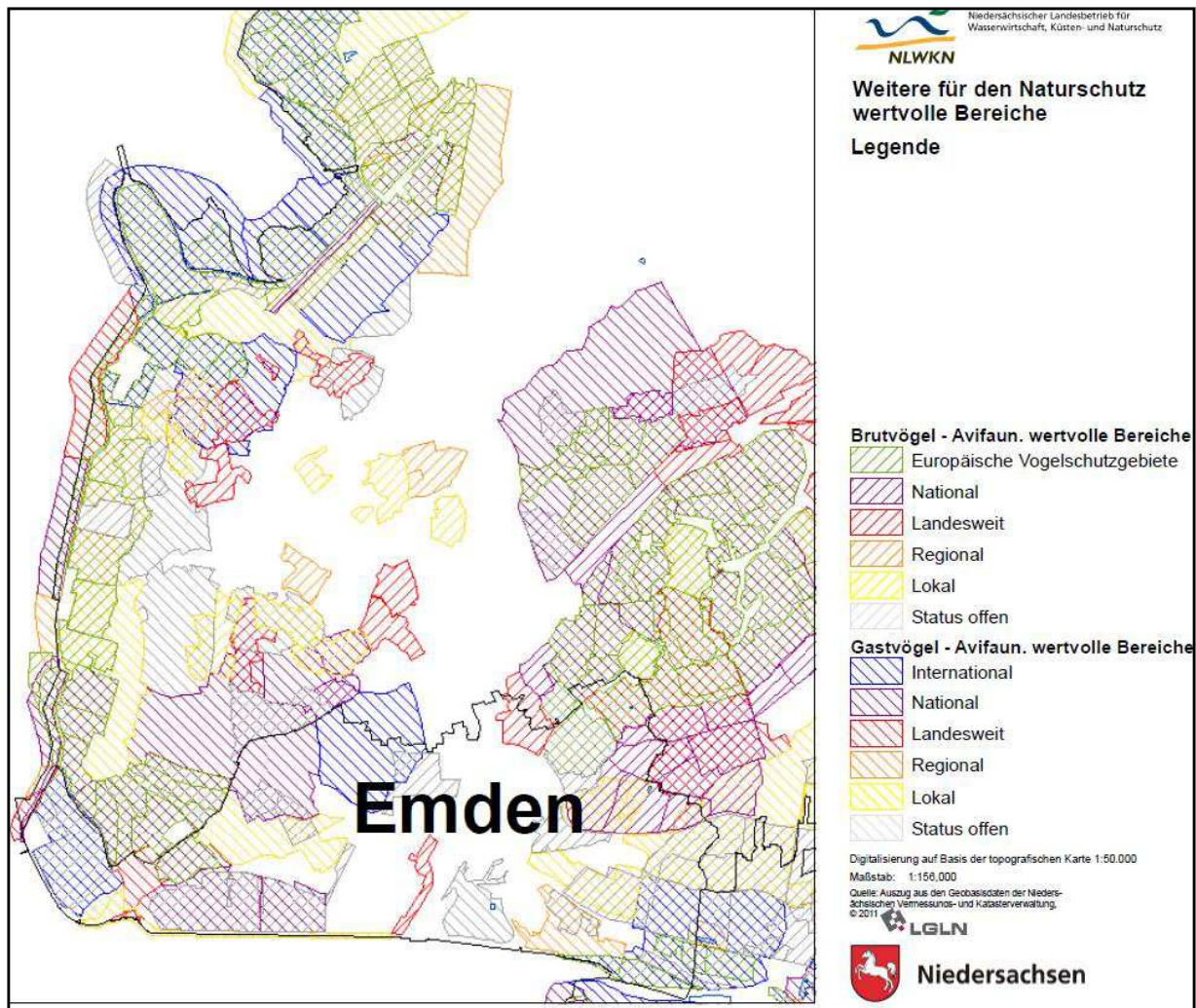


Figure 14: Valuable areas for nature conservation. The community of Krummhörn provides a broad range of national, regional and local areas which are valuable concerning breeding birds and migratory birds, marked by stripes (website Niedersächsisches Ministerium für Umwelt und Klimaschutz (a)).

Nationalpark Niedersächsisches Wattenmeer (Wadden Sea National Park of Lower Saxony)

Various protection areas have been established within the Wadden Sea. One of them is the *Nationalpark Niedersächsisches Wattenmeer*, founded in 1986 (figure 15). The National Park administration in Wilhelmshaven is in close cooperation with the Lower Saxony Ministry for Environment and Climate Change as well as numerous local authorities and organizations (website Nationalpark Wattenmeer (b)).

Since 2009, the worldwide unique Wadden Sea belongs to the UNESCO World heritages. The conservation area starts at the dike's seaside. Within these 3.500 km² of conserved and protected areas (thereof 92 % waters), natural processes are allowed to continue and the biological variety of the plant and animal species is to be maintained and conserved (website Niedersächsisches Ministerium Umwelt und Klimaschutz (b), website Weltnaturerbe Wattenmeer).

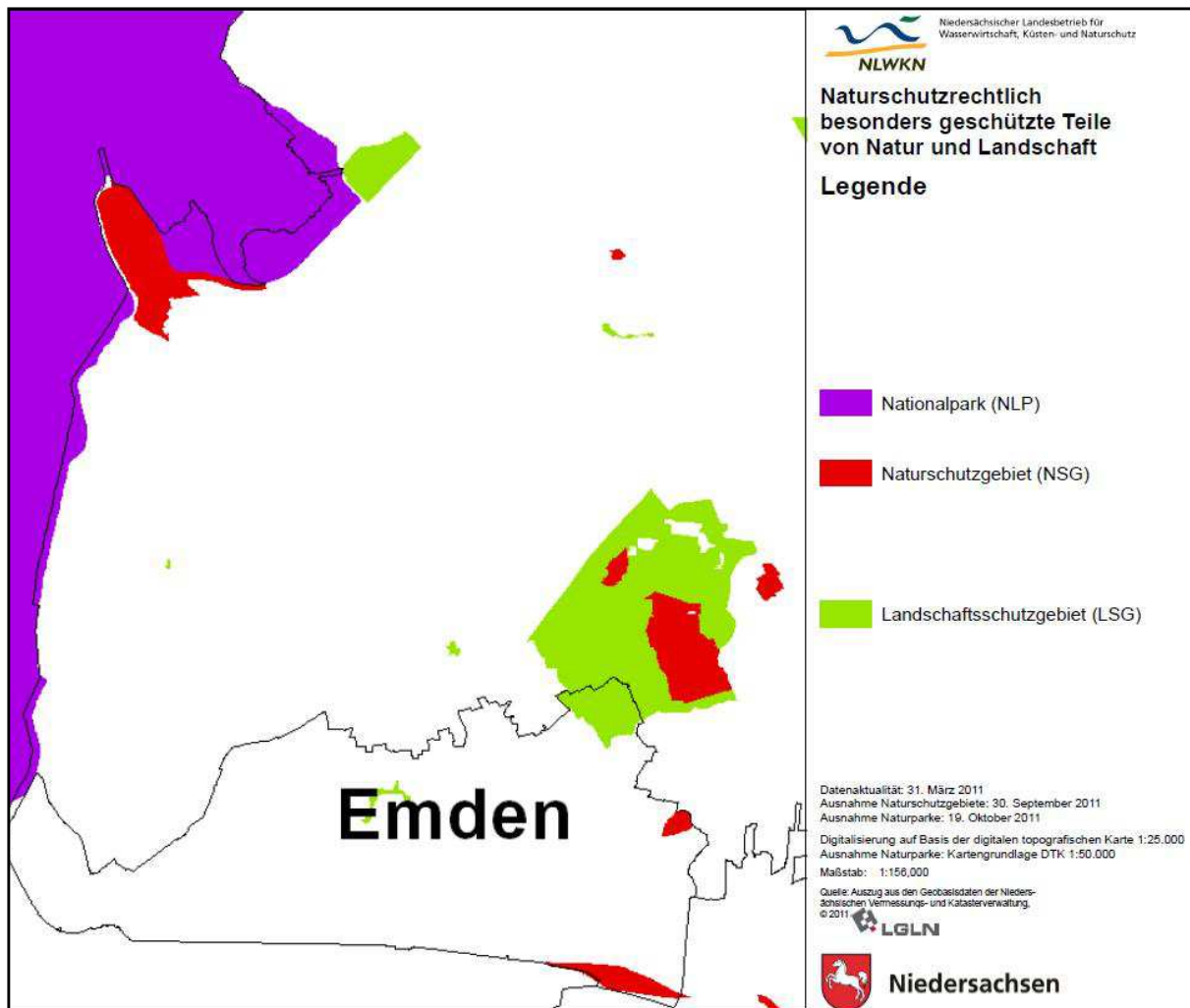


Figure 15: National Park Niedersächsisches Wattenmeer (purple) and nature protection area (red) of the community of Krummhörn. A small area located on Groothusen is designated as landscape protection area (website Niedersächsisches Ministerium für Umwelt und Klimaschutz (a)).

Biosphärenreservat (Biosphere Reserve)

The Wadden Sea National Park of Lower Saxony has been declared as a *Biosphärenreservat* by the UNESCO in 1992. Responsible for its support is the National Park administration. Biosphere reserves protect landscapes from destructive interference and maintain and develop valuable habitats for people and environment. They aim for a sustainable development and for the assurance of a balance between human use and natural cycles. The biosphere reserves provide exemplary findings for research and science, basing on the interactions of natural and social processes (website Nationale Naturlandschaften, website Nationalpark Wattenmeer (a)).

Currently, there is the need to work on strategies for a sustainable land use. On the basis of the wadden areas, the *Biosphärenreservat* will expand into the hinterland and create new development zones. In the future, the region of Krummhörn is planned to be developed as biosphere reserve (N1).

Naturschutzbund Deutschland e.V. (NABU)

The *NABU* aims for nature protection and a sustainable development since 1899. The tasks of the *NABU* include concrete nature conservation projects and environmental education. It acts as an informant and advisor for the public and provides political decision-makers with important issues of environmental protection and nature conservation (website NABU, website NABU Ostfriesland (a)).

The next chapter presents the results. They are generated by analyzing the interviews. The stakeholders' opinions, preferences and needs are extracted with respect to ecosystem services and social impacts resulting from the project.

5. Results

The aim of this research is to investigate the stakeholders' perceptions and opinions on ecosystem services and social impacts concerning the proposed land management scenarios and the accomplishment of the stakeholders' prospects concerning the future development. Furthermore, ecosystem services which are not proposed by the COMTESS project are defined. The semi-structured interviews are used to investigate the stakeholders' positions, interests and needs. Ecosystem services (tables 6a-d) and social impacts (tables 8a-f) have been extracted with the help of the expert interviews. The stakeholders gave statements related to the scenarios which help to complement the scenarios (tables 9a-c). In each table those ecosystem services, social impacts and statements have been evaluated which have been mentioned by more than one stakeholder.

5.1 Ecosystem services

The ecosystem services have been categorized according to the Millennium Ecosystem Assessment (2003). Ecosystem services which are proposed by the research project COMTESS are grey; those with relevance for future land-use management are italic and red. The others are relevant today and in future. The different sectors have different colors.

Based on the interviews, the degree of relevance of each ecosystem service has been determined (table 5). It is divided to "high relevance" (++), "relevant" (+) as well as "not relevant" (-). Impacts which have not any evaluation have not been named by the stakeholders. The determination of social impacts (tables 8a-f) helped to define the relevance of ecosystem services (tables 6a-d).

High relevance (++)	<ul style="list-style-type: none"> - services which were directly named as high relevant - services which were named more than once in different contexts and / or were strongly emphasized
Relevant (+)	<ul style="list-style-type: none"> - services which were directly named as relevant - services which were mentioned during the interview
Not relevant (-)	<ul style="list-style-type: none"> - services which were directly named as not relevant
No evaluation	<ul style="list-style-type: none"> - services which were not named by the stakeholders

Table 5: Evaluation criteria for ecosystem services.







5.1.1 Provisioning services

Provisioning services include the products which are achieved from ecosystem services (MA 2003). The COMTESS project proposes three provisioning services. Two of them, “freshwater retention for agricultural use” and “green energy production using reeds”, are of future but not of contemporary (table 6a). Table 6a shows eight more provisioning services relevant for the region. They have been proposed by the stakeholders.

Category	Provisioning services	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Food and Fiber	Food production	++	++	++			+	++	++	++	++	++	++	++	
	Grassland	++	+	++	++	++	++	++	++	++	++	++	++	++	
	Extensive grassland use				++	++	++	+	++		+				
	<i>Use of dike and dike foreland</i>		++	++	+				++	++	++			-	
	<i>Reed for industry</i>	+	-			+	+	++	-	+			+	+	
Freshwater	<i>Freshwater retention for agricultural use</i>	+	-	+		++		+	-	++	-	+	+	-	
	<i>Drinking water abstraction</i>				+	+				+			+		
Energy	Green energy production using crop	++	+	++	++	+	+	-	-	-	++	++	++	+	+
	Green energy production using other materials	+		+				+	+	+	+				
	<i>Green energy production using reeds, (+) = if it is possible</i>	(+)	-	-	-	(+)	(+)	(+)	-	+	(+)	-	-	-	(+)
Natural medicine	Pharmaceutical plant			+						+					

Table 6a: Evaluation of the provisioning services by the stakeholders.

Legend: ++ = high relevance, + = relevant, - = not relevant, red and italic = of future relevance

Colors:  = proposed by COMTESS,  = Water management,  = Nature conservation,  = Agriculture,  = Policy,  = Tourism

The service “food production” includes plant and animal materials used as food or for the production of food. In order to evaluate the relevance of this service, statements about the necessity of food production, the maintenance of agricultural land and the guarantee of food supply in the future have been taken into account. Especially, the stakeholders of the sectors “water management”, “agriculture” and “policy” mentioned a high relevance for food production, today and in the future. The service “grassland” includes areas for dairy farming and areas for animal food production. In order to evaluate the relevance of this service, statements about the importance of grassland, the maintenance of grassland and its ecological significance for biodiversity have been taken into account.

In the last decades, the characteristic grassland types with their plant and animal communities have declined due to the intensive use of agricultural land. Some stakeholders, especially in the nature conservation sector, appreciate the increasing “extensive use of grassland”. The extensive use of grassland incorporates grazing-projects for example.

The dike foreland provides rich biotopes and habitats for rare plant and animal species and is of high importance for nature conservation. In the past, the dike-foreland was used as agricultural land. Nowadays, only four dike-sheep farming institutions, supported by the *Deichacht*, exist. In the future, the “use of dike and dike foreland” might play a role for agricultural processes in form of grazing projects.

In the future, the service of using “reed for industry” might increase. Reed can be used for roofs thatching and it provides material for industrial purposes.

Prospectively, the service “freshwater retention for agricultural use” might become necessary due to the expected increase of drought periods. This service has been discussed focusing on the establishment of polder areas to store water in wet periods and its use for irrigation measures in case of dry periods. The stakeholders’ opinions are not uniform. Freshwater might also be used for the service “drinking water abstraction”.

Today, crop farming increases in the area of renewable energy. Commercial energy crops are typically densely-planted. Energy is generated by converting the silage to methane. In the region of Krummhörn, maize is used increasingly as energy crop. In order to evaluate the service “green energy production using maize” statements about the relevance of biogas plants and the planting of maize have been taken into account. All sectors expect that the relevance of this service will increase in the future.

There have also been statements about “green energy production using other materials”. In the community of Krummhörn, there are test-fields with *Miscanthus*, *Pennisetum purpureum* (elephant grass) and sugar beets (W3, A1, A2, P1). It is investigated whether these plants provide enough energy for power generation. Rapeseeds are used for oil and energy (biodiesel) generation. Contemporary research figured out that the use of *Teek* has no relevance for energy extraction (W1, W3, P2).

In the future, the service “green energy production using reed” might provide a new possibility to generate renewable energies. Therefore, the reed will be mowed and used for biofuel or biogas. New possibilities of using reed for energy generation are in research progress. According to the stakeholders, this service is the only provisioning service which has no relevance or limited relevance in the future.

The service “pharmaceutical plant” refers to the cultivation of *Silybum marianum* (Marian Thistle). The medical parts of the plant, the ripe seeds, can be used for the cure of liver diseases for example (w3). In the region of Krummhörn, more than 1000 ha are cultivated with this plant as “contract agriculture”.

5.1.2 Regulating services

Regulating services include the benefits of regulating of ecosystem processes (MA 2003). The COMTESS project proposes three regulating services (table 6b). One of them, the “prevention of saltwater intrusion”, is particularly of future interest. The table 6b shows four more regulating services relevant for the region proposed by the stakeholders.

Category	Regulating Services	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Water Regulation	<i>Prevention of salt water intrusion</i>	+	++	-		++		+	-	++	+	++	++		
	<i>Hazard regulation by water retention</i>	++	+	++	+	+	+	++	+	+	+	+	+	-	+
Water Purification	Self-purification of nutrient-enriched water	+	+	+			+	++		+					
Erosion Control	Sediment accretion	++					+			+				+	
	Using reed for stabilization	++		+											
Regulation of human diseases	<i>Human pathogenes</i>									+	+	+			
Storm protection	Salt marshes			++			+		++	+					

Table 6b: Evaluation of the regulating services by the stakeholders.

The relevance of the service “prevention of saltwater intrusion” is twofold. On the one hand, due to the increasing sea level and summer droughts, the groundwater reservoirs might be reduced. This might lead to an increasing salt water intrusion into the groundwater. On the other hand, the rising sea level might lead to dike overtoppings and therefore to salt water intrusion in the hinterland. In order to evaluate the relevance of this service, it has been discussed whether it is necessary or not to protect the hinterland in case of dike overtoppings. Another point of interest was the consideration of a possible salt water intrusion into the groundwater.

Prospectively, the timing and magnitude of water runoff and flooding might be influenced if land uses change. The service “hazard regulation by water retention” has been discussed focusing on the establishment of polder areas to store water in times of extreme events. The polder areas might reduce the pumping activities and pressure on drainage systems to drain the region of Krummhörn. Additionally, in case of dike overtoppings, the intrusion of saltwater might be restricted to these polder areas. All stakeholders (except for one) consider this service as relevant in the future.

Ecosystems help to enhance the water quality. The service “self-purification of nutrient enriched water” focuses on the filtering function of the reeds. In Krummhörn, organic wastes introduced into inland waters by agriculture, settlements and due to the high density of birds (especially geese) are filtered out and decomposed by reed stands in particular.

The service “sediment accretion” is evaluated by statements about the functions of reeds and their tendency towards sediment accretion.

Another service, “using reed for stabilization”, includes that reeds help to prevent erosions and landslides of the drainage systems. The cultivated reed stands are used as bank reinforcements. This is seen as one important task and has a high relevance for the water management sector.

Changes in ecosystems lead to changes in the abundance of human and plant pathogens. Within the service “human pathogens” it has been discussed whether or not pathogens like mosquitoes or fungi might occur more often due to their possibly increasing fitness which results from new water levels. In order to evaluate the relevance of this service, skeptical statements about increasing abundances of pathogens and invasive species have been taken into account.

The service “salt marshes” is an important part of the coastal protection system. It has been evaluated by statements about the functions of the salt marshes leading to sediment accretion in the Wadden Sea. Due to depositions of new sediment layers, the mudflats are growing about 1 cm per year. The salt marshes provide wave attenuation effects (Witting et al. 2004).

5.1.3 Cultural services

Cultural services are determined by nonmaterial benefits people obtain from ecosystems. They are connected to people’s behavior and values (MA 2003). The research project COMTESS proposes the services “recreation and tourism” and “perception of safety”. The cultural services are strongly connected to social impacts. Within this paper, the proposed service “perception of safety” is characterized by feelings and experiences and not connected to ecosystem services. Therefore, it is not evaluated as an ecosystem service but as a social impact in this paper. Three cultural services have been additionally proposed by the stakeholders (table 6c).

Category	Cultural Services	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Sense of place	Community identification and connection	++	++	++	+	+	++	++	++	+	++	+	++	++	+
Aesthetic value	Landscape	+			++	++	++	++	+	++	++	+	++	++	++
Recreation and ecotourism	Recreation and tourism	++	+	+	+	+	+	++	+	++	++	++	+	+	+
	Ecotourism	+	+		++	+	++			+	+		++		+

Table 6c: Evaluation of the cultural services by the stakeholders.

The existing ecosystems provide different landscapes with individual elements and characteristics; for example mosaics of cultivated areas and structural elements like waterways. The service “community identification and connection” refers to the people’s attachment to the area. In order to evaluate the relevance of this service, statements about the community and its ecosystems, the willingness to live there and the relations among traditionally aspects as well as traditional land use have been taken into account.

Aesthetic values may be found in the various aspects of ecosystems. The service “landscape” is highly relevant. It is related to the service “community identification and connection”. The stakeholders refer to the east Frisian characteristics of the cultivated and unique landscape such as typical and historical settlements, intense agriculture and grassland areas, networks of canals and drainage systems and dikes. Especially, the wide and open landscape with its typical ecosystems is the main characteristic of the community of Krummhörn.

The service “recreation and tourism” bases on the natural and cultivated characteristics of the region. This is why tourists visit the area and decide to spend time for resting and relaxing as well as for refreshment and recreation opportunities. The community of Krummhörn provides the tourists a broad range of possible activities which are closely related to the ecosystems and attract tourists. Especially the broad range of different and rare bird species is characteristic for the region. The national park Wadden Sea provides an unique landscape. All stakeholders predict that the attractiveness of the region will lead even more tourists into the area.

The same aspects can be found in the service “ecotourism”. In contrast to conventional tourism, ecotourism tries to eliminate a negative influence on the environment by enhancing the awareness concerning nature and ecosystems. The national park Wadden Sea and other protected areas, like the bird conservation areas, offer opportunities for ecotourism. It is a future challenge to strengthen and promote projects like these. This is of special interest for the nature protection sector.

5.1.4 Supporting services

Supporting services are necessary for the production of all other ecosystem services. These services have an indirect character compared to provisioning, regulating and supporting services which have a more direct and short-term character (MA 2003). The services “reduction of greenhouse gases” and “carbon sequestration” belong to the supporting services because of their long-term character in this research. All services in table 6d are proposed by the COMTESS project, except for “quality of the soil”.

Category	Supporting Services	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Necessary for the production of all other services	Reduction of GHGs	+	++	++	++	++	++	+	++		+	++	+		+
	Carbon sequestration by peat production from reeds	+	-	-	+	+	+	-	+	+	-	-	-	+	-
	Biodiversity of plants	++	++	+	++	++	++	++	++		++	+	+	++	++
	Biodiversity of birds	++	++	+	++	++	++	++	++		+	+	+	++	++
	Quality of soil		++	++	++	++	++	++	++	++	++			+	

Table 6d: Evaluation of the supporting services by the stakeholders.

The “reduction of greenhouse gases” is of global interest. In order to evaluate the relevance of this service, statements about the necessity of reducing CO₂ on global and local scale have been taken into account.

One possibility reducing the CO₂ concentration in the atmosphere is “carbon sequestration by peat production from reeds” by the mineralization of soil organic matter. According to some stakeholders, there is one problem with this service. They think that it takes too long. Nevertheless, other stakeholders still regard it as relevant because of its nature protection characteristics.

Biodiversity is of huge interest in the community of Krummhörn. The stakeholders refer to the importance of “biodiversity of plants” and “biodiversity of birds” for the region. The conservation of biodiversity provides the basis for many other services and the maintenance of ecosystems. Biodiversity enhances the agricultural conditions and the aesthetic values of the landscape for example. Additionally, the maintenance of the habitats, the national park and the protected areas is important.

The service of maintaining the “quality of soil” is of high relevance, too. It is evaluated by statements about the high fertility of the soils. Especially the young-marshes provide advantageous conditions for agricultural use, whereas the old-marshes provide beneficial conditions for grassland use.

5.2 Social impacts

Tables 8a-f show different categories of social impacts. Social impacts are effects and consequences of a project or intervention which are felt or experienced in a corporal and psychical way and influence human well-being (Vanclay 2002, Burge 2003). Furthermore, social impacts refer to the stakeholders' aspirations, fears, perceptions and behavior. An evaluation of whether the social impact is of positive or negative nature has been done with the help of the interviews. The evaluation is divided into "very important and/or positive" (5), "not relevant and/or negative" (1) as well as "very important and negative" (5*) and "not relevant and positive" (1*). Furthermore, 0 represents "uncertainty". The evaluation criteria are shown in table 7. Impacts which have not been mentioned by the stakeholders do not get any evaluation.

5 or 5*	Special emphasis, more than once named in different contexts
4 or 4*	Not as strong as 5 or 5*
3 or 3*	intermediate
2 or 2*	Not as strong as 1 or 1*
1 or 1*	Special emphasis, more than once named in different contexts
0	Uncertainty
No evaluation	Impacts which were not named by the stakeholders

Table 7: Evaluation criteria for the social impacts. Numbers with a * are inverse to the other ones.

5.2.1 Indicative personal impacts

The category of "indicative personal impacts" relates to the stakeholders' community identification and connection (table 8a).

Category	Social impact	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Indicative personal impacts	Attachment to place	5	5	5	3	2	4	5	5	4	5	3	4	5	3
	Obligation to ancestors and traditions	5	5	5	4	5		5	5	5	5	4	4		4
	Participation in decision-making	4			5	5	5	5	5	5	4	4	2		4
	Positive effects of interventions	4	4		5	5	5	3	5	5		4			3
	Need for long-time view	4	3	4			4	4	5	5	4	3	3	3	3
	Trust in policy		2	2			2	2	3		4				
	Trust in the <i>Deichacht</i>	4		4		4			4		4		4		4

Table 8a: Indicative personal impacts determined by the stakeholders.

Legend: 5 = very important and/or positive, 1 = not relevant and/or negative,
 5* = very important and negative, 1* = not relevant and positive,
 0 = uncertainty

Colors: = Water management, = Nature conservation,
 = Agriculture, = Policy, = Tourism

Eleven of the fourteen stakeholders were born and raised in the community of Krummhörn. Therefore, their identification with the community and the “attachment to place” is high. The stakeholders are rooted in East Friesland and they feel comfortable in the landscape.

In addition, the “obligation to ancestors and traditions” is an important point. The people of East Friesland feel strongly connected to their traditions and history. This is especially true for flood protection measures. They are afraid that the land their ancestors reclaimed from the sea might be taken back again. In addition, the stakeholders fear that the current structure will be endangered by new projects.

Active “participation in decision-making” is highly important to every stakeholder, except for one. It is seen as an obligatory for further project process. For most of the stakeholders it is important that the project has “positive effects” as well as positive outcomes for all participants and provide a “long-term view”, also in terms of personal aspiration goals.

Trust is one element of social well-being with strong social effects. On the one hand some stakeholders do not “trust in politicians” because they fear negative effects of policy making. On the other hand, all of them think highly of the *Deichacht* (“trust in the *Deichacht*”).

5.2.2 Indicative climate change impacts

The category of “indicative climate change impacts” relates to the social impacts caused by the climate change (table 8b). Furthermore, it addresses the climate change’s impact on future land use from the stakeholders’ perceptions.

Category	Social impacts	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Indicative climate change impacts	Climate horror scenarios		1	1			2	1		1		2			2
	rising sea level	3*	3*	3*	4*	4*	0	0	0	0	4*	3*	0	0	0
	Increasing droughts (not is region)	1	0	3*	(3)*	(4)*		0	1	(3)*	0	(3)*	2	(3)*	0
	Increasing inland water levels (extreme rainfall)	3*	(3)*	3*	(4)*	(5)*	(4)*	0	(3)*	3*	3*		3*	0	0
	Current perception of safety	4	3*	5	4*	4	3	5	4	4	4	4	4	3	4
	Future perception of safety (after 2050)	3*	4*	3*	5*	3*	4*		3		3*	3*	3*		
	Need for adaption measures	3		4	3	3	3	4	3	4	3	3	3	3	2
	Impacts on populated areas	0	0	0		0	4*	0	0	0	0	3*	0	0	0
	Impacts on agricultural areas	0	0	0		0	4*	0	0	2	0	0	0	0	0

Table 8b: Indicative climate change impacts determined by the stakeholders.

Climate change is a controversial issue. The social effect of “climate horror scenarios” is represented in each sector. The stakeholders are afraid that the climate change is exaggerated and shown in form of horror visions, especially by the media. Furthermore, the stakeholders are afraid of fundamentalist and extreme courses of actions.

The effects of a “rising sea level” have been evaluated in different ways. The stakeholders of the water management sector report a measureable rise of the sea level but they do not expect any harsh effects. One representative of the nature protection sector is sure that the sea level will rise. The other two representatives are not sure about coming developments. The agricultural sector expresses uncertainty, too. The evaluation of the interviewees representing the political sector shows uncertainty and anxiety towards the expected sea level rise. One shared opinion is that in case of an increasing sea level the effects will be negative for the region.

The evaluation of the impacts of “increasing droughts” is differential. Concerning East Friesland, the stakeholders do not expect harsh consequences caused by droughts. But they refer to other regions, like Mecklenburg-Western Pomerania (W2), where impacts are already felt.

The evaluation of the impacts caused by possible “increasing inland water levels” shows almost the same picture. It is characterized by negative effects and uncertainty. Some stakeholders worry about negative impacts of increasing extreme rainfalls events during winter time.

The “perception of safety” is different regarding floods caused by the sea and inland waters and it must be evaluated with regards to two different time periods. The current and mid-term perception of safety is generally regarded as important and positive which means that the stakeholders have a feeling of safety. Two stakeholders of the environmental conservation sector do not feel safe because of the current development of the climate change in combination with existing flood protection measures. In contrast, the “future perception of safety” shows a different picture. While the stakeholders feel presumably safe in the present, they express concerns when looking into the far future.

All stakeholders see the “need for adaptation measures” concerning the climate change and they have positive aspirations towards them. In general, there is uncertainty about the “impacts on populated areas” and “impacts on agricultural areas” caused by the climate change. Two stakeholders share the opinion that populated areas will suffer from the climate change. One stakeholder sees negative and relevant effects for agricultural areas, whereas another one has the perception that the effects of the climate change are not relevant and might even be positive for the region.

5.2.3 Indicative ecological impacts

The category “indicative ecological impacts” relates to the feelings and aspirations about environmental issues (table 8c).

Category	Social impacts	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Indicative ecological impacts	Nature conservation and protection	4	5	4	5	5	5	4	4	3	3	3	3	4	4
	New biotopes, new species		4		5	5	4	4					4	4	
	Overgrown areas				4	4					3*	4	4		3*
	Organic management, sustainable use of resources		5		5	5	5	5	5	4			3		
	Nature conservation has to be open	3	3	4	4	3	2	3	4	4	4	4	4	3	4
	Tourism combined with nature protection measures	4	4		5	4	5		4	4	4		5		4

Table 8c: Indicative ecological impacts determined by the stakeholders.

“Nature conservation and protection” is important for most of the stakeholders. In the community of Krummhörn, this is especially true for the areas under the Directive on the conservation of wild birds (2009/147/EC) and the Directive on the conservation of natural habitats (figure 13). The stakeholders share the positive aspiration that in the future “new biotopes” might be developed and “new species” might migrate due to the development of newly protected areas. The nature protection sector and representatives of the political sector think positively about the establishment of “overgrown areas”, whereas one stakeholder of the political sector and the tourism sector have the feeling that these wilderness might have negative impacts.

An “organic management” is desirable and positive as well as a “sustainable use of resources”, in particular for the nature protection sector and agricultural sector.

In dependence on the stakeholders’ expectations concerning nature conservation, “nature conservation should be open”. This means that the restrictions concerning entering specific areas, like parts of the Leybucht, should be eased. Additionally, the creation of nature protection areas and nature protection measures shall be balanced and harmonized with the various forms of land use. These effects are regarded as positive by most of the stakeholders and only seen negatively by one representative of the nature conservation sector. Nevertheless, all stakeholders believe that “tourism combined with nature protection measures” is important and positive.

5.2.4 Indicative landscape impacts

The category “indicative landscape impacts” relates to the aesthetic quality of the landscape, the livability and how the stakeholders feel about their surroundings (table 8d).

Category	Social impacts	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Indicative landscape impacts	Aesthetic quality	3			4	4	4	4	3	4	4	3	4	4	4
	Cultural-historical values						3	4				4			5
	increasing aesthetic by more water	4	3		3	3	2		3	0	2	0		2	3
	Increasing aesthetic by different forms of land use (mosaic structures)	3			3	4	3		3	4	0	4	3	4	3
	Presence of tourists			3*			5*		3*		4*	3*		3*	

Table 8d: Indicative landscape impacts determined by the stakeholders.

In the stakeholders’ opinion it is relevant and positive to maintain the (current) “aesthetic quality” of the landscape, including the aesthetic quality of the places and recreational opportunities. Furthermore, the maintenance of the village structures and their “cultural-historical values” contributes to the positive aesthetic quality. This is especially important for the tourism sector.

Perceptions of the “increasing aesthetic by more water” are divided. If the countryside’s aesthetic increases with more water areas is controversial. The stakeholders would prefer “different forms of land use” and mosaic structures.

Some stakeholders regard the “presence of tourists” negatively. This is especially true for the area of Greetsiel.

5.2.5 Indicative economic impacts

The category “indicative economic impacts” relates to social impacts in terms of economic activities, material well-being and prosperity of the community (table 8e). In general, financial support is seen as positive.

Category	Social impacts	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Indicative economic impacts	Economic prosperity and resilience of the region & regional marketing	4	4	4	4	5	5	5	5	5	5				4
	Security of income			4	4	4		4	5	5	5		4	4	4
	Diversity of economic activities	3	3	3	3	3	3	4		4	5	3			
	Cultivation depends on market situation			4			4	3	5	4	4		3		
	Effects of rising costs for drainage (acceptance depends on the amount of costs)	(2)		2	0	(3)	3	(3)	1	1	2	2	2	2	
	Subsidies (agriculture and water management)	5		5	3		5	5	5	5	5	4		4	
	financial compensation of land owners in case of resettlement	4				4	4	4	5	5	5	5			
	Presence of tourists for economy	4		4		4		4	3		4		3		4
	Property values	4	3			4	3	4	5	4	5	4	4	4	4
	Property rights	4	3			3	3	3	5	4	5	4	4	4	4
	Structural change in agriculture			2	0		3	0	3	3*	4*	4*		4*	5*

Table 8e: Indicative economic impacts determined by the stakeholders.

The “economic prosperity and resilience of the region” combined with “regional marketing” as well as the “security of (future) income” are very important aspects and regarded as positive for most of the stakeholders. The “diversity of economic activities” is evaluated as intermediate; from the perception of the agricultural sector and policy sector, a diversity of the activities is important. An important factor is that the “cultivation depends on the market situation”. Therefore, the cultivation is influenced by market prices and determined by the economy.

In the stakeholders’ opinion, “effects of rising drainage costs” are not relevant in the future and have no negative impacts on the community. Some stakeholders think that the acceptance of increasing costs might depend on the rising level.

“Subsidies” for agriculture and water management are very important and enhance development, today and in the future. Subsidies are very important instruments of the water management and the agricultural sector.

In the stakeholders’ opinion, it is very important and preferable that the land owners will obtain “financial compensation measures in case of resettlement” when changes concerning their land occur. This is also true for financial compensation measures in case of profit cuts due to for example bird damages.

Krummhörn’s economy benefits from the “presence of tourists”. Especially pensioners like to spend their time and money in the region (W3, T1).

In the future, changing conditions in land use might lead towards changing conditions concerning “property rights”, “property values” and might lead to an increasing “structural change in agriculture”. The property values are expected to increase. Property values and property rights are regarded as important, especially by the political and agricultural sectors.

The effects of structural changes in agriculture have been evaluated in different ways. On the one hand, the stakeholders of the water management sector and nature protection sector report a positive feeling concerning this structural change. On the other hand, the agricultural sector and the political sector think that structural changes in agriculture play an important role. They evaluate them negatively. In their opinion, agricultural holdings suffer under the structural change.

5.2.6 Indicative development impacts

The category “indicative development impacts” relates to expected effects of changing land use as well as the perceptions and aspirations of the stakeholders concerning new projects and new developments in general (table 8f). Similar to the supporting ecosystem services, these impacts are the basis for the already described changes and impacts.

Category	Social impacts	Sector													
		W 1	W 2	W 3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Indicative development impacts	Sustainable land use	5	5	3	5	5	5	5	5	5	4	4	4	4	4
	Security of food and drinking water supply	4	5	5			5	5	5	5	4		5	5	
	Placement of new land use measures	4	4	3	4	4	4	4	3	4	4	4	3	4	3
	Fear of resettlement and expropriation	3*	4*				4*		4*		4*	3*			
	Fear of losing land and perspectives	5*	4*	4*	4*	4*	4*	5*	5*	5*	5*	5*	4*	4*	4*
	Competing land-use	4*	4*	4*	4*	4*	5*	5*	5*	5*	4*	5*		4*	
	Maintenance of agricultural land and grassland	3	5	5	4			5	5	5		4	4	3	4
	Intensive animal farming			4*			5*	4*	3*	2	4*	3*		3*	
	Increasing crop monocultures	4*	4*	4*		4*	4*	2	1	1	3*	3*	3*	4*	3*
	Effects of sealed natural ground	4*	4*	4*				4*					4*		
	Infrastructure	4*	4*	3*	3*					4*	4*		3*	3*	4*
	Need of new special-purpose machines	3	3		3	3			3	3		3	3	3	

Table 8f: Indicative development impacts determined by the stakeholders.

In order to evaluate the impact of “sustainable land use”, statements about the stakeholders’ needs for balanced economic, ecological and social developments in the future have been taken into account. In the future, a sustainable development will have positive effects.

The “security of food and drinking water supply” is regarded as a future challenge. With regards to the increasing (world-) population it is very important to make ensure that food and drinking water supplies are available. This goal must be considered when developing regional development schemes and regional marketing.

An overarching role plays the “placement of new land use measures and strategies”. It is important for the stakeholders that all interests and needs are considered, that they can participate in decision making, that the processes are transparent and that new measures are not established too easily.

With regards to a changing land use in the future, some stakeholders are afraid of “resettlement and expropriation” because of new developments. In addition, every stakeholder expresses the “fear of

losing land and perspectives” and they consider this as an important issue. In the stakeholders’ opinion, these social effects of an intervention are negative.

Today, there is already a “competing land use” and the stakeholders expect that this will increase in the future.

The region is mainly used as agricultural land and grassland. The “maintenance of agricultural land and grassland” is important for the stakeholders, especially for the agricultural sector, and enhances the economic prosperity, the landscape value and the traditional land use of the region. Furthermore, agricultural land and grassland provide areas valuable for nature protection.

Some of the stakeholders, except for one of the agricultural sector, are afraid that the intensive “mass animal farming” will increase in the future. Additionally, the stakeholders see negative impacts of “increasing crop monocultures”. This issue is very important. Especially the increasing cultivation of maize for the generation of bio-energy is regarded as problematic. The stakeholders of the agricultural sector nevertheless think that the increase of the monocultures will not play a significant role, but an increase could lead to negative impacts.

In the stakeholders’ opinion, new developments will have negative impacts on the existing “infrastructure” and the existing infrastructure will have negative impacts on new developments. There might be an increasing demand of infrastructure and its adequacy has to be ensured. Today, the “effects of sealed natural ground” are problematic and might increase in the future. The sealing of natural grounds leads to irrecoverable loss of land and an increasing water runoff which have to be dealt with.

With regards to the establishment of water retention areas and “water storage” in the community, some stakeholders are uncertain about how much water can actually be restored. Additionally, they are unsure if the effects and existing infrastructure are sufficient and economically feasible. This leads to the next point. In case of reed cultivation, the stakeholders refer to the “need of new special-purpose machines”. The stakeholders see a need for new infrastructure and are uncertain if the measures are economically feasible.

5.3 Statements

The analysis of the interviews shows that stakeholders from different sectors share the same opinions on many themes discussed within the interviews. This common ground supports and complements the images of the proposed land management scenarios and the development of the stakeholder-based scenario. With the statements as common ground, a specification of problems, needs and alternatives is possible. Proposals that have been mentioned by only one stakeholder and can be characterized by sector-specific issues have not been included in the tables 9a-c, but are integrated into the discussion.

The tables 9a-c show that in some points the opinions and perceptions of the stakeholders are similar and sector-overlapping. Other statements were highly sector specific. The most impressive consensus can be seen in table 9c: all stakeholders prefer a multifunctional land use and changes are only possible in small areas.

Summing up the results it becomes obvious that the stakeholder come up with more ecosystem services than the COMTESS project suggests. In every category, additional ecosystem services have been named. In addition, the stakeholders mention a lot of social impacts which influence their behavior and well-being. The statements given by the stakeholders enhance the understanding of their interests and needs. Furthermore, the statements lead to a better picture of the scenarios. In general, the results show a consensus between the different sectors. Only a few significant differences are distinguishable. In the next section, the different focal points of the stakeholders will be examined.

In conclusion, it becomes obvious that it is crucial to always take the stakeholders' wishes and needs into account when developing new strategies because their willingness to adopt these innovations increases by their level of participation within the research process. Another result is the awareness of the strong connection between social impacts and ecosystem services. This finding will be discussed in the following chapter.

Scenario	Statements	Sector													
		W1	W2	W3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Water management and Carbon sequestration	Only the area of Freepsum is relevant as retention area and for rewetting. This is of particularly interest for tourism.	X	X				X		X	X	X			X	
	The population will not accept a rewetting of Freepsum		X	X								X	X		
	Greetsiel is a higher lying area. It is not up for debate as polder region. It is engaged in agriculture and provides fertile soils.	X	X				X				X			X	
	Land use change is only in small areas possible		X	X	X	X	X		X	X	X		X	X	X
	The drainage systems are good and there is a capacity for more water, but costs will increase.	X	X	X			X		X		X		X	X	
	Polders are useful to relieve flooding	X		X						X	X				
	Water management with polder areas would be desirable in low lying areas without settlements and industry, if no damage is caused. (*=Temporary, ^=negation)	X	X*	X	X	X	X	X*	X^		X*	X*	X*	X*	
	Fluctuations in water levels of the polders would have adversely effects on nature conservation. Need for right conditions. The reed is negative for some bird species.	X			X	X	X								
	Rising water levels may be retained in existing drainage structures.			X					X				X		
	Increasing construction of rain storage reservoirs in settled areas	X	X					X					X		
	Technical strengthening of the drainage system: wind-water-mills, construction of a wind turbine to generate energy for drainage.	X	X								X				
	Technical strengthening flood protection: coastal protection by dikes (with concrete, asphalt, sheet pile wall), building of a second dike line			X				X	X		X	X	X	X	X
	Increasing fishery in polder areas and sea ¹	X		X		X	X	X		X					X
	Uncertainty concerning water storage capacity of polder ¹	X	X				X	X	X						
	Biogas plants are in competition with food production, without subsidies they are not feasible. They are not sustainable ¹	X	X		X	X	X	X		X	X		X	X	
	Peat formation takes too long time ²			X				X							
Grassland stores CO ₂ and there is uncertainty if the balance of reed concerning CO ₂ storage is more effective ²		X		X		X					X				

¹: Only relevant for the water management scenario, ²: Only relevant for the carbon-sequestration scenario

Table 9a: Statements of the stakeholders addressing the scenarios "Water management" and "Carbon sequestration".

Colors:  = Water management,  = Nature conservation,  = Agriculture,  = Policy,  = Tourism

Scenario	Statements	Sector													
		W1	W2	W3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Trend	East Friesland is a man-made landscape and not natural.							x	x	x	x	x	x		x
	When the coastal protection is continued like today there will be safety	x	x	x			x	x	x		x				
	The scenario-areas will always be valuable. In case of climate change, other plants will be cultivated or there will be grassland or livestock management. The utilization will be similar like today.			x				x	x	x	x	x		x	
	Agriculture without global nutrient fluxes as well as balanced nutrient fluxes is preferable		x				x	x							
	Freepsum should be used as compensation-pool	x	x				x				x				
	Increasing nature conservation on contractual basis („Vertragsnaturschutz“) and increasing cross compliance						x	x	x	x					
	Production integrated compensation							x		x					
	Eviction for conservation areas should be lifted, barring a problem for acceptance (*=negation)		x	x	x*			x			x		x		x
	Quality assurance of nature protection areas, expansion of Natura2000 sites				x	x	x								
	Tourism will continuously evolve. Different possibilities will evolve further, like bicycle routes, (artificial) dunes landscapes and beaches, water tourism, art, leisure residents etc.	x	x	x	x	x		x	x	x	x	x		x	x

Table 9b: Statements of the stakeholders addressing the scenario "Trend".

	Statements	Sector													
		W1	W2	W3	N1	N2	N3	A1	A2	A3	P1	P2	P3	P4	T1
Perceptions	With regard to history there has always been variability in climate change	x	x	x		x	x	x	x				x		
	In future, a multifunctional land use is necessary. This means the combination of flood protection (polder), nature conservation, agriculture, renewable energy and tourism. In future, diversity and mosaic-structures are preferable. A symbiosis between different forms of land use.	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Land use change is only in small areas possible		x	x	x	x	x		x	x	x		x	x	x
	Development of small land use maps				x	x									
	Opportunities and risks must always be weighed	x			x	x	x						x		
	Something has to happen before someone will act						x						x		
	Values of different land uses have to be calculated, it is important that a surplus value exists, land use has to be economically advantageous			x	x	x	x		x	x		x			x
	Creation of a natural landscape as a market instrument, using terms such as world natural heritage, promote sustainability				x	x	x								
	Increasing use and expansion of renewable energy (wind, water, solar)		x					x		x	x	x	x		
	Development of Freepsumer Meer as recreational area and link it with nature conservation	x		x						x	x				
	Reclaim land from the sea by the creation of polders			x					x	x	x	x			
	Land subsidence (via drainage and Kavernen)		x	x	x	x		x	x				x		

Table 9c: Perceptions of the stakeholders addressing the future development of the region.

6. Discussion

In order to investigate the connections between ecosystem services and social impacts as well as to discuss the three proposed land management scenarios, the stakeholders' opinions, interests, perceptions and needs have been extracted out of the interviews.

This section is divided into three parts.

In the first section, the linkages and interconnections of ecosystem services and social impacts are discussed (tables 6a-d and 8a-f). The results extracted out of the interviews were put into a scientific context using an integrative model. This model shows the dependency of the social impacts and the ecosystem services.

Beside the indirect social impacts which influence one category of ecosystem services, the direct social impacts influence primarily one singular ecosystem service. The interviewees describe ecosystem services as either actual relevant or not and provide information about the positive or negative character of an ecosystem service. Furthermore, some stakeholders do not actually mention directly one ecosystem services. They only focus on the social impact. This is why the social impacts are used to determine the relevance of the ecosystem service.

The second part of the discussion focuses on the proposed land management scenarios: namely "water management", "carbon sequestration" and "trend". The scenarios are evaluated and allocated with arguments. In order to do this, the statements shown in table 9a-c have been used. Additionally, sector- and expert-specific knowledge has been taken into account. This section concludes with statements about the stakeholders' prospects and desires of a favorable development of the region of Krummhörn.

The third part discussed the used method of stakeholder integration in the integrative planning process.

Within the discussion, arguments mentioned by the stakeholders are used. Sometimes the arguments are not exclusively limited to a single ecosystem service, social impact or scenario. Therefore, the discussion varies in describing the details. The statements are not necessarily reflecting the addresser's opinion. Only when it is of particular interest, the interviewee is named. The tables 6a-d and 8a-f show the commonness of the stakeholders' opinions. The statements (table 9a-c) are used to outline their opinions.

6.1 Combination of ecosystem services and social impacts

The term “social” is a part of the ecosystem assessment but it needs a closer consideration into the framework. With regards to human well-being, the concept of social impact assessment delivers a more detailed framework for the evaluation of the key components social impacts.

Problems are generated by a separation of ecosystem services and social impacts which both influence and are influenced by each other (figure 4). Therefore, the results are combined into an integrative framework. After an analysis of the stakeholders’ opinions on ecosystem services and social impacts, both results are combined. Within the process of combining, the ecosystem services are left in their categories but the social impacts are handled flexibly. This is necessary because ecosystem services found their matches with more than one specific social impact. The social impacts are divided into direct social impacts which match with one ecosystem service and indirect social impacts which stand for the whole category of ecosystem services.

The ecosystem services are linked with social impacts. That leads to an improved evaluation of the ecosystem services. Additionally, the interests, needs and perceptions of the stakeholders are regarded in a holistic view.

6.1.1 Provisioning services and social impacts

In general, the provisioning services relate to agricultural activities. The connections between the services and direct and indirect social impacts are presented in figure 16. The indirect social impacts are valid for all listed provisioning ecosystem services.

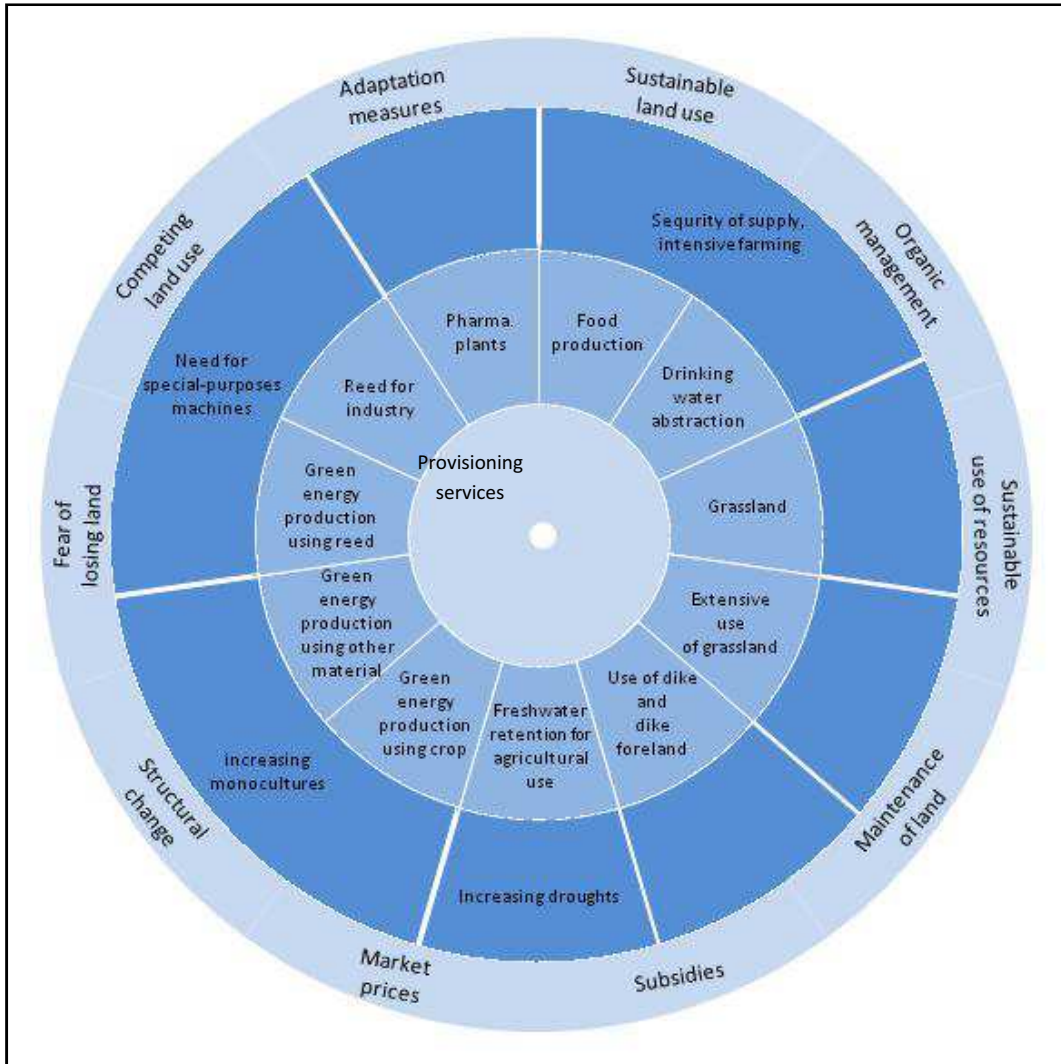


Figure 16: Combination of provisioning services (inner circle) and direct (middle circle) and indirect (outer circle) social impacts.

6.1.1.1 Provisioning services and indirect social impacts

Sustainable land use, organic management and a **sustainable use of the resources** are important challenges. It would be desirable to increase the marketing of **regional products**, an **extensive use of grassland** and an organic land use.

According to the Directive on organic production ((EC) No 834/2007), the “Organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards and a production method in line with the preference of certain consumers for products produced using natural substances and processes. The organic production method thus plays a dual societal role, where it on the one hand provides for a specific market responding to a consumer demand for organic products, and on the other hand delivers public goods contributing to the protection of the environment and animal welfare, as well as to rural development” (article 1, (EC) No 834/2007, further information given on website Europäische Kommission).

There should be a strategy combining natural landscapes with production schemes: the environment should be used as a “market-instrument” (N1). The agricultural sector already includes sustainable land use (figure 17), but financial incentives are necessary to promote sustainable processes (A1). A closer connection between agriculture and nature conservation is desirable.

In Lower Saxony, the government offers a “cooperative nature conservation program” which aims for a long-term conservation and development of grassland habitats. The grassland areas which are currently in use (figure 17) belong to the section “activity-oriented reward” (website Niedersächsisches Ministerium für Umwelt und Klimaschutz (c), website NI-VORIS). The program supports the land users with subsidies in terms of “contract nature conservation” and “cross compliance”. Based on the Council Regulation (EC) No 1290/2005 on the financing of the common agricultural policy, two European agricultural funds have been created. The first one is the European Agricultural Guarantee Fund (EAGF). It facilitates the financing of market measures. The second one is the European Agricultural Fund for Rural Development (EAFRD) and it finances rural development programs (Council Regulation (EC) No 1290/2005 of 21 June 2005). In 2010, the community of Krummhörn got 250.000 € subsidies from the EU; including 50.000 € from the EAGF, while the rest came from EAFRD (website Bundesanstalt für Landwirtschaft und Ernährung). However, from the point of view of the environmental conservation sector, the contract nature protection is too inflexible, unspecific and only used when it is obligatory or matching with the usual cultivation (N1, N3). The agricultural sector constitutes that contract nature protection is desirable, but only if the “financial conditions are worthwhile” (A1) because the agriculture maintains the nature and the landscape. The experts think that green energy production using crops is not consistent with a sustainable land use.

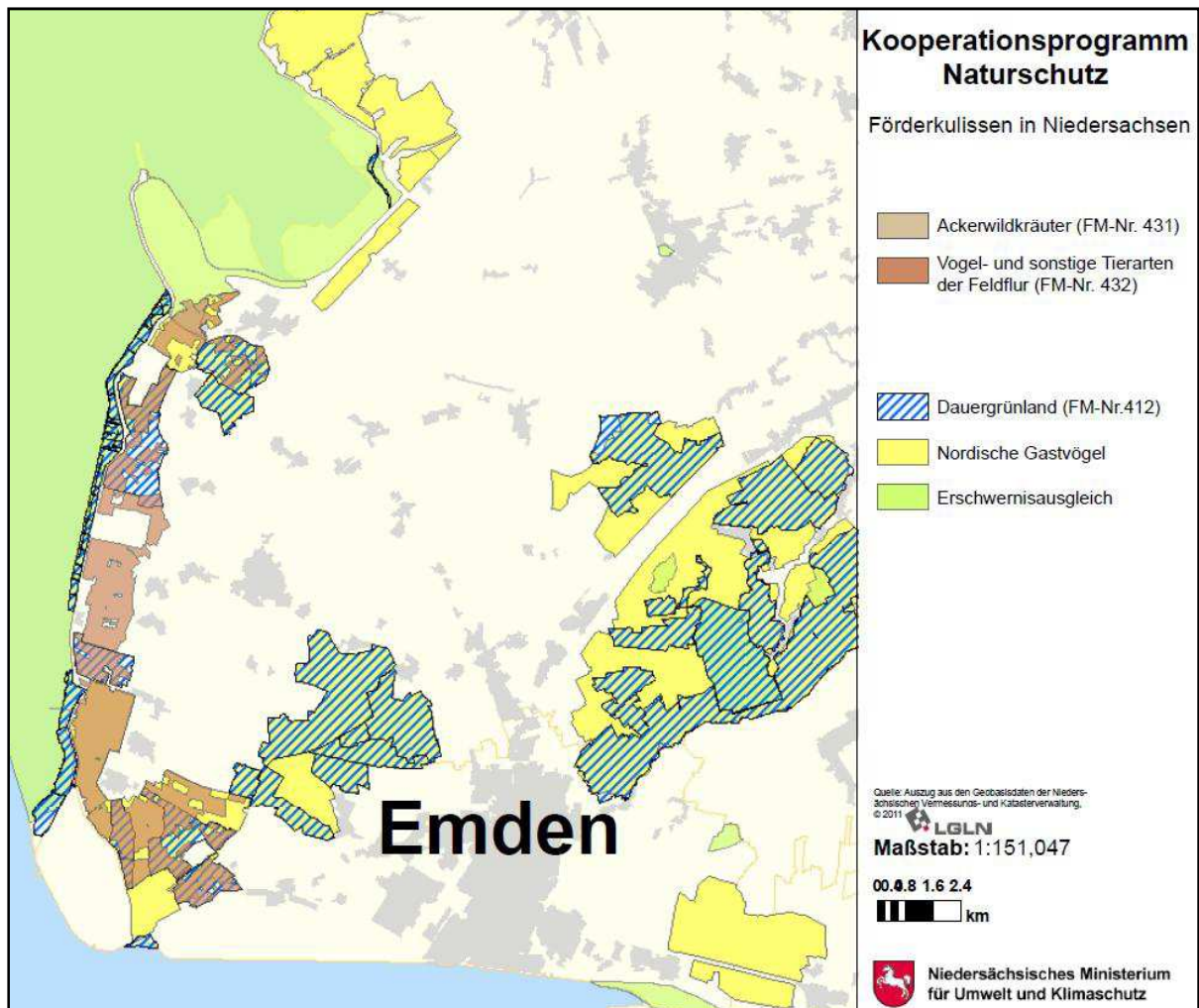


Figure 17: Subsidized areas under the cooperative nature conservation program (website Niedersächsisches Ministerium für Umwelt und Klimaschutz (a)).

The community of Krummhörn largely depends on agricultural production and the **maintenance of agricultural land and grassland**. The area of Krummhörn provides fertile soils with a “soil rating of 55 to 65 points” (A2) and high and increasing assessed values. The sound quality of the soils provides a local advantage compared to other regions in Germany and offers very good conditions for arable farm land and the production of food. The grassland conditions for dairy farming are perfect and it is expected that this sector will increase further (A2). The nature protection sector has a special interest in the maintenance of grassland areas. Grassland is important and useful for a sustainable development. It provides rich habitats for biodiversity and the developed biotopes have to be preserved. Especially extensive land use is valuable.

In the stakeholders’ opinion, the competitive pressure on the world market is increasing and the prices are rising by speculations. The farmers are entrepreneurs who cultivate the most profitable products. They are geared to the **market situation** and highly depend on it.

The interviewees utter controversial opinions about the **structural changes in agriculture**. On the one hand, with an increasing size of the agricultural holdings, their power will increase. The holdings

are enabled to use new techniques and optimize the production processes (A1). On the other hand, small agricultural holdings are rather sustainable and traditional. During the last four years, the number of agricultural holdings decreased by 33 % (LSKN 2010a, see page 35)

The stakeholders fear that they will **lose land** if the land uses change. That is especially true for the agricultural sector. They express that if the people are hungry, they will “crave” for agricultural areas and its re-development (A1). Theoretically, if the land consumption continues like it does today, within the next decades, there will be no agricultural land without any protection measures due to compensation measures (A1). The *Landwirtschaftlicher Hauptverein Ostfriesland* has started a local campaign against the loss of agricultural land (figure 18). The *LHO* argues that the farmers extremely contribute to the food supply and the energy generation. Furthermore, the *LHO* strengthens its position by adducing that in Germany daily 100 ha arable lands and grasslands are lost due to building developments and that the authorities and society decrease the production possibilities. The *LHO* aims for a sustainable use of land and a fair and equitable compensations and subsidies (A1).

So far, the agriculture was able to compensate the development by the improvement of their production and income, but such great leaps forward will possibly not be realizable in the future (W3). Furthermore, the loss of land might also lead to an increase of the cut-throat competition. This might bring about rising land-costs and expenditures in general. The agricultural holdings are specialized and rely on every hectare of land which ensures their existence (A2, A3).



Figure 18: Campaign against the loss of agricultural land. The German farmers claim a land conservation-program for agricultural and silvicultural purposes, friendly provided by stakeholder A1.

The fear of losing land relates to the **competing land use**. The focus is on three areas: food production, energy production and nature protection. Some stakeholder say that it would be desirable to reclaim land from the sea (Leyhörn) as a solution for the increasing land demand and to decrease pressures on different forms of land use. They argue for the rich deposited soils used as arable land. In addition, the use of the dike and dike foreland is of special interest. The nature conservation sector argues for the grazing on the dike foreland which promotes the sustainable land use, preferring grazing-projects. The water management sector thinks beneficial about the grazing on the dike foreland because it diminishes the plant material and biomass which will be washed up the dike. The political sector expresses two different opinions. Firstly, the use of the dike foreland is positive to stop the problem of the geese-feeding. Secondly, the expert P4 brings forward the argument that the areas of the dike foreland have been taken out of production because the farmers had no demand. Today, these wilderness areas will not provide acceptable conditions for extensive grazing. The intensive cost expenditure does not justify a restart of the use.

The opinions concerning climate change and possible **adaption measures** differ. Almost all stakeholders are unsure about possible effects of climate change with regards to agricultural areas. On the one hand, the agricultural processes might suffer under climate change with regards to cultivation possibilities. On the other hand, there are also chances for new developments. For example, new plant species could be cultivated needing less pesticides and external nutrients. Already, there are small changes observable in the plant and animal communities. With regards to agriculture, this has economic reasons, too (P1, N3).

6.1.1.2 Provisioning services and direct social impacts

There are four direct social impacts influencing the relevance of seven provisioning services. **Food production** is an important ecosystem service. The **security of food and drinking water supply** is highly emphasized. Only the nature conservation sector did not put an emphasis on the food production or necessity of food production. The other stakeholders fear that the food production will not be sufficient enough in the future. The mostly named argument was the intended increase of the (world-) population and the connected raise of demand. Due to the fertile soil conditions the area is preferential for the production of food. Almost all stakeholders emphasize the competing demand between the production of biogas and food.

The stakeholders, with the exception of one, do not approve of **intensive animal farming**. It is on the agenda because the preferred areas for intensive animal farming, like Cloppenburg or the Emsland, will be regimented (P2). That is why the pressure on the region of Krummhörn with respect to intensive animal farming will increase. These agricultural industries will have negative impacts on the region, including increasing manure and nutrients which have to be dealt with. In addition, it

negatively influences the drinking water which accumulates nitrate. The stakeholders are afraid of an “industrialization” of the agriculture which is depending on the politics, subsidies, economy and the willingness of the farmers.

The stakeholders explain the relevance of **freshwater retention for agricultural use** with the possibility of **increasing dry periods**. Most of the stakeholders are not afraid about increasing droughts in the Krummhörn. They think that other regions in Germany will be more affected. The region of Krummhörn provides the heavy soils of the marshes accumulating a lot of water and having the “capacity for more water retention” (W3). Within dry periods, the water level has to be regulated or is consistent because of water-inputs from treatment plants or natural springs for example. In case of an increasing groundwater level, the main water-users will have to stop their water abstraction and the sewage is adjusted (W1, W2).

In some areas, the excessive water level causes problems for the agriculture (A2). The experts W1, A2 and P3 think that dryer periods will have positive effects at least with regards to agricultural land use. A2 mentions that wetland areas could be used as arable land due to increasing dry periods. Those stakeholders who see no relevance for freshwater retention agree on not believing in increasing droughts or overwhelming costs of constructing an irrigation system. The interviewees’ who see the relevance for the water retention argue that the freshwater retention might only be useful in the far future. Because in some German areas water is already a limiting factor, the retention of freshwater might be a forward-looking instrument. The interviewee N2 emphasizes that stored freshwater used for irrigation is more sustainable than the use of groundwater. In addition, the retained water could be used for drinking-water abstraction.

The green **energy production using crops**, especially maize, is a good example for a gap between the relevance and the actually perceived social impacts. The stakeholders stress that the green energy production is of high relevance and expected to increase in the future, with exception of the agricultural sector. The agricultural sector emphasizes that the cultivation of maize is of low future relevance. The reason is that the region of Krummhörn is not a maize region. The heavy and wet soils make the harvesting almost impossible. Even though wheat and other crops are usually cultivated in **monocultures**, all stakeholders do not approve of the development of maize monocultures. Although the maize provides an important energy source, it ousts grassland and arable crop land. Furthermore, the cultivation of maize is associated with the intensive use of fertilizers and pesticides. The quality of the soil, the biodiversity and the water management is diminished and damaged.

The stakeholders think critically about the establishment of more biogas plants. The input is out of all proportion to the output and the biogas plants are seen as a “promoter” for the climate change (N3). They mention that politics set the wrong goals. Without subsidies, biogas plants would not be profitable. The political situation leads to a distortion of competition between the different forms of

cultivation (A1). Already, there are two biogas plants in use but the stakeholder A2 does not expect an increase. Although the government will promote the use of biomass for energy generation until 2013 (website BMU).

The cultivation of **reeds for bio-energy** or industrial use is seen as problematic. The stakeholders outline that **new special-purpose machines** and a new infrastructure are necessary for the harvesting. This relates to the investment of money. They also mention that there are different reed species. In order to cultivate reeds in polder areas of the project, it has to be figured out which species grow in brackish waters. The relevance of using reed for green energy generation is low. The stakeholders do not believe that the energy content provided by reeds is relevant for biogas plants. Although the biomass of natural reeds growing in brackish water is similar to the biomass production of maize cultivated for biogas (mown reed: 15 t aboveground dry weight per ha and year, COMTESS (2010)). Additionally, the nature protection sector (N3) examines that the use of reeds is only possible when the bird protection will be guaranteed.

6.1.2 Regulating services and social impacts

The combination of regulating services and possible social impacts is rather difficult (figure 19). Within the realm of this work it is not possible to combine most of the services with direct social impacts. Only the relevance of the hazard regulation by water retention is strengthened with social impacts by the stakeholders.

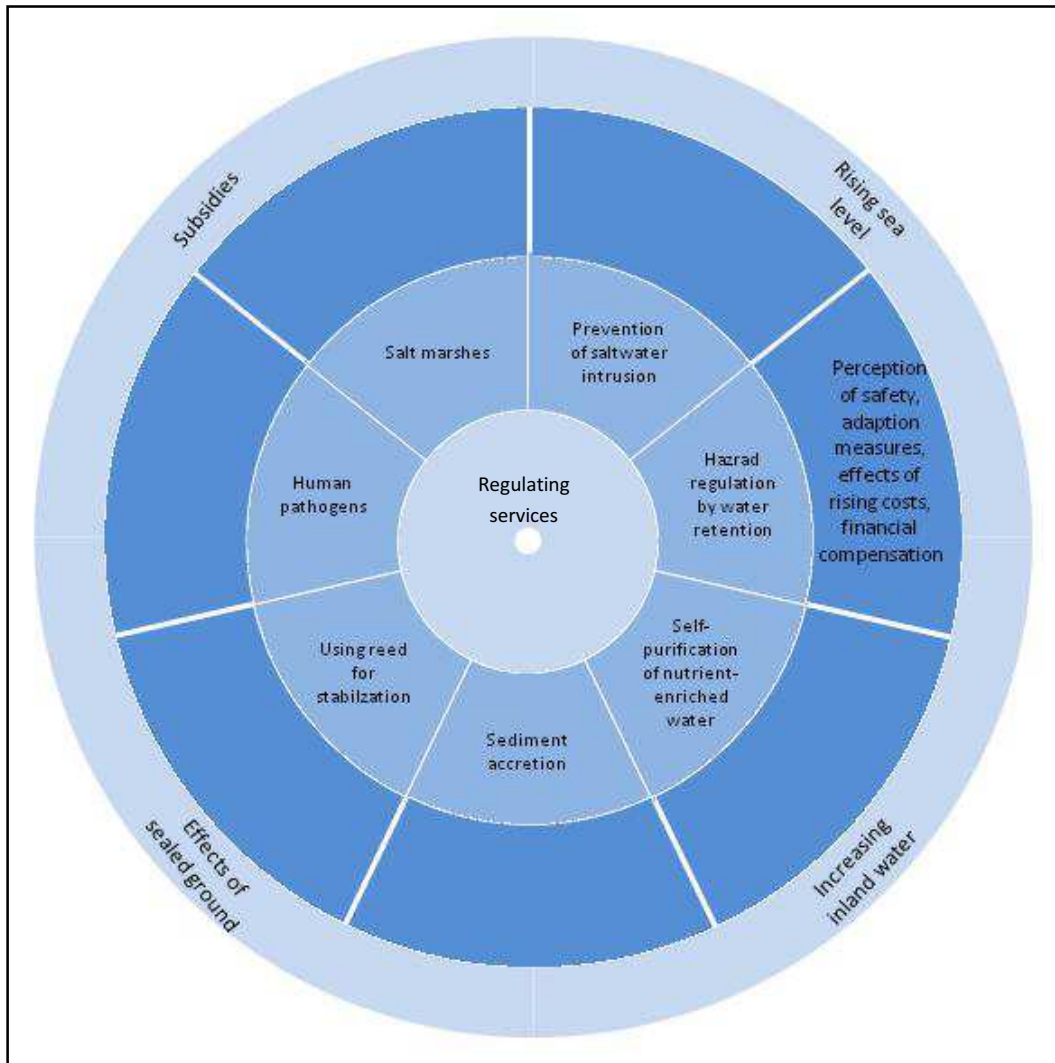


Figure 19: Combination of regulating services (inner circle) and direct (middle circle) and indirect (outer circle) social impacts.

6.1.2.1 Regulating services and indirect social impacts

The indirect social impacts influence the regulating services. With regards to the **rising sea level**, half of the interviewees are unsure about future developments. The other half takes negative impacts of an accelerating sea level into account, like increasing pumping activities due to reduced sewer-time. Most of the stakeholders utter the argument that the actual sea level rise, including flood heights, frequency and wave effects are not known and it has to be kept in mind that there have been significant changes in the past (figure 20).

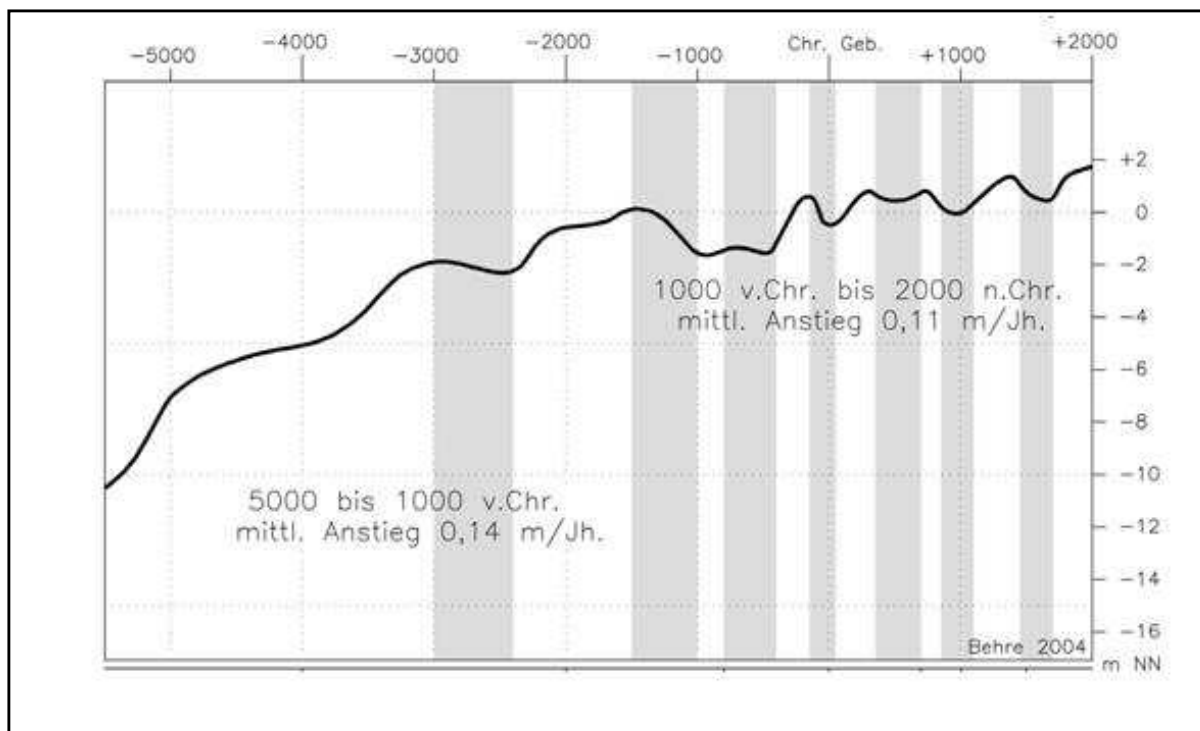


Figure 20: Chronological sequence of the mean sea level of the southern North Sea between 5500 B.C. and today. The grey fields suggest sea level regressions. Between 5000 until 1000 B.C. the average increase was 0,14 m per year and between 1000 B.C. until 2000 A.C. the average increase was 0,11 m per year (Behre 2004).

With regards to **increasing inland water** levels, the stakeholders stress that the drainage systems are in a very good condition and “revised every seven years” (W1). The drainage systems have not yet achieved their maximum capacity. Three stakeholders, W3, A2 and P3, argue for retaining rising water levels caused by winter precipitation within existing drainage structures.

The effects of **sealed natural ground** are seen as problematic, especially in urban areas. The stakeholders mention that an increasing runoff, also caused by increasing precipitations, will have negative effects on the existing systems. A solution might be to provide an increasing establishment of rain storage reservoirs in settled areas.

Even though the members of the community have to pay a certain amount of money for the maintenance of the water management and coastal protection structures, the water management sector strongly depends on **subsidies** for financing the reinforcement, strengthening and new

developments as well as the enhancement of environmental systems. In 2010, the *I. Entwässerungsverband* obtained 730.000 € from EAFRD and national funds. This funding aims for an increasing competitiveness, an improvement of the environment and landscape as well as an increasing quality of life (website Bundesanstalt für Landwirtschaft und Ernährung). In the future, it is of great interest that the subsidies will be maintained.

6.1.2.2 Regulating services and direct social impacts

The direct social impacts concerning **hazard regulation by water retention** focus on the establishment of polder areas to store water and the relieving of existing structures in case of extreme events.

The stakeholders strongly feel that it is necessary to distinguish between short-term and long-term expectations regarding the **perception of safety** and need for **adaptation measures**. They do not expect a great danger within the next 50 years, with the exception for the stakeholders W2 and N1. Expert N2 mentions that the climate change should not be underestimated because a late adaptation will decrease the efficiency of possible measures. Some of the experts fear that the existing protection measures will not be enough in the far future.

Especially the water management sector emphasizes that if the coastal protection is continued like today, safety will be ensured. Additionally, the stakeholders from all sectors, except for the nature conservation sector, argue in favor of a technical strengthening of the dikes with concrete, asphalt or sheet pile walls for example (see page 9). Only four stakeholders think that polder areas are useful to relieve flooding.

The effects of **rising costs** will not influence the social well-being, although three stakeholders mention the dependence on the rising amount. The stakeholders do not think that rising costs will have negative effects on the willingness to pay. They argue that the people prefer safety and therefore they are willing to pay. If they refuse, they will have to leave the region (“De nich will dieken, mutt wieken”).

In case of changing land use conditions, the stakeholders fear that the development of a polder area to **store water** will have negative influences on normal land uses (figure 18), especially agriculture. They fear that the living conditions will suffer from the establishment. In the project areas, there are livelihoods which have to be removed. The experts are not sure about who has to pay financial compensation in case of resettlement.

6.1.3 Cultural services and social impacts

The cultural services show a strong connection to the social impacts (figure 21). Sustainable land use in this sense focuses on the combination of economic and social development combined with the protection of the environment and preservation of natural resources within the community. These issues are of central relevance.

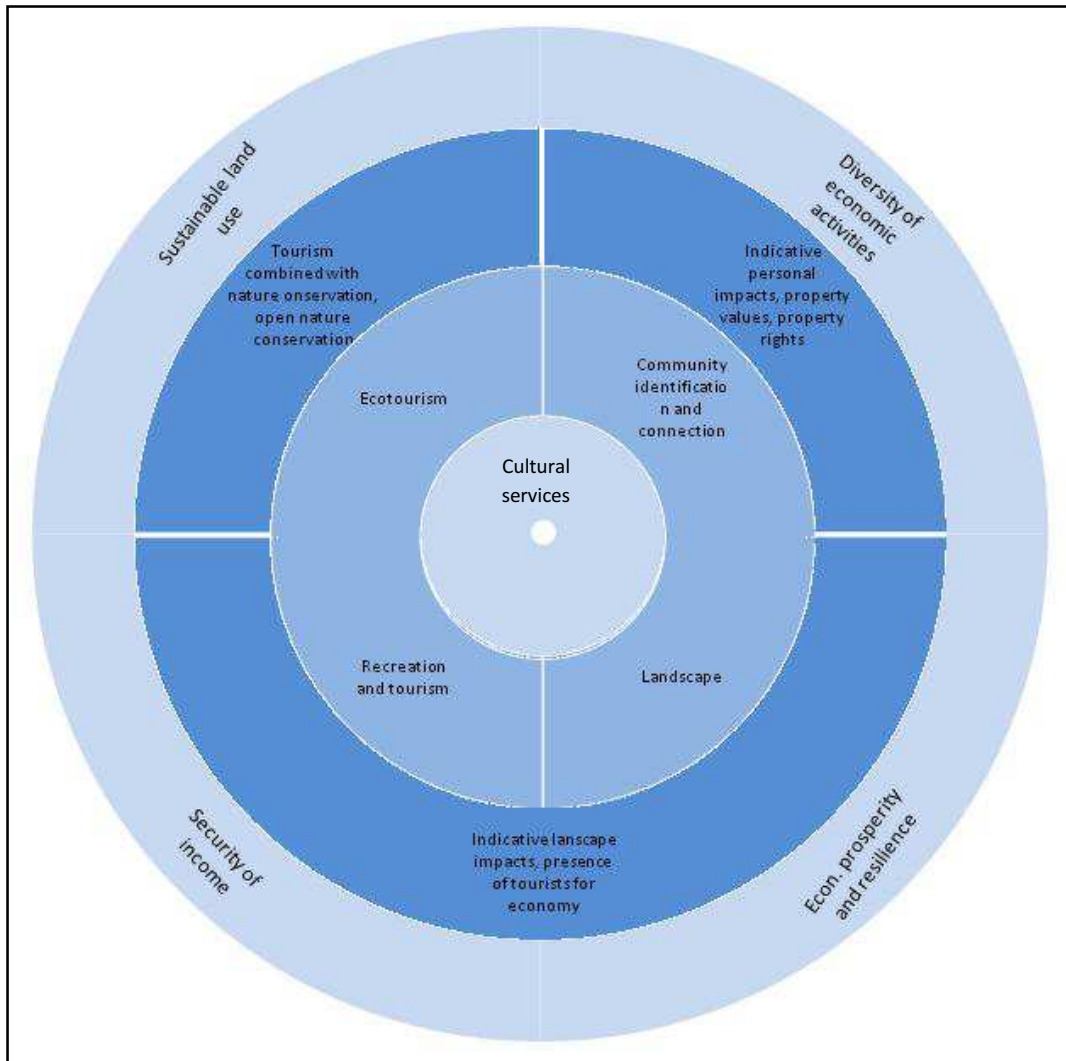


Figure 21: Combination of cultural services (inner circle) and direct (middle circle) and indirect (outer circle) social impacts.

6.1.3.1 Cultural services and indirect social impacts

In contrast to the cultural services which are focusing on the nonmaterial-benefits people obtain from ecosystems and refer to the peoples' behavior and values concerning ecosystems (MA 2003), the **diversity of economic activities**, the **prosperity and resilience of the region** and the **security of income** relate to and enhance the material well-being of the people. This is not exclusive, because

these three indirect social impacts depend on and influence ecosystem services and are of huge relevance.

In the stakeholders' opinion relating to **sustainable land use**, the maintenance of the regional economy and the securing of the regional production are relevant. In terms of ecological concerns, the environmental and sustainable resource management, land preservation, healthy soils, nutrient-balanced management, long-term resource protection as well as nature conservation and extensive land use are enhancing sustainable land use. Concerning social matters, with regards to future generations, the various land uses should be harmonized and effective, migration should be prevented and livelihoods have to be ensured (see page 10f).

6.1.3.2 Cultural services and direct social impacts

There are many direct social impacts matching the ecosystem services. The **community identification and attachment to place** is strongly connected to the **indicative personal impacts**. Especially three social impacts are important.

The first one is the **obligation to ancestors and traditions**. The stakeholders are aware of development projects considering flood protection measures. Especially the tradition of building dikes is a difficult issue. The stakeholders refer to their ancestors who built the dikes and drainage systems by endangering their physical health. Contemporary settings have been created over generations. That is the reason why new measures have to be announced carefully. The identity of the people has to be taken into account. In the past, land has been reclaimed from the sea and the stakeholders fear that it has to be given back. In East Friesland, the dike is seen as a „golden band“ (P1).

The second one is the **participation in decision-making**. The possibilities of the stakeholders to actively participate in decision-making processes are very important. The stakeholders argue for an ongoing communication process and a holistic approach. These are crucial elements of the ongoing project process. They wish for round tables and transparent processes as well as win-win situations and positive outcomes for all involved sectors. Only one stakeholder thinks contra-productive about the participatory character of the project. The interviewee argues that the outcomes are less strong and effective (P3).

The third one relates to the **property values** and **property rights**. The stakeholders are unsure when considering new developments and demand for land-properties. They utter that the peoples' acceptance concerning the abandonment of the living space is critical due to the importance of property values and property rights. Especially P1 argues that the inhabitants of the community are skeptical towards and afraid of new development.

The **aesthetic and recreational** value of the landscape is precious. The residents identify themselves with the landscape. A visible change in the landscape might lead to an “alienation of the culture” (N2). The **aesthetic quality** of the landscape is of crucial importance to maintain a livable environment.

The stakeholders of the agricultural, political and tourism sectors emphasize that East Friesland is a man-made landscape and not “natural”. Important elements of the landscape are the diversity of different land uses, the pastoral, traditional and idyllic character (T1, P1) as well as the terp villages (**cultural-historical value**) representing the typically East Frisian landscape (T1, P2, A1). The maintenance of the aesthetical value is of high importance and everything promoting the aesthetic is positive. The farmers contribute notably to the maintenance of the landscape (T1, P1).

Changes within the landscape have to be planned carefully (P1). Water is an important element of the landscape. The **increase of water areas** in the landscape are regarded controversially. On the one hand, water is an important element for tourism. The establishment of water areas offers new opportunities like more residences, fishing, water-sports or camping. On the other hand, new water areas negatively influence the current landscape (P1, P4). An increase of the water areas might enhance the value of the landscape. Nevertheless, the stakeholders prefer the **mosaic-structures** with a diversity of different elements, without extreme forms of one land use.

The presence of **tourists and recreation** opportunities depend on the landscape and the unique ecosystems. Tourism is regarded as the “white industry” (T1). The community of Krummhörn depends on tourism; it is an important branch of the economy and keeps up employment as well as income rates. Beside these positive effects, in the opinion of some stakeholders, especially expert N3, the **presence of tourists** disrupts daily life and influences the landscape and environment negatively. However, the stakeholders expect an increase of tourism within the coming years. The tourism sector favors an increase of leisure residences, cultural entertainment and activities, like “rad op pad” (a combination of biking and boat trips) and health tourism for example (T1). The tourism sector works with clichés and typical images like the grazing cows, the water and coastal areas and the pastoral, traditional, structured and idyllic character of the community of Krummhörn. Due to changing land uses the attraction of the landscape might decrease. In general, the stakeholders emphasize negatively consequences of an unidirectional landscape.

While Greetsiel is a hotspot of tourism, Freepsum is rather unattractive (T1). Greetsiel is touristic and provides a broad range of activities. The stakeholders argue that Freepsum tend to be a local recreation area. The area of Freepsum provides preferable conditions to **combine nature conservation and tourism**.

In general, the stakeholders prefer a symbiosis between tourism and nature conservation, sustainable development as well as agriculture and water management. So far, **eco tourism** is only a

small part of tourism and not economically valuable (T1). The stakeholders would like to see an expansion of eco tourism and wish that “quality increases and not the intensity” (N3) (further information on website NABU Ostfriesland (c)).

Stakeholders of all sectors, except for the nature conservation sector, emphasize the necessity for an **open nature conservation** concerning tourism. Closed areas will have negative influences on eco tourism. Nature conservation and tourism have to be connected by intelligent measures, like guided tours or plates explaining the environment. Additionally, the world natural heritage and the adequate conditions of the bird protection areas could be used as main attractions (N2, N3). The bird sanctuary areas designated according to the Directive on the conservation of wild birds (2009/147/EC) are of nationwide significance (N3).

6.1.4 Supporting services and social impacts

The supporting ecosystem services underpin the other ecosystem services and have an indirect character (MA 2003). They are strengthened and enhanced by the social impacts (figure 22).

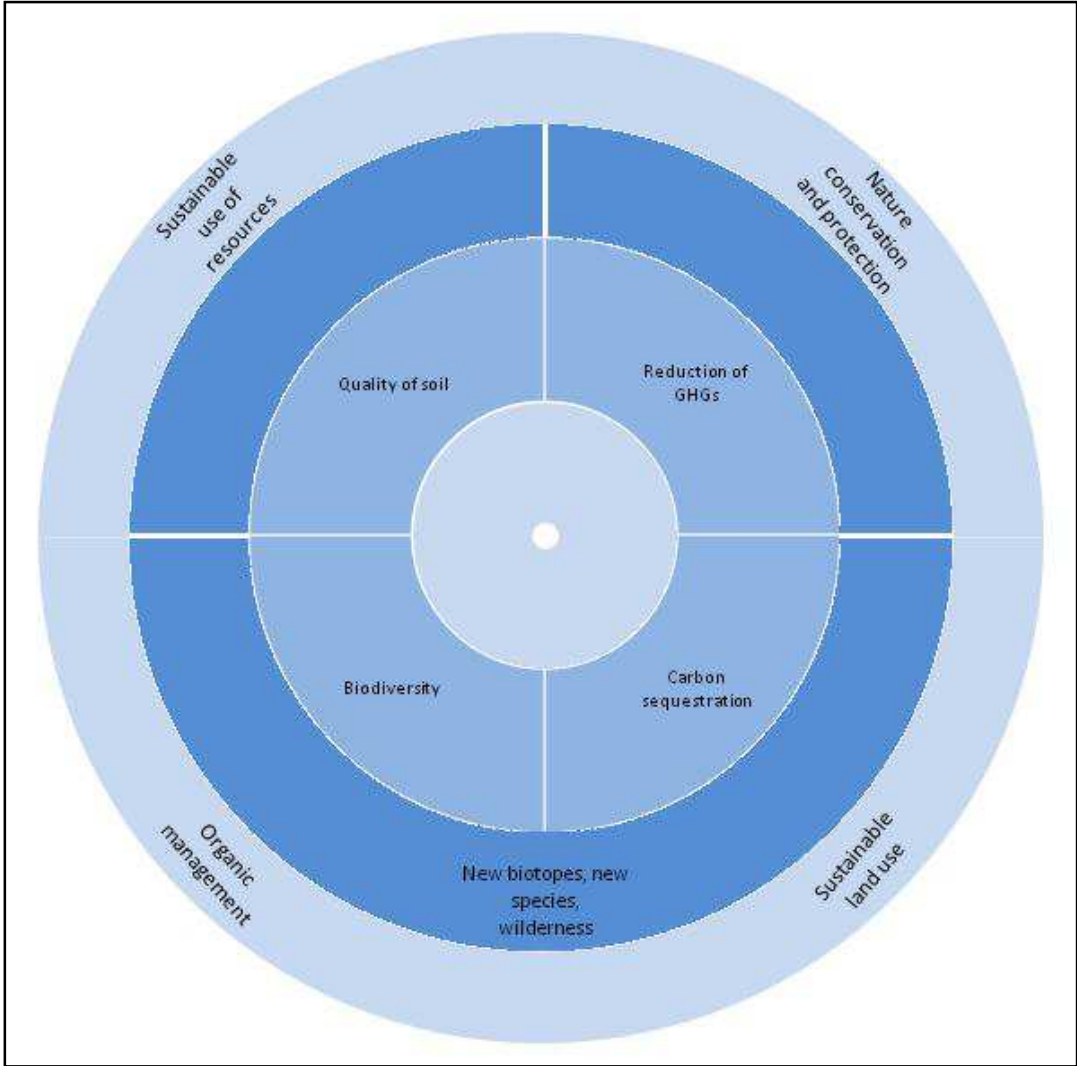


Figure 22: Combination of supporting services (inner circle) and direct (middle circle) and indirect (outer circle) social impacts.

6.1.4.1 Supporting services and indirect social impacts

The indirect social impacts matching this category have already been described before, except for the social impact of **nature conservation and protection**. Nature conservation and protection is a crucial task to maintain **biodiversity** and the **quality of the soils**. This relates also to the **reduction of greenhouse gases** and the **CO₂ sequestration**.

The stakeholders' feelings concerning nature conservation and protection are uniform. The maintenance of the environment is highly relevant. Nevertheless, there is a gap between the sectors concerning opinions about the other sectors. The political, tourism, agricultural and water management sectors have no objections to nature conservation but they have objections to extreme courses of action by the nature conservation sector and the other way round.

The aspirations and perceptions concerning **nature protection** areas differ slightly. The nature protection sector favors an increasing extensive use of grassland. The development of the region has to balance the different interest with an enforced claim towards nature protection (N3). The experts W2, P1 and T1 put an emphasis on the importance of the already developed habitats. They think that negative interventions should be avoided.

Nature protection and conservation is of high significance for the agricultural sector. They stress the connection between nature protection and agricultural uses, like production-integrated compensation measures or an increasing organic management and regional management (like "Naturwert"-products (A1), further information on website LHO). The agricultural sector argues that only small parts of the production areas should be used for nature protection measures because it is critical to take the whole area out of production. Some stakeholders propose to use the area of the Freepsumer Meer as a compensation pool. Interviewee P1 argues in favor for making the nature conservation more accessible to the population to reach a better understanding.

In the future, the region of Krummhörn will be developed towards being a biosphere reserve (N1, N3, P1). Additionally, the existing grasslands will be a landscape protection area (P2). The nature protection sector stresses the increasing development of the Natura2000 habitats, connections between protected areas and corridors as well as a quality assurance of protected areas.

The quality of the soil is precious, as mentioned before. The stakeholders support an organic management to maintain this quality, without damaging processes and with "balanced nutrient fluxes" (W2, N3, A1). This is in line with the Directive on organic management which declares: "In order to minimize the use of non-renewable resources, wastes and by-products of plant and animal origin should be recycled to return nutrients to the land" (article 11, (EC) No 834/2007).

6.1.4.2 Supporting services and direct social impacts

The direct social impacts focusing on carbon sequestration and biodiversity are almost the same. The stakeholders of the water management, nature protection and agricultural sectors gave statements. Because of new developments, the habitats of plants and animals should not be endangered. **New areas** might lead to an increasing biodiversity and **new species** could immigrate. The carbon sequestration by using reeds has been evaluated in different ways. Although the areas along the watersides are valuable habitats with a high biodiversity, increasing reed stands are not automatically beneficial. The reason is a migration of ground-nesting birds. In addition, the stakeholders propose to rather use grassland as carbon dioxide sink than reed stands (W2, N1, N3, P2). Overgrown areas, or “**wilderness**”, lead to increasing biodiversity (N1, N2, P2, P3) or have negative influences on the landscape (T1, P1).

6.2 Land management scenarios

The research project COMTESS proposes three scenarios focusing on the development possibilities of the region Krummhörn. They are “water management”, “carbon sequestration” and “trend. During the research, the experts were asked about their opinions about these scenarios. The opinions, interests and needs about the different ecosystem services and connected social impacts have been discussed above. In this section, it will be discussed what the stakeholders think about the practicability of the scenarios, including general (tables 9a-c) as well as expert-specific statements.

6.2.1 Water management and carbon sequestration

The scenarios “water management” and “carbon sequestration” both have similar elements. They aim for the establishment of two polder areas and the cultivation of reed stands. Possible inland water floods will be restricted to the polder areas. The freshwater might be used for irrigation in dry periods. Additionally, in case of a dike overtopping, the water will be conducted into the polders to avoid a salt water intrusion to the hinterland (COMTESS 2010).

The two scenarios differ in their proposed use of the reed stands. In the first scenario, the reed stands should be used for the generation of green energy. The second scenario aims for an extensive cover of reed fens to yield an active peat formation (COMTESS 2010).

The implementation of these two scenarios is regarded critically (table 9a). The establishment of the two polder areas is controversially discussed and it becomes obvious that the stakeholders are unsure about possible outcomes. The stakeholders regard the implementation as unrealistic and extremely hypothetical and they do not see a realistic way to actually implement them. This becomes especially obvious when analyzing the statements of experts P1 and P4.

Problems concerning the proposed areas

The scenario areas (figure 6) are located within the regions of Greetsiel and the Freepsumer Meer.

Changing the land use is substantial, and it depends on the size and variety of the land. Some of the stakeholders argue in favor of big square measures and the extension of possible areas to the entire region of East Friesland (W1, A1, P2). The others prefer small area solutions. In general, the stakeholders express uncertainty about the placement of the polder areas.

The stakeholders strongly emphasize that the area of Greetsiel is out of consideration. Following reasons have been named by the interviewees: The area is above sea level and therefore, it might be difficult to store the water. In addition, it provides fecund soils. The stakeholders are not willed to give up highly productive arable land. Another point of interest is that the area is a hotspot for tourism.

Expert W1 furthermore explains that not only the community of Krummhörn, but also the city of Norden, drain into the Leybucht. If there was a polder area with increased water levels, Norden is at a disadvantage to drain into it. Consequently, the pumping capacities will either increase or the drainage cannot be guaranteed. Hence, the area of Greetsiel is not adequate for the establishment of a polder.

The community of Krummhörn owns the area of the Freepsumer Meer up to a portion of 80 % (P1). In the stakeholders' opinion only in this area is possibilities to establish a polder. Following reasons have been named by the stakeholders: The geographical conditions are conducive to the establishment of a polder. The lowest point is 2,45 m below sea level (figure 10). In addition, interviewees W2 and P2 argue that the rewetting of the Freepsumer Meer has already been discussed and might be technically practicable. This is supported by the feasibility study done in 2006 (Grundbaulabor Bremen 2006).

Problems that could result from establishing a polder within the area of Freepsum are considered by the nature protection sector. The stakeholders criticize that the feasibility study only focuses on the needs of the tourism sector and its development (N3, P1). The nature conservation sector openly argues against the development of a polder area (N3). In the opinion of expert N3, a rewetting of the area might be impossible, since it provides a very fecund environment and extraordinary conditions attracting a wide variety of rare and protected bird species, like the Black-tailed Godwit (*Limosa limosa*), Redshank (*Tringato tanus*) and others. The interviewee suggest to observe the laws of the Directive on the conservation of natural habitats (92/43/EEC) and the Directive on the conservation of wild birds (2009/147/EC) which are obligatory for the area. The expert strongly points at article 13 of the Directive on the conservation of wild birds, which states that new developments "may not lead to deterioration in the present situation as regards the conservation of the species of birds".

The first Directive aims for a contribution “towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora [...]. Measures taken pursuant to this Directive shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest. [...] (In addition,) measures shall take account of economic, social and cultural requirements and regional and local characteristics” (article 2, 92/43/EEC).

According to the Directive on the conservation of wild birds, there have to be “[...] measures to preserve, maintain or re-establish a sufficient diversity and area of habitats for all the species of birds [...] (article 3, 2009/147/EC). Furthermore, “this Directive relates to the conservation of all species of naturally occurring birds in the wild state [...]. It covers the protection, management and control of these species [...] (article 1, 2009/147/EC).

Taking these Directives into account, there would have to be compensation measures, if the area was used as a polder. Stakeholder N3 mentions that a shallow inland lake provides interesting nature conservation possibilities. The interviewee argues that theoretically a rewetting of the Freepsumer Meer could be aligned with nature protection interest, preconditioned that there is an adequate communication process. The agricultural sector doubts the compensation measures because they suspect that it will lead to an increasing loss of agricultural land (A2).

Problems concerning the development of a polder

The stakeholders W2 and A2 mention a dilemma. On the one hand, the proposed areas can be described as a vulnerable environment and settlements. On the other hand, it is very extensive to maintain the dryness of the area. Although expert W3 mentions that problems might be generated by natural drainages and sewage systems connected to the climate change in the future, an extension of the pumping capacity is desirable for most of the stakeholders.

The stakeholders stress that a water management with polder areas would only be desirable in low lying areas without settlements and industry, where no damage can be caused. In addition, property values and property rights shall be taken into account. The experts are not sure whether the population would agree to a rewetting of the Freepsumer Meer or not. In their opinion, the loss of livelihoods could be seen as a negation factor. In addition, the experts argue that the resettlement will lead to emerging costs and payments of compensation. The experts expect a building of new infrastructure which will result in a high costage. In general, the stakeholders utter that it is beneficial to make a changing water management as transparent and public as possible to generate an increasing acceptance within the population.

Another problem the stakeholders point at is fear of losing land. Especially stakeholder P3 stresses that the area of the Freepsumer Meer has been dried up 200 years ago because of an increasing

demand of land. The interviewee wonders why now the land is not needed anymore. Furthermore, it is questionable which benefits the current land users will obtain.

The water management sector emphasizes that the establishment of a polder will lead to adverse effects with regards to the existing drainage systems. Contemporary, the existing water management is optimized and technically up to date. They argue that the development of a polder leads to an additional pumping activity because the surrounded areas have to be protected against flooding. The experts say that building a new drainage system within the settled areas below sea level will result in a high costage. Especially interviewee W2 fears an increase of inland flooding in these vulnerable regions when polder areas are established.

With regards to storm surges, especially stakeholder A2 argues that the existing dikes are sufficient. In the interviewee's opinion, it would not be effective to change the contemporary state of the art and the expert adds that the costs of the construction and enforcement of the dikes are at an all time low.

Problems concerning the water level of a polder

Expert W1 explains that the contemporary water levels have been in operation for 50 years and the land users have adapted to these water levels (W1). Depending on the location and the drainage systems, an increase of the water levels might result diverse effects. The stakeholder states that it could be theoretically possible to increase the water level of the Freepsumer Meer about 50 cm.

The interviewees strongly suggest to distinguish between a temporary and constant flooding of the polders. On the one hand, some stakeholders, especially from the political sector, favor a temporary flooding of not vulnerable areas. In their opinion, permanent water levels would not provide a puffer-capacity in case of extreme situations. In addition, the temporary flooding might allow an agricultural use of the area.

On the other hand, especially the nature conservation sector argues that fluctuations within the water level might cause adverse effects on the environment. In their opinion, the polder area provides new habitats which will lead to the migration of new species to the area provided that conditions are stable.

Positive effects of a polder area

The stakeholders assume that the establishment of a polder area might lead to positive effects. Only stakeholder A2 completely negates beneficial effects.

In case of increasing water levels caused by the climate change, a polder area provides an opportunity to release the existing drainage structures. Stakeholder W1 argues that a polder area might have beneficial effects because it might be possible to prevent salt water intrusion from intruding into the hinterland.

The stakeholders N1 and N2 mention that an increasing drainage might lead to the subsidence of the surface. In their opinion, this could be avoided by establishing a polder area.

Stakeholder N2 refers to the enhancement of sustainable land use when using the polder's water instead of groundwater for irrigation measures. In addition, endangered species might obtain new habitats.

Problems concerning the cultivation of reeds

The stakeholders' opinions concerning the cultivation of reeds have already been described and discussed above. Concerning the implementation, especially the scenario "carbon sequestration" is regarded as a controversial topic.

On the one hand, the stakeholders W1, A1, P1, P2 and P3 do not see a way to actually implement it, also when taking the duration of a peat formation and the adequacy of the capacities to store the CO₂ into account. On the other hand, the stakeholders W1, A2, N1, N2, and N3 think that the idea is interesting and that it will be possible to realize on a small-scale, if the areas are not in use. The nature conservation sector favors the possible wilderness of the area which could be used for compensation measures.

The experts argue that grassland areas and arable lands deliver a contribution to store atmospheric CO₂. They wonder if the reed stands will be able to improve the CO₂ balance. Especially stakeholder N3 emphasizes that the plough of the grassland areas combined with the release of CO₂ has to be taken into account. In addition, the plough up of the areas needs technologies and fossil energies which might be negative for the CO₂ balance.

6.2.2 Trend scenario

The trend scenario focuses on “business as usual”. In the project’s context, floods might disrupt the contemporary land use and might lead to increasing drainage costs. The economic and ecological viability of the current land management might be reduced (COMTESS 2010).

The statements (tables 9b) concerning the “Trend” -scenario have been discussed above. The stakeholders emphasize that the proposed scenario areas will always be valuable and the current land use will be capable. In the stakeholders’ opinion, the grown structures shall be maintained.

6.2.3 Prospects for the development of the region

Basing on the three proposed land management scenarios, the stakeholders were asked to explain what their prospects and wishes are concerning Krummhörn’s development (table 9c).

The discussion about the social impacts and connecting ecosystem services includes many aspects concerning the contemporary land use as well as expectations of a land use in the future (figures 16, 19, 21, 22).

The stakeholders are for instance aware of “climate horror scenarios”, impose of measures and they fear the loss of land. The stakeholders do not prefer top-down measures which will only be made by political authorities and laid upon the people. In order to trigger the power of the project, especially stakeholder P1 emphasize the importance of taking the planning authority into account.

The stakeholders favor a sustainable and organic management, the maintenance of the biodiversity and the combination of different land uses with nature protection measures. They emphasize the importance of the maintenance of loan programs, the economic prosperity and resilience, agriculture and grasslands as well as the vitality of the landscape’s aesthetic. Stakeholders of all sectors, except for the nature conservation sector, expect that future land use strategies do not differ from today’s.

With regards to the expected climate change, the stakeholders think that the historical development of the climatically conditions have to be taken into account (figure 20). They think that there are inconsistent reports about possible effects of the climate change and a lack of commonly shared opinions.

The stakeholders agree about a multi-functional land use in the future. They utter that it might be necessary to include aspects of all three scenarios into development and decision-making processes. In the stakeholders’ opinion, possible polder areas to store water are of high relevance and they will increase. They also think that this will be true for environmental conservation areas, the maintenance of the agricultural land and grassland and the tourism sector.

In the experts' view, the sustainable use of land gains importance and the production of food, drinking water and energy will become more and more important. The stakeholders believe that the demand for renewable energies, especially wind, water and solar energy, will increase.

Regarding the intended development of the region, the experts are positive that it is necessary to combine the different forms of land use and to consider all interests equally. The stakeholder point out that it will be difficult to implement maximum-claims. Supplementary, the competing land use shall be minimized. They appeal to find compromises, to enhance communication processes, to weigh out developing opportunities and risks and to implement synergies, trade-offs and symbiotic effects into the decision-making processes. The stakeholders favor the network character of the project.

The stakeholders suppose that a multi-functional land use, including the described scenarios, is only possible on a small-scale level and on selected points. Additionally, spatially limited areas might lead to an increasing acceptance of changes in land use and might be promoted by small development programs. Nevertheless, in the stakeholders' opinion, it is most important to keep up the region's characteristic features.

The stakeholders urge for the identification of the ecosystem services' values. Some stakeholders prefer to monetize and calculate as many of the aspects as possible in order to evaluate them. The stakeholders argue in favor of the determination of the surplus values in order to make new developments acceptable and to improve the evaluation.

Additional to the proposed scenarios, the stakeholders named alternatives. For example, they focus on the increasing use of renewable energies (wind, water and solar). Especially stakeholder A1 mentions that East Friesland is an "energy-turning platform". This refers also to improve the energy management of the water management sector (see page 30ff.). Alternatives to the pumping stations with fossil energies are the use of wind-water mills. With regards to the coastal protection system, in the stakeholders' opinion the security of the dikes might be supported by a second dike line. The nature protection sector favors a strengthening of the salt marsh regions.

In conclusion, changes in the land use management are desirable, if all persons concerned will benefit and the well-being is ensured.

6.3 Methodical approach

Stakeholder involvement

Within the scoping process, a stakeholder analysis has been done. This contributes to an early involvement of the stakeholders in the valuation process. A stakeholder analysis is crucial to address stakeholders who are able to identify problems, find ideas and solutions and enhance the practicability and long-term viability of an intervention (figure 5) (see Bryson 2004, Freeman 1984, Eden and Ackermann 1998, Gregory and Keeny 1994, Meltzer 1972).

In order to investigate whether opinions and perceptions of the stakeholders are confirmed or not with the theoretically determined categories of ecosystem services and social impacts, semi-structured expert interviews have been done.

Interviews are highly useful when targeting for an extensive understanding of the interviewees and their perspectives. Data for academic analyses are produced face-to-face (Fontana and Frey 1994).

The expert interviews cover several different areas of subjects, examine separate information adapted to the stakeholders and have a dense data-acquisition. Within qualitative research, expert interviews are a common tool and gain importance (Mayring 2002, Bogner et al. 2005, Flick 2005).

Semi-structured interviews are of special interest as a method within expert interviews. The experts act as sectoral representatives of a specific field of action (Meuser and Nagel 1991, Lamnek 2002, Gläser and Laudel 2004, Flick 2005, Mayring 2002, Bogner et al. 2005). Semi-structured interviews contribute to the understanding of complex subject areas (Fontana and Frey 1994).

In order to address crucial topics and issues of interest, a questionnaire has been developed (Appendix 1). It is important to develop central questions (*“Leitfragen”*) because it helps to structure the interviews (Flick 2005). They are characterized by central problem definitions, open and hypothesis-directed questions, open dialogues and mutual trust (Mayring 2002, Flick 2005, Bogner et al. 2005).

The advantages of semi-structured expert interviews are characterized by the flexibility of the interviewer to adapt to the stakeholder, by the continuous-communicative interaction process between expert and interviewer, by the corresponding statements to former statements and by the critical questioning of competing alternatives (Lamnek 2002, Flick 2005).

Nevertheless, some pitfalls concerning expert interviews might emerge. For example, the expert turns out as a non-expert, the expert is talking about everything but the specific topic, the expert represents his private opinion and not the sector, and the expert imparts knowledge in a “narrative interview” (Lamnek 2002: 176, Meuser and Nagel 1991).

Within the research process, it turned out that the analyzing process is hindered by the pitfalls mentioned above concerning the analyzing time and structure. Stakeholder P3 turned out as a

non-expert. In consequence, the project will not include the interviewee within the further research process, although the stakeholder delivered meaningful answers.

Nevertheless, these obviously negative elements provide also positive aspects. Within the process of interviewing, most of the experts and also the interviewer additionally talked about other issues, expressed private opinions and abated into narrative interviews. This is seen as positive because the interviewees got a feeling of mutual understanding and mutual trust which is a crucial factor for the further research process.

The qualitative content analysis is a classical approach of analyzing complex text material. Objectivity is the main criterion (Flick 2005). Although the content analysis has an interpretative character, subjective intensions should have been avoided.

Communication

Communicating with the experts is a crucial process. During research, it became obvious that it is of central importance how the scenarios are explained and described to the experts (Appendix 1, figure 7).

Two challenges have to be faced: the selection of topics is complex and there are no black-white clusters. In order to reach a substantive communication process, the topics need to be interesting. Additionally, it is important to “translate” the scientific language into understandable units.

Communication is strongly connected to emotions (Fiehler 1990). For that reason, pictures are adequate tools to explain the scenarios in combination with concise and coherent sentences (appendix 1, figure 7). Furthermore, the use of the social categories and impacts helps to reach a better understanding.

The stakeholders need to feel that their opinions contribute to the research process and that they are actively involved. It is important for both sides to avoid verbal attacks and to keep up an atmosphere of respect. Sensibility towards each other is therefore needed in order to prevent hurt feelings and misunderstandings.

Furthermore, to reach a constant and long-term participation, the stakeholders need to know their benefits and expectations. This is provided by the participatory character of the project; the stakeholders will be able to influence the project’s outcomes. They are awaiting further information.

Scenarios

Scenario planning supports decision-making with regards to uncertainty and integrates new strategies in order to justify possible consequences. Therefore, the development of scenarios is an appropriate method to focus on various possible and intended developments by considering relevant variables. Since some variables are chosen to be more relevant than others, scenarios are always constructed and build on hypotheses (Mietzner and Regner 2005, Bishop et al. 2007, Wilkinson 1995).

It is therefore needed to develop plausible and consistent explorations of the future. The development of scenarios includes some advantages; scenarios, for example, lead to a more open view on the world bringing together a wide range of different perspectives. A disadvantage is that if a scenario is far away from the real world, they might not be taken seriously.

Nevertheless, the three proposed land management scenarios need to be specified according to the needs of the stakeholders. The results show that a broader range of ecosystem services is proposed by the stakeholder than the COMTESS project proposed (tables 6a-d).

Additionally, the scope of the project does not take social impacts into account (tables 8a-d), except for the perception of safety. The social impacts are important aspects which have to be considered in order to develop appropriate scenarios. The combination of ecosystem services and social impacts improves this process (figures 16, 19, 21, 22), as mentioned above.

The COMTESS projects aims for the development of a “Stakeholder-based scenario”. This scenario will be developed on the basis of the three proposed scenarios, taking the stakeholders’ land use preferences into account. The stakeholder based scenario will examine emerging discrepancies and synergies which might influence the acceptance and practicability of implementing the proposed land management scenarios. The stakeholders’ viewpoints will be thereby contrasted to economic and ecological rationales. The objective is to analyze perceptions and acceptance towards potential future land use strategies and to run an integrative, collaborative and consensus-oriented group decision-making process in order to consider COMTESS and the results of this project into future land use and regional development schemes (COMTESS 2010).

The expert interviews deliver a starting-point to reach these goals. The stakeholders named perceptions for the intended development of the region (table 9c). Nevertheless, further research is required in order to manifest the results.

The management process helping to develop the stakeholder based scenario and to improve the three proposed scenarios is shown in figure 23. Within all stages stakeholder participation in the integrative planning process is required.

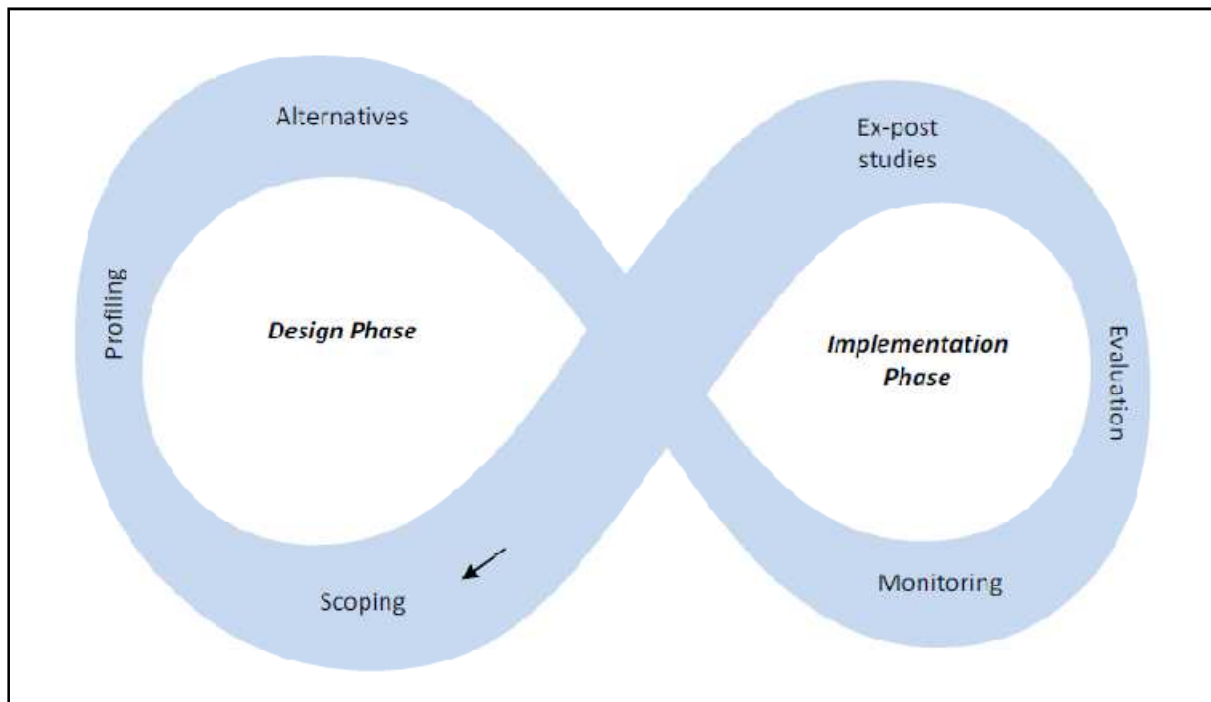


Figure 23: The stages of the management process. Scoping is the starting point, the stages profiling and the formulation of alternatives follows. After this design phase, the implementation phase takes place, starting with a monitoring, then evaluation and last but not least ex-post studies. The management process is iterative, it will start again. The stakeholders' participation and integration is a crucial element (according to Baines et al. 2003).

This paper gives an insight into the design phase (figure 23, table 3). But further research is necessary; there is, for example, the need for more baseline data showing the surplus value of the different ecosystem service and social impacts. The prospects of the stakeholders (table 9c) give a small picture about intended developments, but they have to be extended and transformed to concrete alternatives and estimations of effects concerning an intervention

7. Conclusion and recommendations

The community of Krummhörn is a low lying area (figure 10) and there are spots where the landscape is extremely vulnerable. The expected climate change might disrupt the contemporary land use due to the influences of increasing precipitation and droughts as well as the accelerating sea level and storm surges (figure 1). Therefore, solutions for ensuring a sustainable future for the coastal region need to be found.

The changing climate confronts people with new challenges. They need to think about new ways of development and adaptive strategies. The stakeholders' opinion about the climate change and adaptation measures is affected by uncertainty about possible impacts. In general, the people feel safe and do not see a need to change the existing flood protection structures (table 8b).

Adaptive strategies are the basis for a sustainable land management. Projects developing sustainable strategies influence the structures of both, the community and the ecosystems. For this reason, the development of new land management strategies needs a well-balanced framework which takes social as well as ecological issues into account.

Sustainability can be described as the equilibrium between supply (environment, ecosystem services) and demand (society) and is crucial for the human well-being (figure 4). A sustainable use of the environment is relevant for people with regards to ecological and socio-economic values.

The quality of life is connected to the quality and the maintenance of ecosystems. The ecosystem service approach is a strategy to integrate the management and assessment of natural resources into complex human-environment systems. All ecosystem services influence key components of human well-being (figure 2) and play an important role to sustain and ensure a good quality of life (MA 2003).

Nevertheless, human well-being depends not only on the ecosystem services but also on perceptions, interests and needs of the wider community. Therefore, only focusing on the concept of ecosystem services is not enough to give a complete overview.

The concept of the social impact assessment (Vanclay 2002, Burge 2003, Burge 1999) is an appropriate model to systematically examine and analyze statements about how people feel and might react on changes in their region and how changes might affect the people's life.

In order to reach the goal of a sustainable development, a combined process schema using the concepts of ecosystem services and social impacts assessment has been developed within this paper, considering ecosystem services as well as social impacts in an equal manner (figures 4, 16, 19, 21, 22).

The question remains why these two concepts have been combined and which advantages the combination provides. Following reasons have been taken into account:

1. The scientific background of the ecosystem service approach is often not easy to communicate. The stakeholders express their experiences and needs in social terms. For this reason, the stressed social impacts lead directly or indirectly to the ecosystem services (figures 16, 19, 21, 22).
2. Social impacts promote the evaluation process of the ecosystem services' relevance (tables 6a-d). In addition, the stakeholders give evidence about the positive or negative characteristics concerning the increase or decrease of an ecosystem service (tables 8a-f).
3. The combined framework (figures 16, 19, 21, 22) optimizes decision-making processes by improving the evaluation of the qualitative research (figure 8) and leads to a better understanding of human well-being. In addition, it reduces the complexity and promotes the stakeholder participation.
4. A holistic view is reached by combining social and environmental concerns. This contributes to the development of the land management scenarios and the deepening of the project's context.

In order to generate a complete picture of the possible effects of a project, the strengths of both concepts have been considered. On the process level, the ecosystem service approach is designed to advise and "meet the needs of decision-makers for scientific information on the links between ecosystem change and human well-being" (MA 2003: x). It helps to understand trade-offs concerning the environment, enhances effective response options on a governance-level and integrates land, water and resource management (MA 2003). The social impact assessment aims for the development of a knowledge base to determine possible projects' impacts on a community, the understanding of how an impact will affect a community, the provision of a qualitative evaluation of social impacts as a tool for decision-maker and planning processes and the proposal of alternatives to trigger adaptation measures (Vanclay 2002, Burge 2003, Burge 1999).

In addition, both concepts favor the integration and participation of stakeholders. This paper uses the three stages of the management process described by Baines et al. (2003) and Taylor et al. (2003): **scoping** which aims mainly for the theoretical determination of categories, **profiling** which aims mainly for the selection of baseline data and the **development of alternatives** which aims mainly for the determination of change-options (table 3, figure 23).

The expert's knowledge is used to complete the theoretically developed categories of ecosystem services and social impacts (figure 5). In both concepts categories can be developed in order to reduce the complexity and to organize the flow of information. The ongoing interactions with multiple stakeholders promote the identification of important ecosystem services, identification of

key social issues, synergies and trade-offs. It is of central relevance to integrate the experts within the project's further research process.

In this paper, a framework has been developed to integrate social impacts caused by the project and ecosystem services influenced by the project (figures 16, 19, 21, 22). This model helps to understand the wider community and to integrate the stakeholders into the project. It is difficult for some stakeholder to work with ecosystem services. It is not that they are not interested in, but they are not specifically trained and used to think within ecosystem services. They rather stay within social units. The stakeholders' thinking within social units is common because they identify themselves with social impacts caused by consequences of any action. However, the people are influenced by ecosystem services and the other way round.

The integrated framework of ecosystem services and social impacts shows that a combination is possible; social impacts can be matched with ecosystem services (figures 16, 19, 21, 22). The stakeholders identify more ecosystem services than the COMTESS project proposed (tables 6a-d).

There are chains of causalities leading to the improvement of the evaluation process. The social impacts could be used as "map" guiding towards the ecosystem services. Additionally, the ecosystem services are complemented by the stakeholders' knowledge about social impacts.

In the stakeholders' opinion, valuable and non-valuable elements can be found within the proposed land management scenarios. Every stakeholder predicts that the future development of the community might incorporate different elements from every scenario, with focal point on increasing tourism, sustainable agriculture and extended but agricultural-friendly environmental conservation areas. They aim for a multi-functional land management strategy (table 9c). Nevertheless, additional research is necessary to complete the findings and to promote an ongoing research process.

A major objective is to find consensus among the different perspectives of the stakeholders to implement the proposed project. Therefore, participation, stakeholder involvement, analyses and dialogues as well as community engagement are needed within every development phases (figure 23). The dynamic and transdisciplinary process to promote sustainable land management strategies is iterative. The further research processes need a full accounting of benefits and weigh the surplus values of reduced or enhanced ecosystem services against the anticipated benefits or adverse effects of proposed developments. Additionally, monitoring and evaluation processes as well as ex-post studies need to be included into the management process (figure 23).

The different interests of the stakeholders need to be brought together. When stakeholders with individual expertise work together, they will be able to enhance further projects even better.

Hence, in cooperation with the stakeholders, it is possible to come up with new sustainable land management strategies within a holistic view. Additionally, the stakeholders will participate in the further research process and promote the development of the stakeholder-based scenario.

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Niedersächsisches Wassergesetz (NWG) Vom 19. Februar 2010

III. Appendix 1

Information for the stakeholders

- 1. *Correspondence***
- 2. *Flyer***
- 3. *Questionnaire***

1. Correspondence



Zentrum für Umwelt- und Nachhaltigkeitsforschung
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Betreff Expertengespräch Vorhaben COMTESS

Sehr geehrte/r Frau/ Herr,
wir freuen uns sehr, dass Sie sich für das Forschungsprojekt „COMTESS – Sustainable Coastal Land Management: Trade-offs in Ecosystem Services“ der Carl von Ossietzky Universität Oldenburg interessieren.

Nutzungsstrukturen und das Landschaftsbild der Küstenregionen werden sich in den kommenden Jahrzehnten nicht nur wegen des Klimawandels ändern. Wie dies gelingen kann, das steht in den kommenden drei Jahren im Mittelpunkt des vom Bundesforschungsminister geförderten Projekts COMTESS. Grundlegende Informationen sind diesem Schreiben beigelegt; fortlaufend aktualisierte Informationen finden Sie unter www.comtess.uni-oldenburg.de

Die Krummhörn ist ein zentrales Untersuchungsgebiet von COMTESS. In einem Teilprojekt sollen mit Ihnen und weiteren Experten und Entscheidern der Region Optionen geprüft und entwickelt werden, wie diese Region ca. im Jahr 2050 aussehen könnte.

In einem ersten Schritt sollen in Gesprächen drei Vorschläge von möglichen Landnutzungen (Szenarien) diskutiert werden (siehe anliegende Darstellung). Wichtige und bevorzugte Landnutzungsformen bilden die Basis für das *durch Ihre Mitwirkung* zu entwickelnde Szenario. Dazu werden Expertenmeinungen aus den Sektoren Landwirtschaft, Naturschutz, Tourismus, Küstenschutz, Wasser- und Bodenverbänden sowie auf politischer Ebene eingeholt.

Die bearbeitende Wissenschaftlerin, Frau Leena Felmborg, wird dieses Gespräch mit Ihnen führen und sich dazu kurzfristig mit Ihnen in Verbindung setzen.

Wir würden uns sehr über Ihre Teilnahme an diesem Projekt freuen. Ihr aktives Mitwirken wird helfen, durch COMTESS innovative Landnutzungsstrategien zu entwickeln und Ihnen für Ihre weitere Arbeit zur Verfügung zu stellen.

Sollten Sie weitere Fragen haben, können Sie sich gerne an mich als Leiter des Teilprojektes und im Weiteren an Frau Felmborg wenden.

Mit freundlichen Grüßen

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2. Flyer



Projektpartner

Koordiniert wird COMTESS von Prof. Dr. Michael Kleyer, Arbeitsgruppe Landschaftsökologie der Universität Oldenburg. Beteiligt sind auch die Oldenburger Arbeitsgruppen Bodenkunde und Vergleichende Politikwissenschaft sowie das Zentrum für Umwelt- und Nachhaltigkeitsforschung (COAST), sowie die Universitäten Braunschweig, Greifswald, Hohenheim, Lüneburg, Potsdam und Rostock.

Projektpartner sind die Nationalparke "Vorpommersche Boddenlandschaft" und "Niedersächsisches Wattenmeer" sowie die University of Aarhus (Dänemark) und das Netherlands Institute of Ecology (Niederlande).

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Fotos: Greetsiel, Leena Felmborg

COMTESS

Sustainable Coastal Land Management: Trade-offs in Ecosystem Services

*Nachhaltiges Landmanagement-
Region Krümmhörn*

Vielältige Veränderungen in Klima und Natur wie in Wirtschaft und Gesellschaft werden auch die Region Krümmhörn treffen. Manche dieser Veränderungen sind schon jetzt spürbar oder greifbar. Die Diskussionen um Anpassungsstrategien und die Entwicklung von geeigneten Anpassungsschritten sollten schon jetzt begonnen werden.

Im Mittelpunkt des neuen Verbundforschungsprojektes COMTESS stehen die Chancen und Risiken neuartiger Landnutzungsstrategien, deren ökologische, soziale und ökonomische Folgen betrachtet werden.

Das Projekt wird vom Bundesministerium für Bildung und Forschung (BMBF) im Rahmen des Förderschwerpunkts „Nachhaltiges Landmanagement“ im Zeitraum 2011 bis 2015 gefördert.

Vor dem Hintergrund, dass das derzeitige Landmanagement in Zukunft nicht mehr den sich wandelnden Ansprüchen gerecht werden kann, soll jetzt der Grundstein für zukunftsfähiges Handeln gelegt werden.

Im Zuge des Klimawandels wird das Überflutungsrisiko in der Region Krummhörn steigen. Außerdem müssen je nach Jahreszeit unterschiedliche Auswirkungen berücksichtigt werden: Im Sommer werden lange Trockenperioden auftreten und im Winter werden die Abflussmengen der Siele und Gräben zunehmen.

Szenario Wasser-Management

In den Szenariengebieten werden Flutpolder für Süßwasser bzw. Meerwasser aus Deichüberströmungen bei Sturmfluten geschaffen. Überflutungen sollen sich auf diesen Bereich beschränken. Im Winter wird das überschüssige Regenwasser gespeichert, im Sommer kann es genutzt werden, um die Landflächen zu bewässern. In den Polderflächen werden Röhrichtbestände angesiedelt. Diese sollen zur Produktion grüner Energie genutzt werden.



Szenario Kohlenstoff-Sequestrierung

Dieses Szenario ist dem Szenario Wasser-Management ähnlich. Der Unterschied besteht darin, dass die Polderflächen von den Schilfbeständen bestimmt werden. Durch das ungestörte Wachstum kann eine Torfbildung gefördert werden. Diese trägt dazu bei, dass der Boden CO₂ aus der Atmosphäre aufnimmt und speichert.



Die zwei Szenariengebiete in der Region Krummhörn: Greetsiel und Freepsum.

Szenario Trend

In der Region werden zurzeit hauptsächlich Milchviehwirtschaft und Ackerbau betrieben. Naturschutzflächen und touristische Infrastruktur ergänzen diese Hauptnutzung. Dies wird in diesem Szenario auch die Nutzungsform der Zukunft sein. Eine Herausforderung wird es sein, die ökonomische und ökologische Tragfähigkeit dieser Form der Landnutzung zu be-



wahren. Durch das erhöhte Überflutungsrisiko werden die Kosten für Entwässerung und Küstenschutz stark ansteigen.

Ihr Szenario



Grundlagen für ein nachhaltiges Landmanagement sind die richtigen Anpassungsmaßnahmen. Gemeinsam mit Experten aus den Bereichen Landwirtschaft, Naturschutz, Tourismus, Küstenschutz, Wasser- und Bodenverbänden sowie auf politischer Ebene möchten wir Ihre Präferenzen in Bezug auf explizite räumliche Planung darstellen. Die drei beschriebenen Szenarien bieten dafür eine Grundlage. Um ein tragbares Modell zu entwickeln, das konkrete Handlungsempfehlungen für ein multifunktionales Küstenmanagement berücksichtigt, soll ein vernetzter Austausch in Form von Regionalforen stattfinden. Das Projekt will sorgfältige Planungen vornehmen, um den Küstenraum nachhaltig zu gestalten. Um dies sicherzustellen, ist es uns besonders wichtig, Ihre Meinung einzubeziehen.

3. Questionnaire

Fragebogen für Experten Evaluierung der Szenarien

1. Information über COMTESS, das Ziel des Projekts und des Interviews (10')

Grundlagen: Visualisierung der Szenarien, Fact sheet

Ggf. auf den COMTESS Workshop Dezember 2010 hinweisen. Der Fokus lag auf den Szenarien, die jetzt faktisch aufgearbeitet werden sollen.

Es werden Experten aus Landwirtschaft, Naturschutz, Tourismus, Küstenschutz, Wasserversorgung/ Bodenverbände und auf politischer Ebene befragt.

2. Persönlicher Fragebogen

- a. Für welches Tätigkeitsfeld sind Sie zuständig und welche Verantwortungen beinhaltet dies? (Beruflicher Hintergrund bekannt)
- b. Ist dies Ihre hauptberufliche Tätigkeit? Arbeiten/ engagieren Sie sich ehrenamtlich /nebenberuflich in anderen Bereichen?
- c. Was verbindet Sie mit dieser Region? Warum haben sie sich entschieden in dieser Region zu leben (zugezogen, aufgewachsen)?
- d. Fühlen Sie sich derzeit sicher in der Region im Hinblick auf Überflutungsgefahr?

3. **Generelle Fragen zur Einstellung zum Klimawandel und nachhaltiger Landnutzung.** (15')

Ziel: die generelle Einstellung des Experten zum Thema Klimaanpassung und Landnutzungsmanagement besser zu verstehen

Einstiegsfragen:

- Findet ein Klimawandel ihrer Meinung nach statt und welche Auswirkungen könnten Klimaänderungen an der Nordseeküste haben?
- Wie schätzen Sie die Dringlichkeit von Anpassungsmaßnahmen an den Klimawandel an der Nordseeküste ein? Für welchen Sektor/Bereich (Küstenschutz, Tourismus, Naturschutz, Wassermanagement) sehen Sie die größte Dringlichkeit? Für welche eher eine geringere oder keine Dringlichkeit?
- Welches sind wichtige Faktoren, die einen großen Einfluss auf die Landnutzung in der Region haben? (Warum wird Landnutzung so betrieben, wie sie betrieben wird?)
- Wie würden Sie nachhaltige Landnutzung beschreiben? (Kulturell, sozial, technisch)
- Welche Instrumente werden genutzt? (EU-Ausgleichszahlungen, Regionalplanung, Kompensationsflächen)

Dem Experten überlassen auf welcher Ebene er sich konzentriert, bei Bedarf nach lokaler, regionaler, nationaler oder internationaler Ebene fragen.

4. Evaluierung der 3 COMTESS Szenarien (45')

Den befragten Experten erklären, dass in den nächsten 45', das Ziel des Interviews ist die 3 COMTESS Szenarien zu besprechen. Dieser Teil sollte zeitlich begrenzt sein, da es wichtiger für das Projekt ist, dass der Expert uns hilft ein 4. Szenario zu bauen.

Die 3 Szenarien werden erst kurz beschrieben mit Hilfe von vorhandenem Material

Die Eigenschaften der ausgewählten Szenarien erfragen. (45')

4.1 Wassermanagement:

- Ihrer Meinung nach, wäre die zukünftige Speicherung von Winter-Süßwasser (und die damit verbundene Entlastung in Nassperioden) für trockene Sommer eine passende Landnutzungsstrategie?
- Welche Nutzungen könnte man aus neuen Süßwasserflächen entwickeln? Könnten sie Gewinnen (aus ökologischer, ökonomischer, gesellschaftlicher Sicht) bringen? Welche?
- Ihrer Meinung nach, wäre die zukünftige Entstehung von Schilfflächen auf früherem Grünland, um Bioenergie zu fördern, eine passende Landnutzungsstrategie?
- Welche Akzeptanz haben Schilfflächen und damit verbunden der Ausbau von erneuerbaren Energien unter der Bevölkerung (Landwirte, Förster, Einwohner, Touristen)?
- Welche Akzeptanz würde eine Polderregion, die nicht nur zur Speicherung von Süßwasser sondern auch als Aufnahmebecken für Überflutungen dient, finden? Könnte Deich-overtopping Akzeptanz finden?
- Würden Sie sich (der betreffende Sektor) an Projekten, die die Umwandlung vom Grünland in Wasserfläche / Schilffläche fördern, beteiligen (Focus auf Energiegewinnung)? Unter welchen Bedingungen?
- Scheint dieses Szenario für die Region / Ortschaft realistisch? Machbar? Wünschenswert?
- Welche wären die positiven Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Welche wären die negativen Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Wer würde am meisten davon profitieren (Winners)? In wie weit?
- Wer wäre am meisten davon betroffen (Losers)? In wie weit?
- Welche Resonanz würde eine auf dieses Szenario basierte Landnutzungsstrategie haben?
- Welche Argumente könnte man benutzen, um Akteure auf die positiven Auswirkungen des Szenarios aufmerksam zu machen?
- Welche Argumente könnte man benutzen, um Entscheidungsträger auf die negativen Auswirkungen des Szenarios aufmerksam zu machen?

4.2 Torfbildung und Kohlenstoffbindung:

Einstiegfragen:

Fragen für alle Experten:

- Welche Assoziationen werden mit Feuchtgebieten/ Landschaften mit Reedbewuchs gemacht?
- Ihrer Meinung nach, wäre die Schaffung von Reedflächen zur Speicherung von Kohlenstoff eine passende Landnutzungsstrategie?
- Werden Naturschutzmaßnahmen von der lokalen Bevölkerung unterstützt? Welche? Von wem?
- Stößen weitere Naturschutzmaßnahmen auf Widerstand von der lokalen Bevölkerung? Von welchen Akteuren?
- Würden Sie sich (der Sektor) an der Schaffung von Reedflächen mit dem Ziel, diese als CO₂ Senke zu nutzen, beteiligen? Unter welchen Bedingungen?
- Scheint dieses Szenario für die Region / Ortschaft realistisch? Machbar? Wünschenswert?
- Welche wären die positiven Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Welche wären die negativen Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
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- Welche Resonanz würde eine auf dieses Szenario basierte Landnutzungsstrategie haben?
- Welche Argumente könnte man benutzen, um Akteure auf die positiven Auswirkungen des Szenarios aufmerksam zu machen?
- Welche Argumente könnte man benutzen, um Entscheidungsträger auf die negativen Auswirkungen des Szenarios aufmerksam zu machen?

4.3 Business as usual:

Fragen für alle Experten:

- Halten Sie die jetzige Nutzungsstruktur für Leistungsfähig, auch im Hinblick auf die nächsten Jahrzehnte?

Dem Expert überlassen auf welcher Aspekt er sich konzentriert, bei Bedarf nach ökonomischen, ökologischen, gesellschaftlichen, kulturellen Aspekten fragen

- Welche Perspektive hat die derzeitige Nutzungsstruktur?
- Welche Anreize haben Landwirte ihre Aktivität fortzuführen?
- Vor welchen Problemen stehen Landwirte?
- Rechtfertigt die derzeitige Landnutzungsstruktur den weiteren Ausbau der Deiche und der Entwässerungsstruktur?
- Wer soll die Kosten tragen? Ist das realistisch?
- Ihrer Meinung nach, im Hinblick auf die zu erwartenden hohen Kosten der Entwässerung, wie kann dem entgegnet werden (Anpassung, Kompensation)?

- Scheint dieses Szenario für die Region / Ortschaft realistisch? Machbar? Wünschenswert?
- Welche wären die positiven Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Welche wären die negativen Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Wer würde am meisten davon profitieren (Winners)? In wie weit?
- Wer wäre am meisten davon betroffen (Losers)? In wie weit?
- Welche Resonanz würde eine auf diesem Szenario basierte Landnutzungsstrategie haben?
- Welche Argumente könnte man benutzen, um Akteure auf die positiven Auswirkungen des Szenarios aufmerksam zu machen?
- Welche Argumente könnte man benutzen, um Entscheidungsträger auf die negativen Auswirkungen des Szenarios aufmerksam zu machen?

4.4 Elemente zur Entwicklung des 4. Szenarios sammeln (45'):

- Was ist nicht in den 3 Szenarien berücksichtigt worden?
- Welche Aspekte, die in den Szenarien berücksichtigt wurden, scheinen Ihnen unwichtig?
- Welche Aspekte sollten priorisiert werden?
- Welches Zukunftsszenario wäre für Sie realistisch? Und wünschenswert?

Dem Experten überlassen, auf welchen Aspekt er sich konzentriert, bei Bedarf nach Küstenschutz, Landwirtschaftliche Entwicklung, Naturschutz, Lokale ökonomisch Entwicklung, usw. fragen.

- Welche wären die positiven Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Welche wären die negativen Auswirkungen solcher Entwicklung? (aus ökologischer, ökonomischer, gesellschaftlicher Sicht? Lokale / regionale Ebene?)
- Welche Akteure würden am meisten davon profitieren (Winners)? In wie weit?
- Welche Akteure wären am meisten davon betroffen (Losers)? In wie weit?
- Welche Resonanz würde eine auf dieses Szenario basierte Landnutzungsstrategie haben?
- Welche Argumente könnte man benutzen, um Akteure auf die positiven Auswirkungen des Szenarios aufmerksam zu machen?
- Welche Argumente könnte man benutzen, um Entscheidungsträger auf die negativen Auswirkungen des Szenarios aufmerksam zu machen?

5. Weiterführende Fragen zur Realisierbarkeit

- Was sind Ihrer Meinung nach die wichtigsten Aspekte, die in der zukünftigen Planung der Region berücksichtigt werden sollten?
- Welches Zukunftsszenario wäre Ihrer Meinung nach realistisch?
- Wie sehen Sie die Entwicklung im zeitlichen Rahmen und im Hinblick auf Durchführbarkeit? Wie fern, wie nah sind die Szenarien?
- Sind einzelne Elemente in der derzeitigen Zukunftsplanung berücksichtigt oder mit derzeitigen Ansätzen verzahnt (Maßnahmenplanung, Raumplanung)?
- Halten Sie eine neuartige Zukunftsplanung wie in den Szenarien für implementierbar?
- Wie schätzen Sie generell die Akzeptanz der Bevölkerung ein?
- Würde eine neue Landnutzung im Sinne der Szenarien das Gefühl der Sicherheit im Hinblick auf Überflutungen und damit verbundenen negativen Auswirkungen steigern?
- Würde eine neue Landnutzung im Sinne der Szenarien den Erholungswert und Ästhetik der Region steigern? (Hinblick auf Freizeit, Tourismus)
- Sehen Sie Änderungen im täglichen Leben, der Verfügbarkeit von Ressourcen, im persönlichen Recht (auf Land), Effektivität der Landnutzung oder Kultur?
- Gibt es Aspekte in dieser Befragung, die Sie vermissen oder die wünschenswert wären?
- Sind die gegebenen Informationen ausreichend?
- Nach weiteren relevanten Personen / Experten fragen

IV. Appendix 2

Extra book (320 pages), available on request.

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The appendix 2 contains confidential data.

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Sperrvermerk

Der Anhang 2 enthält vertrauliche Daten.

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Oldenburg,

Leena Karrasch